Sector Guidance Note

IPPC S5.01

Integrated Pollution Prevention and Control (IPPC)
&
Integrated Pollution Control (IPC)

Interim Sector Guidance for the incineration of waste and fuel manufactured from or including waste

ENVIRONMENT AND HERITAGE SERVICE

SEPA

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Executive Summary

This guidance has been produced by the Environment Agency for England and Wales in collaboration with the Scottish Environment Protection Agency (SEPA) and the Northern Ireland Environment and Heritage Service (EHS). Together these are referred to as "the Regulator" in this document. Its publication follows consultation with industry, government departments and non-governmental organisations.

This document provides interim technical guidance on both Integrated Pollution Prevention and Control, and updated guidance for processes authorised under Integrated Pollution Control.

What are IPPC & IPC

Integrated Pollution Prevention and Control (IPPC) and its predecessor regime, Integrated Pollution Control (IPC) are regulatory systems that employ an integrated approach to control the environmental impacts of certain industrial activities. They each involve determining the appropriate controls for industry to protect the environment through a single permitting process. To gain a Permit, Operators will have to show that they have systematically developed proposals to apply the 'Best Available Techniques' (BAT) and meet certain other requirements, taking account of relevant local factors.

The Regulators intend to implement IPPC to:

- protect the environment as a whole;
- promote the use of "clean technology" to minimise waste at source ;
- encourage innovation, by leaving significant responsibility for developing satisfactory solutions to environmental issues with industrial Operators; and
- provide a "one-stop shop" for administering applications for Permits to operate.

Once a Permit has been issued, other parts of IPPC come into play. These include compliance monitoring, periodic Permit reviews, variation of Permit conditions and transfers of Permits between Operators. IPPC also provides for the restoration of industrial sites when the permitted activities cease to operate.

This Guidance and the BREF

This UK Guidance for delivering the PPC (IPPC) Regulations in the Incineration sector is produced in advance of the BAT Reference document (BREF). The European Commission programme states that it will commence work on the waste incineration BREF in 2001. This guidance will be reviewed and updated as required when the BREF is available.

The aims of this Guidance

The aims of this Guidance are to:

- provide a clear structure and methodology which operators making an application should follow to ensure that all aspects of the PPC Regulations (see Appendix 2 for equivalent legislation in Scotland and Northern Ireland) and other relevant Regulations have been addressed and it should thereby assist the Operator to make a satisfactory application;
- minimise the effort by both Operator and Regulator in the permitting of an installation by use of clear indicative standards and the use of material from previous applications, and from accredited Environmental Management Systems (EMSs);
- improve the consistency of applications by ensuring that all relevant issues are addressed;
- increase the transparency of the permitting process by having a structure in which the operators response to each issue, and any departures from the standards, can be seen clearly;
- improve consistency of regulation across installations and sectors by facilitating the comparison of applications;
- provide a very brief description of the activities to assist the reader to understand the context of the requirements;
- provide a summary of the BAT techniques for pollution control from UK experience which are relevant in the UK context expressed, where possible, as clear indicative standards and which need to be addressed by Applicants;
- provide an arrangement of information which allows the reader to find, quickly all of the guidance associated with:
    - a subject (e.g. accidents, energy or noise) (Sections 2.1 and 2.5 - 2.11);
    - the technical areas (e.g. furnace requirements) (Sections 2.3 - 2.4);
    - particular emissions (e.g. NOx or dioxins) (Section 3).

Additionally, to assist Operators in making applications, separate, horizontal guidance is available on a range of topics such as waste minimisation, monitoring, calculating stack heights etc. The majority of this guidance is available free through the Environment Agency, SEPA or EHS (Northern Ireland) web sites (see References).

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1.1 Understanding IPPC and BAT, IPC and BATNEEC

IPPC and the Regulations

Integrated Pollution Prevention and Control (IPPC) and its predecessor, Integrated Pollution Control (IPC) are regulatory systems that employ an integrated approach to control the environmental impacts of certain industrial activities. They involve the determination of appropriate controls for industry to protect the environment through a single permitting process. To gain an IPPC Permit, Operators will have to show that they have systematically developed proposals to apply the 'Best Available Techniques' (BAT) and meet certain other requirements, taking account of relevant local factors.

Although no **new** authorisations will be issued under the old IPC regime**, certain existing processes will continue to be regulated under IPC** (where the Best Available Techniques Not Entailing Excessive Cost or BATNEEC must be used) until IPPC applies to them (see Refs. 3 & 4). **This guidance therefore outlines the techniques and standards that are considered to represent both BAT and BATNEEC.** While IPPC considerations are wider in many places than IPC the cost/benefit balance for any technique will often be the same. Where the differences between BAT and BATNEEC arise these are highlighted in the text. Where the term BAT is used it should be taken to also mean BATNEEC unless specifically stated.

The essence of BAT and BATNEEC is that the selection of techniques to protect the environment should achieve an appropriate balance between realising environmental benefits and costs incurred by Operators.

IPPC operates under the Pollution Prevention and Control (England and Wales) Regulations, (see Ref. 2 and Appendix 2). These Regulations have been made under the Pollution Prevention and Control (PPC) Act 1999 and implement the EC Directive 96/61 on IPPC. Further information on the overall system of IPPC, together with Government policy and more detailed advice on the interpretation of the Regulations, can be found in the Department of the Environment, Transport and the Regions (DETR) document *IPPC: A Practical Guide,* (see Ref. 3).

Installation based, NOT national emission limits

The "BAT" approach of IPPC is different from regulatory approaches based on fixed national emission limits (except where General Binding Rules have been issued by the Secretary of State). The legal instrument which ultimately defines BAT is the Permit and this can only be issued at the installation level.

Indicative BAT standards

Indicative BAT standards (essentially for BAT but also covering other aspects) are laid out in national guidance (such as this) and should be applied unless there is strong justification for another course of action. It should be noted that BAT includes both the technical components of the installation given in Section 2 and the benchmark levels identified in Section 3. Departures from those standards, in either direction, can be justified at the local level taking into account the technical characteristics of the installation concerned, its geographical location and the local environmental conditions. Notwithstanding this, the mandatory EU emission limits and process standards that relate to waste incineration processes must be met first, although BAT may dictate even tighter controls.

BAT and EQSs

The "BAT" (and BATNEEC) approach is also different from, but complementary to, regulatory approaches based on Environmental Quality Standards (EQS). Essentially BAT requires measures to be taken to **prevent** or, where this is not practicable, to reduce emissions. That is, if emissions can be reduced further, or prevented altogether, at reasonable cost, then this should be done **irrespective** of whether any environmental quality standards are already being met. It requires us not to consider the environment as a recipient of pollutants and waste, which can be filled up to a given level, but to do all that is practicable to minimise the impact of industrial activities. The process considers what can be reasonably achieved within the installation first (this is covered by Sections 2 and 3 of this Guidance) and only then checks to ensure that the local environmental conditions are secure, (Section 4 of this Guidance and Ref. 5). The BAT (and BATNEEC) approach is, in this respect, a more precautionary one, which may go beyond the requirements of Environmental Quality Standards.

Conversely, it is feasible that the application of what is BAT/BATNEEC may lead to a situation in which an EQS is still threatened. The Regulations therefore allow for expenditure beyond BAT/BATNEEC where necessary. However, this situation should arise very rarely assuming that the EQS is soundly based on an assessment of harm. The BAT/BATNNEC assessment, which balances cost against benefit (or prevention of harm) should in most cases have come to the same conclusion about the expenditure which is appropriate to protect the environment.

Advice on the relationship of environmental quality standards and other standards and obligations is given in *IPPC: A Practical Guide* (see Ref. 3). General information relevant to this sector and specific requirements for each substance are given in Section 3.

Assessing BAT/BATNEEC at the sector level

The assessment of BAT takes place at a number of levels. At the European level, the EC issues a BAT reference document (BREF) for each sector. The BREF is the result of an **exchange of information** which member states should take into account when determining BAT, but which leaves flexibility to member states in its application. The European BREF for waste incineration is not expected to be published until 2003. This UK Guidance is therefore produced in advance of the BREF and lays down the indicative standards and expectations in the UK. This guidance will therefore be revised as necessary when the BREF is available. At the national level, techniques which are considered to be BAT should, first of all, represent an appropriate balance of costs and benefits for a typical, well-performing installation in that sector. Secondly, the techniques should normally be affordable without making the sector as a whole uncompetitive either on a European basis or worldwide.

Similar considerations apply to the assessment of BATNEEC for existing IPC authorised processes. Although there is no formal link to European guidance, UK guidance on BATNEEC takes account of industry sector performance and standards outside as well as inside the UK.

Assessing BAT/BATNEEC at the installation level

When assessing the applicability of the sectoral, indicative BAT/BATNEEC standards at the installation level departures may be justified in either direction as described above. The most appropriate technique may depend upon local factors and, where the answer is not self evident, a local assessment of the costs and benefits of the available options may be needed to establish the best option. Individual company profitability is **not** considered.

In summary, departures may be justified on the grounds of the technical characteristics of the installation concerned, its geographical location and the local environmental conditions but not on grounds of individual company profitability. Further information on this can be found in the IPPC Guide for Applicants, (see Refs. 3 and 4).

While BAT/BATNEEC cannot be limited by individual company profitability, company finance may be taken into account in the following limited circumstances:

- where the BAT cost/benefit balance of an improvement only becomes favourable when the relevant item of plant is due for renewal/renovation anyway (e.g. BAT for the sector may be to change to a different design of furnace when a furnace comes up for rebuild). In effect, these are cases where BAT for the sector can be expressed in terms of local investment cycles.
- where a number of expensive improvements are needed, a phasing programme may be appropriate as long as it is not so extended that it could be seen to be rewarding a poor performing installation, (see Ref. 5 for more details).

Innovation

The Regulators encourage the development and introduction of new and innovative techniques which meet the BAT/BATNEEC criteria and are looking for continuous improvement in the overall environmental performance of the process as a part of progressive sustainable development. This Note describes the appropriate indicative standards at the time of writing. However, Operators should keep up to date with the best available techniques relevant to the activity and this Note may not be cited in an attempt to delay the introduction of improved, available techniques. The technical characteristics of a particular installation may allow for opportunities not foreseen in the Guidance; as BAT/BATNEEC is ultimately determined at the installation level (except in the case of GBRs) it is valid to consider these even where they go beyond the indicative standards.

New installations

The indicative requirements apply to both new and existing activities but it will be more difficult to justify departures from them in the case of new activities. For new installations, the indicative requirements should normally be in place before the commencement of operations. In some cases, such as where the requirement is for an audit of ongoing operations, this is not feasible and indicative upgrading timescales are given for such cases.

Existing installations - standards

For an existing activity, a less strict proposal (or an extended timescale) may, for example, be acceptable where the activity already operates to a standard that is very close to an indicative requirement (see Section 2 for further guidance).

Upgrading timescales will be set in the improvement programme of the Permit. Improvements fall into a number of categories:

- the many good practice requirements in Section 2, such as management systems, waste, water and energy audits, bunding, good housekeeping measures to prevent fugitive or accidental emissions, energy baseline measures, waste handling facilities and monitoring equipment;
- the larger, usually more capital intensive improvements;
- longer term studies required for control, environmental impacts etc.

All improvements should be carried out at the earliest opportunity and to a programme approved by the Regulator.

Specific improvements may be required to ensure compliance with the standards outlined in the Waste Incineration Directive (2000/76/EC) and national legislation implementing the Directive. These improvements should be carried out within the timescales given below. The whole programme (including any other items outlined in this guidance but not required by the Directive) should be completed at the latest within 3 years of the issue of the Permit. Any longer timescales will need to be justified by the Operator in accordance with the principles above.

Improvement	By:
New incineration installations covered by the Waste Incineration Directive (2000/76/EC) to meet at least the standards outlined in WID	From the first day of operation – with immediate effect.
New incineration installations that are ***not*** covered by WID to meet those standards outlined in the WID that are also BAT (i.e. Operators must specifically justify any departures from WID).	28 December 2005 or earlier of BAT dictates
Existing incineration installations covered by WID to meet the standards of WID	28 December 2005 or earlier if BAT dictates
Existing incineration installations that are ***not*** covered by WID to meet those standards outlined in the WID that are also BAT (i.e. Operators must specifically justify any departures from WID).	28 December 2005 or earlier if BAT dictates

The Applicant should include a proposed timetable covering all improvements.

This guidance provides further information on techniques that may be appropriate for meeting BAT and WID.

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1.2 Making an IPPC Application

Complete the separate APPLICATION FORM.

The Application Form contains a number of questions about your ***techniques****,* ***emissions*** *and* ***impact on the environment****. The sections in this Guidance Note are numbered to match the application form and describe in detail how to answer the questions.*

The *Guide for Applicants* (see Ref. 4) will help filling in the form.

In SECTION 2, describe your proposals and justify that the TECHNIQUES employed are BAT by addressing the issues raised and the indicative standards in the outlined BAT boxes.

Departures may be justified as described in Section 1.1.

Indicative requirements (standards, benchmarks, improvement timescales etc.) are what the Agency would expect for the majority of installations.
If they apply to you, simply confirm compliance.
There may, however, be good site-specific reasons for departure. You should justify any departures.
See Section 1.1.

Assess further options

In SECTION 3, identify the EMISSION LEVELS that will result from the techniques described in Section 2 and compare with Benchmarks (given in Section 3).

If the comparison is unsatisfactory (taking any site-specific matters into account) revisit the measures in Section 2 as necessary.

Justifications may vary from a simple statement to a full cost benefit analysis *(Note 1)*. **Where the costs and the cross-media benefits of different options need to be assessed the "Assessment of BAT from Several Options" part of Ref. 5 will help you to do this.**

In SECTION 4, assess the ENVIRONMENTAL IMPACT and confirm acceptability

Assess that these overall emissions resulting from your view of BAT for the activities or installation will provide a high level of protection for the environment as a whole. The "Assessing Impact of the Installation" part of Ref. 5 will help you to do this.

If the impact is not acceptable, it will be necessary to consider further options, revisiting the techniques in Section 2.

Note 1 The amount of detail needed to support the application should be sufficient to support the Applicant's contention that either the conditions of the guidance have been met or an alternative measure has been justified. The level of detail should be commensurate with the scale of the operation and its ability to cause pollution. An Applicant is not required to supply detail that could not reasonably be expected to contribute to a decision to issue a Permit.

Note 2 **For existing IPC or Waste Management Permit holders**, your response to each point in Sections 2, 3 or 4 may rely heavily on your previous application. The Regulator does not wish you to duplicate information as long as the previous information adequately addresses the issues. However, the more the information can be reorganised to demonstrate that all the issues have been adequate addressed the better. You will need to send us copies of any information referred to.

Note 3 The contents of the outlined BAT boxes in Sections 2, 3 and 4, and additional blank tables etc., are available electronically on the Environment Agency's Website, for the assistance of Applicants.

1.3 Installations and Processes Covered by this Note

1.3.1 Existing IPC authorised processes

Existing IPC Authorised Processes described as Part A processes in schedule 1 of The Environmental Protection (Prescribed Processes and Substances) Regulations 1991 SI472 (as amended) under the following sections:

5.1(a) & 5.1(b)	- chemical waste incinerators
5.1(bb)	- certain plants burning certain solid or liquid “hazardous waste”
5.1(c)	- incinerators (for any waste) of capacity > 1te/hr
5.1(d)	- the burning out of metal containers
1.3(c)	- the burning of fuels derived from or comprising wastes in dedicated plant

Although not primarily intended for processes whose primary purpose is the generation of energy or production of material products, the information in this guidance may also be applicable these processes where they burn waste or waste derived fuels. These processes are likely to be most aptly authorised under other sections of SI472. Guidance on the interpretation of the sections outlined above is provided in SI472 (as amended).

No **new** IPC authorisations can be issued after 31 December 2000. The specific IPC information provided in this guidance will therefore only be applicable to processes which are already authorised under IPC and do not require an IPPC permit. **Existing IPC processes** will come under IPPC in one of three ways:

- Permitting according to the transitional schedule in the Regulations (Ref. 2);
- Permitting ahead of the schedule by agreement;
- Permitting ahead of the transitional schedule in the case of a “substantial change”.

Further guidance on when an IPPC permit is required is provided elsewhere (Ref. 3).

1.3.2 New and existing IPPC installations

New and existing IPPC installations described as Part A(1) activities in schedule 1 of the Pollution Prevention and Control (England and Wales) Regulations 2000 S.I.1973, under the following sections:

5.1(a) & 5.1(b)	- chemical waste incinerators
5.1(c)	- certain plants burning certain solid or liquid “hazardous waste”
5.1(d) & (e)	- incinerators (for any waste) of capacity > 1te/hr
5.1(f)	- the burning out of metal containers
1.1(c)	- the burning of fuels derived from or comprising waste in dedicated plant

It is important to note that the Regulations give detailed guidance on the interpretation of the sections outlined above. For example they state that “incineration includes pyrolysis”. As such, the pyrolysis of waste materials is included in this guidance.

The installation includes the main activities as stated above and associated activities which have a technical connection with the main activities and which may have an effect on emissions and pollution. They include, as appropriate:

- storage and handling of raw materials;
- storage, handling, preparation, selection and management of incoming waste;
- the control and abatement systems for emissions to all media;
- water abstraction and treatment plant;
- cooling systems;
- heat transfer systems;
- energy recovery and power production systems;
- storage and despatch of waste and other materials;
- on-site waste handling and recycling facilities.

Figure1-1 shows the main operations.

However, the impact of the activities on the environment may be wider than just the on-site activities. The Note, and the Regulations, cover issues downstream of the installation such as the disposal of wastes and wastewaters.

Advice on the extent of the physical site which is contained within the installation, for example split sites, is given in *IPPC Part A(1) Installations: Guide for Applicants,* see Ref. 4. Operators are advised to discuss this issue with the Agency prior to preparing their application. Particular examples relevant to incineration installations would be:

- A site includes an ash treatment and/or recycling centre;
- A site includes a waste transfer operation for separately delivered recyclable materials;
- A site includes a materials recovery facility, the residues of which are sent to the incinerator.

In each of these cases it will be necessary to consider guidance provided in *IPPC: A Practical Guide* (Ref. 3). The extent to which the associated activity is dedicated to the incineration unit will become a part of the Regulator's decision.

Where associated activities are carried out in conjunction with the main activities and are not covered in this guidance note (for example ash treatment operations), reference should be made to:

- other relevant IPPC Guidance Notes (e.g. S0.01 - Guidance for the Waste Treatment Sector) and,
- other relevant guidance notes issued under EPA 90 (e.g. Ref. 20 - Monitoring),
- where appropriate, the Secretary of State's Guidance for Local Authority Air Pollution Control. (NB In Northern Ireland this guidance is produced by the Department of the Environment),
- Agency guidance on waste management (e.g. Guidance on Clinical Waste Management)

For this sector, this would apply in particular to guidance on solid waste (ash) treatment plant, the design and operation of materials recovery facilities and waste derived fuel *production* plants.

1.3.3 Activities NOT covered by this note

This note provides guidance where the **primary purpose** of the installation is the destruction of wastes or waste derived fuels in **dedicated plant.** There are many situations where wastes or waste derived fuel are burned as a substitute for, or in addition to, primary fuels in the course of a manufacturing or other operation.

For example, waste or waste derived oils are sometimes burned in power stations, and waste solvents or tyres may be burned in a cement works. Such processes are likely to be "most aptly" authorised not as "incinerators" but under separate, specific sections of the Regulations as, for example a power station or cement works. **The techniques that represent BAT for these installations will be outlined in their own sector specific guidance**. As such, this guidance stops short of outlining the design or operational techniques appropriate in such circumstances but concentrates upon "dedicated incineration plant". This guidance does, however, outline techniques that should be ***considered*** when determining BAT for the prevention of releases at all plats where waste is burned.

It is important to note that, where wastes are co-combusted with other fuels, the provisions of European legislation (Ref. 25) will require implementation via the IPPC Permit. This may include a requirement to determine emission limit values for the installation on a pro-rata basis, according to the heat derived from the primary and substitute fuel, or specific emission limits. Each of these situations will need to be assessed individually. Therefore, if an Operator proposes to use fuels derived from, or comprising wastes it is essential that this is discussed with the Regulator at an early stage.

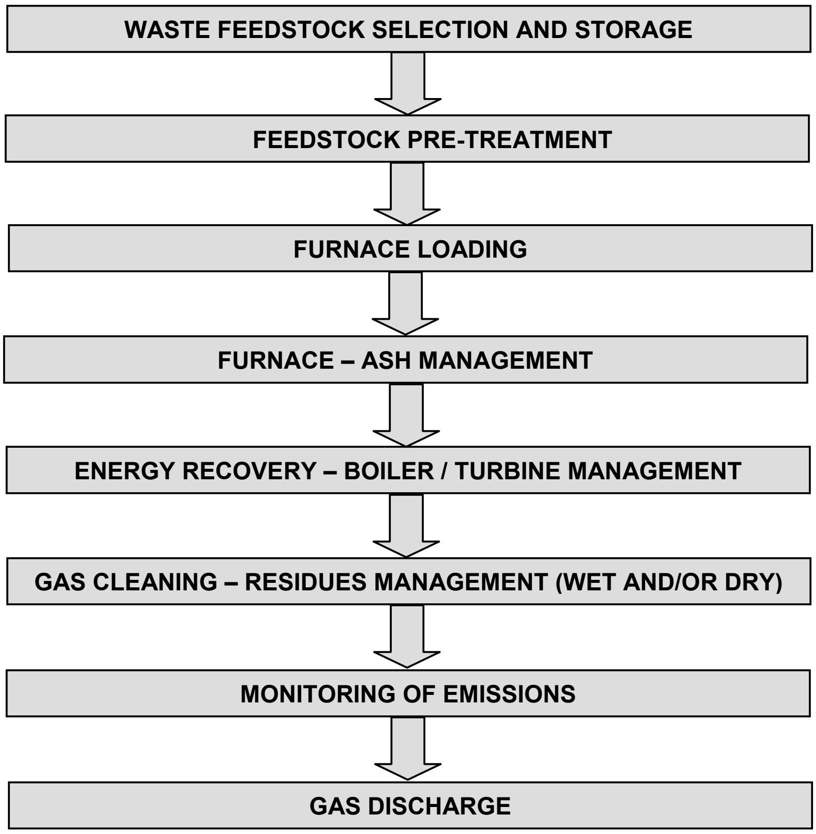

Figure 1-1 - Outline of the Main Incineration Techniques

1.4 Review Periods

Permits can be reviewed or varied at any time. However, the PPC Regulations impose a requirement on Regulators to review Permits in certain specific circumstances such as where the pollution caused by the installation is of such significance that the existing emission limit values need to be revised or new limits set.

In addition, Regulators are required to review the conditions of Permits "periodically". The Government stated in its third consultation paper (England, Wales and Scotland) on the implementation of IPPC, that the new sector-specific IPPC Sector Guidance Notes would provide guidance on appropriate review periods for each sector. These would take into consideration guidance on the relevant criteria, to be provided by the Government. Examples of the likely relevant criteria for setting these review periods are "the risk and level of environmental impacts associated with the sector" and "the cost to the Regulators and regulated industry of undertaking the reviews".

The Regulators consider that at the present time, having regard to those criteria, it is in fact appropriate to set indicative minimum review periods which differ only between those sectors which have been subject to integrated permitting (i.e. IPC or Waste Management Licensing), and those which have not. It is therefore proposed that Permit conditions should normally be reviewed on the following basis:

- for individual activities **NOT** previously subject to regulation under IPC or Waste Management Licensing, a review should normally be carried out within four years of the issue of the IPPC Permit;
- for individual activities previously subject to regulation under IPC or Waste Management Licensing, a review should normally be carried out within six years of the issue of the IPPC Permit.

This means that activities/installations not currently in IPC or Waste Management Licensing will be initially reviewed within four years and thereafter within six years.

An exception to this is where discharges of List I or List II substances have been permitted or where disposal or tipping for the purposes of disposal, of any matter which might lead to an indirect discharge of any substance on List I or II. In such cases the review must be carried out within four years.

This period will be kept under review and, if any of the above factors change significantly, may be shortened or extended.

The information in this guidance will itself be reviewed following issue of the BREF. It is anticipated that the BREF will be available in 2004.

1.5 Key Issues for this Sector

European legislation

The incineration of waste is subject to specific European legislation, setting baseline operational and emission standards for the majority of installations burning waste or fuels derived from waste, either alone or in combination with other fuels. Where they apply, the standards of the Directives must be met as a minimum. If the application of BAT / BATNEEC results in tighter limits than these standards then the tighter limits must be applied.

The Environment Agency intends to produce separate “regulatory guidance” on the new Waste Incineration Directive (WID 2000/76/EC). The enabling legislation will aim to implement the Directive requirements, and WID will eventually apply in the majority of situations. The standards set out in this guidance take direct account of the directive (as well as other relevant legislation).

The scope of WID is wide and will cover the majority of situations where waste is burned in installations either alone or in combination with other fuels. For definitive guidance on the scope of the directive, readers should refer to Article 2 of the directive where provision is made for the exclusion from WID requirements of those installations burning ONLY certain types of waste. Interpretation of the directive is complex and it is recommended that this is discussed with the Regulator well before an application is submitted.

Of particular interest to this sector will be the directive emission limit values for releases to air which are outlined in Section 3. In addition, WID (and other Directives that it will replace by 28 December 2005, e.g. HWID) sets a variety of operational standards in respect of: delivery and reception of waste; combustion requirements; residue composition; control and monitoring; abnormal operating conditions. ***These requirements have been incorporated in the relevant sections of this guidance when outlining what is considered to be the BAT.***

Feedstock composition

Many wastes vary in terms of physical and chemical composition. The nature of the waste to be treated is an important factor in determining what is BAT for an individual installation. Operators must demonstrate that they have designed their installations such that the operating envelope is sufficiently wide to ensure emission limits are met over the range of operational conditions that will be encountered. In some cases it may be necessary for Operators to restrict the wastes types burned or pre-treat the waste feed in order to prevent short-term exceedences of emission limits.

Feedstock management / storage / preparation

Where waste feed stocks are more highly heterogeneous in their nature it is more likely that greater effort will be required to manage that waste such that the installation design envelope is not exceeded. This may include consideration of upstream waste collection as well as on-site sorting and pre-treatment. Further details regarding suitable techniques and the criteria for their selection are provided in Sections 2.2 and 2.3.

Furnace requirements and combustion control

There are a wide variety of furnace types. Whilst one design may be well suited to a particular waste stream it may not be capable of treating another waste. The physical properties of the waste are usually the key parameters that should be considered when selecting a particular furnace design e.g. fluidised bed furnaces require wastes fed to them to be of a particular particle size range.

In all cases it is necessary to ensure that the overall process ensures wastes are effectively and thoroughly treated so as to minimise polluting emissions. In particular this includes a need to ensure that releases attributable to inefficient combustion are prevented through the optimisation of combustion conditions. Optimisation should aim to achieve steady state process conditions through the application of suitable controls. These may include waste pre-treatment as well as in-process methods. Furnace types and requirements are further discussed in Sections 2.3.3 and 2.3.4 respectively.

Energy recovery and boiler design

The process of combustion gives rise to very significant quantities of heat. The heat generated should be recovered as far as practicable (this is a WID requirement). This will include consideration of opportunities to increase energy recovery through for example, electricity generation, combined heat and power, the generation of process steam or district heating, or combinations of these.

Whilst increasing energy recovery is important, the use of wastes (and waste derived fuels) as a source of energy must be a secondary consideration after ensuring their safe destruction. For example, in many incineration plant energy recovery achieved by raising steam in a boiler. It is important that the energy recovery itself does not give rise to the production of additional polluting species. Boiler design and energy recovery are therefore important and are further considered in Sections 2.3.7 and 2.7 respectively. Where waste are used as a regular or additional fuel it is a requirement of European legislation that its co-incineration should not cause higher emissions of polluting substances than those dedicated to waste incineration.

Abatement technology and its operation

The provision and effective operation of flue gas cleaning equipment is essential and a key step to meeting mandatory emission standards and minimising the release of pollutants that cannot be prevented through the use of up-stream techniques. Air abatement issues are discussed in Section 2.3.8. A breakdown by plant type (i.e. municipal, clinical etc) is also included in that section.

Residues handling and disposal

The purpose of an incinerator is to maximise the safe destruction waste and to minimise the production of residues in terms of their quantity and harmfulness. The nature of the wastes treated and the throughput dictate the quantities of waste produced. Waste is in the form of grate or bottom ash, fly ash, and residues from the air pollution control (APC) equipment. In some plants the fly ash and APC residues are combined. All of these ashes have the potential to be difficult to handle on account of their physical characteristics, some may be classed as special wastes (e.g. APC residues). All installations must make adequate provision for the on-site management of these wastes.

It is possible that significant quantities of some types of ash can be recycled. If disposal of ash is planned, the Operator will be required to justify why recovery is “technically and economically impossible” for it to be recovered, together with “the measures planned to avoid or reduce any impact on the environment”. These matters are further discussed in Sections 2.2, 2.5 and 2.6.

Monitoring and reporting

European Directives include minimum monitoring requirements. Continuous emission monitors (CEMs) are specified in many cases. Regular spot monitoring is required to back up CEM measurements, along with CEM calibration and confidence level assurances. On-line dial-up Regulator access to monitors and historical emissions data is considered BAT in some circumstances. Further details are included in Section 2.10.

Public perception and planning issues

Public perception of incineration is generally poor. Proposals for new waste incinerators or the incineration of waste derived fuels are frequently accompanied by significant concern in local communities. The most common concerns relate to the perceived impact of incinerator emissions to air upon human health and the environment. The alternatives to incineration, and the selection of the site concerned are also frequently questioned.

Although still the thermal treatment of waste, and usually incorporating a combustion stage, pyrolysis and gasification may be proposed as alternatives to incineration. For many waste types, the emission performance of such plant has yet to be demonstrated consistently on a commercial scale. Whilst well suited to some waste types and offering some potential advantages, the data concerning the general application of these techniques and their economics is in many cases not fully developed (see also Section 1.7 - pyrolysis and gasification)

Some of the issues raised (e.g. traffic, visual amenity, location) fall within the remit of the planning authority rather than to the Regulator and should be addressed in a planning application. Guidance on the content of planning applications should be sought from the relevant planning authority. Environmental impact assessments (EIA) are a likely requirement of the planning process. There is considerable scope for assessments submitted in respect of the EIA to be provided in support of the Operator’s application. In order to avoid unnecessary duplication it is very important that Operators discuss the scope of such assessments with the Regulator, the planning authority and other stake holders at an early stage.

The Regulator considers that Operators and developers of waste burning installations have a duty to inform and consult with local communities. The Regulator will work closely with local planning authorities in order to improve communication of the facts relating to particular proposals and will place information regarding emissions in the public domain.

Waste strategy

Waste strategy is of particular relevance to municipal waste incineration. Waste strategies for Scotland, England and Wales were published in 2000. Statutory targets for the recycling and recovery of waste were published and a hierarchy of waste disposal options (with landfill as the least desirable option) was included. Restrictions upon the quantities of certain types of waste that may be landfilled were set in European legislation (Ref. 25) in 1999.

Although waste prevention will become increasingly important, evidence of waste arising trends suggests there is a continued need to plan suitable disposal outlets. The wastes that are produced, that can no longer be landfilled, and cannot practicably be recycled will therefore require disposal. This could lead to an increase in the number of municipal incineration plants.

When considering the strategic need for incineration the requirements of Government policies (including consideration of the Best Practicable Environmental Option), regional and local waste disposal plans should be reflected in the size and location of plant. Matters relating to this are considered further in Sections 2.6 and 4.2.

Incineration is likely to have a continuing role in ensuring the BPEO is selected for the management of waste.

Noise

There are noise sources at waste incineration installations that should be addressed (see Section 2.9).

Odour

Odour may arise from storage and handling of raw waste, poor site hygiene or from stack emissions where combustion is poor. All or these situations are avoidable through the use of BAT (see Section 2.3.13).

Accident risk

Apart from the normal process and spillage risks, risks of releases to air through abnormal operating conditions must be considered. Interlocks are required to prevent waste feed when combustion conditions do not meet the required standards. Other accidental release scenarios should be identified and suitable engineering or procedural measures put in place. Shut-down of the process is required under certain circumstances. Further details are provided in Section 2.8.

Site restoration

Some incinerators will have been operating on the same site for many years. Others may be constructed on the site of former industrial sites including power stations and waste management sites. There may well be historical ground contamination that could be confused with potential future contamination from the activities as they will be operated under IPPC. In such cases it will be necessary to assess the degree of contamination as a baseline for future operations.

Long range trans-boundary pollution

Dedicated waste incineration plants are unlikely to be of sufficient size to have significant trans-boundary effects. Power stations and other processes that co-incinerate waste will need to consider this aspect. Further guidance may be found in the sector specific guidance for those processes.

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1.6 Summary of Releases

RELEASES → / SOURCE ↓	Particulate matter	Hydrogen chloride	Oxides of sulphur	Oxides of nitrogen	Oxides of carbon	Dioxins	Organic compounds / odour	Mercury & cadmium	Other heavy metals	Alkali metals & oxides and alkali earth metals & oxides	Acids/alkalis/salts	Hydrogen fluoride
Applicable to:												
Chemical waste	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y
Clinical waste	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y
Municipal waste	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Animal carcasses	Y	Y	Y	Y	Y	Y	Y			Y	Y	
Sewage sludge	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Occurs in:												
Combustion gases	A	A	A	A	A	A	A	A	A			A
Waste storage and heating [Note1,2]	AL									WL		
Boiler water treatment & blowdown											W	
Scrubber liquor / sludge residues	WL					WL	WL	WL	WL	WL	WL	
Grate ash, fly ash and sorbents	AL					AL	AL	AL	AL	AL	AL	
Occasional releases from ash quenching	W					W	W	W	W	W	W	
KEY	**A – Release to Air, W – Release to Water, L – Release to Land**											

Notes:

1 Includes separated sludges released to land.
2 Includes disinfectant releases to sewer.
3 Heavy metal releases to land, may be present in both organic and inorganic forms, and similarly for organic compounds, which may be organometallic compounds.

1.7 Overview of the Activities in this Sector

No. of UK Part A Installations	
Municipal waste incinerators	12 sites
Clinical waste incinerators	?
Chemical waste incinerators	3 sites
Refuse derived fuel incinerators	3 sites
Animal carcass incinerators	?
Sewage sludge incinerators	?
Waste pyrolysers	?
Waste gasifiers	?
Drum incinerators	2 sites

Summary of the activities

This section provides a very brief description of incineration activities.

The industry provides a means for the disposal of a variety of waste types, and depending upon the type of waste, to recover energy from that waste. If not designed and operated properly installations have the potential for significant releases to water, air and land.

Common process stages

Although technologies differ slightly depending upon the precise nature of the feedstock (e.g. grate, hearth and abatement plant design differences) there are common purpose process stages to all waste incinerators.

The main components are:

- Feed stock storage, handling and possibly treatment;
- Furnace loading and charging operations;
- Solid waste transport in furnace;
- Furnace design, e.g. rotary hearth, moving grate, fluidised bed;
- Residue removal and management, i.e. ash;
- Combustion control, e.g. air staging, NOx control;
- Gas residence, cooling and heat transfer;;
- Energy recovery, e.g. steam boilers, turbine generation;
- Gas cleanup equipment, e.g. reagent injection, contact vessels, scrubbers, baghouses etc.;
- Discharge of gases.

Pyrolysis and Gasification:

Pyrolysis and gasification plants differ from this general layout in that they include a starved air stage as the initial thermal treatment. However, when combined with a subsequent combustion stage in order to recover energy (rather than converting the waste feed to a waste derived fuel or other product) they too contain essentially the same process steps.

Municipal waste incineration (MWI)

Installations accept domestic waste and some commercial and industrial wastes of a similar character to domestic waste. The number of municipal waste incineration installations is predicted to increase significantly over the next 10 to 20 years as alternatives to landfill are sought for wastes that cannot practicably be reduced or recycled.

Some of the new installations will replace those that closed in the 1990s because they could not be upgraded to meet the requirements of European legislation. Modern MWIs must achieve the tightest standards required by European legislation. The emission levels set for waste incineration are generally lower than for other industrial combustion sectors. Although each case will need to be assessed on its merits, at the legislative emission levels, incinerators are not expected to give rise to a significant deterioration in local environmental quality.

Enhanced recycling of the municipal and commercial wastes usually disposed of at such plant is not expected to alter the calorific value of feed-stocks as the removal of combustible fractions (paper, plastic etc) is counteracted by the removal of metals, glass and (higher moisture content) vegetable matter. Despite this, it is still necessary to consider the mode of waste collection and segregation in the catchment area, and any pre-treatment, or sorting stages, in order to predict the composition of the intended waste feedstock. Only once knowledge of the feedstock is secured will it be possible to select the BAT for the incineration of that waste.

Energy should be recovered from the waste in the form of electricity and / or steam. Heat may be supplied for local use in some cases.

Clinical waste incinerators (CWI)

CWIs provide for the disposal of healthcare wastes arising typically from hospitals, veterinary and dental practices, and pharmaceutical research plants. Some of the wastes produced in these locations may be classed as hazardous wastes and it is therefore important that good segregation of such waste is practised at the point of the waste arising in order to demonstrate that the provisions of the Hazardous Waste Incineration Directive (Ref. 26) will not apply. In practice, the quantities and proportion of such waste arising tends to be very small and are unlikely to alter the performance of a typical CWI.

Many CWIs are situated on the site where the waste is produced. The capacity of the majority of these is below 1 te/hr and are therefore part B installations and are not covered here. This guidance only relates to CWIs of a capacity greater than 1te/hr, unless they burn certain hazardous wastes as defined in the legislation (Ref. 26). Where Operators are unsure of the requirements they should discuss their situation with the Regulator.

Sanitation of certain clinical wastes may be achieved using autoclaves, or microwave technology. Having used these techniques to reduce the immediate biological hazards, the resultant waste may then be incinerated as non-clinical waste.

The provision of an effective, rapid and hygienic disposal route is of particular importance in this sector. This is particularly the case where wastes are of an infectious or unpleasant nature. Particular care is required to ensure that the health and safety of plant operators is considered when designing the waste reception, storage and transfer stages of the installation. Every attempt should be made to eliminate physical contact with the waste, ensure it is soundly packaged in accordance with relevant health and safety guidance – needles and other sharps are a particular concern.

Energy is usually recovered, commonly in the form of steam to heat the hospital at which the incinerator is located, thus saving on primary fuels.

Chemical waste incinerators

Chemical waste incinerators provide a means of disposal for hazardous wastes. They may be operated in-house by a company wishing to destroy its own wastes, or merchant incinerators which receive wastes of a wide array of types, and from a range of sources.

At merchant incinerators or those in-house ones taking a variety of waste streams, the variation in the types of waste, and their high hazard and environmental pollution potential means that such process must adopt the very highest technological and management standards.

The Hazardous Waste Incineration Directive (HWID) must be complied with at all installations burning hazardous wastes (including co-incineration at production plants or power stations).

Opportunities for energy recovery are significant for some waste streams (e.g. solvent wastes).

Sewage sludge incinerators

Interest in the disposal of sewage sludge by thermal means has increased with the removal of alternative disposal outlets (e.g. disposal at sea). There are a number of plants operating and proposed.

Fluidised bed technology has proven effective in this sub-sector and may help to achieve compliance with WID owing to the reduced thermal NOx generation compensating for relatively high fuel nitrogen. There are a number of projects that are considering the use of pyrolysis and gasification.

Industrialised sewage catchments can lead to elevated levels of metals in the waste feed. Abatement design must therefore carefully consider this. The scope of the IPPC installation may in some cases extend to the sewage treatment works on the same site.

Energy recovery opportunities are significant. It may be possible for gasification / pyrolysis to be coupled with engines or gas turbines in order to increase electricity recovery. It is common for combustion heat (or steam) to be re-circulated for sludge drying or other applications.

Animal carcass and animal remains incinerators

Between 1995 and 2000 the number of ACIs in England and Wales increased from 1 to 6. The key driver for this expansion has been the response to BSE. Capacity of ACIs was reported to be 4000 carcasses per week in the year 2000. With culled cattle arising from the over thirty months scheme (OTMS) numbering in excess of 10,000 per week, stock piles of rendered meat and bone meal (MBM), specified risk material (SRM) and insufficient overall alternative disposal capacity, the number of plants in this sector looks set to rise.

Installations burning only animal carcasses are presently exempted from the Waste Incineration Directive (WID) but must comply with other specific legislation. Installations that burn other animal remains (including MBM) do fall within WID from the dates specified.

In general the design and operational standards of this sector has been lower than other sectors, and will need improvement to meet WID standards.

Drum incinerators

This sector provides a means of burning out the contents of contaminated metal drums such that they may be re-used.

The application of HWID has lead to a decline in the number of plants operating in this sector. It would appear unlikely that there will be growth in this sector.

Pyrolysis & gasification plants

Pyrolysis and gasification are a type of thermal waste treatment that may have application across a range of waste types and offer a potential alternative to conventional combustion. Commercial scale plants have been developed for the treatment of selected waste types that fall within a reliable physical and chemical specification e.g. some sewage sludges and wood wastes.

There are *theoretical* advantages in that the thermal degradation stages are split into two by first generating a gas, and then subsequently combusting that gas. This can improve opportunities for process control and hence reduce emissions. Liquid and solid residues can also be recovered – these may have further uses with some, well segregated waste streams.

A further *theoretical* advantage is to be gained from the burning of the gas produced in gas engines or gas turbines. This would improve the efficiency of energy recovery as these generation technologies do not have the same inherent losses a steam turbines.

Despite these theoretical advantages the techniques have yet to be developed widely and reliably at a commercial scale, although some successful plants have been developed for specific waste streams (e.g. sewage sludge). The economics of this sub-sector would appear to suggest that wider application, to include general municipal waste streams would only become viable at disposal costs greater than those in the UK. However, coupled with systems to segregate, select and pre-treat waste they may become competitive for individual waste fractions.

Despite some claims for greatly reduced emissions compared to mass burn incineration there is insufficient data to draw this conclusion on a general basis.

Comparison of Pyrolysis and Gasification with Incineration:

The following points should be noted:

- There is wider variation in the processes with pyrolysis and gasification plants than is the case for combustion plants. Generalisations regarding performance must therefore be regarded with caution.
- Many applications are at an early stage of development and performance data limited and sometimes conflicting.
- Pyrolysis and gasification generally require waste pre-treatments to produce a more homogeneous fuel than is required by combustion plants. This pre-treatment may lead to reductions in emissions spikes although the same would be true for incineration with pre-treatment.
- Pyrolysis and gasification plants may be able to recover a higher proportion of energy from the fraction of waste burned by burning the gas produced in engines or gas turbines. However, achieving directive requirements regarding combustion residence time and CO and VOC emissions limit values is a concern.
- Fuel bound nitrogen may be converted to ammonia and hydrogen cyanide which may require removal prior to combustion to prevent elevated NOx levels.
- Solid and liquid residues have the potential to contain higher levels of organic pollutants and heavy metals than incineration and further treatment may be required.
- There would appear to be little evidence to support claims that pyrolysis and gasification emit lower amounts of dioxins to air than modern incineration installations.
- Smaller plants appear to be more cost competitive with incineration than larger plants in the municipal sector.
- Niche applications for some well-characterised wastes streams would appear to offer the main market for this technology.

Refuse derived fuel plants

Fuels may be derived from a variety of combustible wastes with either no pre-treatment or complex treatment depending on the source and nature of the waste.

Types of RDF include:

- Waste oil
- Waste solvents e.g. secondary liquid fuels (SLF)
- Municipal RDF
- Agricultural residues e.g. straw, poultry litter
- Tyres
- Industrial bio-mass residues e.g. wood, food residues, paper sludge

Some of these are already subject to HWID. In the majority of cases (excluding certain clean wood and biomass residues specified in WID) the remainder will be required to meet the standard outlined in the WID.

Co-incinerators

Co-incineration relates to the burning of wastes or waste derived fuels with other non-waste (primary) fuels in installations whose primary purpose is the generation of energy or the production of material products. Common examples are cement works and power stations. There can be advantages in recovering the energy from the waste burned provided it does not give rise to unacceptable pollution hazards (and can meet European emission requirements).

These installations will be covered by WID (or HWID). Although BAT for this sector is outlined in the relevant sector guidance, this guidance does include information relevant to the emission limit and other operational standards that must be met, (see Sections 2 and 3).

1.8 Economic Aspects

Waste disposal is an essential service. Disposal costs are eventually, largely borne by the consumer. Options for disposing of waste are limited, and it is with these other options, primarily landfill, that the incineration sector competes.

Legislative pressures on incineration and other disposal methods presently play a key role in predicting the viability of incineration as a disposal option. The Landfill Directive in particular, sets challenging targets for the reduction of reliance upon landfill in the UK. Current UK waste strategy requires significant increases in recycling performance in the municipal sector. Other factors, specific to each sector are outlined below. Increases in the cost of waste disposal can enable individual incineration sectors to provide for enhanced environmental performance and may facilitate the development of otherwise uneconomic disposal techniques.

In general there are economies of scale to be gained at larger throughput plant. This and the greater mass emissions generated may justify the application of tighter environmental standards at the larger plant in each sector. However, in many cases plant throughput will be limited by factors such as: land availability; a need to comply with proximity requirements; and transport costs.

At the small plant scale it is possible that the minimum operational standards required by European legislation (Ref. 25) will render some existing plants uneconomic, unless disposal costs increase further. Larger existing plant requiring upgrade to meet the new standards may also incur significant expenditure. Current trends indicate that disposal costs in many sectors are likely to continue to increase significantly ahead of inflation.

1.8.1 Sub-sector specific information

Municipal waste incineration sub-sector

There are currently 12 operational MWIs in the UK. Waste growth of 3% per annum has been seen in recent years and predictions are that this is set to continue for at least the next decade. Even after allowances have been made for the increased recycling rates required by Government, the move from landfill needed to fulfil the requirements of the Landfill Directive is widely predicted to result in capacity growth in this sub-sector.

Estimates of the number of new municipal incinerators required in the UK are greatly dependent upon plant size and recycling levels achieved. Estimates (Ref. 27) based upon incineration plant capacity of 200 Kte/annum and a recycling rate of 33%, are that 8 to 26 million tonnes of capacity would be required. This equates to between 40 and 130 new plants.

All plants are required to meet the standards of existing European Directives. New plants must meet the standards of the most recent Waste Incineration Directive (2000/76/EC). Existing must meet these standards not later than 28 December 2005. Although not common, in some cases BAT may require higher environmental performance standards than the minimum standards set in the Directives. This is most likely to be the case at large plant, where economies of scale may be evident, or those situated in areas where local environmental conditions dictate additional controls are required to further reduce installation air emission contributions to background pollution.

Planning requirements are in the majority of cases likely to restrict the development of very large throughput (>500 Kte/annum approx.) MWIs, because the Operator is required to demonstrate compliance with policies relating to the proximity of the plant to the waste produced. New plants (which meet WID standards) of throughput below 100 Kte/annum are being introduced in the UK. Even smaller plant may be considered to be economical for selected or pre-treated waste streams.

Gate fees for municipal waste disposal are paid by local authorities. The size of the local authority waste management budget and the contracts agreed with disposal service providers will therefore have an important influence upon the development of both recycling and disposal outlets within a region. Local and regional waste disposal plans have a key role in the development of new facilities.

Financial support for energy from waste projects has been obtained by some projects under the Government's non fossil fuels / renewable energy programmes. It is important that the maximisation of electricity production should not be achieved at the expense of the exploitation of realistic opportunities for overall increased recovery of heat (e.g. through use of combined heat and power, district heating), or without consideration of opportunities to further reduce (mainly NOx) emissions through the use of selected catalytic reduction.

Evidence suggests that the developers of new municipal waste incinerators face significant costs (up to 7 figures) in respect of the preparation and submission of planning applications and pollution control licences.

Developers of MWIs tend to be part of large utility companies with diverse interests. Cost sensitivity to individual environmental improvements may therefore limited. Investment capital is available in the sector but this may, at least in part, need to be raised against wider company assets.

Clinical waste sub-sector

There is currently considered to be incineration capacity in excess of demand. It is estimated (Ref. 28) that in the period 2003/2006 there will be 30 CWIs, providing an approximate disposal capacity of 175 Kte/annum. Factors that may influence capacity include the use of alternative treatments such as sterilisation, micro-waving and increased segregation of waste at source. The Landfill Directive may result in an increase in clinical waste requiring disposal, but its impact on the UK incineration market as a whole is expected to be limited (see below).

The WID may lead to the closure of a number of smaller CWIs (smaller part Bs) and improve the economics of the remaining, compliant processes. The upgrading of some CWIs to meet the standards of the HWID in 2000, (in order to allow them to incinerate small quantities of certain hazardous wastes) is likely to mean that these processes will have the least difficulty in meeting the standards of the WID. Furthermore, it is possible that these HWID authorised plants may be in a good position to exploit any opportunities arising from the banning of the landfill of certain wastes under the Landfill Directive.

There is some sensitivity to costs and improvements beyond Directive standards may be difficult to justify. The anticipated closure of some plants is evidence of this.

Chemical (hazardous) waste sub-sector

There are currently only three merchant ChWIs in the UK following the closure of a fourth owing to a reported lack of buoyancy on the market. Competition within the sector, with the co-incineration of liquid wastes in cement kilns and the need for compliance with HWID may be responsible.

No new capacity is currently anticipated in this sector. There may be opportunities for increased plant utilisation as the Landfill Directive takes effect and the landfill of certain hazardous wastes is banned..

Although this sub-sector does not appear set for significant expansion, it is noted that the parent companies may operate on a much wider footing and have continued to be capable of raising capital to finance significant projects in similar fields.

In-house ChWIs may be operated for economic or policy reasons. Unit operational costs may be in excess of those found on the open market, but in-house disposal remains attractive where security or reliability of an available disposal route are factors. For waste gases, export may be impractical and in-house disposal will remain the favoured option. The provisions of the WID do not apply to the incineration of waste gases although BAT will apply.

The Landfill Directive may result in increased disposal costs for some waste streams and result in the development of in house waste treatment facilities, including incineration plant. In-house plants often represent a relatively small investment in relation to the overall facility they serve. These plants are therefore relatively insensitive to the cost of environmental improvements.

Sewage sludge sub-sector

The majority of new sewage sludge incinerators built in recent years provide an outlet for the disposal of sewage sludge diverted from dumping at sea following the 1998 ban, and for additional sludge arising from the wider use of secondary treatments installed to comply with the Urban Waste Water Directive. Some water companies have elected for alternative means of disposal including:

- Sludge pelletisation for use as fuel
- Sludge treatment for use as fertiliser
- Other thermal waste treatments e.g. Gasification or pyrolysis

The choice of disposal option will be based on a variety of factors including cost and availability of alternatives. This is influenced by:

- Proximity to and availability of suitable agricultural land for use as fertiliser / conditioner
- Sludge quality compared to land spreading criteria (influenced by industrial effluents and legislation)
- Ability to gain permission for incineration or alternatives

Incineration capacity increased four fold between 1995 and 1998 (6 new plants commissioned with a combined capacity of 344,600 tonnes dry solid per annum). Whether sufficient capacity exists at present or expansion is required will depend upon continued availability and economics of alternative disposal routes.

Although water companies have come under increasing pressure from their fiscal Regulator in respect of cost reductions, where compliance with legislative obligations is required they will be required to make the necessary investment and meet these obligations. The disposal of sludges by incineration will therefore be expected to meet the standards required by WID.

Animal carcass and animal remains sub-sectors

Between 1995 and 2000 the number of ACIs in England and Wales increased from 1 to 6. The key driver for this expansion has been the response to BSE. Capacity of ACIs was reported to be 4000 carcasses per week in the year 2000. With culled cattle arising from the over thirty months scheme (OTMS) numbering in excess of 10,000 per week, stock piles of rendered meat and bone meal (MBM), specified risk material (SRM) and insufficient overall alternative disposal capacity, the number of plants in this sector looks set to rise.

The cost of cattle disposal will be directly influenced by the capital and revenues cost of the disposal option chosen. In the incineration sector reduced emission limit values have a great influence over operational costs and hence gate disposal fees.

With the introduction of the WID (and other potential legislation influencing animal carcass only incinerators) the common emission limits concentrations and other requirements may serve to improve the economics of relatively larger plant. Smaller (part B) plant may need to upgrade their throughput to increase revenues in order to offset the application of WID.

Existing installations that are exempted from WID (animal carcass ONLY incinerators) must justify why they cannot meet WID standards. This justification is less likely to be acceptable for new installations. Particular attention should be paid to proposed legislative changes that may eventually harmonise incineration standards for ACIs. The eventual need to meet these standards is likely to mean that new plant will find it cheaper to design for them from day one rather than undertake expensive and technologically difficult upgrading at a later date.

Drum incineration sub-sector

The application of HWID has lead to a dramatic decline in the number of plants operating in this sector. It would appear unlikely that there will be growth in this sector.

Pyrolysis and gasification sub-sector

Commercial scale plants have been developed in the UK for the treatment of selected waste types that fall within a reliable physical and chemical specification e.g. some sewage sludges and wood wastes. Operators are developing plants for thermal treatment of municipal wastes. The majority of these plants are of relatively smaller scale.

In general it would appear that it is at the smaller end of the market (under approx. 100Kte pa) that costs of incineration (per unit disposed) increase and may converge with those of pyrolysis and gasification. However, the fact that relatively few proposals have yet reached full commercial scale exploitation means that the available cost data is sparse, and may be based on technology suppliers estimates rather than realised costs of operating plants.

Pyrolysis and gasification may benefit from potentially greater energy recovery revenues (if high efficiency generation can be used and guarantee the required emission limit values) and provide niche solutions for certain waste types. However, there remains a need for technology providers to develop and demonstrate UK operational plant to provide consistently reported data upon which conclusions regarding economics and environmental performance can be judged, and compliance with WID requirements demonstrated. Until this data is available, significant market penetration may be delayed owing to the additional risk perceived by financiers and purchasers.

Refuse derived fuel and co-incineration sub-sectors

Generalisations are difficult for these sectors, but it is possible that the waste hierarchy will encourage the recovery of energy from wastes that would otherwise be disposed of. Increased waste segregation at source may reveal additional opportunities for the economic recovery of energy from individual waste fractions.

At the sub-sector level, economics will be determined by the specific type of fuel, its availability and the type of plant required to secure its incineration and compliance with the WID (or HWID) standards. In particular the need for pre-treatment stages may result in significant additional costs. Where pre-treatment has already been carried out, costs (capital and revenue) will be reduced, but this can be balanced by a relatively more expensive price for the pre-prepared fuel.

WID provides mandatory environmental performance criteria for all installation in these sectors. Only at installations that have very large waste throughputs (and consequent potential impacts) is it possible that improvements beyond WID may be achieved within BAT. Further improvements may also be appropriate at installations where the process or abatement design in place for the primary fuel is such that its operation with a refuse derived fuel may already allow for standards better than the directive standards to be achieved.

Individual Situations:

1. ***Municipal RDF*** – some plants burning RDF are undergoing upgrade at the time of writing to meet new emission standards. The fact that these have been financed would appear to indicate that sector economics are adequate. The role of recycling credits and energy generation subsidies may be significant in supporting such schemes.
2. ***Poultry litter*** – whilst a number of plant upgrades have taken place, there have been few new plants developed in this sub-sector in recent years.
3. ***MBM Combustion*** – significant new projects have been financed. The quantity of MBM requiring disposal may lead to further proposals (this would also be true of animal remains and carcass incinerators)
4. ***Tyre Combustion*** – tyres offer a significant disposal problem but at an average CV of 32Mj/kg represent a significant energy recovery opportunity. Preparing the tyres to allow incineration has proved problematic in some instances. Opportunities for co-incineration in power stations and cement kilns offer a means of recovering energy and may even reduce emissions at those installations compared with the primary fuel. The relatively low level of exploitation of these opportunities may reflect technical difficulties, problems gaining permission or the public relations aspects of waste burning. Pyrolysis and gasification may be suited to this sector as they may be able to capitalise on the high volatile content of the tyres to produce a fuel rich off gas.
5. ***Secondary Liquid Fuels*** – the relatively widespread use of SLF and compliance with the existing HWID would indicate that the use of SLF remains economically viable.

1.8.2 Generic cost information required

Capital, revenue and annualised cost data for a variety of abatement and monitoring techniques are provided in the BAT report - Review of IPC Technical Guidance for Chapter 5 and 1.3c Vol1 March 2000 (Ref. 29).

Operators will be expected to justify their selected techniques using the H1 methodology (Ref. 5) (E1 for IPC) – thus comparing the costs of different techniques against the environmental gains. The key cost related aspects outlined below are of particular interest in this sector, and will require justification in the application. This section is intended as a guide. It should not be considered to be all encompassing.

Where it is not possible for uncertain (but potentially significant) factors such as “reliability” or “operational experience” to be quantified, these may still be included in any accompanying qualitative discussion that justifies the final BAT selection. In many cases such factors will be the dominant indicators of environmental performance:

1. ***Waste pre-treatment:***

Waste is often of a highly heterogeneous nature. This can create problems during its incineration including short-term exceedences of emissions limits and unnecessary waste production through the over-dosing with reagents to control peak emission rates.

The degree of pre-incineration waste treatment will therefore require justification and should take into account the following:

- What are the benefits to be accrued from pre-treatment?
- Additional capital and revenue costs of the pre-treatment options?
- Costs and consequences associated with not implementing pre-treatment? e.g. waste disposal costs for additional reagent waste arising?

See also Section 2.3.1 (incoming waste management) and section 2.3.8 (abatement of point source emissions to air).

2. ***NOx control techniques:***

There are a variety of approaches available for the prevention and control of NOx, (see Sections 2.3.3 - furnace types, 2.3.4 - furnace requirements and Section 2.3.8 - abatement for details).

Operators will in particular be required to provide cost arguments comparing the NOx control techniques selected and take into account the following:

- Could waste pre-treatment reduce NOx production?
- Could a lower NOx furnace be used? e.g. fluidised bed
- Could staged combustion be used?
- Can FGR be used to reduce the need for reagent injection?
- Could SCR be used instead of or as well as SNCR?

Note: Recent cost comparisons for SCR and SNCR appear to have shown some conversion. Figures quoted in a recent application (year 2001) of £1,181/te NOx avoided with SNCR and £3,513/te of NOx avoided with SCR. Further reductions in SCR cost could lead to it becoming BAT in some situations and its possible use should be examined (see Section 2.3.8 for further comment on secondary NOx abatement and NOx cost benefit study requirements).

3. ***Acid Gas Treatment:***

There are a variety of approaches to acid gas control. The techniques are outlined in Section 2.3.8 - abatement of point source emissions to air.

The key cost related elements that must be considered in order to demonstrate that the selection chosen is the BAT are:

- Can waste elimination / pre-treatment be used to control inputs?
- What are the costs and benefits of waste pre-treatment? e.g. reduction in reagent and APC residue disposal costs? Capital and revenue costs of pre-treatment plant?
- Can reagent dosing be linked to acid gas load using fast response monitoring and adjustment?
- Would an alternative reagent assist?
- Justify why wet scrubbing is not employed?

4. ***Stack height***

Stack height increases will result in reduced ground level impacts but there are restrictions on this.

- Could the stack height be increased to reduce ground level impacts?

See Section 2.3.5 - Chimneys and vents, and Section 4 - Impact.

5. ***Energy recovery***

The primary purpose of the installations in this sector is the safe disposal of waste. The recovery of energy from the waste is an important, but secondary consideration. Nonetheless, installations should be designed and operated such that *"the heat generated ….is recovered as far as practicable"* (ref WID). See also Section 2.3.7 - Boiler design and Section 2.7 - Energy.

Operators must therefore justify how the degree of energy recovered is the BAT. This will require consideration of:

- How much energy is produced per tonnes of waste incinerated? What is the "net" energy production / consumption (i.e. less parasitic loads) of the installation per unit of waste incinerated?
- Will increased energy recovery result in increased emissions from the installation?
- What are the costs (capex / opex) of the options for increasing the energy recovered?
- Justify why combined heat and power and / or district heating cannot be used?
- Can waste heat be used to heat primary / secondary air? Or to heat the final gas discharge (to reduce plume visibility, improve dispersion, allow for SCR?)

2 TECHNIQUES FOR POLLUTION CONTROL

BAT Boxes to help in preparing applications

This section summarises, in the outlined BAT boxes,

- what is required in the application
- the indicative BAT requirements (i.e. what is BAT in most circumstances) against which the application will be judged.

At the top of each BAT box is the question which is being addressed. It will be seen that these deal with the questions in the Application Form relating to environmental performance of the installation.

Although referred to as "BAT", the requirements also cover the other requirements of the PPC Regulations and requirements of other Regulations (such as the Waste Management Licensing Regulations (see Appendix 2 for equivalent legislation in Scotland and Northern Ireland) and the Groundwater Regulations insofar as they are relevant to an IPPC Permit).

Indicative BAT requirements

Where it has been possible for the Regulator to make a judgement on what will normally be BAT, the, indicative requirements are clear and prescriptive. In such cases:

- If you propose to comply with the indicative requirement, you need only describe how you will do so, if this is not obvious from the wording of the requirement itself.
- If you propose to depart from any indicative requirements, you should justify your proposal. Such departures may be stricter or less strict than the indicative requirements:
- Stricter proposals may be appropriate where:
  - new techniques have become available after the publication of the guidance;
  - the particular technical configuration at your installation makes higher standards practicable;
  - the local environment is particularly sensitive.
- Less strict proposals may be justified due to particular factors relating to your installation or the local environment. For example, you may operate to a standard that is very close to an indicative requirement, but using different plant or processes from that upon which the indicative requirement is based. In such a case it may impose a disproportionate cost to replace the old plant with the new techniques for only a small decrease in emissions.

In other cases, the main BAT candidates are identified, but the final choice can only be made on an installation-specific basis. In further cases, aspects of the installation may not be covered by the guidance at all.

Justifying proposals

Whether you are:

- justifying departures from clear indicative requirements;
- assessing options to determine which of those identified by guidance is best for a your site; or
- developing proposals for parts (or possibly all) of an installation that are not covered by guidance.

The costs and benefits of a range of options should be compared. However, the level of detail required depends on the environmental significance of the matter in question. In the more complex cases (e.g. where the options available would lead to significantly different environmental effects, or where the cost implications are a major factor) it will be necessary to develop proposals through a more detailed analysis of the costs and benefits of options. The Agency's methodology for such assessments is set out in the IPPC H1 "*Assessment of BAT and Environmental Impact for IPPC* (in preparation).

In many situations, however, it will not be necessary to carry out a detailed analysis of options. For example, where an indicative standard is inappropriate for obvious technical reasons, or where there are only minor additional emissions, it may be possible to justify a departure in just a few words.

Prevention is the priority.

In responding to the requirements the Operator should keep the following general principles in mind.

- As a first principle there should be evidence in the application that full consideration has been given to the possibility of **PREVENTING** the release of harmful substances, e.g. by:
  - substituting materials or processes (see Section 2.2.1);
  - preventing releases of water altogether (see Section 2.2.3); or by
  - preventing waste emissions by reuse or recovery.
- Only where that is not practicable should the second principle be adopted of reducing emissions which may cause harm.

Further explanation of the requirements of Section 2 is given in Section B2 of the Guide for Applicants.

2.1 Management Techniques

Within IPPC, an effective system of management is a key technique for ensuring that all appropriate pollution prevention and control techniques are delivered reliably and on an integrated basis. The Regulators strongly support the operation of environmental management systems (EMSs). An Operator with such a system will find it easier to complete not only this section but also the technical/regulatory requirements in the following sections.

The Regulators recommend that the ISO 14001 standard is used as the basis for an environmental management system. Certification to this standard and/or registration under EMAS (EC Eco Management and Audit Scheme) (OJ L168, 10.7.93) are also strongly supported by the Regulator. Both certification and registration provide independent verification that the EMS conforms to an assessable standard. EMAS now incorporates ISO 14001 as the specification for the EMS element. For further details about ISO 14001 and EMAS contact British Standards Institute (BSI) and the Institute of Environmental Management and Assessment (IEMA) respectively.

The steps required in this and subsequent sections may help the Operator to make good any shortfalls in their management system. An effective EMS will help the Operator to maintain compliance with regulatory requirements and to manage other significant environmental impacts. While the requirements below are considered to be BAT for IPPC, they are the same techniques as required in a formal EMS and are also capable of delivering wider environmental benefits. However, it is information on their applicability to IPPC which is primarily required in this application.

Application Form
Question 2.1

Provide details of your proposed management techniques.

With the Application the Operator should:

1. Describe their management system to demonstrate how it meets the ***"Requirements for an effective management system"*** below. The description should make clear who holds responsibility for each of the requirements. The second column explains where in the application the response to each requirement is best dealt with to avoid duplication. Copies of all procedures are not needed, but examples may be included in your application.

   If you are certified to ISO 14001 or registered under EMAS (or both), you may provide a statement derived from certification records/assessments to support your application.

   Further specific management procedures are dealt with under the appropriate section on the remainder of the document. It is recommended that you understand all the requirements of the application before completing this section, as many management issues are dealt with in other sections.

2. The type of management system employed will depend upon the scale and complexity of the operations undertaken. The Operator should demonstrate that the proposals are BAT, by confirming compliance with the indicative requirements below, or by justifying departures (as described in Section 1.2 and in the Guide for Applicants) or alternative measures.

Indicative BAT Requirements

BAT for management techniques

The Operator should have a management system in place for the activities which delivers the requirements given in column 1 below. The development of any aspects of the management system not already in place should be completed within the timescale given in Section 1.1.

Requirement for an effective management system	How delivered for IPPC
1. **Clear management structure and allocated responsibilities** for environmental performance, in particular meeting the aspects of the IPPC Permit	Describe in this section who has allocated responsibilities
2. **Identification, assessment and management of significant environmental impacts**	By responding to the requirements in Section 4.1 in the application
3. **Compliance with legal and other requirements applicable to activities impacting on the environment**	Compliance with the Permit satisfies this requirement

Cont.

4. **Establishing an environmental policy and setting objectives and targets** to prevent pollution, meet legal requirements and continually improve environmental performance	The Applicant should make proposals in response to each of Sections 2.2 to 2.12. These proposals may be incorporated within the Permit improvement programme
5. **Environmental improvement programmes to implement policy objectives and targets**	
6. **Establish operational controls to prevent and minimise significant environmental impacts**	By responding to the requirements in Sections 2.2 to 2.7, 2.11 and 2.12 in the application
7. **Preventative maintenance programmes for relevant plant and equipment** – method of recording and reviews	Describe system here. List procedures in Section 2.3
8. **Emergency planning and accident prevention**	By responding to the requirements in Section 2.8 in the application
9. **Monitoring and measuring performance** Identify key indicators of environmental performance and establish and maintain a programme to measure and monitor indicators to enable review and improvement of performance	Describe in this Section
10. **Monitoring and control systems**: • to ensure that the installation functions as intended; • to detect faults and unintended operations; • to detect slow changes in plant performance to trigger preventative maintenance	By responding to the requirements in Section 2.10 in the application
11. **Training** Provision of adequate procedures and training for all relevant staff (including contractors and those purchasing equipment and materials), which should include: • a clear statement of the skills and competencies required for each job; • awareness of the regulatory implications of the Permit for the activity and their work activities; • awareness of all potential environmental effects from operation under normal and abnormal circumstances; • prevention of accidental emissions and action to be taken when accidental emissions occur; • implementation and maintenance of training records; Expertise required depends on the activities being carried out. However, both technical and managerial staff upon whom the installation's compliance depends need sufficient qualifications, training and experience for their roles. This may be assessed against any industry sector standards or codes of practice	To be described in this Section confirming that training for each of the areas covered by Sections 2.2 to 2.3 and 2.5 to 2.10 are covered
12. **Communication and reporting of incidents of actual or potential non-compliance and complaints** Actions taken in response, and about proposed changes to operations	Describe in this Section
13. **Auditing** Regular, (preferably) independent, audits to check that all activities are being carried out in conformity with these requirements. All of these requirements should be audited at least once per year	Describe in this Section

Cont.

14. **Corrective action to analyse faults and prevent recurrence** Define responsibility and authority for handling and investigating non-conformance, taking action to mitigate any impacts caused and for initiating and completing corrective and preventive action Recording, investigating, taking corrective action and preventing recurrence, in response to environmental complaints and incidents	Describe in this Section how this is dealt with for each of Sections 2.2 to 2.3 and 2.5 to 2.10 as appropriate
15. **Reviewing and Reporting Environmental Performance** Senior management review environmental performance and ensure appropriate action taken where necessary to ensure that policy commitments are met and that policy remains relevant. Review progress of the Management Programmes at least annually. Incorporate environmental issues in all other relevant aspects of the business, insofar as they are required by IPPC, in particular: • the control of process change on the installation; • design and review of new facilities, engineering and other capital projects; • capital approval; • the allocation of resources; • planning and scheduling; • incorporation of environmental aspects into normal operating procedures; • purchasing policy; • accounting for environmental costs against the process involved rather than as overheads. Report on environmental performance, based on the results of management reviews (annual or linked to the audit cycle), for: • information required by the Regulator; and • effectiveness of the management system against objectives and targets, and future planned improvements. Report externally preferably via public environmental statement	Describe in this Section Describe in this Section This will become a Permit requirement Describe in this Section Describe in this Section
16. **Managing documentation and records** List the core elements of the EMS (policies, responsibilities, procedures etc) and links to related documentation in order to be able to control, locate and update documentation. Describe how environmental records and results of audits and reviews are identified, maintained and stored	Describe in this Section

Selection of raw materials

2.2 Materials Inputs

This section covers the use of **raw materials, water and waste input** and the relevant techniques for both minimising their use and minimising their impact by selection. It also provides a summary (Section 2.2.2 - Waste minimisation) of the main techniques that should be considered for **minimising the waste** produced by the installation. The choice of fuels is covered under Section 2.7.3 - Energy.

As a general principle, the Operator will need to demonstrate the measures taken to:

Reduce
Substitute
Understand

- **reduce** the use of chemicals and other materials (Section 2.2.2);
- **substitute** less harmful materials or those which can be more readily abated and when abated lead to substances which in themselves are more readily dealt with;
- **understand** the fate of by-products and contaminants and their environmental impact (Section 4).

Special considerations for the waste incineration sector

Unlike other sectors, where the production of a material product by the consumption of the minimum quantity of raw materials is the aim, the waste incineration sector has ***the primary purpose of consuming the waste*** that is fed to it, for the purpose of its safe disposal.

Whilst it remains valid to consider reducing consumption of other raw materials (e.g. reagents used for pollution control purposes and water) in the same way as other sectors, the approach in respect of waste that will actually *be disposed of* in the installation is necessarily different. This is because the quantity and type of waste to be disposed of, and hence the capacity of, the installation will be selected according to the amount of waste of a particular type that requires disposal. At the installation level, there will therefore be limited scope to consider how the *overall quantity* of waste might be reduced– this is a wider consideration, beyond the scope of an individual permit. Such wider, strategic factors are however important when sizing the installation, and it will remain for the Operator to demonstrate how the installation fits within local, regional and national waste strategy and plans.

Despite the comments made in the paragraph above, from a pollution control perspective at the sector level, it remains valid to carefully consider the ***composition*** of the waste. The collection, selection and treatment chain will determine the type and composition of waste that will finally be incinerated. This in turn will determine the techniques that will represent the BAT at the incinerator. The influence of waste type on plant design is discussed in Section 2.2.1.2.

2.2.1 Raw materials selection

This section looks at the general issues concerning the **selection and substitution** of raw materials (Section 2.2.1.1) and wastes (Section 2.2.1.2). Section 2.2.2 describes the general techniques to **minimise** the use of raw materials.

2.2.1.1 Reagent selection

Summary of materials in use

The principal raw materials that may be consumed (excluding waste feed) in the incineration sector are:

- Lime - Calcium hydroxide ($Ca(OH)_2$) - reagent for gas treatment;
- Sodium Bicarbonate ($NaHCO_3$) - reagent for gas treatment;
- Sodium Hydroxide (NaOH) - reagent for gas treatment;
- Water - make up for neutralisation reagents / boiler water / cooling towers;
- Urea or Ammonia - reagent for NOx reduction;
- Activated Carbon - reagent for dioxin / heavy metal absorption;
- Catalysts - where SCR is used; or in catalytic bag filters
- Water treatment chemicals - for boiler water conditioning;
- Effluent treatment plant chemicals - mainly acids and alkalis for pH balancing and precipitation;
- Fuels - either gas or fuel oil for start up and temperature stabilisation;
- Biocides - to reduce fouling in direct cooling systems and for biological safety in cooling water.

Selection of raw materials

Application Form Question 2.2 (part 1)

Identify the raw and auxiliary materials, other substances and water that you propose to use.

With the Application the Operator should:

1. supply a list of the materials used, which have the potential for significant environmental impact, including:
   - the chemical composition of the materials where relevant;
   - the quantities used,
   - the fate of the material (i.e. approximate percentages to each media and to the product),
   - environmental impact where known (e.g. degradability, bioaccumulation potential, toxicity to relevant species).
   - any reasonably practicable alternative raw materials which may have a lower environmental impact including, but not be limited to, any alternatives described in BAT Requirement 5 below (the substitution principle).

   Generic information about materials, and grouping information of those of a similar type, is normally adequate rather than listing every commercial alternative used. A common sense approach to the level of detail should be used; ensuring that any material could have a significant effect of the environment is included. Product data sheets should be available on-site.
2. justify (e.g. on the basis of impact on product quality), the continued use of any substance for which there is a less hazardous alternative and that the proposed raw material section is therefore BAT;
3. for existing activities, identify shortfalls in the above information, e.g. the environmental impact of certain substances, which the Operator believes require longer term studies to establish.

Indicative BAT Requirements

BAT for selection

1. The Operator should:
   - complete any longer-term studies (Item 3 above),
   - carry out any substitutions identified,

   as improvement conditions to a timescale to be approved by the Regulator.
2. The Operator should maintain a detailed inventory of raw materials used on-site.
3. The Operator should have procedures for the regular review of new developments in raw materials and the implementation of any suitable ones which are less hazardous.
4. The Operator should have quality assurance procedures for the control of the content of raw materials.
5. The following raw material substitution criteria should be applied where appropriate:

Raw material	Selection criteria
Alkaline reagents	• low concentrations of persistent pollutants in the reagent itself e.g. metals • high pollutant absorption efficiency is required • low waste production i.e. low concentrations of unused reagent in waste • possibility to recycle to decrease waste production
Activated Carbon	• low concentrations of persistent pollutants e.g. metals • high porosity to enhance absorption efficiency • care required when changing supplier / source is required as absorption characteristics may change
NaOH	• Only “low mercury” NaOH should be used. **(#)**

Cont.

Selection of raw materials

Raw material	Selection criteria
Support Fuels	• Support fuels shall not give rise to higher emissions than burning gas oil, liquified gas or natural gas. • All uses of support fuel other than natural gas will require justification.
Dispersants/ surfactants	• Only chemicals with high biodegradability and known degradation products should be used. • Alkylphenolethoxylates should be avoided. **(#)**
Biocides	• Only chemicals with high biodegradability and known degradation products should be used. • Environmental assessment should consider site specific nature of receiving waters before deciding on material suitability e.g. saline or freshwater environments

2.2.1.2 Waste selection - Influence of waste type on plant design

This section deals with the influence that the composition of **the waste that is fed to** the incineration installation has upon BAT. Some data for waste compositions is included in Section 2.2.4.

Understanding the physical and chemical nature of the waste stream is of paramount importance. BAT for an incineration installation will depend to a large extent upon the type of wastes that are being incinerated. Without this knowledge it will not be possible for an installation to be designed so as to meet the requirements of BAT.

Applicants must identify and consider:

- All waste streams that are to be incinerated.
  - expressed according to the European Waste Catalogue categories;
  - according to the premises where the waste arises and the consequent general character of the waste;
- the throughput of each line for each waste type in tonnes per year and per hour,
- The physical nature of the waste:
  - its CV range;
  - its moisture range;
  - its ash content;
  - its density / friability;
- The chemical composition of the waste:
  - Identify the range of pollutant loads that will be generated pre-abatement and show how their emission will be prevented or minimised (e.g. PCBs, Halogens, Metals),
- How the plant design envelope accounts for waste composition variation,
- Particular wastes that may cause difficulties and how they will be prevented from entry to the installation or managed to avoid emission exceedences or other problems,
- How the waste will be managed on-site and upstream of the plant to prevent exceedence of plant design envelope,
- How the nature of the waste may change over the plant lifetime and how this has been taken into account.

The Applicant should demonstrate that their plant has been designed and will be managed and operated such that the heterogeneity of the waste is accounted for. Operational plant will be able to demonstrate this by reference to actual plant data for emissions and other operational parameters. New plant may be able to make reference to the performance of other operational plant of the same design but must consider the possibility of local variations in waste character, plant modifications and management.

Waste minimisation

2.2.2 Waste minimisation (minimising the use of raw materials)

Principles

The prevention and minimisation of waste and emissions to the environment is a general principle of IPPC. Operators will be expected to consider the application of waste minimisation techniques so that, wherever practicable, all types of wastes and emissions are prevented or reduced to a minimum. The steps below will also help to ensure the prudent use of natural resources.

Waste minimisation can be defined simply as:

"a systematic approach to the reduction of waste at source, by understanding and changing processes and activities to prevent and reduce waste".

A variety of techniques can be classified under the general term of waste minimisation and they range from basic housekeeping techniques through statistical measurement techniques, to the application of clean technologies. In the context of waste minimisation and this Guidance, **waste** relates to the inefficient use of raw materials and other substances at an installation. A consequence of waste minimisation will be the reduction of gaseous, liquid and solid emissions.

Key operational features of waste minimisation will be:

- the ongoing identification and implementation of waste prevention opportunities;
- the active participation and commitment of staff at all levels including, e.g. staff suggestion schemes;
- monitoring of materials usage and reporting against key performance measures.

For the primary inputs to waste activities e.g. the waste to landfill, the requirements of this section may have been met "upstream" of the installation. However, there may still be arisings which are relevant.

See Ref. 7 for detailed information, guides and case studies on waste minimisation techniques.

Application Form Question 2.2 (part 2)

Identify the raw and auxiliary materials, other substances and water that you propose to use.

With the Application the Operator should:

1. identify, from a knowledge of the plant, the main opportunities for waste minimisation and supply information on waste minimisation audits and exercises and the improvements made or planned.

Indicative BAT Requirements

Note: The guidance in this section is limited and does not discuss the potential disadvantages of each of the techniques outlined. Further detail regarding each of the techniques, their advantages and disadvantages should be consulted. This may be found in Section 2.3 - Main activities and abatement).

BAT for waste minimisation

1. A regular **waste minimisation audit** should be carried out. Where one has not been carried out recently, an initial comprehensive audit should be carried out at the earliest opportunity within the improvement programme. New plants will need to have been operating for some time before an audit will be meaningful. Further audits should be at least as frequent as the IPPC Permit reviews. The audit should be carried out as follows:

   The Operator should analyse the use of raw materials, assess the opportunities for reductions and provide an action plan for improvements using the following three essential steps:
   i) process mapping;
   ii) raw materials mass balance;
   iii) action plan.

   The use and fate of raw materials and other materials, including reactants, intermediates, by-products, solvents and other support materials, such as inerting agents, fuels, catalysts and abatement agents, should be mapped onto a process flow diagram (see Ref. 7) using data from the raw materials inventory (see Section 2.2.1) and other company data as appropriate. Data should be incorporated for each principal stage of the operation in order to construct a mass balance for the installation.

   Using this information, opportunities for improved efficiency, changes in process and waste reduction should be generated and assessed, and an action plan prepared for the implementation of improvements to a time-scale approved by the Regulator.

Cont.

Waste minimisation

2. **References** provide detailed information, guides and case studies on waste minimisation techniques. Section 2.3 covers cleaner technologies and waste minimisation opportunities specific to the main activities in this sector.

3. **Feedstock Heterogeneity**

Improving feedstock heterogeneity can minimise residues by improving operational stability throughout the installation. This will in turn lead to improved ability to optimise operational and environmental performance and reduce the amount of reagents used and wastes produced.

Operators should consider at least the following techniques for improving feedstock heterogeneity:

- Upstream waste management
- Procedures for removal of problem wastes
- On or off site waste treatment / mixing

4. **Furnace Conditions**

The prime purpose of incineration is to thermally treat wastes in order to minimise the amount and harmfulness of the residues arising for further disposal. Good combustion conditions are the key to securing this.

Operators should consider at least the following key techniques to minimise residue production:

- burnout in the furnace should achieve less than 3% TOC (e.g. by improving waste agitation on the bed / burnout time and temperature exposure)
- SNCR reagent dosing should be optimised to prevent ammonia slip to ash

5. **Gas Treatment Conditions**

Optimising alkaline (and other) reagent use will prevent the production of wastes (unused or contaminated) reagent.

Operators should consider at least the following techniques:

- alkaline reagent recycle
- wet scrubbing
- optimisation of reagent dosing and reaction conditions

6. **Waste Management**

Operators should consider at least the following techniques:

- On site or off-site waste treatments to improve suitability for recovery or disposal.

Mixing of wastes produced on site can cause contamination of a large amount of waste with a smaller amount such that it cannot be recovered or easily disposed of. Operators ***must*** ensure that the plant design appropriately segregates waste streams within the plant, in order to facilitate their recovery or disposal. This ***must*** include at least:

- APC residues produced must be stored separately from bottom ash.

Further guidance on each of these techniques may be found in Section 2.3 - Main activities.

Water use

2.2.3 Water use

Incinerators are not generally considered to be major users of water. Water use does not therefore tend to be a primary environmental concern although it is important to recognise that wet scrubbing and some cooling systems can consume relatively larger quantities of water. The minimisation of water consumption will however make a contribution to improving environmental performance of the installation, but should be considered on a case by case basis.

Summary of the activities

Major water uses in incineration plants are:

- gas scrubbing – particularly wet scrubbing
- ash discharge quench baths
- evaporation from wet cooling towers

Other uses include boiler water make up and wash down operations.

Application Form Question 2.2 (part 3)

Identify the raw and auxiliary materials, other substances and <u>water</u> that you propose to use.

With the Application the Operator should:

1. supply information on water consumption and comparison with any available benchmarks;
2. supply a diagram of the water circuits with indicative flows;
3. describe the current or proposed position with regard to the indicative BAT requirements below, or any other techniques which are pertinent to the installation;
4. demonstrate that the proposals are BAT, by confirming compliance with the indicative requirements, by justifying departures (as described in Section 1.2 and in the Guide for Applicants) or alternative measures;
5. describe, in particular, any water audits already conducted and the improvements made or planned.

Indicative BAT Requirements

BAT for water efficiency

1. A regular review of water use (water efficiency audit) should be carried out. Where one has not been carried out recently, an initial comprehensive audit should be carried out at the earliest opportunity within the improvement programme. New plants will need to have been operating for some time before an audit will be meaningful. Further audits should be at least as frequent as the IPPC Permit reviews. The audit should be carried out as follows:
   - The Operator should produce flow diagrams and water mass balances for the activities.
   - Water efficiency objectives should be established by comparison with sector guidance or, where not available, national benchmarks (see Ref. 9). In justifying any departures from these (see Section 1.2), or where benchmarks are not available, the techniques described below and those in the existing sector guidance should be taken into account. The constraints on reducing water use beyond a certain level should be identified by each Operator, as this is usually installation-specific.
   - Water pinch techniques should be used in the more complex situations, particularly on chemical plant, to identify the opportunities for maximising reuse and minimising use of water (see ETBPP publications, Ref. 8).
   - Using this information, opportunities for reduction in water use should be generated and assessed and an action plan prepared for the implementation of improvements to a timescale approved by the Regulator.
2. The following general principles should be applied in sequence to reduce emissions to water:
   - water-efficient techniques should be used at source where possible;
   - water should be recycled within the process from which it issues, by treating it first if necessary. Where this is not practicable, it should be recycled to another part of the process which has a lower water quality requirement;
   - in particular, uncontaminated roof and surface water, which cannot be used, should be discharged separately.

Cont.

Water use

BAT for water efficiency (cont)

3. Measures should be implemented to minimise contamination risk of process or surface water, (see Section 2.3.12).

4. To identify the scope for substituting water from recycled sources, the water quality requirements associated with each use should be identified. Less contaminated water streams, e.g. cooling waters, should be kept separate where there is scope for reuse, possibly after some form of treatment.

5. Ultimately wastewater will need some form of treatment (see Section 2.3.10). However, in many applications, the best conventional effluent treatment produces a good water quality which may be usable in the process directly or when mixed with fresh water. While treated effluent quality can vary, it can be recycled selectively when the quality is adequate, reverting to discharge when the quality falls below that which the system can tolerate. The Operator should identify where treated water from the effluent treatment plant could be used and justify where it is not.

   In particular, the cost of membrane and de-ionisation technology continues to reduce. They can be applied to individual process streams or to the final effluent from the effluent treatment plant. Ultimately, they could completely replace the ETP plant, leading to much reduced effluent volume. There remains, however, a concentrated effluent stream but, where this is sufficiently small, and particularly where waste heat is available for further treatment by evaporation, a zero effluent system could be produced.

   The advantages and disadvantages of wet scrubbing systems are discussed in Section 2.3.8.3 on page 78. Operators should assess the costs and benefits of providing such a system.

6. Water used in cleaning and washing down should be minimised by:
   - vacuuming, scraping or mopping in preference to hosing down;
   - evaluating the scope for reusing wash water;
   - trigger controls on all hoses, hand lances and washing equipment.

Benchmarks for water consumption

7. Dry scrubbing systems do not consume significant quantities of water, with only a little required for ash quench and conditioning.

8. Semi dry gas scrubbing typically consume 250-350Kg / tonne of waste incinerated.

9. MWIs using wet scrubbing can consume up to 850Kg / tonne of waste incinerated, although this should be reduced by scrubber liquor re-circulation. Care must be taken to ensure that, where liquors are recirculated, this does not result in higher emissions to air. Clean water input should therefore be made at the final (polishing) scrubber. Liquor treatment to remove pollutants will allow for further reductions in water consumption than simple bleed and top up systems.

10. The nature of the wastes treated in HWIs means that higher levels of water consumption (up to 1100 Kg/tonne of waste) may be justified to ensure emissions to air are controlled – which is the primary objective. Multi-stage wet scrubbing systems provide for lower water consumption by re-circulating the used stack end scrubber water to earlier scrubbing / quench stages. Cooling of the final stage clean scrubber water helps to prevent scrubber water losses by evaporation with exhaust gases, but consideration should also be given to stack exit temperatures and consequent plume dispersion characteristics.

11. Most CWIs employ dry scrubbing and therefore consume relatively little water.

12. There is little data available for other incineration plant types. In general the more variable the waste feed (e.g. drum incineration) the greater the justification for the use of the wet scrubbing techniques that can be associated with higher levels of water consumption if they are not of the closed loop type.

13. In justifying any departures from these benchmarks the techniques described below should be taken into account. The constraints on reducing water use beyond a certain level should be identified by each Operator, as this is usually installation-specific. With the majority of fresh water being used for gas scrubbing it will be important that Operators justify their choice of technique. In general the following may represent BAT with regard to water consumption (provided reagent use is similar and closed loop wet systems are not practicable):
    - MWIs - dry or semi-dry scrubbing;
    - HWIs - wet scrubbing;
    - CWIs - dry or semi-dry scrubbing.

Cont.

Water use

BAT for water efficiency (cont)

14. Other incinerators should be assessed on a case by case basis and the Operator required to justify why lower water consumption techniques cannot be used (in order to minimise water consumption). The nature of the waste feed in terms of its composition and heterogeneity, the need to ensure emissions to air are controlled within emission limit values and the quantities of waste produced from the gas treatment are all factors that may justify the use of greater quantities of water, although closed loop effluent recycle systems may meet all of these criteria providing there is sufficient space and wet plumes are not an issue. Other prevention options such as waste pre-treatment (to improve heterogeneity) or feed management (to remove or dilute high pollutant load items) should also be considered as these may reduce the need for water scrubbing systems.

Other Techniques for reducing gross water use

15. Other techniques include:

- In ***wet systems*** - provision of multi-stage scrubbers in series:
  - with the effluents from the clean scrubbers used as feed for the dirty scrubber / quench;
  - clean water feeds to final polishing / clean end scrubbers;
  - dirty water bleeds only or primarily from dirty end scrubbing / quench stages;
  - consider the possibility of scrubber liquor treatment and re-circulation.
- In ***semi-dry systems*** the quantity of water should be measured and minimised, but without compromising the ability of the abatement plant to effectively treat stack gases and meet emission limit values. Whilst the use of BAT will entail demonstration that water is not over consumed, it should not result in reductions that could result in reagent handling (pumping) difficulties, or poor reagent reaction conditions (e.g. moisture, temperature or contact time).
- Optimisation of wet and semi-dry reagent dose rates by linking them to up-stream HCl concentrations (fast response monitors and feedback controls are required) can prevent over consumption of both water and reagent. It may also be possible to reduce water consumption through the alteration of alkaline reagent concentration (rather than volumetric pumping rate changes) - this will require very small mixing tanks in order to effect a sufficiently fast concentration change. Computer software will be required to automatically manage such systems.
- Water used in cleaning and washing down should be minimised by:
  - evaluating the scope for reusing washwater;
  - trigger controls on all hoses, hand lances and washing equipment.
- Fresh water should only be used for:
  - dilution of chemicals (e.g. for gas scrubbing media);
  - vacuum pump sealing (note, below, that this can be much reduced or even eliminated);
  - to make up for evaporative losses.
- Fresh water consumption should be directly measured and recorded regularly - typically on a daily basis.
- Specific points of fresh water use, circuit overflows and recycled water quality should be monitored particularly the discharge to the ETP.
- Water-sealed vacuum pumps may account for considerable water use and arrangements should be reviewed by considering improvements such as:
  - cascading seal water through high to low pressure pumps;
  - by using modern designs with improved internal recirculation of water within the pump casing (up to 50% reduction);

  PLUS
  - filtering and cooling seal water with a heat exchanger prior to re-use in the pumps (90% reduction potential), or
  - filtering and cooling seal water with a cooling tower prior to re-use in the pumps (95% reduction potential), or
  - filtering and cooling seal water with injected fresh water prior to re-use in the pumps (65% reduction potential),

  OR
  - recycling the hot seal water.
- any other cooling waters should be separated from contaminated process waters and re-used wherever practicable, possibly after some form of treatment, e.g. re-cooling and screening.

Cont.

Water use

BAT for water efficiency (cont)

Recycling of water

16. Consideration should be given to multiple uses of water to minimise consumption. This includes the re-use of scrubber effluents as a quench media (in HWIs) and the treatment of scrubber liquors for re-use.

Site drainage or roof water may be suitable for a wide variety of uses even after rudimentary treatment. Such uses range from on-site feed to toilet facilities, wash down water, quench or scrubber feed. Operators should demonstrate in their application that such uses have been considered and justify the techniques selected and rejected.

In some cases effluent treatment produces a good quality water which may be usable in the process directly or in a mixture, with fresh water. While treated effluent quality can vary it can be recycled selectively, when the quality is adequate, reverting to discharge when the quality falls below that which the system can tolerate. The Operator should confirm the positions in which treated water from the ETP is, or is planned to be, used and justify where it is not.

2.2.4 Typical waste compositions

This section provides general information regarding the composition of wastes.

Physical characteristics

Waste chemical characteristics

Waste chemicals in bulk liquid form are handled by pipeline or tanker and may be burned on the site where they arise. They are often suitable as a substitute fuel. In some cases these types of waste can be potentially less harmful to the environment than the fossil fuels they displace. Bulk quantities produced by large continuous processes tend to be more consistent than those from smaller or batch operations where wastes may not be well segregated.

Waste chemicals can also be in solid form or in drums (containing either liquid or solids). These and occasional waste clearouts (e.g. laboratories etc) can be extremely variable and expensive to identify and process.

Gaseous waste chemicals can cover a wide spectrum from a high CV gas which could be used as a fuel to VOCs at a concentration of a few mg/m^3 which are causing an odour problem.

Municipal waste characteristics

Municipal waste varies in composition both seasonally, (e.g. wet garden refuse can make combustion difficult in the autumn) and geographically depending on the type of commercial operations and socio-economic conditions in the catchment area.

While putrescible materials lead to the odour and health hazards of the raw incoming waste, municipal waste will also be contaminated with a variety of materials that may be a hazard to the environment, e.g. waste paint, oil, pesticide or household cleaners. It may contain batteries, plastics, packaging etc, which may contain toxic constituents such as cadmium or lead, although other controls are tending to diminish these problems. Municipal waste may also contain some clinical wastes.

Wastes that may give rise to high levels of acid gases (e.g. PVC and plasterboard) require careful management to prevent overloading of abatement plant and potential exceedences of emission limits.

Improvements in UK recycling performance are unlikely to effect the combustion performance of plants in the foreseeable future. This is because non-combustibles, such as glass and metal, will be removed as well as some of the combustible fraction.

Clinical waste characteristics

Clinical waste is defined in "The Collection and Disposal of Waste Regulations 1988" as including:

- any waste which consists wholly or partly of human and animal tissue, blood or any other body fluids, excretions, drugs or pharmaceutical products, swabs or dressings, or syringes, needles, or other sharp instruments, being waste which unless rendered safe may prove hazardous to any person coming into contact with it;
- any other waste arising from medical, dental, veterinary (including small carcasses in some ***CWIs***), pharmaceutical or similar practice, investigation, treatment, care, teaching, or research, or the collection of blood for transfusion, being waste which may cause infection to any person coming into contact with it.

Clinical waste may contain small quantities of certain hazardous wastes (e.g. prescription only medicines) that cannot practicably be segregated from the waste stream. Where this is the case the waste stream would not be considered by the Regulator to fall within the scope of the Hazardous Waste Incineration Directive (EC/96/67). Where larger quantities of hazardous waste are received (e.g. pharmacy clear outs) that could be segregated without undue difficulty the provisions of the HWID will apply until 28 December 2005 when those provisions will be replaced and revised by those under the Waste Incineration Directive (2000/76/EC).

Sewage sludge characteristics

Sewage sludge arises from two principal sources, either of which require de-watering:

- the removal of solids from raw sewage. This primary sludge has a solids content of about 5% and consists of both organic and inorganic substances;
- the removal by settlement of solids produced during biological treatment processes i.e. surplus activated sludge and humus sludge. This is known as secondary sludge.

The physical and chemical composition will vary according to the treatment processes at the particular works and the nature of the catchment. Sludges from works in industrial catchments, or those with certain industries (e.g. metal plating) may have elevated levels of some pollutants.

Some sludges may be dried or even pelletised to produce a highly combustible waste or for use as a fertiliser.

Drum characteristics

Drums containing residual chemical waste will usually be of the 210 litre steel variety. They may of the “open head” type, used for solids, powders, waxes, greases etc, in which the whole lid is removable, held in place with a clamping ring or of the “tight head” type, used for liquids, with a filler hole and screwed bung in the top. Wherever possible drums will be washed rather than burned out as the former is much less expensive. However in many cases drums cannot be cleaned adequately by this method and incineration is the only method. It is these drums which form the feedstock for this process. The types of contamination are extremely variable.

Animal carcass characteristics

Animal carcasses (which include remains) come typically from domestic pets brought in by individuals, animals from vets and currently BSE bovine stock. As with clinical waste, odour and the potential health hazard from the incoming waste can be significant.

Incoming waste composition

Table 2-1 - Typical constituents

Wastes	Typical constituents - % of dry weight										
	Hydrocarbon content	Oxygen	Chlorine	Sulphur	Fluorine	Nitrogen	Phosphorus	Mercury	Cadmium	Other heavy metals	Iron
Chemical waste	very variable										
Clinical waste	42 - 56	21	1-4	0.07-0.17	-	0.07-0.45	-				
Municipal waste	18 - 36	12 - 21	0.25 - 0.8	0.08 - 0.6	0.01 - 0.02	0.4 - 0.8					0.5 - 2.4
Animal carcasses	7	3	as salt	in fur	-	in protein	-	-	-	-	-
Sewage sludge	35 - 57	13 - 19	0.07- 1	0.2 - 1.3	0.03 - 0.06	3 - 5		*	*	*	
Refuse Derived Fuel	Very variable – may comprise a single consistent waste stream (e.g. tyres) or the broader specification of a pelletised or floc fuel derived from municipal waste. For details see earlier guidance note S2 1.05.										
Drum recovery	very variable										

* ***Mercury*** *- typically < 1.0 mg/kg DS (Dry Solids) in non-industrial areas. Average 3 mg/kg rising to EC land spreading limit of 25 mg/kg in industrial areas. However the trend is for the industrial causes to diminish and as dentistry becomes the major source for rural and industrial values to become more closely aligned.*

Cadmium *- 4-6 mg/kg DS in non-industrial areas. Average 5 mg/kg rising to EC land spreading limit of 40 mg/kg in industrial areas.*

Antimony, arsenic, lead, chromium, cobalt, copper manganese, nickel, vanadium and tin *- total 700 mg/kg DS in non- industrial areas. Average 2000-3000 mg/kg rising beyond EC land spreading limit to 8000 mg/kg, on occasions, in industrial areas.*

Waste feedstock

Table 2-2 - Combustion characteristics

Wastes	Calorific Value (MJ/kg) (Note 1)	Moisture (%) (Note 2)	Volatile hydrocarbon content (%) (Note 3)	Ash content (%)
Chemical waste	very variable			
Clinical waste	13-25(av 21)	9-15	42-56	7-20
Municipal waste	6.3 -15.8	33	18-36	13-32
Animal carcasses	<3 whole carcass	85		
Sewage sludge	12-19	60-65		26-41
Coal - for comparison	23	8	26	10
Refuse derived fuel	Very variable – may comprise a single consistent waste stream (e.g. tyres) or the broader specification of a pelletised or floc fuel derived from municipal waste. For details see earlier guidance note S2 1.05.			
Drum recovery	little	very variable		

Note 1 *Calorific values are net, i.e. after deducting the heat required to evaporate the water.*

Note 2 *% of weight of incoming waste as received.*

Note 3 *% of dry weight.*

2.3 The Main Activities (including abatement)

This section deals with the main incineration installation activities (including any "directly associated activities") that may have an influence upon **preventing** the generation of potentially polluting emissions:

- incoming waste management (see Section 2.3.1)
- waste charging (see Section 2.3.2)
- furnace types (see Section 2.3.3)
- furnace requirements (see Section 2.3.4)
- chimneys and vents (see Section 2.3.5)
- cooling towers (for local pollution prevention) (see Section 2.3.6)
- boiler design (for local pollution prevention) (see Section 2.3.7)

Abatement technology for releases to air and water can be found under Sections 2.3.8 to 2.3.11.

The **minimisation of waste** is dealt with as follows:

- by comment **within a section dealing with a particular technique** that may have significant influence over the quantities or nature of wastes produced e.g. poor burnout leading to elevated quantities of bottom ash,
- by comments in Section 2.2 where wastes arise from raw material selection,
- by summary of the key waste minimisation considerations under Section 2.6.

Application Form Question 2.3

Describe the proposed installation activities and the proposed techniques and measures to prevent and reduce waste arisings and emissions of substances and heat (including during periods of start-up or shut-down, momentary stoppage, leak or malfunction).

With the Application the Operator should:

1. provide adequate **<u>process descriptions</u>** of the activities and the abatement and control equipment for all of the activities such that the Regulator can understand the process in sufficient detail to assess the Operator's proposals and, in particular, to assess opportunities for further improvements. This should include:
   - process flow sheet diagrams (schematics);
   - diagrams of the main plant items where they have environmental relevance; e.g. landfill liner design, incinerator furnace design, abatement plant design etc.;
   - details of any chemical reactions and their reaction kinetics/energy balance;
   - control system philosophy and how the control system incorporates environmental monitoring information;
   - annual production, mass and energy balance information;
   - venting and emergency relief provisions;
   - summary of extant operating and maintenance procedures;
   - a description of how protection is provided during abnormal operating conditions such as momentary stoppages, start-up, and shut-down for as long as is necessary to ensure compliance with release limits in Permits;
   - additionally, for some applications it may be appropriate to supply piping and instrumentation diagrams for systems containing potentially polluting substances.

   If there is uncertainty, the degree of detail required should be established in pre-application discussions.

2. describe the current or proposed position for all of the indicative BAT requirements for each subsection of 2.3, or any others which are pertinent to the installation;

3. identify shortfalls in the above information which the Operator believes require longer term studies to establish;

4. demonstrate that the proposals are BAT, by confirming compliance with the indicative requirements, by justifying departures (as described in Section 1.2 and in the Guide for Applicants) or alternative measure;

Cont.

In assessing the integrated impacts of proposals and balancing the impacts of different techniques it should be noted that energy should be taken into account whether or not there is a Climate Change Agreement or Trading Agreement in place (see Section 2.7.2).

Indicative BAT Requirements

See each subsection of this Section 2.3.

Incoming waste handling

2.3.1 Incoming waste management

This section deals with the techniques required to manage incoming waste effectively. This includes:

- Securing the suitability of the waste to be accepted before it is delivered
- Management of the waste on the site
- The need for pre-treatment

The prevention of waste production at the installation is dealt in this guidance as described at the beginning of Section 2.3. The management of wastes produced is dealt with in Section 2.5.

2.3.1.1 Legislative obligations for incoming waste management

European Directives contain mandatory minimum requirements regarding the ***handling of incoming waste*** at all installations that fall within their remit. The standards described may also represent BAT for installations not covered by the Directives.

All ***new plants*** covered by the Waste Incineration Directive (2000/76/EC) will be required to meet at least the standards outlined in the Directive from 28 December 2002. Site specific BAT may require these standards to be adopted before this date, or even standards that go beyond those required by WID.

Incoming waste management at existing municipal waste incinerators

The "old" municipal incineration directives (89/369/EEC and 89/429/EEC) did not contain any specific requirements in respect of the handling of incoming waste. BAT standards therefore apply. These are outlined later in this Section (2.3.1).

Existing municipal waste incinerators will be expected to meet at least the minimum requirements of the Waste Incineration Directive (2000/76/EC) by 28 December 2005 at the latest (see this Section below). Site specific BAT may require these standards to be adopted before this date, or even standards that go beyond those required by WID.

As the standards for waste checking, document management and waste handling that are outlined in the WID represent BAT, they should be adopted at all new plants from the first day of operation.

Incoming waste management at existing hazardous waste incinerators

The standards below relate to all installations that fall within the control of the current Hazardous Waste Incineration Directive (94/67/EC). WID will apply to existing installations in this sector from 28 December 2005:

HWID waste management requirements applicable to existing HWIs:

- the Operator shall take all necessary measures concerning the delivery and reception of waste in order to prevent or, where that is not practicable, to reduce as far as possible negative effects on the environment, in particular the pollution of air, soil, surface and ground water, and the risks to human health.

  Note: *This requirement relates to the design of the reception area as well as the management of the waste. See Section 2.3.1.4 for guidance on waste handling.*
- Prior to accepting the waste at the incineration plant, the Operator shall have available a description of the waste covering:
  - The physical, and as far as practicable, the chemical composition of the waste and all information necessary to evaluate its suitability for the intended process.
  - The hazard characteristics of the waste, the substances with which it cannot be mixed, and the precautions to be taken in handling the waste.

    Note: *This does not require everything to be thoroughly characterised, nor every item to be sampled. Whilst meeting the minimum requirements an approach proportionate to the risk should be adopted. This should be taken to include all other information necessary to evaluate suitability of the waste for the intended incineration process. Sampling and analysis regimes for incoming waste should be sufficient to enable the Operator to categorise the waste such that its subsequent storage and treatment does not give rise to exceedence of emission limit values in particular, or other hazards.*
- Sufficient information should be obtained prior to receipt of the waste onto the site to ensure that it can be either:
  - Be safely offloaded for safe storage and further characterisation prior to incineration or pretreatment or

Incoming waste handling

- Be directly incinerated without need for further characterisation (i.e. the description is already sufficiently detailed given the nature and source of the waste)

- Prior to accepting the waste at the incineration plant, at least the following reception procedures shall be carried out by the Operator:
  - Determination of the mass of the waste;

    Note: *The Operator should make provision to determine the mass by the use of a weighbridge, loading mechanism weigh devices, weigh vessels or through calculation. This may be carried out before the load is delivered to the site and recorded on the relevant paperwork.*
  - the checking of those documents required by Directive 91/689/EEC and, where applicable, those required by Council Regulation (EEC) No. 259/93 of 1 February 1993 on the supervision and control of shipments of waste within, into and out of the European Community and by dangerous goods transport regulations,

    Note: *Special waste and transfrontier shipment of waste paperwork must be checked before the waste is accepted. This includes both pre-notification and notification upon transfer to the disposal site.*
  - The taking of representative samples, unless inappropriate, as far as possible before unloading, to verify conformity with the description provided and to enable the competent authorities to identify the nature of the wastes treated. These samples shall be kept for at least 1 month after the incineration.

    Note: *This requirement does not mean that every item requires sampling or analysis, in many cases this would be impractical (e.g. laboratory disposals). Bulk loads are more likely to require sampling. The frequency and scope of sampling and /or analysis should be adapted to take account of the source of the waste, its variability, the reliability and adequacy of the information available from the waste producer, experience of dealing with wastes of that type and the likely hazards that the waste may pose in relation to the process concerned.*

- Exemptions may be granted from the second and third of the above bullets for industrial plants and undertakings incinerating their own waste at the place of production of the waste provided that the same level of protection is met.

  Note: *This means that in-house plants, burning their own wastes do not necessarily need to go to the same lengths (in relation to document checking, sampling and analysis) as those plants accepting waste from other sites. It reflects the fact that persons incinerating their own waste have greater knowledge of the waste stream and that the risks are consequently reduced.*

Incoming waste management at all incineration and co-incineration plants covered by WID

Existing installations will need to meet the standards of the “new” incineration directive (WID) by 28 December 2005 at the latest. New installations will need to comply from 28 December 2002. Site specific BAT may require these standards to be adopted before this date, or even standards that go beyond those required by WID.

WID incoming waste management requirements:

These standards apply to all installations that fall within the control of Waste Incineration Directive (2000/76/EC):

- ***Article 5(1)*** The Operator of the incineration or co-incineration plant shall take all necessary precautions concerning the delivery and reception of waste in order to prevent or to limit as far as practicable negative effects on the environment, in particular the pollution of air, soil, surface water and groundwater as well as odours and noise, and direct risks to human health. These measures shall meet at least the requirements set out in [Articles 5(3) and 5(4) below].

  Note: *This applies to hazardous and non-hazardous waste incineration. It relates to the design of the reception area as well as the management of the waste. The use of BAT as outlined in this guidance will in the majority of cases fulfil these requirements.*

- ***Article 5(2)*** The Operator shall determine the mass of each category of waste, if possible according to the EWC, prior to accepting the waste at the incineration or co-incineration plant.

  Note: *This applies to hazardous and non-hazardous waste incineration. The waste categories to be treated should be outlined in the application, using EWC where possible. The Operator should make provision to determine the mass by the use of a weighbridge, loading mechanism weigh devices, weigh vessels or through calculation. This may be carried out before the load is delivered to the site and recorded on the relevant paperwork.*

- ***Article 5(3)*** Prior to accepting hazardous waste at the incineration or co-incineration plant, the Operator shall have available information about the waste for the purpose of verifying, inter alia, compliance with the permit requirements specified in Article 4(5). This information shall cover:

Incoming waste handling

(a) all the administrative information on the generating process contained in the documents mentioned in paragraph 4(a);

(b) the physical, and as far as practicable, chemical composition of the waste and all other information necessary to evaluate its suitability for the intended incineration process;

(c) the hazardous characteristics of the waste, the substances with which it cannot be mixed, and the precautions to be taken in handling the waste.

Note: *This does not require everything to be thoroughly characterised, nor every item to be sampled. Whilst meeting the minimum requirements an approach proportionate to the risk should be adopted. In particular this is emphasised by 5(3)(b) – which describes a need to have "all other information necessary to evaluate suitability for the intended [hazardous waste] incineration process". Regulators should require sampling and analysis regimes for incoming waste that are sufficient to enable the Operator to categorise the waste such that its subsequent storage and treatment does not give rise to exceedence of authorised emission limits in particular.*

- Sufficient information should be obtained prior to receipt of the waste onto the site to ensure that it can be either:
  - safely offloaded for safe storage and further characterisation prior to incineration or pretreatment, or
  - incinerated without need for further characterisation (i.e. the description is already sufficiently detailed given the nature and source of the waste).
- ***Article 5(4)*** Prior to accepting hazardous waste at the incineration or co-incineration plant, at least the following reception procedures shall be carried out by the Operator:

(a) the checking of those documents required by Directive 91/689/EEC and, where applicable, those required by Council Regulation (EEC) No 259/93 of 1 February 1993 on the supervision, and control of shipments of waste within, into and out of the European Community and by dangerous-goods transport regulations;

(b) the taking of representative samples, unless inappropriate, e.g. for infectious clinical waste, as far as possible before unloading, to verify conformity with the information provided for in paragraph 3 by carrying out controls and to enable the competent authorities to identify the nature of the wastes treated. These samples shall be kept for at least one month after the incineration.

Note: *This requirement only relates to incineration or co-incineration installations receiving hazardous wastes. It does not mean that every item requires sampling or analysis, in many cases this would be impractical (e.g. laboratory disposals). Bulk loads are more likely to require sampling. The frequency and scope of sampling and /or analysis should be adapted to take account of the source of the waste, its variability, the reliability and adequacy of the information available from the waste producer, experience of dealing with wastes of that type and the likely hazards that the waste may pose in relation to the process concerned.*

- ***Article 5(5)*** Exemptions may be granted from [articles 5(2), (3) and (4)] for industrial plants and undertakings incinerating or co-incinerating only their own waste at the place of generation of the waste provided that the requirements of this Directive are met.

Note: *This means that in-house plants, burning their own wastes do not necessarily need to go to the same lengths (in relation to document checking, sampling and analysis) as those plants accepting waste from other sites. It reflects the fact that persons incinerating their own waste have greater knowledge of the waste stream and that the risks are consequently reduced.*

2.3.1.2 Other incoming waste management requirements applicable to all incineration processes

- Waste **pre-treatment** should be carried out to the degree necessary to control emissions within ELVs and to prevent unnecessary waste production.
- A high standard of **housekeeping** should be maintained in all areas with suitable equipment provided and maintained to clean up spilled materials.
- **Loading and unloading** of vehicles should only be done in designated areas provided with proper hard standing. Such areas should have appropriate falls to an adequate drainage system.
- Uncontained or potentially **odorous** waste should be stored inside buildings with suitable odour control e.g. negative pressure created by feeding combustion air, automatic or restricted orifice size doorways.
- **Fire fighting** provisions are required, especially for MWI reception bunkers, CWI storage and for chemical wastes.

Incoming waste handling

- **Fuels and treatment chemicals** should be stored in tanks or silos. Liquid fuels and chemicals, if not supplied in drums, should be stored in tanks provided with closed loop vapour systems and/or scrubbers. Silos for powders or finely divided particulate matter require fabric filters.
- **Contamination of rainwater** should be minimised through the provision of roofing and drainage segregation. Provision must be made for dealing with all forms of potential water release or run-off. Storage capacity should be provided for contaminated rainwater to allow for sampling and testing prior to release (see also WID article 8(7)).

See control of fugitive emissions to water (Section 2.3.11) for further details.

2.3.1.3 Municipal waste management

Legislative requirements for the delivery and reception of wastes at MWIs will arise from WID and are considered to represent BAT. There are specific requirements in respect of checking of statutory documentation, and a general duty to "take all necessary precautions". This is therefore a site and operation specific, risk based judgement. Operators must therefore **adopt procedures and a management system** to enable the identification and management of the risks associated with the receipt of the wastes. Procedures should take account of the matters noted in this guidance and the duties arising from the Directive (see Section 2.3.1.1 - legislative obligations).

Incoming municipal waste should be:

- in covered vehicles or containers,
- unloaded into enclosed reception bunkers or sorting areas with odour control (see below).
- Designs and handling procedures should avoid any dispersal of litter.
- Techniques should be used to improve the homogeneity of waste fed to the incinerator.
- Inspection procedures should be used to ensure any "problem" wastes are removed and placed in a designated storage area pending removal.
- Waste may then transferred to the feed chute e.g. by a grab crane.
- Where the waste is not pre-treated or sorted, smaller grab sizes should be used on a more frequent basis to allow for greater waste inspection

To minimise odour:

- doors, normally self closing, should be provided for any potentially odorous indoor areas;
- bunkers should be ventilated with the extracted air being used as a source of furnace combustion air;
- during shut-down, particularly where there is only one furnace, doors will limit odour spread while still allowing vehicle access and air should be extracted via a separate system.
- extracted air which is not incinerated should be treated (see Section 2.3.13 - Odour);
- where there is a recycling facility before the incinerator, the volumes of odorous air which need to be extracted may well exceed the furnace requirements if attention is not given to building sealing arrangements at the design stage;
- bunker management procedures (mixing and periodic emptying and cleaning) should be employed to avoid the development of anaerobic conditions;
- wastes shall be removed on a first in, first out basis so as not to exceed a specified maximum storage time (e.g. 4 days or less if problems arise);
- During shut downs waste shall be diverted away from the site if odour management is not effective.
- Generally, multiple stream plants are preferred to large single stream plants to provide continuity of odour control and waste movement.
- the quantity of incoming waste being stored should be limited to the agreed design limit, and must be confined to the designated areas.

Where dust emission needs controlling, low volume water fog sprays should operate above the storage bunkers. Liquid run-off and wash down from the storage and handling areas should be minimised and be used in the process, such as in the ash quench, wherever possible.

Pre-treatment of municipal waste:

Preferred practice for raw municipal waste may include the removal of large bulky items, followed by the extraction of recyclables and the shredding the remaining waste, although this may be carried out prior to delivery to the installation. Such pre-treatment can help ensure a more consistent feed to the furnace thereby aiding good process control and preventing emissions.

A particle size reduction system is essential for **fluidised bed incinerators**. However, there have been significant operational problems (including high maintenance costs and fires) with front-end **materials recycling facilities** (MRF) handling raw mixed municipal waste.

Dirty MRFs may produce lower grade recyclables than those segregated at source. Furthermore, where recyclables are already being removed by means of doorstep collection or other schemes, provided emission limit values are guaranteed, the additional cost of a front end MRF may not be justified. Where waste feed pre-treatment is not practicable the maximum degree of **waste mixing** will improve consistency and this should be defined in operating procedures. **Where not adopted, Applicants must clearly demonstrate why waste shredding / MRF techniques are not BAT.**

Decisions regarding the need for and extent of waste treatment at municipal waste incinerators should take account of the wider waste strategy adopted in the locality as this will influence the composition of the waste delivered. For example, where removal of recyclables is being carried out within the waste catchment area (as demonstrated by recycling performance or facility provision) incineration without further front end MRF or shredding may be justifiable as BAT for the remaining waste, provided statutory emission limit values can be secured and the additional environmental gains are outweighed by the costs.

2.3.1.4 Chemical waste management

Legislative requirements for the delivery and reception of wastes at HWIs arise from HWID (and eventually WID). The legislation sets some specific requirements in respect of checking of statutory documentation, but also include a general duty to “take all necessary precautions”. This is therefore a site and operation specific, risk based judgement. Operators must therefore **adopt procedures and a management system** to enable the identification and management of the risks associated with the receipt of hazardous wastes. These procedures should take account of the matters noted in this guidance and the duties arising from the Directives (see Section 2.3.1.1 - legislative obligations).

In particular, sufficient information should be obtained prior to receipt of the waste onto the site to ensure that it can be either:

- safely offloaded for safe storage and further characterisation prior to incineration or pretreatment or
- incinerated without need for further characterisation (i.e. the description is already sufficiently detailed given the nature and source of the waste and the intended treatment)

This should include consideration of **odour risks** (e.g. mercaptans, thiols, amines) – with high odour risk wastes offloaded, stored and transferred along dedicated “high odour” routes with closed loop or abated vents.

Whether liquids or sludges are delivered by tanker, in drums or by pipeline, the waste should be held in a buffer store pending suitable chemical analysis prior to blending and feeding to the incinerator. This should include checks on its compatibility with waste already in any bulk storage tank(s) where it will be stored.

For **merchant incinerators**, systems should be in place to:

- ensure that waste arrives with information covering:
  - its physical and chemical composition;
  - any other information necessary to assess its suitability for incineration;
  - its hazard characteristics;
  - substances with which it cannot be mixed; and
  - handling precautions.
- confirm the information by:
  - checking that the quantity is as declared by the consignor;
  - documentation checks; and
  - sampling where appropriate. Samples should be kept for at least 1 month after incineration. Small scale compatibility tests are normally carried out with a sample of the contents of the receiving tank to ensure that there are no reactions which lead to heat release, gassing or other undesirable consequences.

For **in-house incinerators** procedures should be in place to give the same level of protection, and, in particular, where non hazardous waste is being burned, to ensure that only the agreed wastes are burned.

Pre-treatment of hazardous waste:

The highly heterogeneous nature of hazardous wastes means that there may be significant advantages to be gained from waste blending and / or pre-treatment.

A procedure should be in place to ensure that waste is treated / blended to give the most constant combustion conditions possible.

Incoming waste handling

Liquid wastes may require screening or filtering to remove solids and thereby ensure steady combustion.

Storage of hazardous wastes:

Bulk storage **tanks** should:

- be sited above ground;
- be bunded ;
- be fitted with protection against overfilling;
- have level gauges visible from the filling point which should be clearly labelled; and
- have releases from vents controlled by back venting (particularly for high vapour pressure fluids), by feeding to the incinerator, by carbon filters or by condensation possibly using an appropriate refrigerant. The use of floating roof tanks can avoid venting but introduces the problems of seals. Scrubbing is acceptable if the VOCs will not subsequently come out of solution or if the liquor can be adequately treated or can be fed to the incinerator. (There may be safety implications with both venting to the incinerator and with the use of carbon filters. The Operator should consult HSE on details of the specific design.)

Drummed waste should:

- be stored in areas protected from heat and direct sunlight, preferably under cover;
- be stored on an impervious surface which has an adequate fall to a collection sump;
- not be stored more than 2 rows high;
- be analysed as soon as practicable, and then either emptied into bulk storage tanks or passed to the incinerator for destruction. The authorisation should limit both the maximum number of drums which may be held on site and the maximum periods that drummed waste may be held after receipt; and
- be subject to routine procedures for checking the condition of drums and pallets.

Air from drum storage opening/transfer points should be treated as for tank vapours above. Similarly, methods should be employed to ensure that containers which have been emptied should be stored and disposed of without giving rise to emissions to atmosphere and odours.

Pipework should preferably be overground and welded where possible to minimise the number of flanges. Where it must be underground it should be double-contained, for example by a sleeve or duct, and a means provided to detect any leakage into that outer containment.

Maintenance:

The site **preventative maintenance programme** should include assessment of all waste handling equipment to prevent fugitive odour (or other) releases; e.g. seals on pumps, valves and flanges etc.

2.3.1.5 Clinical waste management

All installations should consider the implication of the waste incineration directive. New facilities should be designed to meet the Directive standards and existing ones upgraded by 28 December 2005 at the latest. Some facilities may already be required to meet the requirements of HWID.

The Agency has issued guidance (Ref: Technical guidance on clinical waste management facilities - version 1.2 - Feb 2001) in respect of the storage and handling of clinical waste at sites subject to waste management licensing. Its requirements have been taken into account in this section, but it should be referred to for full details if required.

A control system should be in place that **tracks the waste** from the point of arising to the incinerator. Modern systems use bar coding and computer logging. Statutory waste transfer documentation should be checked. Waste descriptions should be sufficient to identify the nature of the waste and its source.

The opening of containers to check waste meets relevant descriptions is not advised. This being the case, Operators of incineration facilities are responsible for providing waste producers and carriers with sufficient information to enable them to **adequately segregate waste** at the point of production, and for auditing these systems to ensure they are carried out. This is to prevent the inclusion of wastes with particular environmental or regulatory significance (e.g. hazardous waste which may require the installation to meet the requirements of HWID)

Clinical waste is sometimes pre-sorted by a separate waste handling company. The Operator needs to be able to identify (without opening any bags) the nature of the waste received, since the calorific value can vary greatly depending on the source of the waste and if a large consignment of a particular type arrives it can upset the incinerator operating conditions. Installations should account for this potential variability by providing means to secure a more consistent feed. This may include selective loading /

Incoming waste handling

management of identified waste types to blend the feed and/or large pre-charging feed hoppers to facilitate mixing.

Waste is ideally handled in locked, readily cleanable, wheeled containers which are only opened immediately prior to incineration, as this provides assurance that the waste does not get diverted elsewhere, and minimises spillages and the risk to Operators. Alternatively, disposable containers (sealed) can be used for transporting and feeding clinical waste into the incinerator. Handling of individual plastic bags of clinical waste should be minimised. **Rigid containers** are a requirement of health and safety legislation from 1 January 2002 and are considered BAT.

Plastic waste containers that will be incinerated **should not be made of PVC** in order to reduce chlorine loadings. Operators should advise suppliers of this requirement and reinforce it as required.

Waste awaiting incineration should be held in a **secure storage facility** designed and constructed so as to contain spillages and prevent access by unauthorised personnel. This should be covered where the containers are not reliably weatherproof. New installations should provide storage within the building that houses the incinerator and dust ventilation air to the incinerator wherever possible. Existing facilities should consider this option, but physical restriction may prevent this. Sharps containers should be stored securely prior to incineration.

A **container wash and disinfectant area** should be provided. All storage areas, containers, loaders, conveyors etc should be designed to facilitate effective disinfection. While it is preferable for process water to be fed back to the incinerator (e.g. ash quench) it is accepted that the washdown volumes can be high. With even the best sewage treatment works, the strong disinfectants discharged to sewer may not be completely broken down and could pass to the receiving water. Operators should consider methods for minimising the discharge and should provide justification that the disinfectants used are biodegradable both in the STW and in the receiving water. On site effluent treatment may be required in some, large-scale situations.

Storage times for clinical waste should be minimised and selected according to the nature of the specific wastes, with the highest risk wastes processed as soon as possible. Clinical waste with a known risk of contamination with human pathogens should be treated prior to its collection (e.g. autoclaving). As a general guide, waste should not routinely be stored for longer than 48 hours unless refrigerated storage (at <5 Celsius) is provided. Storage in excess of one week should be in freezers (< 0 Celsius). Contingency plans should be made to deal with breakdowns.

2.3.1.6 Animal waste management

Animal carcass incineration

Installations burning only animal carcasses are exempt from the requirements of WID, but remains subject to BAT and legislation made to implement Directive 90/667/EEC – this Directive may be amended to include controls specific to incineration (e.g. air emission limits).

Carcasses awaiting incineration should be stored either in the refrigerated trailers in which they arrive or in separate, refrigerated storage. This should:

- be totally enclosed with a self-closing door;
- be lockable;
- be bird-, insect- and rodent-proof;
- be cleaned and disinfected each week; and
- have effective means of odour control.

Odours can be treated in a variety of ways - see Section 2.3.13 - Odour. Containment and treatment are strongly preferred to masking. Carcasses should, at all times, be transported so as to prevent dragging them across the floor. Smaller carcasses are best handled in plastic wheeled bins with lids to contain the odours.

All vehicles, containers, trailers, storage areas, loaders, conveyors and equipment used for the collection, transfer and handling of carcasses should be designed for easy and effective cleansing and disinfection, be constructed of impervious materials and be kept clean.

Floors should have a chemical resistant finish to prevent attack by the cleaning and disinfecting materials and should be sloped to a holding pit.

Washdown water may contain pathogens and should be injected into the furnace except where adequate on-site effluent facilities are provided. Sumps and transfer equipment integrity should be checked and maintained. Hypochlorite disinfectant may give rise to additional chlorine loading and should therefore be considered carefully.

PVC packaging should be avoided to prevent additional chlorine loading on the incinerator.

Incoming waste handling

Other Animal Waste Incineration (including MBM)

Installations that burn any animal wastes other than carcasses are subject to WID and (in addition to the guidance given above) must therefore comply with the requirements of the Directive outlined in Section 2.3.1.1 in respect of incoming waste handling, delivery and reception.

Similar standards to those outlined above for carcass incineration should be adopted. Clinical waste standards may be appropriate in some cases depending upon the nature of the waste and the location of the installation.

Security of stored wastes is particularly important in respect of meat arising from culls to prevent theft.

MBM handling should take account of its potentially dusty nature. It should be stored in agitated silos to prevent agglomeration. Silo vents should be filtered and loading operations should use closed loop vents to the delivery tanker. Earthing may be required during loading to prevent dust explosions due to static.

Where MBM (or other wastes) have been stored for considerable periods it is likely that compaction will have taken place. The lumps may therefore require size reduction prior to incineration – this will be particularly the case where fluidised bed combustors are used. Longer-term storage also increases the risk that the waste will contain pyrolysed fat that may self-combust. Adequate fire detection and control should be provided.

Transport of MBM from the silo to the combustor may be achieved using belt or screw conveyors, or by pneumatic means. Screw conveyors may assist with breaking up lumps.

All storage and transfer should be carried out such that odour is contained. This may be provided by means of containment of all plant within a building with automatic doors and extracted air passed to the combustor or by the use of (well-maintained) sealed storage and transfer systems.

2.3.1.7 Sewage sludge management

Sewage sludge should be de-watered to produce a sludge cake of sufficiently low water moisture content to be incinerated without the use of supplementary fuel (except for start-up). This is referred to as autogenous or autothermic combustion. Further drying will not necessarily provide any overall energy advantage, although it would minimise problems of visible plume (see also Section 2.3.5).

Sewage sludge cannot be effectively de-watered without prior conditioning. This is normally by the addition of polyelectrolyte but can be achieved by thermal conditioning, the addition of ash, or the addition of chemicals such as calcium hydroxide, ferrous sulphate, ferric chloride, or aluminium chlorohydrate.

De-watering systems include plate presses, rotary vacuum filters, centrifuges and filter presses. Where the de-watered sludge is not autogenous, further drying is normally accomplished, by means of a sludge dryer, to reduce the water content and minimise the supplementary fuel requirements. This photograph shows a belt press de-watering plant.

The effluent from de-watering cannot be discharged directly without treatment. The usual practice would be to return it to the sewage treatment works. The Operator should ensure that in doing so, the sewage treatment plant will remain able to meet its statutory obligations in respect of discharges to controlled waters.

Where treatment is required solids removal may be achieved using flocculents and efficient settlement by lamella settlement or similar (see Technical Guidance Note on effluent treatment Ref. 11) or alternatively by filtration. Solids should be returned to the incinerator feed. Neutralisation and the use of odour control additives may be required prior to return to the STW.

Odour is caused mainly by long dwell times in the sewerage systems before the sewage arrives at the treatment plant. It arises in tank areas, from sludge de-watering; from filtrate treatment, and from conveyor systems and should be controlled by:

- self-closing doors should be provided to all access points;
- all handling and de-watering areas, and conveying systems should be ventilated with the extracted air preferably being used as a source of furnace combustion air;
- during shut-down, particularly where there is only one furnace, air should be extracted via a separate system; and
- extracted air, which is not incinerated, should be treated (see Section 2.3.13 - Odour).

2.3.1.8 Drum incineration management

Drums should be unloaded to an intermediate reception area where the consignment is verified against the delivery note and the number of drums and their contents recorded. Because most drums are received as part of regular consignments from major chemical companies with little variance in the chemicals being transported in the drums, it is normal practice to place reliance on the quality system of the drum supplier. However, Operators should carry out spot checks to verify that the delivery note system is being rigorously operated by the drum suppliers.

Where the furnace cannot handle halogenated substances these must be identified and rejected. Where the furnace has that capability it may be advantageous, economically and from the point of view of minimising the use of energy, to operate the furnace at the higher temperatures (see Section 2.3.4 - furnace requirements) only when burning chlorinated wastes. Under these circumstances a strict waste segregation scheme will be necessary.

Where contents cannot be verified the drums must be segregated and analysed to ensure that the plant has the capability and is authorised to burn them.

Authorisations should limit both the quantity of drums to be held and the maximum period for which they can be held prior to incineration.

Residual chemicals will spill out of the drums if care is not taken. Procedures should be rigorously observed to ensure that:

- caps and lids are kept securely in place;
- drums are preferably stored vertically; and
- where stored horizontally the fill points are towards the top.

Attention should be given to ensuring the impervious nature of the storage areas and that the drainage and water treatment arrangements are adequate.

Drums have their lids removed prior to incineration. New incinerators should preferably be designed to enable the drums to be up-ended on to the conveyor and for all of the contents which drain out to of the drums to be carried into the incinerator. This has distinct advantages of requiring less fuel and minimises the need to dispose of drainings to landfill. The design must take into account the drainage apron details, the burner positions and the residence time in both primary and secondary chambers.

Where the incinerator is not designed to accommodate the drainings, the drums should be drained of excess residual content and the drainings should be transferred to a purpose-built chemical incinerator. The Operator should justify, to the satisfaction of the Regulator, any other form of disposal. A fixed drainage station should be provided; a loose container may be accidentally knocked over and discharge into the drains. Ensuring good drainage from the drums avoids chemicals dripping on to the floor at the entry to the furnace where conditions for combustion are not ideal.

To control odour and release of VOCs, drums should be opened and de-headed in an enclosed area with extraction to the furnace or to other odour control devices - (see Section 2.3.13 - Odour). The time between opening and incineration should be kept to the minimum consistent with ensuring that the drums are adequately drained.

2.3.1.9 Waste management - pyrolysis and gasification installations

The handling required will depend upon the type of waste that is being treated and should follow the appropriate waste type specific guidance outlined in this Section (2.3.1).

Pyrolysis and gasification installations that subsequently burn the products of these processes are covered by the WID and will therefore also be required to meet the standards outlined in the directive (see 2.3.1.1).

Those processes that are operating have generally required waste to fall within a well-defined specification. It is therefore likely that heterogeneous waste streams (e.g. municipal waste) will need careful selection and/or waste pre-treatment prior to charging to such systems.

2.3.1.10 Waste management at refuse derived fuel installations

This sub-section is targeted at dedicated RDF installations. The handling required will depend upon the type of RDF and should follow the appropriate waste type specific guidance outlined in this section (2.3.1) above (e.g. SLF has similar hazards to some chemical wastes, municipal RDF has similar hazards to municipal waste). Unless specifically exempted, all RDF plants will be required to meet the standards required by WID (see Section 2.3.1.1).

Specific guidance in respect of issues arising from the handling of individual types of RDF (e.g. tyres, poultry litter, wood, straw) can be found in earlier Agency guidance (S2 1.05) and should be consulted.

Incoming waste handling

It will however be necessary to ensure that the techniques selected comply with WID and in particular the following basic principles:

- Sufficient information should be obtained prior to receipt of the waste onto the site to ensure that it can be either:
  - safely offloaded for safe storage and further characterisation prior to incineration or pre-treatment or
  - incinerated without need for further characterisation (i.e. the description is already sufficiently detailed given the nature and source of the waste and the intended treatment)
- the RDF should be stored and transferred such that it cannot escape from control or give rise to potentially polluting emissions or contamination. This should take in to account the physical and chemical nature of the RDF concerned.
- It will generally be BAT to store RDF under cover, or in purpose built containment in areas of contained or controlled drainage, with suitable fire protection systems.
- It will generally be BAT to handle and transfer the RDF using sealed systems to prevent its escape.
- Odour control may be important for some RDF types. Guidance on odour control for municipal waste installations should be taken into account, (Section 2.3.1.3).

RDF management techniques at co-incineration plants whose prime purpose is the production of energy or material products (e.g. cement works or power stations that are defined as co-incinerators under WID) should take account of the guidance given above and that found in the relevant sector guidance (e.g. cement and lime). The aim should be to handle RDF (or other wastes) at these co-incineration installations in a manner which fulfils the requirements of the WID and compliments the BAT for general raw materials handling in that sector as outlined in the relevant sector guidance.

2.3.1.11 Waste management at Co-incinerators

Specific techniques for waste management at co-incineration plant are not detailed in this guidance. Guidance on handling of incoming raw materials and fuels detailed in the sector specific guidance for the particular industry concerned should be consulted (e.g. cement and lime sector guidance). It will be necessary for the techniques selected to satisfy the requirements of HWID and WID – the requirements of these directives are discussed in Section 2.3.1.1.

As the directive requirements of co-incineration plants may be different to incineration plants (and there is a need to ensure the installation is correctly defined) the Directives themselves and relevant Agency guidance on their application to co-incineration should be consulted and discussed with the Regulator at an early stage.

Waste charging

2.3.2 Waste charging

2.3.2.1 Legislative obligations and generic requirements for waste charging

The following paragraphs are applicable to all installations covered by WID /HWID and is also likely to represent BAT at other plants:

The HWID and WID have slightly different wording but essentially say that:

"Incineration and co-incineration plants shall have and operate an automatic system to prevent waste feed:

(a) at start-up, until the [required] temperature …has been reached;

(b) whenever the [required] temperature … is not maintained;

(c) whenever the continuous monitors … show that any emission limit value is exceeded due to disturbances or failures of the purification devices."

Waste charging must therefore be interlocked with furnace conditions so that charging cannot take place when the temperatures and air-flows are inadequate or when any flue gas cleaning bypasses are open or where the continuous monitors show that the emission limit values are being exceeded.

Designs should endeavour to make the charging operation as airtight as possible and the fan control system should be capable of responding to changes in furnace pressure during charging, to avoid escape of fumes or excess air flows.

In systems that use a waste filled charging chute or hopper to achieve an airtight seal, the mechanism that loads the chute should be interlocked to prevent loading under the conditions outlined by the directives.

Where continuously monitored emission limit values are exceeded for any reason (including reasons other than disturbances or failures of the purification devices e.g. poor combustion control), the Operator should act to correct the situation as soon as practicable until normal operations can be restored. This should include consideration of waste charging feed rates.

Charging Rates

Charging rates outside the installation design capacity seriously undermine environmental performance. The capacity will vary according to the CV of the waste fed. The design should be declared in the application and a firing diagram included. At all installations close attention should be paid to the procedures that are designed to ensure that the design charging rate is not exceeded. Operators should record throughput rates and not exceed that declared in the application. Operators should alter mass throughput rates in order to ensure optimum combustion conditions are achieved, whilst ensuring that waste residence in the chamber is sufficient to secure ash burnout requirements.

2.3.2.2 Chemical waste

Chemical waste charging

Most liquid chemicals are introduced to the furnace by conventional liquid fuel burners. It is essential to ensure good mixing and atomisation. Heating to control viscosity should be limited to being well within the flash point of the liquid.

Where whole drums of waste are fed directly, the incinerator will have to be fitted with a suitable handling mechanism and must be designed to withstand any resulting increase in pressure. While shredding is an option it is more usually found that careful packaging and scheduling of the charges is the key to satisfactory operation. Particular attention should be paid to this aspect.

A well managed storage area, with detailed labelling and inventories will assist in making up loads (e.g. pallets) to be fed to the incinerator such that they do not give rise to excessive loads of substances which may be difficult to incinerate (e.g. Iodine).

Sealed delivery chambers should be used where there is a risk of either waste or products of combustion escaping from the feed mechanism. Positive pressure inert gas blanketing may be necessary to prevent reactions in the feeder system. Purge gases should be fed to the incinerator.

2.3.2.3 Municipal waste and clinical waste

Municipal and clinical waste charging

Normal feed mechanisms for solid wastes include ram, gravity and hopper feeds. The arrangements should be engineered to prevent back flow of combustion products through the waste feed and should include a low-level alarm in the feed hopper.

Waste charging

Doors isolate the furnace from the feed chute to prevent the fire burning back up the chute. Provision should be made for preventing the ignition of the waste which is in contact with the outside of the door, such as double doors and/or a cooling system. Water-cooled chutes are currently in use.

The provision of consistent feed is crucial to ensuring steady combustion conditions. Systems in which the grate steadily draws the waste on to it are preferred. Where feed is intermittent, particular care in the control of the combustion is needed (see Section 2.3.4 - Furnace requirements).

With moving grate systems it is particularly important that operating procedures show how overloading of the furnace will be prevented. There should be an automatic means to vary the waste feed rate to maintain good combustion conditions. This should be controlled by measured combustion parameters and may allow for manual intervention by trained operators if required.

2.3.2.4 Sewage sludge

Sewage sludge waste charging

Because of the homogeneous nature of sludge, its injection to the furnace usually causes few problems. The degree of pre-dewatering will impact upon the feed mechanism used. Very dry cakes from plate presses may give rise to handling and charging difficulties that lead to less stable combustion conditions. The water content of the sludge may assist in suppression of NOx production. Very wet sludges will have a low CV and may lead to combustion problems. The settlement chemicals used in the sewage works may contain chlorine and sulphur molecules that will exert an additional acid gas loading.

2.3.2.5 Drum incineration

Drum charging

Drums should be fed to the furnace in sequence, according to their contents, to ensure that the calorific value fed to the incinerator is as constant as possible.

Inevitably there will be some drips from the drums as the feed conveyor takes them across the apron to the furnace entry. The apron section should effectively contain liquid and should be regularly cleaned to prevent the build up of combustible material, (see also Section 2.3.1 - Waste handling).

Because the furnace must be open to allow the drums to pass in (and out) the incinerator has to achieve the required operating temperatures whilst coping with considerable ingress of cold air and operating at high excess air levels. Arrangements for feeding the drums should be engineered to prevent fugitive emissions. Doors and interlocking are not practicable because of the high frequency of drum loading. Water curtains are effective at minimising “puffing” releases from the feed entry and the exit; they also keep dust and ash burning around the entry to a minimum and provide a quench for the drums.

There should be no drums in the furnace on start-up and feed should be stopped when the conditions in the furnace do not meet those given in Section 2.3.4 - Furnace requirements.

2.3.2.6 Animal carcasses

Animal carcass charging

Feed is intermittent, by front loader vehicle, ram feed or manual. The doors have to open to admit the carcasses; as a result air will be drawn into the furnace when waste is charged and control of the fans, as above, is of critical importance. Because of this and because the protection of abatement plant is usually limited, and also because regulation (by the Regulator) of feed control is difficult, the opening of the doors should be interlocked with the draught.

2.3.2.7 Pyrolysis and gasification plants

Pyrolysis and gasification plants require careful control of air ingress during waste charging operations. Packed rams and screw feeders are suitable for use. Feed throats that reduce in diameter may help to maintain a good seal, as may shredding waste to prevent mechanical blockages. Charging mechanisms must be of appropriate design and materials to resist the reactor back pressures and corrosion that could lead to escape of the gases produced.

WID (HWID) requirements must be fulfilled at installations covered by the directive. Directive standards may also represent BAT for installations not falling within the directives and should represent the starting point for site specific determination of BAT.

2.3.2.8 Refuse derived fuels

It will generally be BAT to charge the RDF using sealed systems to prevent its escape and allow control of air fed to the furnace.

WID (HWID) requirements must be fulfilled.

Waste charging

Co-incinerator charging

2.3.2.9 Co-incinerators

Specific techniques for charging at co-incineration plant are not detailed in this guidance. Guidance detailed in the sector specific guidance for the particular industry concerned should be consulted (e.g. cement and lime sector guidance). It will be necessary for the techniques selected to satisfy the requirements of HWID and WID – the requirements of these directives are discussed in Section 2.3.1.1.

2.3.3 Furnace types

2.3.3.1 *Introduction*

"Furnaces" has been divided into 2 sections; **this section describes the furnace designs available** while Section 2.3.4 deals with the design and performance requirements for BAT. More detailed descriptions of furnace types may be found in the literature.

RDF and Co-incineration

Refuse derived fuel does not have its own sub-section here because it is a *waste type* rather than a specific furnace design. RDF may be burned in a variety of plant providing that plant is designed to receive fuels of similar physical, chemical and combustion characteristics e.g. where a high CV liquid RDF replaces a high CV liquid primary fuel.

Co-incineration furnace design is also not included here - refer to sector specific guidance.

Table 2-3 - Summary of Combustion Technology Application

Combustion Technologies - known to be used in the UK: UK - suitable or likely to be: S	**Waste Type**					
	Chemical	**Clinical**	**RDF (note 4)**	**Municipal**	**Sewage sludge**	**Animal carcass**
Fixed hearth						UK
Fixed stepped hearth		UK		UK		
Moving hearth (normally sloping and stepped)		UK	UK	UK		
Pulsed hearth	S (Note 1)	UK		S		S
Rotary kiln	UK	UK	S?	S	S	S
Fluidised bed (note 2)			UK	S	UK	
Liquid injection	UK		S?		S	
Semi pyrolytic	UK	UK	S	S		S
Gasification (note 2)	S	S	S	S	S	S
Pyrolysis (note 2)	S	S	UK	UK	S	S
Cyclonic combustors						
Gas incinerators	UK					
Drum incinerators	UK					

Notes:
1. *For mainly solid chemical wastes.*
2. *May only be suitable for selected / pre-treated waste fractions*
3. *RDF suitability will depend on the individual nature of the RDF concerned.*

2.3.3.2 *Fixed hearth incinerators*

While these have been used for clinical waste and even chemical waste they would now normally only be acceptable for the incineration of consistent wastes whose combustion has a low relative pollution potential. They are in use for animal carcass incineration where the containment offered by the fixed hearth may assist in ensuring unburned liquids (e.g. fat) do not leak out.

The primary chamber waste is normally over-fired with primary air. Support burners are often required. Proper mixing of waste on the hearth is difficult and requires careful adjustment of the feed and ash removal rates. Achieving consistent burnout is difficult. The skill and training of the Operator are particularly important. Such designs may have difficulty in meeting WID standards, mainly due to the semi-batch nature of the waste travel on the grate and de-ashing operations.

A secondary chamber with injection of supplementary fuel and secondary air is essential.

Furnace types

2.3.3.3 Fixed hearth stepped furnace incinerators

Used, in particular, for ***CWI*** these comprise a series of steps (typically 3) with embedded primary air channels, down which the waste is moved by a series of rams. The first step is a drying stage, with sub stoichiometric oxygen conditions, during which most volatile compounds are released and burn above the grate in the combustion chamber. The remaining, less volatile material is pushed onto the next step where the main combustion takes place. The third step is the burnout stage before the ash is discharged into a final ash burnout chamber. The material can typically spend 8 hours on the hearths and a further 8 hours in the burnout chamber to achieve burnout performance of less than 1% carbon in ash. Throughput rates should be altered to ensure good burnout.

The steps between hearths provide agitation as the waste tumbles down the step; however, this can also produce surges of unburned particulate and hydrocarbons and consequently the provision for good secondary combustion and residence time becomes more important.

Gas combustion takes place in the primary chamber and in a subsequent secondary combustion chamber.

2.3.3.4 Moving grate incinerators

Municipal waste is the main application for these incinerators which can be designed to handle large volumes of waste. Older grates such as horizontal (Continuous Travelling Grate Stoker), W-Grate or oscillating grate have now been largely replaced by either:

- ***The roller grate***, which consists of five to eight adjacent drum or roller grates, located in a stepped formation to form an inclined surface with the drums rotating in the direction of waste movement. Combustion control is enhanced by independent air feed to each roller;
- ***The stepped inclined grate*** which uses moving bars, rockers or vibration to move the waste down each of the grates (normally three). A separate drive and air supply is provided to each grate to provide the different conditions required for drying, combustion and burnout as described for the fixed stepped hearth above. In some cases the air supply is further subdivided to give better control.
- ***Inclined counter-rotating grates*** in which the grate bars rotate backwards provide good waste agitation whilst preventing waste from tumbling down the forward inclined grate.
- Some designs incorporate a ***rotary section*** to provide additional agitation and enhance burnout.

In larger furnaces it is possible for the required residence time to be achieved in a single chamber but this may be more difficult to verify (see Section 2.3.4.4 - Validation of combustion conditions).

2.3.3.5 Pulsed hearth incinerators

The pulsed hearth incinerator uses the pulsed movement of one or more refractory hearths to move the waste and ash through the incinerator. The hearths, which are stepped at each side to form a U shape, are suspended from four external supports. The pulsing action of the hearth is achieved pneumatically. They have been used for municipal, clinical, animal carcasses and other solid wastes.

The smooth hearth can handle difficult wastes with reduced risk of jamming or loss of liquid wastes. There are no moving mechanical parts exposed to burning material or hot gases. The main difficulties, have been in achieving effective and reliable burnout of the solid wastes. For clinical waste it should be noted that the burnout time on the hearth has been short in installations to date when compared with stepped hearth incinerators, (see Section 2.5 for details on ash handling).

2.3.3.6 Rotary kiln incinerators

Rotary kilns have wide application and can be of the complete rotation or partial rotation type. They have the benefit of good waste agitation and achieve good burnout provided waste residence time in the furnace is adequate. They can be used in combination with other designs to provide additional ash burnout.

Incineration in a rotary kiln is normally a two-stage process consisting of a kiln and a separate secondary combustion chamber. The kiln itself, which is the primary combustion chamber, is a cylindrical shell lined with a refractory. The kiln is inclined downwards from the feed end and rotates slowly about its cylindrical axis. The rotation moves the waste through the kiln with a tumbling action so as to expose fresh surfaces to heat and oxygen. Structures within the kiln may be added to increase turbulence and to slow the passage of liquid wastes. Residence time of the solids going through the kiln may be changed by adjusting the kiln's rotational speed.Due to the absence of exposed metal surfaces, rotary kilns are normally able to operate at high temperatures and often operate in a slagging mode. Slagging kilns operate at a temperature high enough to melt inorganic waste and produce a fused glassy slag which is low in organics and has a low leaching rate. This has

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made them particularly suitable for ***hazardous waste*** incineration where whole drums and solid wastes can be completely destroyed. The slagging temperature may be reduced and the slag's viscosity controlled by additives. Molten slag is drained from the kiln and solidified by quenching in a water bath. In other cases the ash is collected dry.

Careful attention needs to be paid to the seals between the rotating kiln and the end plates to prevent leakage of gases and unburnt waste. Tumbling of the waste may generate fine particles requiring secondary combustion and good particulate abatement.

2.3.3.7 Fuidised bed incinerators

Fluidised beds are only suitable for reasonably homogeneous materials and are therefore the main designs for the incineration of ***sewage sludge***. Fluidised bed technology may also be used for any waste that has been sufficiently treated, including treated ***municipal waste*** and **refuse derived fuels**.

Most fluidised beds fall into 2 categories - circulating (CFB) and bubbling (BFB). A fluidised bed incinerator is normally a single stage process. It consists of a refractory-lined shell. The chamber contains a granular bed consisting of an inert material such as sand or limestone. This bed is supported on a distribution plate and fluidised by air or other gas being blown up through the plate. Ancillary equipment includes a fuel burner, a waste feed mechanism and possibly an afterburner chamber to provide adequate residence time..

The CFB is based on the same principle as BFBs. The difference is the fluidisation velocity. In a CFB the high airflow creates greater mixing of the air and fuel. Particles are carried out of the vertical combustion chamber by the flue gas and are removed in an integral cyclone. The solids from the cyclone, the vast majority of which are sand, are returned to the fluid bed.

The high fluidisation velocities may result in carry over of fine particulate matter However, modern dust collection equipment can be expected to handle this.

The advantages of a fluidised bed incinerator include:

- combustion efficiency is high and temperatures are uniform, making residence time calculations more reliable;
- lower temperature leads to low NO_X;
- simple furnace - no moving parts; and
- the sand provides continuous attrition of the burning material removing the layer of char as it forms and exposing fresh material for combustion. This assists with both the rate of combustion and burnout.

An ***MWI*** fluidised bed is operational in the UK. The waste is pre-sized by means of a crusher / shredder. There have been operational problems with the waste pre-treatment stages that have lead to significant down time.

2.3.3.8 Starved air (semi-pyrolytic) incinerators

See also gasification (Section 2.3.3.13). More a method of control than a specific configuration, the concept can be applied to various designs. The primary chamber operates at sub-stoichiometric air levels to evolve a gas that is combusted in a secondary zone operating under excess air conditions. A supplementary fuel burner is required in the secondary zone to ensure the required combustion conditions are maintained at all times. The design of the secondary combustion zone and support burner will need to consider the full range of characteristics of the gas evolved to ensure that unburned gas is not released.

The advantages can be a more controlled burn leading to lower releases of NOx, VOCs and CO. The relatively low combustion airflow results in low entrainment of particulate in the flue gas.

2.3.3.9 Cyclonic combustion

Cyclonic combustion techniques, for the destruction of organic wastes, were reported upon as an emerging technique in earlier Agency guidance on incineration (ref.: S2 5.01). The technique was reported to be characterised by reasonably high temperatures and very good mixing, achieving high destruction rates at short residence times e.g. 99.99999% destruction at 1200 °C for 0.25 seconds. The technique was reported to produce a vitrified slag. It is not known whether commercial applications have been developed.

2.3.3.10 Liquid injection incinerators

Liquid injection incinerators are covered by WID.

Liquid injection incinerators, which are usually refractory lined cylindrical chambers, are used for the incineration of chemical waste. The furnace is often divided into several chambers or zones. In the first, highly combustible liquids such as waste oils and solvents are burned. Aqueous mixtures containing combustible solids and low calorific value wastes may be injected into the secondary zones.

A secondary combustion chamber is sometimes used, but is not always necessary if the combustion conditions in the primary chamber provide the required temperatures and residence time.

2.3.3.11 Gas incinerators

The incineration of waste gases (unless the gas arises from the thermal treatment of waste) are not covered by WID. Because of the homogeneous and generally very clean nature of the feedstock it is likely that very low emission levels can be achieved using BAT. Emissions should be below those outlined in WID.

Whether considered to be a piece of abatement plant or an incinerator in its own right, these devices fall into the categories of:

- conventional flame incineration at around 850-950 °C;
- catalytic incineration at around 350-400 °C; and
- flameless (gas passes through a hot granular bed) at around 850-1200 °C.

Devices are available to cover airflows from 1 to 30,000 m^3/h and have been banked together in units up to 400,000 m^3/h. VOC destruction rates can be typically 99.99% but can be as high as 99.9999%, where required, by choice of the appropriate system. Such destruction rates can be achieved with residence times less than 0.2 s and with virtually no NO_X production. The devices can be heated electrically or by injection of fuel gas to the feed stream but are normally self-supporting, as long as the VOC content of the feed is at least 0.5 to 1.0 g/m^3. While it is generally beneficial to recuperate the heat in the bed, systems which reverse flow through the bed to recover thermal energy, will not normally achieve the very high destruction rates because small quantities of gas bypass when the changeover valves are operated. Flameless devices are not generally suitable where there is a significant particulate burden.

2.3.3.12 Drum incinerators

Drum incinerators are all of the same basic design, comprising a conveyor system which takes the inverted drum through a long narrow furnace where the burners, normally gas fired, burn out the residual contents and burn off, or at least loosen, the paint. The gases pass to a secondary chamber where further burners ensure effective combustion.

2.3.3.13 Gasification installations

This section provides a basic summary of the gasification process. More detailed description of individual types of gasification plants may be found in the BAT report on waste pyrolysis and gasification activities.

Gasification is the conversion of a solid or liquid feedstock into a gas by partial oxidation under the application of heat. Partial oxidation is achieved by restricting the supply of oxidant, normally air. For organic based feedstock, such as most wastes, the resultant gas is typically a mixture of carbon monoxide, carbon dioxide, hydrogen, methane, water, nitrogen and small amounts of higher hydrocarbons. The gas has a relatively low CV, typically 4 to 10 MJ/Nm3, and may be highly corrosive and toxic owing to the partially reduced species present. Particular attention must therefore be paid to ensuring the gas produced in the reactor and passed to the combustion stage is contained. This should include attention to ensure:

- Consistent waste feed characteristics are obtained (pre-treatment is likely to be required for heterogeneous wastes) to ensure even reaction rates and internal plant pressures
- The plant must be sealed to contain the gases produced
- The materials of construction must be able to withstand the highly corrosive environments which they will be subjected to.

Air is the normal oxidant, although oxygen enriched air or oxygen can be used. The gas CV will be higher (10 to 15 MJ/Nm3) when air is not used due to the absence of nitrogen.

For most waste feedstock, the gas produced will contain tars and particulate. Depending upon the combustion technology selected the gas may require cleaning before combustion.

Where the gas (or solid or liquid products) produced are subsequently combusted, the installation will be required to meet the standards of the WID.

There are four main categories of gasification plant:

1. ***Rotating kiln*** – similar to rotary kin incinerators except that they operate under sub-stoichiometric conditions.
2. ***Fixed bed reactors*** – waste is loaded through the top of a shaft chamber. Oxidant is added through a grate or tuyeres at the base of the shaft. In *updraft* versions the fuel gas is removed from the top of the shaft, in *downdraft* versions from the base.
3. ***Fluidised bed reactors*** – similar to incineration but at sub-stoichiometric conditions. Such systems can be operated at high pressure as part of a gasification combined cycle to supply fuel gas to a gas turbine.
4. ***Other systems*** – are reported to be available but there is little information on design and performance.

2.3.3.14 Pyrolysis installations

This section provides a basic summary of the pyrolysis process. More detailed descriptions of individual types of pyrolysis plants may be found in the BAT report on waste pyrolysis and gasification activities.

Pyrolysis is the thermal degradation of a material in the complete absence of an oxidising agent. Most pyrolysis plants have an externally heated chamber that is sealed to prevent air ingress. In practice, complete elimination of air is very difficult and some oxidation may occur.

The process generally occurs in the range of 400 to 1000 Celsius. The heat breaks complex molecules into simpler ones which form gas, liquid or solid (char). The relative proportions depend upon the temperature, the nature of the waste feed and the time it is exposed to that temperature. Long exposures to lower temperatures (400 to 500 Celsius) maximise char productions (e.g. charcoal production). Short exposures (<1 second) to high temperatures (500 to 1000 °C) are known as “flash pyrolysis” and increase the proportion of gas or liquid.

There are four main types of pyrolysis installations:

1. ***Externally heated rotating kiln*** – the waste is degraded in an externally heated rotating drum. The heat is obtained from combustion of a proportion of the fuel gas. The gas produced is cleaned using scrubbers or filters before combustion.
2. ***Heated tube systems*** – similar to the rotating kiln except that the waste is pushed through a static heated tube by a screw feed or ram.
3. ***Fluidised bed system*** – have higher heat transfer rates so can be used for flash pyrolysis giving high liquid yields and often used for wood or similar shredded materials. Heat may be added by external heat transfer or directly from a combustion process.
4. ***Other systems*** – these are generally based on externally heated static kilns

If gas is the principle product, it is likely to have a CV range of 15 to 30 MJ/Nm^3 (cf. CV on natural gas of approx. 39 MJ/Nm^3). This gas can be burned in boilers, engines or gas turbines. The raw gas will contain highly toxic and corrosive reduced species. Similar considerations to those outlined above for gasification plant apply.

If a liquid (pyrolysis oil) is required it is necessary to stop the reactions that would otherwise go on to produce a gas, typically by condensation. Pyrolysis oil is a complex mixture of organic compounds. Some of these oils may have value as a product when certain selected feedstock are pyrolysed. Where waste feedstock are concerned, the main uses are likely to be as a liquid fuel

Pyrolysis processes produce two main types of solid residues:

- Ash from inert solid material present in the waste e.g. glass, stones etc
- Carbon char – which may be used as a product (e.g. carbon black) or burned as a fuel or disposed of as a waste residue.

Where the char is disposed of (rather than burned as a fuel or used as a product) the WID 3% TOC limit will apply. Although the char may consist of primarily elemental carbon (which is not included in the TOC test) , it is still possible that the 3% TOC level will be exceeded. Where this is the case BAT will require further processing of the char such that the residues ultimately produced for disposal meet the 3% TOC standard. This additional processing may involve the use of a water gas reactor or combustion.

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This subsequent combustion of a product of pyrolysis (whether the solid, liquid or gaseous product) will mean that the WID will apply to the installation. Guidance on its application can be found throughout this document, but it is advised that early discussion with the Regulator takes place to clarify the application of the directive to the individual pyrolysis installation.

If the waste feed to the pyrolysis installation is (or can be treated to be) sufficiently heterogeneous, and the gas produced either is (or can be treated to be) of good quality, it is theoretically possible that high levels of electricity generation may be achieved through the use of gas engines or gas turbines. At present there is mixed evidence regarding the ability of such systems to meet the stringent requirements of WID in respect of emissions to air. However, Operators proposing pyrolysis should justify their selected power generation technology and explore opportunities to produce clean, high quality fuel gases that may be burned in higher energy efficiency plant (i.e. those that do not depend upon a steam cycle) and can comply with WID emission limit values.

Furnace requirements

2.3.4 Furnace requirements

Good furnace design and combustion control are the most important factors for ensuring wastes are effectively destroyed and that the production of potentially harmful emissions are minimised. This section provides guidance on the techniques that represent BAT at each stage of the process.

2.3.4.1 Legislative obligations

Obligations

European directives already set minimum standards for operating conditions of municipal and hazardous waste incinerators. The new Waste Incineration Directive (2000/76/EC) extends the scope of these requirements to the majority of waste incinerators and other co-incinerators that burn wastes or fuels derived from wastes.

The following summarises the main combustion related requirements arising from European legislation:

- The gases resulting from the combustion of non-hazardous wastes must be maintained at above 850 °C for at least 2 seconds.
- The gases resulting from the combustion of hazardous wastes with a halogen content greater than 1% (as chlorine) must be maintained at above 1100 °C for at least 2 seconds.
- There should be at least 6% oxygen at installations subject to MWID and HWID (this is required of MWIs and HWIs only and only until 28 December 2005 (or from 28 December 2002 for new installations) when they become regulated under WID. WID does not specify oxygen concentrations – it should however be noted that BAT will require sufficiently oxidising conditions at the final combustion stage to provide for good combustion. In many situations BAT may equate to the 6% oxygen requirement unless the operator can demonstrate otherwise.
- Incinerators must be provided with auxiliary burners to achieve and maintain the required temperatures. This does not apply to co-incineration unless BAT requires them.
- The combustion temperature and residence time, and the oxygen content of the stack gases, must be validated at least once, and under the most unfavourable operational conditions (see Section 2.3.4.4 - Validation of combustion conditions).
- Residues (ash) shall be minimised in their amount and harmfulness.
- Incinerator slag and bottom ashes shall not exceed 3% TOC or 5% LOI (dry weight). This does not apply to co-incineration where BAT for the sector will apply (see sector specific guidance).
- Installations should not give rise to significant ground level air pollution.

Whilst it is recognised that these requirements (along with the emission limit values noted elsewhere in this guidance) set high technological standards, Operators will still need to consider the use of techniques that may further reduce releases and demonstrate that their installation and its operation is the BAT.

2.3.4.2 Grates and primary air

Application Form Question 2.3 (cont.)

BAT for grates and primary aIr is as follows:

With the Application the Operator should:

1. supply the general Application requirements for Section 2.3 on page 39 for this aspect of the activities.

Indicative BAT Requirements

BAT for grates and primary air

1. Residence time of the waste in the furnace should be long enough to ensure complete burnout, (see also Section 2.5 - Ash handling), and should be controllable. WID requires that bottom ash (i.e. not fly ash or APC residues) shall have a Total Organic Carbon content of below 3% w/w dry.
2. For gasification and pyrolysis plants the WID 3% TOC requirement applies to the “ash” produced at the subsequent combustion stage rather than the initial reaction stage – which may be set up to deliberately produce a high carbon char for subsequent use as a fuel or other use. Where this char is used as a fuel the 3% TOC will apply to that process (along with other WID requirements). If the char produced is not put to any beneficial use (e.g. disposed of to landfill) the pyrolysis / gasification installation will be expected process the char such that it can meet the 3% TOC requirement and recover energy from the char e.g. using water gas reactor or combustion stages.
3. Primary air supply should be controllable, and where there are separate grates should be separately controllable between the grates.

Cont.

Furnace requirements

4. For most designs of furnace (fluidised beds may be an exception), primary air should be controlled both to minimise NO_X (Section 2.3.8.3) production and minimise velocities and the entrainment of particulate (Section 2.3.8.3). Starved air systems can be very effective in controlling these while maintaining low levels of CO (Section 2.3.8.3).

5. Heavy metal oxides and alkali metal salts in the fly ash arise from the volatilisation of inorganic compounds. Proper distribution of air and fuel, avoiding hot zones, will reduce the amount of inorganic material volatilised.

6. Higher primary airflow through grates may be required to reduce temperatures. The use of water-cooled grates may minimise the airflow requirements

2.3.4.3 Combustion chambers, secondary air system designs and supplementary burners

Application Form Question 2.3 (cont.)

BAT for combustion chambers, secondary air system designs and supplementary burners is as follows:

With the Application the Operator should:

1. supply the general Application requirements for Section 2.3 on page 39 for this aspect of the activities.

Indicative BAT Requirements

BAT for combustion chambers etc.

1. Combustion chambers, casings, ducts and ancillary equipment should be made, and maintained, as gas-tight as practicable. They should be maintained under slight reduced pressure and designed to prevent both the release of gases and disturbance of combustion conditions during waste charging. Control of the induced draft fan, primary air and the feed rate should be balanced.

2. Gas temperature in the primary zone and at the point of exit from the secondary combustion chamber should be continuously monitored and recorded, and audible and visual alarms should be triggered when the temperature falls below the minimum specified. The charging system (see also Section 2.3.2 - Waste charging) should be interlocked with the validated combustion temperature to automatically prevent additional waste feed:
   - At start up, until the combustion temperature is reached
   - Whenever the relevant combustion temperature is not maintained
   - Whenever the continuos emission monitors show exceedences of the emission limit values (over the appropriate averaging period).

3. All incinerators should be fitted with a burner which automatically switches on if the temperature falls below the relevant temperature at any time when unburned waste is in the incinerator and to ensure that the temperature conditions are met prior to waste being admitted on start-up.

Supplementary burners and fuels

4. Supplementary burners must be provided at all incineration installations in order to secure and maintain the required combustion temperatures. Co-incineration plants are not required to include supplementary burners under EC legislation but they may be required by BAT for the particular sector (see relevant sector guidance)
   - the burners must be capable of supporting the combustion temperature under all conditions when there is waste in the furnace;
   - the burners may be used for initial start-up, temperature maintenance and final shut-down
   - the application should state the start up and shut down sequence, including the temperatures at which the waste will be introduced, and prevented, and at what temperature the supplementary burners will trigger
   - automated systems should be used trigger the supplementary burners and to prevent additional waste feed until the required temperature is re-established

Cont.

Furnace requirements

5. Supplementary fuels used in such burners should be of a type which, in effect, produce release levels no worse than those from burning gas oil, as defined by Directive 75/716/EEC; lower levels may be dictated by BAT.

   Supplementary fuels that are wastes or waste derived may only be used as support fuel if:
   - They do not give rise to emissions worse than gas oil (this may be judged by considering the unburned waste composition against that of gas oil and considering the effect on emissions)
   - Combustion temperatures are greater than those outlined in the table below – this effectively means that waste derived fuels cannot be used for start-up, but may be used for maintaining temperatures above the minimum.
   - any other fuels proposed should be the subject of trials.

BAT for combustion chambers etc. (cont.)

6. The criteria which govern efficient combustion of furnace gases are:
   - adequate oxygen content to ensure complete combustion;
   - sufficient temperature to promote combustion;
   - sufficient time to complete the combustion reactions; and
   - turbulence to promote mixing.

   Whether the above criteria can be met in a single chambered furnace, or will require secondary or even tertiary chambers, is for the designer to decide and justify. The requirements of European legislation must, however, be complied with. These are summarised at point 7 below.

7. All incineration plant should be equipped and operated in such a way that the temperature of the combustion gas is raised to that specified in Table 2.4, after the last injection of air, in a controlled and homogeneous fashion and even under the most unfavourable conditions anticipated, for at least ***two seconds.***

   These ***temperatures*** should be maintained during start-up and at the end of an incineration cycle and for as long as combustible waste is in the combustion chamber.

   Oxygen levels should generally be in ***excess of 6%v/v*** or, if not the reason why not should be stated and justified (including consideration of the advantages and disadvantages of operating at the chosen oxygen level). It must still be demonstrated that oxygen levels will be adequate to ensure oxidative combustion and hence destruction of organic species at the final combustion stage, (see Section 2.3.4.5 regarding oxygen levels).

   Other operating conditions may be acceptable provided that it can be clearly demonstrated to the satisfaction of the Regulator that the release limits will be met and the process represents a better technique.

Table 2-4 - Furnace gas temperatures

Process	Minimum temperature °C
Chemical waste	850 (1100)
Clinical waste	1000 (1100)
Municipal waste	850
Animal carcasses	850
Sewage Sludge	850
Gasification (combustion of products of gasification)	850
Pyrolysis (combustion of products of pyrolysis)	850
Co-incineration	850 (1100)
Refuse Derived Fuels	850 (1100)
Drum recovery	850 (1100)

Note 1: Figures in brackets apply where wastes containing more than 1% halogenated organic substances (expressed as chlorine) or where other thermally resistant substances are to be incinerated.

Note 2: Minimum temperature is normally that measured near the inner wall of the combustion chamber.

Furnace requirements

2.3.4.4 Validation of Combustion Conditions

European legislation requires that combustion temperature and residence time (incinerators and co-incinerators) are subjected to appropriate validation at least once when the plant is brought into service, under the most unfavourable operating conditions.

Because it can be prohibitively expensive to retrofit existing plant it is vital that designers ensure that the residence time and temperature requirements are considered at the earliest possible stage.

Detailed consideration of the techniques that fulfil this requirement are contained in the BAT report on validation of combustion conditions. This guidance summarises some of the key issues and highlights the BAT.

Application Form Question 2.3 (cont.)

BAT for validation of combustion conditions:

With the Application the Operator should:

1. Supply the general Application requirements for Section 2.3 on page 39 for this aspect of the activities.
2. Demonstrate that the design selected can meet the combustion requirements outlined in this guidance (Section 2.3.4.1) and in relevant European legislation. Guidance on how to demonstrate this in the application is given in this section below.
3. Explain how the applicant intends to validate the combustion residence time and temperature, and the exhaust gas oxygen concentration when the installation is brought into service.
4. Confirm the worst case combustion conditions under which the validations outlined in 3 above will be carried out.

Indicative BAT Requirements combustion validation

BAT for assessing residence time and turbulence

1. At the ***design stage*** and for the application Operators should:
   - Use CFD to demonstrate that the residence time and temperature requirements will be met in the chosen design and to identify the ideal (or best practicable) locations for temperature monitoring for the purposes of validation measurements.
   - Outline the assumptions and inputs used in the CFD modelling and explain how these are representative of the chosen design
   - Identify the qualifying zone over which the residence time and temperature will meet the residence time and temperature requirements.
   - Use a model that is representative of the real flow situation in the qualifying zone (this is most likely to be a combination of plug flow and stirred reactor flow rather than one extreme)
   - Taking account of this guidance and the BAT report, confirm the details of the method that will be used to validate temperature and residence time modelling, including identification of the worst case conditions under which the test(s) will be carried out. (Note: At a well operated plant the worst case conditions selected may equate to those at the extremes of the plant firing diagram).
   - Identify the locations for the temperature measurements required to undertake validation.
2. Unless not practicable (see 3 below) at the ***operational stage*** the validation techniques used should:
   - Measure worst case gas residence time using a time of flight method (as specified in the BAT report)
   - Use multiple traverse measurements of gas temperature to identify (or confirm) the lowest gas temperature location at, or shortly after, the qualifying secondary combustion zone.
   - Confirm that 95% of the one-minute mean temperatures (continuously monitored at the identified lowest temperature location over a period of at least one hour) exceed the stated minimum temperature requirement.
   - Use suction pyrometers to measure temperatures (acoustic pyrometers or shielded thermocouples may only be used if calibrated against suction pyrometers, (see also Section 2.10 - Monitoring of process variables).

Cont.

Furnace requirements

3. At some ***existing installations*** it may not be possible to carry out the measurements as specified in 6 above. The following matters are considered to be valid when assessing the costs and practicality of carrying out temperature / residence validation. They should be considered when justifying a site specific approach at existing installations:
   - Compliance with combustion related emission limit values (e.g. VOC, NOx, CO) for releases to air may be taken as indicative of adequate combustion and allow for reduced cost validation methods.
   - The siting of new monitoring access holes may be problematic at existing installations.

4. The "***qualifying zone***" over which the temperature and residence time shall be required to comply is defined as follows:
   - Should not include areas where primary combustion occurs but relate to the *completion* of combustion
   - Should be referred to as the qualifying secondary combustion zone or **QSCZ.**
   - Should commence at a location after the last injection of secondary (or over fire) air and will therefore generally exclude residence time achieved in the primary combustion unit or zone.
   - Does not require reset where support burners are located provided they maintain temperature above the required level.
   - Would require reset where tertiary air is added

5. The ***test conditions*** for validation measurements should be:
   - Carried out over a range of operational conditions including the "most unfavourable" and normal operation.
   - The "most unfavourable" condition is considered to arise as a consequence of a combination of:
     - waste type being at the boundary of the design envelope in respect of it combustion related parameters (e.g. CV, moisture)
     - the process operating at the limits of its operational range as defined by the plant firing diagram.
   - Each condition should be tested twice during the validation programme
   - The monitoring within each test period should last at least one hour

For more detailed guidance on validation methodologies refer to the BAT report on validation of combustion conditions.

2.3.4.5 Measuring oxygen levels

Application Form Question 2.3 (cont.)

BAT for measuring oxygen levels is:

With the Application the Operator should:

1. supply the general Application requirements for Section 2.3 on page 39 for this aspect of the activities.

Indicative BAT Requirements

BAT for measuring oxygen levels

1. The EC Directives do not state whether combustion oxygen levels are measured wet or dry. Zirconia based techniques measure the wet level whereas extractive systems measure the dry levels. The difference between the dry and the wet figures may be 20%, e.g. 8% oxygen expressed as a wet measurement or 10% dry.

2. This emphasises the need to set the oxygen control point at a level for a particular plant and waste which takes account of the speed with which the control system can introduce more secondary air in response to fluctuations in the rate of combustion on the grate. The larger the fluctuations and slower the rate of response of the control system, (see Section 2.3.4.6 - Combustion control) the larger the margin of excess oxygen must be. Some operations are running with 12% excess oxygen whereas a ***ChWI*** burning a consistent liquid feed may only need 2% to achieve effective combustion. During short-term perturbations the level will therefore fall below these values.

Furnace requirements

2.3.4.6 Combustion control

Application Form Question 2.3 (cont.)

BAT for combustion control is as follows:

With the Application the Operator should:

1. supply the general Application requirements for Section 2.3 on page 39 for this aspect of the activities.

Indicative BAT Requirements

BAT for combustion control

1. Careful consideration must be given to maintaining optimum control of the combustion process at any instant, especially when burning wastes of very variable moisture content and calorific value and those which cannot be readily charged to the furnace at a steady rate.
2. Control will be better where the largest perturbation (be it a single drum to a ChWI, or the tumbling of a mass of waste in an MWI) is small compared with total mass being burned.
3. Because waste feed rate is a relatively slow acting control parameter, shorter term fluctuations, especially during stoking, need to be controlled by primary and secondary air flow rates and burner operation.
4. The shortest-term fluctuations are usually caused by sudden conflagrations of the non-homogeneous wastes and take place in the order of seconds. Fast response measuring systems (such as CO or oxygen sensors) must be used to avoid short term releases (particularly of CO and unburned hydrocarbons) before the control system reacts.
5. Operators should demonstrate how their control system will deal with both:
   - the largest normal perturbation; and
   - the shortest duration perturbation which is significant in the particular process.
6. Potentially the response time of CO detector systems may be brought down to the microsecond level. Alternatively rapid response can be obtained by taking measurements just above the bed, using acoustic (which can be expensive) or optical/infra-red temperature monitoring. On some plants, this alone has shown significant reductions in CO releases. Better control also improves efficiency and can save fuel where burners are regularly employed. Such techniques can be valuable for improving performance on existing plants.
7. To be effective, rapid monitoring needs to be combined with a secondary air supply arrangement which can also respond rapidly. Techniques include:
   - keeping secondary jets clear of slag and operational - particularly in MWIs. Jet performance can be monitored by simple air flow or pressure instrumentation, backed up with viewing windows;
   - oxygen injection, via lances, has been used for merchant ChWI in the US and Germany with significant reductions in the number of high CO events
   - although there are no known examples it would appear to be possible to provide capacity in the air supply ductwork upstream of the jets and higher pressure fans, with control to the jets being by damper opening so that, on opening of the dampers, there will be an immediate increase in air flow through the jets. This may provide a much faster response than that obtained by controlling the fan speed.
8. Starved air systems reduce both the oxygen content and the temperature in the area where the NO_X is normally formed. They can combine good NO_X and good CO performance particularly used with separate chambers, (see Section 2.3.8).
9. Where support burners are used (supplementary firing) the use of low NO_X burners is BAT.
10. Methane (natural gas) addition is an emerging technique, although not yet commercially proven, in which the gas is either injected into the bed where it can suppress the formation of NO_X or into the secondary combustion area (termed reburn) where it can reduce the NO_X which has already formed back to N_2.

Furnace requirements

2.3.4.7 Combined incineration of different waste types

This section relates to the combustion of different types of wastes within the same incinerator. It does not deal with the combustion of wastes with, or in the place of, other fuels at installations whose primary purpose is the generation of energy or the production of materials. The techniques that represent BAT in these circumstances should be determined by reference to the appropriate sector guidance.

Application Form Question 2.3 (cont.)

BAT for combined incineration of differing waste types is as follows:

With the Application the Operator should:

1. supply the general Application requirements for Section 2.3 on page 39 for this aspect of the activities.

Indicative BAT Requirements

BAT for co-incineration of differing waste types

Because BAT for the incineration a particular waste will be dependent upon the characteristics of that waste a dedicated furnace, abatement system and monitoring train is likely to be BAT where anything other than very low proportions of alternative waste types are proposed.

Where combined abatement is used at existing plant, the design should address the potential for loss of efflux velocity at the stack top when either incineration line is not operating and monitor at locations that may allow calculation of emission limit values for each line.

It will not be acceptable to use combined flue dilution to meet emission limits.

Clinical waste in MWIs

1. Waste which would normally render clinical waste hazardous, i.e. sharps, pharmaceuticals, infectious waste and body tissue (beyond incidental amounts) should be incinerated in dedicated CWI plant. The incineration of some types of clinical waste may require the plant to meet the requirements of HWID.

2. WID requires that infectious clinical waste is placed straight in the furnace without first being mixed with other waste, and without direct handling.

3. Generally, the more innocuous waste, i.e. Class E waste as defined by the Health and Safety Commission in Safe Disposal of Clinical Wastes (1992), which is suitable for landfill, may be burned in a well run MWI, but only if:
   - the incinerator meets the modern standards expected for municipal waste;
   - a strict code of quality control is exercised on the source of the waste and its handling into the incinerator and the procedures for these are regularly audited;
   - the CW is burned within 24 hrs and records are kept of temperature and quantity of waste fed;
   - that procedures are in place to divert and transfer waste already held, should the incinerator be out of action;
   - a mass throughput limit is applied which corresponds to a small fraction of the total waste burned - say < 10%.

Clinical waste in ACIs

4. Animal carcass incinerators are unlikely to be able to meet the standards required (WID) to enable them to incinerate other types of wastes.

Sewage sludge in MWIs

5. There are no current applications for this arrangement. Any proposals for this or any other co-incineration project will be dealt with as they arise.

Furnace requirements

2.3.4.8 Flue gas recirculation (FGR)

Application Form Question 2.3 (cont.)

BAT for NOx prevention is as follows:

With the Application the Operator should:

1. supply the general Application requirements for Section 2.3 on page 39 for this aspect of the activities.

Indicative BAT Requirements

BAT for flue gas recirculation

1. All incineration plants are expected to include FGR or provide a clearly made site specific justification why FGR is not used (addressing each of the points below).
2. More secondary air is required to provide turbulence than is needed simply for supplying oxygen. The resulting excess oxygen encourages both NO_X and dioxin formation. ***FGR*** replaces 10-20% of secondary air (with N_2 and CO_2) reducing oxygen and peak temperatures thereby reducing NO_X generation.
3. FGR gives around 20% NO_X reduction, but it has, in combination with repositioning air inlets (using CFD to optimise locations) and improved control, given 25-35% reduction.
4. Higher re-circulation rates may give rise to corrosion owing to elevated CO concentrations. At the lower levels this is not expected to be significant enough to prevent the routine use of this emission prevention technique.
5. The thermal efficiency of the installation may be increased by the re-circulation of the already warmed stack gases. This additional heat retention will need dissipation to prevent increased furnace temperatures altering the thermal profile of the operational plant. In new plant this may be addressed at the design stage (e.g. by providing a larger heat capacity boiler). Existing plants may find increasing heat removal rates highly capital intensive – although this may be recovered through increased heat recovery. Reductions in waste throughput could also reduce thermal load, but this will also be expensive and may be impractical in some situations.
6. The costs of retrofitting FGR may be prohibitive for existing plant owing to the space required for the ducting and other (heat removal and throughput) factors detailed in 5 above. Such situations will be assessed on a site specific basis.
7. The injection of ammonia or urea (***SNCR***), which converts both NO and NO_2 to nitrogen and water, can further reduce NO_X levels (typically by 35-45%). Its use in conjunction with FGR has shown total reductions of up to 80% and may represent the BAT in many situations. The use of the two techniques in combination also reduces reagent consumption for SNCR. The abatement of NOx using SNCR and other techniques (e.g. SCR) is discussed further in Section 2.3.8.

2.3.5 Chimneys and vents

2.3.5.1 General

Requirements in respect of the assessment of environmental impact of releases to air are outlined in Section 4.1.

With other factors the same (e.g. plume temperature, efflux velocity) higher release points result in lower ground level pollutant concentrations. Operators should justify the selected release height selected and include their assessment in the application.

The assessment should include graphs showing:

- The change in unit ground level pollution concentration against stack height
- stack height against additional cost
- the change in unit ground level pollution against cost

The assessment should also take account of other factors such as the need to further reduce a particular pollutant concentration below a specific significance threshold or planning restrictions. The costs associated with increasing stack height should generally be restricted to construction and maintenance costs. Costs associated with gaining or amending planning permission should be detailed separately but may be taken into account (but should not be over weighted) when justifying the selected stack height.

2.3.5.2 Wet plumes

Wet plumes may not disperse well and can ground easily. Additionally there can be local visual amenity issues and, in severe cases, loss of light issues. Therefore, unless it is agreed that these issues are not locally significant, the gas should be discharged at conditions of temperature and moisture content that avoid saturation under a wide range of weather conditions. The requirement could be specified as a maximum permissible length of plume or as no visible plume for a given percentage of the year.

The normal option to reduce plume visibility is to add heat, but **the use of energy should be balanced against the benefits gained**. Plumes must be abated sufficiently to ensure good pollutant dispersion but a limited visible plume may be acceptable in some conditions. Eliminating plume visibility under all meteorological conditions may not be possible and could result in excessive energy use, to a point that it would not be considered to represent BAT.

Alternatively, moisture can be removed by cooling and condensation, followed by reheat. However, where this is not an inherent part of a wet scrubbing process (where temperature is typically reduced to around 70 °C for scrubbing purposes), the disadvantage would be the generation of a significant liquid effluent stream.

As a further option, to minimise expense and energy use, Operators may wish to guarantee to reduce load under extreme weather conditions rather than to over-design a plume abatement system.

2.3.5.3 Dump stacks and bypasses

Dump stacks should only be included where they are essential for safety reasons. In general in should be possible for dump stacks to be ducted to the main stack, thus forming a bypass and improving dispersion with the additional height and allowing monitoring equipment to quantify the release.

Systems must be designed so that the dump stack is not normally expected to operate. Operational frequencies greater than once per year are unlikely to acceptable. When a dump stacks or emergency bypass operates this will be considered to be a period of “abnormal operation” and the process should be reduced or closed down (Ref. WID Article 13).

Start-up and shutdown should normally be achieved without any releases from the dump stack. An abatement system bypass, linking to the main stack may be operated on start-up where this has been authorised and is necessary to prevent damage to abatement systems.

Electric heating is an available option for new bag filters to avoid the need for bypass on start-up. Failure of the flue gas cleaning plant should not normally lead to operation of the dump stack. The reliability of heat removal systems, in particular feed pumps and dump condensers, should be demonstrated to be adequate.

Further guidance in respect of ***abnormal operating conditions*** may be found in Section 2.8 - Accidents and their consequences.

Cooling towers

2.3.6 Cooling systems (local pollution prevention aspects)

This section deals with the local pollution aspects of cooling systems. Energy efficiency aspects are discussion in greater detail in Section 2.7, and in the cross sector BAT reference note on industrial cooling systems.

2.3.6.1 Cooling systems types

Cooling systems are mainly required at incineration installations for:

- Condensing boiler water for re-circulation after a steam turbine (the major use);
- Cooling scrubber waters to reduce scrubber water evaporative losses;
- Cooling quench water;;
- Cooling of mechanical operations (e.g. pumps etc);
- Condenser chilling.

The main cooling systems in use at waste incineration installations are where electricity is generated using steam turbines. The need to retain (expensive) boiler water means that they will be closed circuit (i.e. the boiler water is retained within the system for re-circulation).

The main differences arise in the design of the heat exchanger and the source and fate of the cooling medium. In this sector the cooling medium is usually supplied by:

- Once through sea water or river water;
- Evaporative cooling tower;
- Forced draft air cooling.

Table 2-5- Cooling system type - advantages and disadvantages

Cooling System Type	Advantages	Disadvantages
Once through	• Greater cooling efficiency may improve energy recovery • Low noise impact • Low visual impact	• Possible fish kill • Possible thermal release effect in water course • Bio-fouling • Biocide discharges
Evaporative cooling	• Good cooling efficiency • Small plot possible	• high visual impact • water consumption • chemical treatments for bio-hazard control
Air cooling	• No water intake or discharge • Unobtrusive design • No water consumption	• Possible noise impacts • Lower cooling efficiency • Power supply costs

Application Form Question 2.3 (cont.)

BAT for cooling systems is as follows:

With the Application the Operator should:

1. supply the general Application requirements for Section 2.3 on page 39 for this aspect of the activities.

2. Justify their chosen technique with regard to the criteria and guidance outlined in this section.

Indicative BAT Requirements

2.3.6.2 Discharge of cooling tower water

BAT for cooling systems

1. Where evaporative cooling towers are used, biocides lead to prescribed releases to both air and water and their use should be minimised (commensurate with meeting health and safety requirements) by optimising the dosing regime (e.g. intermittent shock dosing or only dosing at critical times of the year). The use of automatic mechanical cleaning systems for main condensers minimises the use of biocides.

Cont.

Cooling towers

BAT for cooling systems (cont.)

2. The engineering of the biocide system should prevent accidental overdoses of biocide being released to the environment. This would involve monitoring of levels in the outgoing water coupled with automatic operation of the final discharge valves, as well as bunding of storage vessels and adequate operating procedures.

2.3.6.3 Cooling water intakes

3. Once through cooling systems can be more efficient and may therefore improve the overall energy efficiency of the installation. Such systems will only be suitable where:
   - There is adequate provision of water (e.g. coastal sites);
   - CHP or district heating cannot practicably use the waste heat on a closed loop;
   - Fish (and other aquatic life) kill by the water intake has been assessed and will not be significant;
   - Thermal and biocide dispersion are such that environmental impacts are not significant;
   - The energy and any other environmental benefits can be demonstrated to outweigh alternative technological solutions (e.g. air condensers).

2.3.6.4 Cooling tower plumes

4. Large condensed plumes, such as those from evaporative cooling towers, which come down to ground level can contain harmful substances and cause loss of light, poor visibility and icing of roads. Such effects should be avoided.

5. If required, plume abatement should preferably use reject heat. The degree of abatement required will depend upon local factors. Plume modelling should be employed by an Operator to confirm that the visible (condensed) plume will not ground beyond the boundary fence nor reach areas of habitation at a height that will cause significant loss of light.

6. Eliminating plume visibility under all meteorological conditions may not be possible and could result in excessive energy use, to a point that it would not be considered to represent BAT. As an alternative, an Operator may design for particular conditions of temperature and humidity and, when conditions worse than those are experienced, reduce load or take other appropriate action (e.g. use air cooling) to ensure that the requirements are met.

2.3.6.5 Releases to land

7. Timber used in cooling towers is usually treated with CCA (copper sulphate, potassium dichromate, arsenic pentoxide), most of which remains well bound to the timber over its operating life, but initial surface residues can lead to significant levels in the purge water. Specifications for treated timber should include the requirement for controlled washing at the treatment site.

8. On final disposal, incineration of the cooling tower timber in the installation may only be carried out if it has been specifically authorised.

Boiler design

2.3.7 Boiler design

This section deals with boiler design as it relates to the minimisation of local pollution.

Energy efficiency matters are dealt with in Section 2.7. However, it should be noted at this stage that WID requires *"any heat generated by the incineration or the co-incineration process shall be recovered as far as practicable".* The design of boilers clearly has a crucial role in ensuring hat this requirement is fulfilled at many installations, but this must not be at the expense of unacceptable additional local pollution.

Application Form Question 2.3 (cont.)

BAT for pollution prevention is as follows:

With the Application the Operator should:

1 supply the general Application requirements for Section 2.3 on page 39 for this aspect of the activities.

2 Explain how their boiler design takes account of the guidance in this section in respect of designing the boiler to prevent emissions.

Indicative BAT Requirements

BAT for flue gas recirculation

Minimising dioxin production by boiler design and operation:

1. Slow rates of combustion gas cooling should be avoided may increase the scope for *the de-novo* formation of dioxins and furans.

   The primary temperature zone of concern is between **450 and 200 °C**, however dioxins will still be formed outside this range at a decreasing rate as the temperature moves further away from this core range, (see Section 2.3.8 - Dioxins).

   It should be stressed that the philosophy for dioxin control has its emphasis on preventing formation (rather than subsequent abatement) and, as one of the primary sites for formation, the design and operation of the waste heat boiler is important. The main techniques are:

2. Maximum rate of decrease of gas temperature which is achieved by:
   - ensuring that the steam/metal heat transfer surface temperature is a minimum (around 170 °C) where the flue gas is in the *de novo* synthesis temperature range, subject to acid dew point considerations;
   - CFD is used to confirm that there are no pockets of stagnant or low velocity gas;
   - boiler passes are progressively decreased in volume so that the gas velocity increases through the boiler; and
   - boundary layers of slow moving gas are prevented along the boiler surfaces.

   A balance must be maintained, to ensure that these design measures are not made at the expense of a major effect on boiler efficiency.

3. ***Minimising boiler deposits*** (which contain substances which catalytically enhance dioxin formation) is a problem with most wastes. Municipal waste, in particular, leads to deposits of sodium and potassium sulphates, and to a lesser extent chlorides. Fly ash can then adhere to these deposits to compound the problem. In the initial stages the material is easily removed by sootblower, on-line. As the fouling increases the deposits become fused and can only be removed off-line. Control methods include:
   - design features to maintain critical surface temperatures below the sticking temperature. This includes not only the arrangement of cooling surfaces, but also avoiding peak combustion temperatures by good waste mixing (where relevant) (see Section 2.3.1 - Incoming waste handling), uniform waste feed (see Section 2.3.2 - Waste charging) and good primary and secondary air control (see Section 2.3.4 - Furnace requirements);
   - additives to prevent sodium and potassium depositing (mixed success); and
   - on-line cleaning by:
     - boiler tube rapping, by striking the tubes (limited success) or lifting and dropping whole banks of tubes (limited experience);

Cont.

- continuously allowing steel shot to fall through the tubes (applied successfully to economiser sections);
- steam or compressed air soot blowing; and
- off-line cleaning.

4. NOx reduction techniques may also help to minimise dioxin emissions- (see Section 2.3.8 - Dioxins, Section 2.3.4.8 - FGR and Section 2.3.8 - SNCR and SCR).

Minimising releases to water from boilers:

Boiler blow-down contains small amounts of solids plus water treatment chemicals - mainly phosphates with possibly small amounts of alkalis, hydrazine and ammonia used for pH control and de-aeration.

Water treatment and de-ionisation plant effluent usually comprises separate acid and alkali streams which are mixed together and pH adjusted for discharge. Soluble and suspended solids content will depend on the original water supply, be it towns water, river or estuary water. Soluble sulphates are also likely to be present from the use of sulphuric acid for regeneration of the ion exchange material. The presence of salts in the release should be considered.

Wash water and cleaning solutions, containing for example citric acid, sodium hydroxide, alkali phosphates, iron oxides in suspension, hydrochloric or hydrofluoric acids, may be generated during maintenance. Complex toxic corrosion inhibitors may be present in these liquors.

5. All these liquors should be neutralised or treated on- or off-site to produce an acceptable waste before discharge or disposal to a licensed waste disposal facility.

Abatement to air

2.3.8 Abatement of point source emissions to air

2.3.8.1 Legislative requirements

Following the use of techniques to reduce the production of pollutants (including consideration of waste pre-treatment options) it will be necessary for abatement techniques to be employed that will meet the emission limit value requirements of European Directives, ***as a minimum.*** The Operator will be required to demonstrate in their application that BAT has been employed. It will not be sufficient to simply design a plant so as to meet the emission limit values, without considering how further emission reductions may be obtained through the use of BAT.

Installations in this sector that are exempted from the requirements of WID will be expected to meet the standards of the directive in all cases other than where the Operator can clearly demonstrate that the costs of meeting the particular requirements outweigh the benefits. New installations are less likely to be able to justify departures from the directive standards than existing installations.

2.3.8.2 Nature of the emissions to air

Sources

The nature of the emissions to air from the combustion of wastes is relatively well characterised. The potential releases will depend on the nature of the waste. In general emissions will comprise:

- Particulate matter
- acid gases e.g. HCl, HF, SO_X , NO_X
- heavy metals
- volatile organic compounds, carbon monoxide, dioxins and furans
- carbon dioxide and water

2.3.8.3 Control of point source emissions to air

Guidance

Abatement technology should be selected such that the emission limit requirements of European legislation are complied with ***as a minimum***. Operators will not only be required to demonstrate that their techniques will meet these standards but will also need to demonstrate why further emission reductions cannot be made through the use of BAT.

There may be benefits accrued from using a number of the techniques described in this section in combination. Furthermore, the selection of one particular abatement system or a particular combustion design (e.g. fluidised bed) may, for valid engineering and environmental reasons, exclude the use of, or undermine the performance of, an alternative abatement system. It will therefore be appropriate for operators to justify their individual equipment selections by reference to the performance of the installation as a whole i.e. operators should set out a number of alternative installation designs and compare the overall performance. Guidance on the assessment of alternative installation designs has been produced by the Agency (H1) and should be used to justify the chosen option.

The nature and source of the emissions expected from each activity is given in previous sections and will be confirmed in detail in the Operator's response to Section 3.1.

Cross-sectoral guidance on abatement techniques for point source emissions to air can be found in Ref. 10.

Application Form
Question 2.3 (cont.)

Control of Point Source Emissions to Air

With the Application the Operator should:

1. supply the general Application requirements for Section 2.3 on page 39 for control and abatement equipment; and in addition

2. describe the measures and procedures in place and proposed to prevent or reduce point source emissions to air. This should include, but is not limited to, the general measures described below and justify where any of the measures are not employed.

Cont.

Abatement to air

3. provide the following with the application as appropriate. If there is doubt, the degree of detail required should be established in pre-application discussions:
   - a description of the abatement equipment for the activity;
   - the identification of the main chemical constituents of the emissions (particularly for mixtures of VOCs) and assessment of the fate of these chemicals in the environment;
   - measures to increase the security with which the required performance is delivered;
   - measures to ensure that there is adequate dispersion of the emission(s) to prevent exceedences of local ground level pollution thresholds and limit national and transboundary pollution impacts, based on the most sensitive receptor, be it human health, soil or terrestrial ecosystems;
   - damage to health or soil or terrestrial ecosystems.
4. demonstrate that an appropriate assessment of vent and chimney heights has been made. Guidance is given in Technical Guidance Note D1 (Ref. 12); for this sector this will need to be supported by more detailed dispersion modelling as described in Section 4.1.
5. where appropriate, also recognise the chimney or vent as an emergency emission point and the likely behaviour. Process upsets or equipment failure giving rise to abnormally high emission levels over short periods should be assessed. Even if the Applicant can demonstrate a very low probability of occurrence, the height of the chimney or vent should nevertheless be set to avoid any significant risk to health. Wherever possible, the use of abatement bypasses should be avoided. It may be possible to design out their routine use for start-up by providing heated bag houses in order to prevent dew point problems. At new plant any essential major bypasses should be ducted to the main stack to ensure maximum dispersion. At existing plant this is also preferred but costs should be considered in relation to the likely impacts and frequency of use. The impact of fugitive emissions can also be assessed in many cases

Indicative BAT Requirements

1. The Operator should complete any detailed studies required into abatement or control options (see item 3 in Section 2.3) as an improvement condition to a timescale to be agreed with the Regulator but in any case within the timescale given in Section 1.1;

Particulate matter

BAT for particulate matter

2. Filters impregnated with catalysts that destroy dioxins and furans have been developed and their use as an additional control should be considered.
3. **Fabric filters** are proven and when correctly operated and maintained provide reliable abatement of particulate matter to below 5mg/m^3 and are likely to be BAT for many applications. They cannot be used at high temperatures (over approx. 250 °C) as this may give rise to fire risk (incorrect temperatures may also lead to a reduction in acid gas absorption by some alkaline reagents).
4. The fabric filter should have multiple compartments, which can be individually isolated in case of individual bag failures. There should be sufficient of these to allow adequate performance to be maintained when filter bags fail, i.e. design should incorporate capacity for meeting emission limits during on stream maintenance.
5. There should be bag burst detectors on each compartment to indicate the need for maintenance when this happens. These may be of the differential pressure type. This type of system provides better control of emissions than simple observation of emitted particulate levels.
6. Where wet scrubbing is used in combination with fabric filters (e.g. HWI), the cool and wet gases may require reheat (using indirect heat exchange from an otherwise waste heat source where practicable) to prevent dew point problems.
7. **Ceramic filters** provide an alternative where high temperature filtration is required, although their use has generally been limited to smaller plant owing the larger gas volumes (and hence filtration plant capacity required) at higher temperatures. Fabric filters tend to be less susceptible to “blinding” and are therefore generally considered BAT.

Cont.

Abatement to air

BAT for particulate matter (cont.)

8. **Electrostatic precipitators (EPs)**, either wet or dry, are not capable of abating particulate to the same extent as fabric filters and are not considered adequate on their own. EPs do however have the advantage of low pressure gradients which may result in lower parasitic energy loads derived from induced draft fans. They may therefore provide a means of reducing particulate loading on bag filters and hence reduced energy consumption. However, this energy saving will be minimal where reagents are dosed onto barrier filters as the contribution of the particulate load to the overall pressure drop is itself relatively minor in comparison to that created by the filters themselves and the reagent cake layer formed.

9. **Wet scrubbers** are not considered to be BAT for particulate abatement on their own, as they are not capable of meeting the same emission levels as other techniques. They can however offer advantages in respect of the control of other substances (e.g. soluble acid gases) and may represent the BAT in combination with barrier filtration techniques as mentioned above. They give rise to liquid effluent, which, if not recycled into the process, requires treatment and disposal. This has implications when considering the BPEO.

Plume visibility is likely to be increased where wet scrubbers are employed unless plume reheat is employed – the source of this heat will have implications in relation to the overall energy efficiency of the installation with other waste heat being an acceptable source, but with the use of additional imported energy sources unlikely to represent the BAT.

Oxides of nitrogen

BAT for NOx

The following techniques may represent the BAT for the reduction of oxides of nitrogen discharges to the atmosphere.

Primary NO_X measures

10. ***Fuel Selection*** There are not likely to be opportunities to reduce fuel NOx in this sector. Wastes which are nitrogen rich (e.g. sewage sludge) will need to pay particular attention to the techniques for NOx reduction outlined below.

11. ***Combustion Chamber Design -*** Fluidised bed combustors (FBC) operate at relatively lower combustion temperatures than other systems. They can therefore produce less thermal NOx than other designs and are commonly used for sewage sludge incineration. They are well suited to wastes of a consistent and small particle size but are not suited to large or heterogeneous waste feeds (e.g. raw municipal waste) if they are not pre-treated. Waste feed preparation stages have proved problematic for some waste streams (e.g. mixed raw municipal waste) with breakdowns and fires occurring. The potential NOx reductions of combining FBC and feed preparation must therefore be weighed against these potential difficulties for heterogeneous waste types.

Where the emission limit values stated in European Directives can be guaranteed without the need for secondary abatement (e.g. reagent injection), and the waste is suitable, FBC with limited (or no) reagent injection may represent the BAT. However, such guarantees are not generally being given. This, and the ability of other non-FBC techniques to meet the required emission levels, and provide optimal reagent reaction conditions (see SNCR below) at slightly higher furnace temperatures means that there is currently little to choose between these technologies. The primary consideration should therefore remain that of waste characteristics.

12. ***Air Control – primary and secondary -*** High excess air at the combustion stage can increase NOx production. All equipment should therefore be sealed to prevent fugitive air ingress and maintained under slight negative pressure to allow control of air input (and to prevent combustion gas releases).

Primary and secondary air feed should be optimised so that conditions in the combustion chamber secure oxidative combustion of gases (and hence destruction of organic specie), while not being excessive which would result in higher NOx production.

At new plant, or those undertaking upgrade of the combustion chamber,

- CFD should be used to select optimal primary and secondary air input regimes;
- alternative (multiple) air injection ports and directional injection nozzles should be provided to allow for in service optimisation.

Cont.

Abatement to air

BAT for NOx (cont.)

Existing municipal and hazardous waste incinerators are required (respectively) to comply with MWID/HWID requirements that oxygen should be present in at least 6% excess until 28 December 2005. After this date these plants (and other existing incinerators) will be required to meet the standards of the new Directive (200/76/EC). This new Directive does not specify a minimum excess oxygen concentration. This being the case operators will be required to state the level of excess oxygen they intend to operate at, and justify how this will meet the requirements of achieving oxidative combustion whilst minimising NOx production. It would be appropriate to include in the application data to show how emissions would change were the oxygen concentration to vary either side of the selected optimal point.

Pyrolysis and gasification plants are a special case in that they are specifically designed to operate the initial waste destruction stage at reduced oxygen levels. Pyrolysis itself requires the exclusion of oxygen and semi-pyrolytic and gasification plant use sub-stoichiometric levels to promote gas evolution. It is important that these “reaction” stages are sealed, and that air flows are well controlled to prevent gas escape and to create optimal conditions. The considerations stated in this section regarding balancing the need for oxidative combustion and NOx prevention are relevant to the *subsequent combustion* of the products that result from the earlier “reaction” stages.

Technical guidance for the combustion of products of these processes in internal combustion engines or gas turbines is provided in other Agency guidance. However, it is important to note that their subsequent combustion will be required to comply with WID standards

13. ***Temperature Control*** Temperatures must meet the requirements of the relevant Directives i.e. greater than 850 °C or 1100 °C where hazardous waste contains greater than 1% w/w halogenated organics (as chlorine). The location at which this temperature should be met should be that which relates to achieving the required residence time of 2 seconds. These requirements must be met at all times when waste is being burned including start up and shut down.

    Excessive or uneven temperatures should however be avoided as this may lead to higher NOx. Water cooled grates may assist with temperature control.

    As with 12 above, for pyrolysis and gasification plants these consideration relate to the subsequent combustion of the products of the reaction stage, rather than to the initial reaction stage itself.

14. ***Flue Gas Recirculation*** provides an effective means of NOx prevention by replacing 10 to 20% of secondary air with re-circulated flue gases. It has the additional benefit of reducing the consumption of reagents used for secondary NOx control (see below) and may increase overall energy recovery by retaining heat from stack gases. The commercial use of this technique and its inclusion in recent applications indicates that concerns regarding additional corrosion arising from higher CO levels are not as significant as had been expected. Furthermore the removal of the strict requirement to achieve 6% excess oxygen may facilitate this technique. It is therefore considered likely that FGR represents BAT for all new plant in this sector. Retrofits at existing plants may prove expensive or impractical due primarily to the space required for ducting. It will be necessary for existing plants to include consideration of FGR when assessing BAT for NOx reduction – revenue cost savings from reduced reagent use should be considered along with other factors when determining the site specific BAT. Re-circulation rates grater than 20% may give rise to excessively reducing conditions, incomplete combustion, elevated CO and VOC emissions and corrosion – they should therefore be regarded with caution.

Secondary NO_X measures

Secondary measures should be considered ***after*** the application of primary NOx reduction measures outlined above. The use of secondary measures without applying the primary measures outlined above (including FGR) is unlikely to represent BAT as the primary techniques will serve to reduce the production of NOx, which in turn will reduce reagent consumption during secondary treatment stages.

15. ***Selective non catalytic reduction (SNCR)***

    Injection of **NH_2 -X compounds** into the furnace reduces NO_X emissions by chemically reducing it to nitrogen and water. Ammonia and urea injection are suitable and either may represent the BAT. When dosing is optimised ammonia tends to give rise to lower nitrous oxide formation (a potent greenhouse gas) however urea may be effective over a slightly wider temperature window and is easier to handle. SNCR relies on an optimum temperature around 900 °C, and sufficient retention time must be provided for the injected agents to react with NO. Port injection locations must therefore be optimised (CFD modelling may be useful and is likely to be essential for all new plant). (Cont.)

Abatement to air

BAT for NOx (cont.)

Poorly optimised reagent injection may give rise to elevated emissions of ammonia. NO_X levels should be monitored and the addition of reagent closely controlled to minimise the possibility of ammonia slippage.

SNCR should be used where NO_X emissions are above WID release levels. It is probable that SNCR will be required to ensure WID standards are met. In order to comply with WID daily average NOx standards reagent injection rate set points are usually set such that longer term average releases are typically in the range of 150 to 180mg/m^3. At higher reagent dosing rates further NOx reductions can be achieved but only with increasing cost – reductions significantly beyond WID compliance therefore appear unlikely to represent BAT. This may not be the case at large plant (over 250K te/yr. waste throughput) or where local environmental conditions justify additional NOx reduction.

16. ***Selective catalytic reduction (SCR)***

SCR reduces NO and NO_2 to N_2 with the addition of NH_3 and a catalyst at a temperature range of about 300-400^{o}C. SCR technology can also reduce VOCs, CO and dioxin emissions

SCR is a proven technology in the waste incineration sector, particularly in continental Europe where NOx emissions of below 70mg/m^3 are achieved. The costs of this technique (and lower UK disposal gate fees) currently make this technique unlikely to be BAT for the UK. However, it is possible that this situation will change.

The additional costs of SCR are derived mainly from the energy requirements of achieving the required temperature range. To avoid catalyst poisoning the SCR unit is requires combustion gases to be relatively clean. This means that the SCR unit must be positioned down stream of the particulate and acid gas filtration plant. With the exit temperature from the filtration unit being significantly below that required for SCR, the combustion gases must be reheated.

All applications must therefore include in their cost benefit assessment consideration of the use of SCR and justify if it is not employed. Similarly the adoption of the technique must also be justified against the alternatives (e.g. SNCR) focussing particularly upon the potential for reduced energy efficiency with SCR owing to gas re-heat.

17. ***NOx control: cost/benefit study***

Operators should provide a cost benefit study using the methodology in H1 (Ref. 5), to demonstrate the relative merits of primary measures, SNCR and SCR for the installation. The comparison will show the cost per tonne of NO_X abated over the projected life of the plant using the asset lives and typical discount rates given in that document.

Acid gases and halogens

BAT for acid gases and halogens

Techniques that may represent BAT to minimise acid gas and halogen releases are summarised below. The technique that represents BAT in one incineration sub-sector may be different to that which provides a solution for another. This will generally relate to the potential of the particular waste stream to give rise to acid gas emissions, their quantity and variability.

Primary acid gas measures

18. ***Fuel Selection***

Start up and support fuels should be low in sulphur. Sulphur contents of below 0.2%w/w are commonly available. The waste incineration directive prevents the use of fuels at start up, shut down or as support fuels which can cause higher emissions than those of gas oil (as defined by Art 1(1) of Directive 75/716/EEC), liquefied gas or natural gas. In requiring the relevant combustion temperature to be maintained at all times when waste is being burned, WID also effectively prevents the use of wastes as a start up fuel – regardless of specification.

Owing to the primary purpose of incineration being the disposal of waste, there may, in many cases be few opportunities to influence releases through waste selection. It is fundamental that the installation should be designed to cope with the type of waste it is to receive (see abatement design envelope below). However, it may be the case that a particular waste stream is known to create particular difficulties at the installation or that the waste stream has changed. An example of this is large quantities of PVC plastics or plaster board where they are not well mixed with other waste at municipal waste incinerators. Where such problems occur, the Operator will be expected to take whatever steps are necessary to ensure compliance.

Cont.

Abatement to air

BAT for acid gases and halogens (cont.)

This may include:

- Up stream waste management to prevent the inclusion of problem wastes;
- Use of front end waste treatment techniques;
- Abatement plant operation trimming;
- Abatement plant redesign and rebuild.

These options are discussed further below. The chosen options will depend upon the nature of the particular waste stream and decisions regarding the ability to reliably segregate the problematic fractions.

19. ***Waste Treatment***

Waste treatment techniques may assist with preventing releases of acid gases by:

- Allowing the removal of problem wastes;
- Homogenising the waste feed to provide for improved process stability.

This can assist by:

- Minimising the quantity of reagent required to treat the acid gases;
- Minimising the amount if waste reagent requiring re-circulation or disposal.

Waste treatment requirements should be considered at the installation design stage and will be required where the waste exhibits such a heterogeneous nature that:

- Emission limit values are not be complied with;
- The abatement design envelope (see abatement design limits below) is required to be so wide that it would necessitate very large reagent consumption i.e. overdosing and waste production;
- Incineration without pre-treatment may be dangerous from an operational perspective.

20. ***Abatement Design Limits***

Waste varies in terms of its physical and chemical nature depending upon its source and whether it has undergone any pre-segregation or treatment. All installations must therefore be clear about the types of wastes they intend to receive and their composition. Applications must very clearly outline the composition of the types of waste that will be incinerated and demonstrate that the installation design takes the full range of likely compositions into account. Existing installations may be able to illustrate this with real data regarding waste types and emissions compliance.

In particular the abatement plant design envelope must be wide enough to account for the variation in raw flue acid gas concentrations that will be encountered. Particular care must be taken to ensure that short term fluctuations are considered.

The design of the acid gas abatement system must take full account of the flue gas loading and the reaction kinetics of the reagent selected in the conditions that will be encountered in the equipment. In-situ temperatures and moisture contents will have a key role in determining the residence time that is required to ensure effective acid gas neutralisation (and removal). Once the abatement plant design has been established, sufficient over-capacity should be provided to allow for maintenance or waste heterogeneity variables.

Applications must pay particular attention describing how waste will be managed to prevent operation outside the design envelope and possible exceedence of authorised limits. This shall include consideration of:

- The breadth of waste composition likely to be encountered in the waste types to be received;
- Identification of any particular wastes which may cause high acid gas loading – this should make reference to any commonly encountered difficulties within the particular sector;
- Measures to be taken to prevent the incineration of the wastes identified, including the upstream management of wastes to prevent their inclusion with other waste;
- Measures to treat or mix wastes to ensure peaks are smoothed out;
- Plant detection and control measures included to deal with short term high acid gas loading (see below).

Cont.

Abatement to air

BAT for acid gases and halogens (cont.)

Secondary acid gas measures

21. ***Abatement Type – wet / dry / semi dry***

There are three main techniques for the control of acid gases, wet scrubbing, semi-dry scrubbing and dry scrubbing. Each has advantages and disadvantages, and each may represent the BAT in different circumstances dependent mainly upon the type of waste being incinerated, but also depending upon other decisions taken in respect of overall process design.

Generally wet scrubbing will provide the greatest security in terms of meeting air emission limit values, particularly where wastes are of very varied composition. This is because the wet conditions and low operating temperatures, enhances the capture of the water soluble acid gas species. Wet scrubbing is therefore well suited to plant with exceptionally high or variable acid gas loading e.g.HWIs. Wet scrubbing does however have disadvantages regarding the production of an effluent stream and of a wet plume which may require energy input to reheat it. Dry and semi-dry systems are available. The advantages and disadvantages of these are outlined in Table 2-6 below. Operators will be required to justify their selected technology by referring to the factors indicated.

Table 2 6- Abatement type - advantages and disadvantages for acid gas control

Abatement Type	Advantages	Disadvantages
Wet	• High reaction rates • Good performance over range of loadings • Low reagent consumption • Low solid residues production • Reagent delivery may bevaried by concentration and flow rate • Condensation effect may assist with metals abatement	• Large effluent disposal and water consumption if not fully treated for re-cycle • Effluent treatment plant required • May result in wet plume • Energy required for effluent treatment and plume reheat • Wet systems may experience higher corrosion • Pre-scrubbing particulate removal may be required
Dry	• Low water use • Reagent consumption may be reduced by recycling in plant	• Reaction rates low therefore larger residence time required • Higher solid residue production • Reagent delivery only by input rate
Semi-dry	• Medium reaction rates • Medium water use Reagent delivery may be varied by concentration and input rate	• Higher solid waste residues • In process reagent recycle not proven

Guidance on the general suitability of each of these systems to different incineration sub-sectors is given in Section 2.3.9 below.

22. ***Alkaline Reagent Selection***

Consistent low acid waste streams:

It may be possible for some waste streams of very consistent composition, that can be demonstrated to be reliably very low in halogens (e.g. well segregated non-halogenated waste solvent streams incinerated on the site of production) to be incinerated without alkaline scrubbing. Indeed, to do so where clearly not necessary is itself unlikely to be BAT owing to the unnecessary consumption of reagent. Water scrubbing only may be acceptable in these circumstances.

However, in general, provision for alkaline reagent injection will need to be made wherever the concentration of acid gases or acid gas forming materials in raw flue gases exceed the standardised flue gas emission limit concentrations outlined in Section 3.3.

Cont.

Abatement to air

BAT for acid gases and halogens (cont.)

Other waste streams:

For the vast majority of waste streams the injection of alkaline reagents will be required to absorb acid gases and meet the required emission limit values. The most commonly used reagents are:

- Sodium Bicarbonate (NaHCO);
- Lime($Ca(OH)_2$);
- Sodium Hydroxide (NaOH).

Although the basic stoichiometry of these reagents would indicate that lime, with two hydroxyl molecules per molecule of reagent would provide for more efficient removal of acid gases, sodium hydroxide is, in practice, the most efficient and lime the least. This is explained by the relative reaction rates achieved i.e. the lime / acid reaction takes longer to reach completion.

All of these reagents can be effectively used to secure the emission limit values outlined in Section 3.3, and may represent BAT in an individual situation. The advantages and disadvantages of these are outlined in Table 2-7 below. Operators will be required to justify their selected technology by referring to the factors indicated.

Table 2 7- Reagent selection - advantages and disadvantages for acid gas control

Reagent	Advantages	Disadvantages	Comments
Sodium Hydroxide	Highest removal rates Copes well with high acid load Low solid waste production	Effluent requires treatment Corrosive material ETP sludge for disposal	Suitable for HWIs and DIs
Lime	Very good removal rates Low leaching solid residue Copes well with medium acid loads Temperature of reaction well suited to use with bag filters Wet, dry and semi dry systems available	Corrosive material Some handling / pumping difficulties May give greater residue volume if no in-plant recycle	Wide range of uses
Sodium Bicarbonate	Good removal rates Easiest to handle Dry recycle systems proven	Effient temperature range may be at upper end for use with bag filters – ceramics required? Leachable solid residues Bicarbonate more expensive	Often used at CWIs Not proven at large plant

Guidance on the general suitability of each of these systems to different incineration sub-sectors is given in Section 2.3.9 below.

23. ***Alkaline Reagent Dosing Control***

Optimisation of the alkaline reagent dosing system is the BAT. This is because a well optimised reagent doing control system will:

- Control acid gas emissions within emission limit values;
- Reduce consumption of reagent;
- Reduce production of alkaline residues.

Optimisation in this context means delivering the right amount of reagent to absorb acid gases to meet emission limit values, without wasting reagent and producing excessive residues. The techniques that are considered BAT for securing this optimisation are:

- Trimming reagent dosing to acid load using fast response upstream HCl monitoring as a trigger;
- Ensuring reagent concentration can be rapidly changed through use of variable speed pumps / screw feeders and / or low volume intermediate silos (which will allow for more rapid concentration changes);
- Small silo load cell systems provide close control on reagent delivery rates in dry systems;

Cont.

Abatement to air

BAT for acid gases and halogens

- Good (preventative) maintenance of all reagent handling and delivery equipment;
- Sufficient absorption buffer capacity retained in abatement system to maintain abatement when feed fails;
- multiple or back-up feed systems on standby to maintain reagent feed.

24. ***Acid gas control: Cost/benefit study***

Operators should provide a cost benefit study using the methodology in H1 (Ref. 5), to demonstrate the relative merits of the selected primary and secondary measures for the installation with the alternatives outlined above. The comparison will include the cost per tonne of acid abated (as HCl) over the projected life of the plant using the asset lives and typical discount rates given in that document.

As some technological options will be mutually exclusive, it will be acceptable to assess the overall viable installation design alternatives in relation to that selected, whilst providing comment regarding the reasons why any apparently better individual process stages are not selected on grounds over overall incompatibility.

Other releases

BAT for other releases

25. ***Carbon oxides (CO_2, CO) and VOCs***

Carbon Dioxide:

All measures that reduce fuel energy use also reduce the CO_2 emissions. The selection, when possible, of raw materials with low organic matter content and fuels with low ratio of carbon content to calorific value reduces CO_2 emissions. In this sector this is only relevant to the support fuels used. In general natural gas will be the preferred option. If not available low sulphur gas oil provides an alternative.

The global warming potential (GWP) of the installation will be derived mainly from the CO_2 releases arising from the waste combustion. As it is the purpose of an incinerator to convert wastes into (primarily) water and CO_2 attention should not focus upon these releases but upon the following:

- CO_2 equivalent releases resulting from N2O releases – these can contribute in the order of 10% of the GWP – these may be minimised by appropriate selection and optimisation of SNCR reagent injection;
- Improving installation energy efficiency (including recovery) will prevent CO_2 release by other installations. This may be demonstrate by providing energy balance (Sankey) diagrams and quoting the net energy production per tonne of waste produced, (see energy requirements in Section 2.7).

Carbon Monoxide and VOCs:

Elevated CO emissions are indicative of poorly controlled combustion and may be indicative of elevated releases of other products of poor combustion e.g. VOCs, NOx, Dioxins. The general comments made in this section are therefore applicable to VOCs as for CO.

Carbon monoxide emissions are not influenced to any significant extent by the conventionally employed abatement techniques. Reductions in CO may be achieved using catalytic oxidation, pulsed corona or re-burn techniques but these are not known to be used at a commercial scale and would in any event be less preferable to primary techniques for the prevention of CO formation.

VOCs may be removed to some extent by means of wet scrubbing but they are liable to come out of solution.

Reductions in CO and VOC emissions may be achieved by:

- Ensuring the furnace and combustion requirements outlined earlier in this guidance are complied with, (see Section 2.3.4):

Securing consistent waste feed characteristics (e.g. CV, moisture) and feed rates, (see Section 2.3.2 - Waste charging).

Cont.

Abatement to air

BAT for other releases (cont.)

Starved air systems such as pyrolysis, semi-pyrolytic and gasification processes by their nature deliberately create combustible gases that will comprise high concentrations of CO and VOCs. These often highly noxious partially reduced gases will require subsequent oxidative combustion prior to release. This may be achieved in boilers, engines or gas turbines. Current evidence concerning the ability of these processes to meet the required standards is contradictory. In all cases Operators will therefore be required to demonstrate that the chosen combustion stage, either alone or in combination with a secondary combustion stage, will be capable of meeting the temperature and residence times outlined in this guidance, the WID and the relevant emission limit values.

Starved air systems such as pyrolysis, semi-pyrolytic and gasification processes by their nature deliberately create combustible gases that will comprise high concentrations of CO and VOCs. These often highly noxious partially reduced gases will require subsequent oxidative combustion prior to release.

Current evidence concerning the ability of these processes to meet the required standards is contradictory. In all cases Operators will therefore be required to demonstrate that the chosen combustion stage, either alone or in combination with a secondary combustion stage, will be capable of meeting the temperature and residence times outlined in this guidance, the WID and the relevant emission limit values.

26. ***Dioxins and furans***

Although fitting carbon, or catalyst impregnated fabric filters, can abate the release of dioxins, the primary method of minimising releases is by careful control of combustion conditions. The gas residence times, temperatures and oxygen contents at the combustion stage must be such that any dioxins/furans should be efficiently destroyed, (see Section 2.3.4 - Furnace requirements).

Operators should also ensure that the conditions for *de novo* synthesis are avoided. This may be achieved by ensuring exit gas streams should be quickly cooled through the *de novo* temperature region between 450 °C and 200 °C. Where energy will be recovered, boiler design should consider this factor, (see Section 2.3.7 - Boiler design).

Dioxin/furan formation needs sources of organic materials and chlorine and thus the limiting of chlorine input may have some effect where this is possible. Where higher concentrations are unavoidable (e.g. HWIs) the prevention of dioxin releases will become a dominant factor in the plant design to an extent that the recovery of energy from the waste stream may be excluded in favour of rapid quench using water. Such quench systems must be designed to achieve a maximum exit temperature of 200 °C (in practice a temperature of approx. 70 °C is likely).

Dioxins tend to adhere to particulate matter and therefore ***efficient particulate abatement*** will remove dioxin/furans from the gas phase. Bag filters impregnated with catalyst specifically developed for the destruction of dioxins/furans are now commercially available and, where fabric filters are installed, should be used where the benchmarks in Section 3.3 cannot be otherwise achieved.

FGR, SNCR and SCR are all reported to assist in the prevention of dioxin formation and their destruction.

Carbon injection has a proven record of reducing dioxin emissions at a wide range of facilities for relatively little cost and is therefore BAT. The carbon is commonly injected into the gas stream with the acid gas abatement reagent, prior to retention upon filtration equipment.

27. ***Metals***

Operators are likely to have little control over the metal content of the wastes they receive. However, in the case of mercury (Hg) there is some scope for control at CWIs as the main sources would appear to be dental amalgum although some batteries may also contain Hg (and other cadmium). Up-stream waste segregation should be encouraged where releases approach emission limits.

Carbon injection gives reliable and effective mercury reductions (greater than 90% reduction) and should be incorporated wherever there is a risk that the waste may contain Hg. In practice it will be required for all wastes streams other than those from known reliable and consistent sources.

Cont.

Abatement to air

BAT for other releases (cont.)

For the majority of metals particulate abatement is the main means of ensuring releases are minimised.

At HWIs additional special measures may be required for Hg abatement, including:

- Cold wet scrubbing (vapour phase Hg is greatly reduced between 200 and 100C)
- Chemical conversion by addition of reagents to wet scrubbers to enhance capture
- Sulphide addition to gas filtration systems

Fixed bed absorbers are reported to prove effective for Hg removal, as has the addition of lignite coke prior to wet scrubbing.

28. ***Wet plumes***

Wet plumes do not disperse well and tend to ground easily. Additionally there can be local visual amenity issues and, in severe cases, loss of light issues. Therefore the gas should be discharged ideally at conditions of temperature and moisture content that avoid saturation under a wide range of weather conditions.

The normal option is to reduce water input to the process. Alternatively heat can be added, however the use of energy should be balanced against the benefits gained. Plumes must be abated sufficiently to ensure good dispersion but a limited visible plume may be acceptable in cold damp conditions.

Alternatively moisture can be removed by cooling and condensation followed by reheat. However, where this is not an inherent part of a wet scrubbing process (where temperature is typically reduced to around 70°C for scrubbing purposes), the disadvantage would be the generation of a significant liquid effluent stream.

As a further option, to minimise expense and energy use, Operators may wish to guarantee to reduce load under extreme weather conditions rather than to over design a plume abatement system.

2.3.9 Review of commonly proposed techniques for control of releases to air – by plant type

This section provides a review of those techniques recently proposed or currently employed in each sub-sector of the incineration industry. They may represent BAT where emissions limits and other criteria are being achieved.

They are **provided as a guide only and DO NOT cover all aspects of each plant type**, only some particularly areas where they differ from one another or there are particular, sub-sector specific issues. **They should not be relied upon without referring to the rest of this guidance.**

Individual installations are still required to demonstrate:

- Site specific selection of BAT – taking into account, for example, local environmental factors
- Ability to meet the minimum standards required by Directives, including emission limit values

Candidate BAT for abatement of point sources to air by plant type

2.3.9.1 Municipal waste incinerators

In order to prevent releases to air new UK plants are adopting:

- Waste selection by upstream removal of recyclable or provision of a waste treatment stage;
- Staged combustion with close combustion control techniques;
- Temperatures in the range 900 to 1000 °C and residence times of greater than 2 seconds;
- Flue gas re-circulation;
- Selective non-catalytic reduction (with either urea or ammonia injection);
- Rapid temperature reduction from 450 to 200 °C (for dioxin control);
- Feed forward control systems for alkaline reagent injection;
- Semi-dry lime injection systems;
- Carbon injection for Hg and dioxin absorption;
- Bag filters;
- Sufficient burnout techniques (including time) to maintain total organic carbon levels below 3% in bottom ash;
- Electricity generation using steam turbines – with options for developing waste heat use.

2.3.9.2 Clinical waste incinerators

Modern CWIs although much smaller, are similar in design to MWIs. The common differences are:

- Waste pre-treatment is less used;
- Waste management procedures must take account of potentially greater health and safety hazards;
- Combustion temperatures are higher and will be in excess of 1100 °C for hazardous waste;
- Dry acid scrubbing systems are sometimes adopted;
- Steam generation only may be favoured over electricity plus steam (usually where there is a high and dependable local steam demand).

2.3.9.3 Chemical waste incinerators

- Waste pre-treatment and blending is often carried out;
- Waste management procedures, including handling and charging operations are often elaborate – reflecting the hazardous nature of the waste;
- On site QA and laboratory operations are often provided;
- Combustion temperatures in excess of 1100 °C are used;
- Multi-stage wet or combined wet and dry scrubbing is the norm;
- Waste water treatment and re-circulation may not be maximised;
- Heat recovery is often limited to internal heat exchange and does not extend to full recovery.

2.3.9.4 Sewage sludge incinerators

- Fluidised beds are being adopted to assist in reducing NOx production – additional techniques may be required to achieve WID emission limit values owing to high waste feed nitrogen levels;

- Over dried sludges may be auto-thermal and generate significant energy but can also increase NOx production. The additional water in wetter sludges may suppress temperatures reducing NOx formation;
- Staged combustion, semi-pyrolytic, gasification or fully pyrolytic may be applied in this sub-sector;
- Acid gas control issues are similar to other sub-sectors but generally less of concern.

2.3.9.5 Animal carcass and animal remains incinerators

- Many of these plants will require substantial upgrades of abatement plant and monitoring equipment to meet the standards of WID;
- Sulphur levels in carcasses have lead to higher than expected acid gas releases meaning acid gas abatement is required;
- A rotary kiln plant already achieves below 200mg/m^3 NOx;
- Carcass crushing using an auger to feed the furnace with the addition of limestone may help to avoid production of liquid slag which could leak from the furnace;
- Liquids are prone to leak from primary chambers – techniques should be used to prevent this or direct the liquids to the secondary combustion chamber (at one plant the secondary chamber is beneath the primary);
- The practice of using multiple smaller units of proven design may be beneficial com[pared with fewer, larger purpose built furnaces.

2.3.9.6 Drum incinerators

Issues are similar to HWIs. The main concern is compliance with HWID emission limits and monitoring requirements.

- Lime injection and bag filters have been adopted.

2.3.9.7 Pyrolysis and gasification plants

Pyrolysis and gasification plants utilise many of the techniques that are common to waste combustion techniques e.g. combustion gas cleaning etc. The key areas where there are additional techniques that may effect emissions to air are:

- ***Waste handling*** – more extensive waste processing may be required;
- ***Waste charging*** – care required to control or eliminate air ingress;
- ***Reactor control*** – waste particle size, reactor temperature and oxidant / fuel ratio (gasification only) need to be controlled to control the gas, liquid, solid residue split;
- ***Fuel gas cleaning*** – pre-combustion cleaning to remove particulate (by filtration) and nitrogen compounds (ammonia can be removed by wet acid scrubbing) – may be required to prevent fouling of engines and gas turbines;
- ***Elevated CO and VOC levels*** are reported where engines and gas turbines are used for combustion of fuel gas – residence times may also be a concern;
- ***Liquid residue treatment*** – is likely to be required where elevated levels of phenols and PAHs are encountered. This would be less likely where this product is put to some beneficial use;
- ***Solid residue treatment*** – some specifications of char may be put to bone fide beneficial use. Some plants include an integral residue vitrification step – yielding a highly stable residue. Levels of organic carbon may be of concern in respect of compliance with WID 3% TOC limits.

Further details regarding techniques used in the pyrolysis and gasification sub-sector may be found in Sections 2.3.3.13 and 2.3.3.14, and in the BAT report on waste pyrolysis and gasification issues.

2.3.9.8 Refuse derived fuel incinerators

Techniques are similar to those adopted at other incineration installations. As a refuse derived fuel, many of the feedstock encountered will fall within a more easily defined specification than mixed untreated wastes. This should mean that emissions are more easily controlled, although this will depend upon the precise nature of the RDF incinerated.

2.3.9.9 Co-incinerators

Specific abatement techniques for co-incinerators are not specified in this guidance. Information regarding the techniques that represent BAT for each sector in respect of the non-waste fuels use at these installations are provided in the sector specific guidance.

Abatement to air

In considering candidate techniques for the co-incineration of wastes Operators should consider:

- The suitability of the abatement techniques outlined in this guidance to the particular industrial situation;
- The emission limit value that must be met to comply with incineration directives (HWID and WID) – see emissions section for guidance on calculation of emission limits. Note that these represent the minimum standards and that BAT may require further emission reductions;
- Waste composition and combustion characteristics in relation to existing fuels – in some cases wastes may reduce pollutant loading;
- Temperatures which the abatement equipment will be required to run at;
- Particulate sizes and pollutant loading.

2.3.10 Abatement of point source emissions to surface water and sewer

The nature and source of the emissions expected from each activity will be confirmed in detail in the Operator's response to Section 3.1. In addition to the techniques below, guidance on cost-effective effluent treatment techniques can be found in ETBPP Guides (Ref. 8).

2.3.10.1 Legislative Requirements

European legislation (WID and HWID) set requirements in respect of:

- The design criteria for prevention of waste water releases (these are discussed in relation to overall plant design to minimise releases in Section 2.3.12 - Fugitive releases to water;
- Maximum emission limits for releases to water arising from air pollution control devices (see Section 3.4).

Following the use of techniques to reduce the production of pollutants it will be necessary for abatement techniques to be employed that will meet the emission limit value requirements of European Directives, ***as a minimum.*** An Operator will be required to demonstrate in their application that BAT has been employed. It will not be sufficient to simply design a plant so as to meet the emission limit values, without considering how further emission reductions may be obtained through the use of BAT. It is probable that the use of BAT will result in emissions considerably lower than those indicated by the legislation.

2.3.10.2 Nature of the effluent

Effluents may arise from incineration processes as follows:

- Air abatement equipment (e.g. wet scrubbers);
- Boiler blow-down;
- Cooling water discharges;
- Road drainage;
- Incoming waste handling areas;
- Raw material storage areas;
- Ash and other residue handling areas;
- On-site effluent treatment.

Good design should prevent the production of the majority of these effluents from being produced. Process and site infrastructure design should aim to prevent the contamination of rainwater by the effective segregation of site drainage from potentially contaminated areas.

Through the recycling of effluents produced to ash quench baths it is possible to eliminate any need for routine discharges of waste water (other than rain water) from the site. At the same time this method assists in preventing fugitive dust releases from ash storage and handling.

Techniques for Treatment of Scrubber Liquors

Whether scrubber liquors are to be re-used in the process or discharged, there is normally a need to separate out the pollutants captured. If this is not done, and the water is re-injected into the incinerator, the indestructible ones will simply build up in the circuit as they are repeatedly recycled. Treatment is typically as follows:

- basic treatment normally comprises neutralisation, flocculation, coagulation and settling. Settling is much more effective when techniques such as lammella plates are used (see Ref.11). Filtration may be necessary for separation of fine precipitates;
- for cadmium, mercury and other heavy metals, precipitating the metals either as hydroxides or sulphides followed by appropriate solids separation can remove up to 90% or more of most heavy metals but probably less than 70% of cadmium and nickel;
- the use of specialist complexing precipitation agents, such as TMT (trimercapto-s-triazine tri-sodium salt) can settle similar percentages and has the advantage of forming stronger bonds with the metals and therefore results in lower leaching. It is, however, more expensive;
- the settled solids should then be de-watered by filter, centrifuge or evaporation, to make them easier to handle and subsequently stabilise, prior to landfilling;

Contd/…

Effluent treatment

- organics, including dioxins, furans and PAHs should be measured in the treated effluent and, if present, are best removed by activated carbon which can be returned to the incinerator for destruction. This will also remove residual mercury. Alternatively if the heavy metals have been removed the treated water itself could be returned to the incinerator, where salt concentration does not prevent it;
- The liquor will, however, still contain salts, in particular chlorides and sulphates. If the receiving water can support this level of salinity the treated water may be discharged. If not, then ion exchange resins, microfiltration and evaporation techniques could be used. Once treated to this degree, the water may be recycled;
- where salts need to be removed, because of the nature of the receiving water, evaporation and reverse osmosis are established techniques

Application Form Question 2.3 (cont.) | Effluent Treatment

With the Application the Operator should:

1. supply the general Application requirements for Section 2.3 on page 39 to prevent or reduce point source emissions to water and land; and in addition
2. include, where appropriate, off site treatment in the description of the wastewater treatment system for the activity;
3. provide, where effluent is discharged, a justification for not cleaning the effluent to a level at which it can be reused (e.g. by ultrafiltration where appropriate);
4. describe measures taken to increase the reliability with which the required control and abatement performance is delivered (there may be a biological plant susceptible bulking or poisoning – what measures ensure reliability?, heavy metals are measured only occasionally – what techniques ensure that they are controlled all the time? etc.); identify the main chemical constituents of the treated effluent (including the make-up of the COD) and assessment of the fate of these chemicals in the environment. These steps will be carried out as in response to Sections 3.1 and 4.1 but need to be understood here in order to demonstrate that the controls are adequate. This applies whether treatment is on- or off-site;
5. identify the toxicity of the treated effluent (see Section 2.10). Until the Regulator's toxicity guidance is available, this should, unless already in hand, normally be carried out as part of an improvement programme;
6. where there are harmful substances or levels of residual toxicity, identify the causes of the toxicity and the techniques proposed to reduce the potential impacts;
7. Demonstrate that the techniques selected fulfil the specific requirements of WID or HWID in respect of the prevention and control of discharges of water (see Section 3.4 - Standards and obligation for discharges to water) arising from air pollution control equipment (e.g. wet scrubbers).

Indicative BAT Requirements

BAT for effluent

1. The Operator should complete any detailed studies required into abatement or control options (see item **3** in Section 2.3) as an improvement condition to a timescale to be agreed with the Regulator but in any case within the timescale given in Section 1.1;
2. The following general principles should be applied in sequence to control emissions to water:
   - water use should be minimised and wastewater reused or recycled (see Section 2.2.3);
   - contamination risk of process or surface water should be minimised (see Section 2.3.12);
   - ultimately, surplus water is likely to need treatment to meet the requirements of BAT (and statutory and non-statutory objectives). Generally, effluent streams should be kept separate as treatment will be more efficient. However, the properties of dissimilar waste streams should be used where possible to avoid adding further chemicals, e.g. neutralising waste acid and alkaline streams. Also, biological treatment can occasionally be inhibited by concentrated streams, while dilution, by mixing streams, can assist treatment;
   - systems should be engineered to avoid effluent by-passing the treatment plant.

Cont.

Effluent treatment

BAT for effluent (cont.)

3. All emissions should be controlled, as a minimum, to avoid a breach of water quality standards (see Sections 3.2 and 4.1) but noting that where BAT can deliver prevention or reduction at reasonable cost it should do so (see Section 1.1). Calculations and/or modelling to demonstrate this will be carried out in response to Section 4.1.

4. With regard to BOD, the nature of the receiving water should be taken into account. However, in IPPC the prevention or reduction of BOD is also subject to BAT and further reductions which can be made at reasonable cost should be carried out. Furthermore, irrespective of the receiving water, the adequacy of the plant to minimise the emission of specific persistent harmful substances must also be considered. Guidance on treatment of persistent substances can be found in References (see Ref. 11).

5. Where effluent is treated off-site at a sewage treatment works, the above factors apply in particular demonstrating that:
   - the treatment provided at the sewage treatment works is as good as would be achieved if the emission was treated on-site, based on reduction of load (not concentration) of each substance to the receiving water;
   - the probability of sewer bypass, via storm/emergency overflows or at intermediate sewage pumping stations, is acceptably low;
   - action plans in the event of bypass, e.g. knowing when bypass is occurring, rescheduling activities such as cleaning or even shutting down when bypass is occurring;
   - a suitable monitoring programme is in place for emissions to sewer, taking into consideration the potential inhibition of any downstream biological processes and actions plan for any such event.

Fugitives

2.3.11 Control of fugitive emissions to air

At many installations fugitive, or diffuse, emissions may be more significant than point source emissions. Details will be found in the appropriate sector guidance but common examples of the sources of fugitive emissions are:

- open vessels (e.g. the effluent treatment plant);
- storage areas (e.g. bays, stockpiles, lagoons etc.);
- the loading and unloading of transport containers;
- transferring material from one vessel to another (e.g. furnace, ladle, reactors, silos);
- conveyor systems;
- pipework and ductwork systems (e.g. pumps, valves, flanges, catchpots, drains, inspection hatches etc.);
- poor building containment and extraction;
- potential for bypass of abatement equipment (to air or water);
- accidental loss of containment from failed plant and equipment.

Application Form Question 2.3 (cont.)

Fugitive emissions to air

With the Application the Operator should:

1. supply the general Application requirements for Section 2.3 on page 39 for control of fugitive emissions to air; and in addition,

2. identify, and where possible quantify, significant fugitive emissions to air from all relevant sources, including those below, estimating the proportion of total emissions which are attributable to fugitive releases for each substance; these steps will be carried out as in response to Section 3.1 but need to be understood here in order to demonstrate that the controls are adequate.

BAT for fugitives

Indicative BAT Requirements

1. The Operator should complete any detailed studies required into abatement or control options (see item 3 in Section 2.3) as an improvement condition to a timescale to be agreed with the Regulator but in any case within the timescale given in Section 1.1.

2. Where there are opportunities for reductions, the Permit may require the updated inventory of fugitive emissions to be submitted on a regular basis.

3. ***Dust*** - The following general techniques should be employed where appropriate:
   - covering of skips and vessels;
   - avoidance of outdoor or uncovered stockpiles (where practicable);
   - where unavoidable, use of sprays, binders, stockpile management techniques, windbreaks etc.;
   - wheel and road cleaning (avoiding transfer of pollution to water and wind blow);
   - closed conveyors, pneumatic conveying (noting the higher energy needs), minimising drops;
   - mobile and stationary vacuum cleaning;
   - ventilation and collection in suitable abatement equipment;
   - closed storage with automatic handling system;
   - regular housekeeping.

4. **VOCs**
   - When transferring volatile liquids, e.g. SLF, the following techniques should be employed – subsurface filling via filling pipes extended to the bottom of the container, the use of vapour balance lines that transfer the vapour from the container being filled to the one being emptied, or an enclosed system with extraction to suitable abatement plant.
   - Vent systems should be chosen to minimise breathing emissions (e.g. pressure/vacuum valves) and, where relevant, should be fitted with knock-out pots and appropriate abatement equipment.

Cont.

Fugitives

BAT for fugitives (cont.)

Odour - See Section 2.3.13.

Particulate releases from other process operations have the potential for significant fugitive dust release. Control measures to minimise such releases are summarised below:

5. ***Housekeeping***

A high standard of house-keeping should be maintained in all areas with particular attention being paid to those parts of the plant where process and waste materials are stored or loaded. Loading and unloading of vehicles should only be done in designated areas provided with proper hard-standing. Hard-standing areas should be constructed with appropriate falls to an adequate drainage system.

6. ***Materials handling***

The receipt, handling and storage of all materials should be carried out so as to minimise the emission of dust to the air.

Stocks of dusty materials, should be stored in silos or covered storage, vented to air if necessary through suitable arrestment equipment.

Bulk cement, clinker and quicklime should be stored in closed buildings or silos. These silos should be vented to suitable arrestment plant, for example bag filters. Storage silos should be equipped with audible or visual high level alarms to warn of overfilling. The correct operation and use of such alarms should be checked regularly.

Seating of pressure relief valves to all silos should be checked periodically.

For emissions from ancillary processing equipment (crushing, screening, blending, packing, loading etc.), dust containment and arrestment should be the preferred option. However, it is recognised that in some cases, such as remote mineral conveyors, suppression techniques where properly designed, used and maintained, can be an effective alternative means of control.

The transfer of cement or lime should be by air slide, elevator, screw feeder, enclosed chain conveyor, gravity or pneumatic means or suitably enclosed belt conveyor. Transport of other dusty materials, such as clinker, inside buildings should be carried out so as to prevent or minimise airborne dust emissions. Where conveyors are used, they should be of sufficient capacity to handle maximum loads and should be provided with protection against wind-whipping, for example by fitting side boards. Conveyor discharges should be arranged to minimise free fall at all times. Where dusty materials are conveyed outside buildings, above ground conveyors (or other mechanical means) should be fully enclosed and extracted to suitable arrestment plant.

Other materials which may generate airborne dust emissions, for example crushed rock, coarse aggregate, or coal should be delivered, stored and handled so as to prevent or minimise dust emissions - for example by dampening or covering.

Road vehicles or rail wagons should be loaded in such a way as to minimise airborne dust emissions. If they are loaded with dry materials, this should be carried out where local dust control measures are provided, for example extract ventilation to arrestment plant.

The packing of lime and cement into bags should be carried out using purpose-designed plant fitted with extraction equipment and the displaced air ducted to suitable arrestment plant, for example bag filters. Arrestment plant should be fitted with a failure warning device, for example a pressure drop sensor and alarm.

All spillages should be cleaned up promptly using, for example, a vacuum cleaner or vacuum system. Particular attention should be paid to preventing and cleaning up deposits of dust on support structures and roofs in order to minimise wind entrainment of deposited dust.

In designing a new process, consideration should be given to a layout, which minimises vehicle movement on site.

Fugitives

2.3.12 Control of fugitive emissions to surface water, sewer and groundwater

Application Form Question 2.3 (cont.) → Fugitive Emissions to Water

With the Application the Operator should:

1. supply the general Application requirements for Section 2.3 on page 39 for control of fugitive emissions to water; and in addition,

2. identify, and quantify where possible quantify, significant fugitive emissions to water from all relevant sources, estimating the proportion of total emissions which are attributable to fugitive releases for each substance; these steps will be carried out as in response to Section 3.1 but need to be understood here in order to demonstrate that the controls are adequate.

3. Outline how the techniques selected fulfil the general requirements of WID or HWID in respect of the prevention and control of fugitive discharges of water (see Section 3.4 - Standards and obligation for discharges to water).

Indicative BAT Requirements

1. Where there are opportunities for reductions, the Permit may require the updated inventory of fugitive emissions to be submitted on a regular basis.

2. ***Subsurface structures – the Operator should:***
   - establish and record the routing of all installation drains and subsurface pipework;
   - identify all subsurface sumps and storage vessels;
   - engineer systems to ensure leakages from pipes etc are minimised and where these occur, can be readily detected, particularly where hazardous (e.g. listed) substances are involved;
   - provide in particular, secondary containment and/or leakage detection for such subsurface pipework, sumps and storage vessels;
   - establish an inspection and maintenance programme for all subsurface structures, e.g. pressure tests, leak tests, material thickness checks or CCTV.

3. ***Surfacing – the Operator should:***
   - describe the design(#),and condition of the surfacing of all operational areas;
   - have an inspection and maintenance programme of impervious surfaces and containment kerbs;
   - justify where operational areas have not been equipped with:
     - an impervious surface;
     - spill containment kerbs;
     - sealed construction joints;
     - connection to a sealed drainage system.

   (# Relevant information may include as appropriate: capacities; thicknesses; falls; material; permeability; strength/reinforcement; resistance to chemical attack; inspection and maintenance procedures; and quality assurance procedures.)

4. ***Bunds***

   All tanks containing liquids whose spillage could be harmful to the environment should be bunded. For further information on bund sizing and design, see Ref. 11. Bunds should:
   - be impermeable and resistant to the stored materials;
   - have no outlet (i.e. no drains or taps) and drain to a blind collection point;
   - have pipework routed within bunded areas with no penetration of contained surfaces;
   - be designed to catch leaks from tanks or fittings;
   - have a capacity which is the greater of 110% of the largest tank or 25% of the total tankage;
   - be subject to regular visual inspection and any contents pumped out or otherwise removed under manual control after checking for contamination;
   - where not frequently inspected, be fitted with a high-level probe and an alarm as appropriate;
   - have fill points within the bund where possible or otherwise provide adequate containment;
   - have a routine programmed inspection of bunds, (normally visual but extending to water testing where structural integrity is in doubt).

2.3.13 Odour

Application Form Question 2.3 (cont.)

Odour control

With the Application the Operator should:

1. supply the general Application requirements for Section 2.3 on page 39 for odour control; and in addition, where odour could potentially be a problem, the Operator should:
2. ***categorise the emissions as follows:***
   - ***a.*** ***a high level release which is expected to be acknowledged in the Permit*** – i.e. there will be an allowed release from the process (e.g. An odorous release from a stack or high level scrubber) and an element of BAT is adequate dispersion between source and receptor to prevent odour nuisance. The release will be allowed under the Permit but it is acknowledged that, under certain conditions, the plume may ground causing odour problems. Conditions in Permits are likely to be based on the actions to take when such events occur.
   - ***b.*** ***release should be preventable – i.e.*** releases can normally be contained within the site boundary by using BAT such as containment, good practice or odour abatement.
   - ***c.*** ***release is not preventable under all circumstances*** e.g. from a landfill or uncovered effluent treatment plant but potential problems are controlled by a programme of good practice measures;
3. for each relevant category, demonstrate that there will not be an odour problem from the emissions under normal conditions (see odour guidance).
4. for each relevant category, identify the actions to be taken in the event of abnormal events or conditions which might lead to odour, or potential odour problems (see odour guidance).
5. describe the current or proposed position with regard to any techniques given below or in Ref. 22.

Indicative BAT Requirements

1. The requirements for odour control will be sector specific and dependant upon the sources and nature of the potential odour. In general terms:
   - where odour can be contained, for example within buildings, the Operator should ensure that the maintenance of the containment and the management of the operations are such as to prevent its release at all times;
   - Where odour releases are permitted, (see examples above):
     - for new installations or significant changes, the releases should be modelled to demonstrate a low frequency of ground level concentrations above the odour threshold (or other threshold of acceptability). For occasions where weather conditions or other incidents are liable, in the view of the Regulator, to cause exceedences of the threshold of acceptability, the Operator should take appropriate and timely action, including shutting down the operations, to prevent further annoyance,
     - for existing installations, the same principle applies, except that where experience shows there to be no odour problem such modelling and actions will not be necessary.
2. For complex installations, for example where there are a number of potential sources of odorous releases or where there is an extensive programme of improvements to bring odour under control, an odour management plan should be maintained. The Regulator may incorporate the odour management plan in the Permit.
3. Substances present in emissions to air, which are known to be odorous, should be identified and quantified. Techniques should be employed to ensure that they are minimised to prevent them being noticeable outside the site boundary (Ref. 22).

Cont.

Odour

4. **Odour may arise from:**
   - raw material handling, See the appropriate box in Section 2.3.1 - Incoming waste handling; and
   - the stack flue gas where there is poor combustion control or poor dispersion. Poor dispersion can occur, particularly where there is a condensing water vapour plume at the discharge from the stack;
   - scrubber discharges under similar conditions; and
   - ash handling.

5. **Odour can be controlled by:**
   - enclosing odorous areas (applicable to all);
   - enclosing odorous waste all the way to the furnace (ACI, CWI);
   - confining waste to the designated areas (all);
   - ensuring that putrescible waste is incinerated within an agreed timescale (MWI, CWI, ACI, SSI);
   - refrigeration of such waste which is to be stored for longer than an agreed timescale (CWI, ACI);
   - regular cleaning and (for putrescible wastes) disinfection of waste handling areas (all);
   - design of areas to facilitate cleaning (all);
   - ensuring that the transport of waste and ash is in covered vehicles, where appropriate (all);
   - ensuring good dispersion at all times from any release points (all);
   - preventing anaerobic conditions by aeration, turning of waste and short timescales (SSI, MWI);
   - chlorination of waters being returned to STW or in storage (SSI);
   - drawing air from odorous areas at a rate which will ensure that odour is captured (all); and
   - treating such extracted air prior to release to destroy the odours - see below.

   The use of these techniques should obviate the need for odour masking or counteractants.

6. **Treatment of captured odour**

   Using odorous air as furnace air is an ideal way of dealing with. The quantity of contaminated air which can be handled this way is obviously limited by the needs of the furnace. A disadvantage is the need to consider provision for odour control when the incinerator is not operating.

   Biofilters e.g. peat or compost beds can provide odour control provided there is sufficient land availability. Gas flow through the media needs to be slow for them to be effective. They have been demonstrated to be very effective in sewage sludge applications. Not suited to combustion gas treatment.

   Scrubbing for odour typically would use counter current columns with acids or oxidising agents such as potassium permanganate. A 3-stage scrubbing sequence using sulphuric acid, sodium hydroxide/hydrogen peroxide and sodium hydroxide may be effective.

   Carbon filters are effective, especially where the total quantity of organic compounds is small, otherwise they can be expensive to run and lead to a significant waste which needs to be disposed of. If it cannot be recovered then, preferably, spent odour abatement carbon should be fed to the furnace, to destroy the odorous compounds, recover the energy content of the carbon and minimise waste arisings.

   The use of BAT should prevent offensive odours beyond the installation boundary.

7. Further guidance will be given in *Odour Assessment and Control – Guidance for Regulators and Industry* (see Ref. 22) along with information on dispersion design criteria. Until this guidance is available Operators should use the above information and, if in doubt, discuss odour issues with the Regulator.

Groundwater

2.4 Emissions to Groundwater

Groundwater protection legislation

The Groundwater Regulations came into force on 1 April 1999 (see Appendix 2 for equivalent legislation in Scotland and Northern Ireland). An IPPC Permit will be subject to the following requirements under these Regulations.

i. It shall not be granted at all if it would permit the direct discharge of a List I substance (Regulation 4(1)) (except in limited circumstances – see note 1 below).

ii. If the Permit allows the disposal of a List I substance or any other activity which might lead to an indirect discharge (see note 2 below) of a List I substance then **prior investigation** (as defined in Regulation 7) is required and the Permit shall not be granted if this reveals that indirect discharges of List I substances would occur and in any event conditions to secure prevention of such discharges must be imposed (Regulation 4(2) and (3)).

iii. In the case of List II substances, Permits allowing direct discharges or possible indirect discharges cannot be granted unless there has been a prior investigation and conditions must be imposed to prevent groundwater pollution (Regulation 5).

iv. The Regulations contain further detailed provisions covering **surveillance** of groundwater (Regulation 8); conditions required when direct discharges are permitted (Regulation 9); when indirect discharges are permitted (Regulation 10); and review periods and compliance (Regulation 11).

The principles, powers and responsibilities for groundwater protection in England and Wales, together with the Agency's policies in this regard, are outlined in the Environment Agency's document "*Policy and Practice for the Protection of Groundwater*"(PPPG) (see Ref. 23). This outlines the concepts of vulnerability and risk and the likely acceptability from the Agency's viewpoint of certain activities within groundwater protection zones.

A **Prior investigation** of the potential effect on groundwater of on-site disposal activities or discharges to groundwater. Such investigations will vary from case to case, but the Regulator is likely to require a map of the proposed disposal area; a description of the underlying geology, hydrogeology and soil type, including the depth of saturated zone and quality of groundwater; the proximity of the site to any surface waters and abstraction points, and the relationship between ground and surface waters; the composition and volume of waste to be disposed of; and the rate of planned disposal.

B **Surveillance** - this will also vary from case to case, but will include monitoring of groundwater quality and ensuring the necessary precautions to prevent groundwater pollution are being undertaken.

Note 1 The Regulations state that, subject to certain conditions, the discharges of List I substances to groundwater may be authorised if the groundwater is "permanently unsuitable for other uses". Advice must be sought from the Regulator where this is being considered as a justification for such discharges.

Note 2 List I and List II refer to the list in the Groundwater Regulations and should not be confused with the similar lists in the Dangerous Substances Directive.

Application Form Question 2.4

Identify if there may be a discharge of any List I or List II substances and if any are identified, explain how the requirements of the Groundwater Regulations 1998 have been addressed.

With the Application the Operator should:

Meeting the requirements of the Groundwater Regulations

1. confirm that there are no direct or indirect emissions to groundwater of List I or List II substances from the installation, or

2. where there are such releases, provide the information and surveillance arrangements described in A and B above.

Under these Regulations the Permit may not be granted if the situation is not satisfactory, therefore, with the application, the Operator should supply information on list I and list II substances and if necessary, prior investigation and surveillance information:

List I and List II substances

List I

1.-(1) Subject to sub-paragraph (2) below, a substance is in list I if it belongs to one of the following families or groups of substances-

(a) organohalogen compounds and substances which may form such compounds in the aquatic environment;

(b) organophosphorus compounds;

(c) organotin compounds;

(d) substances which possess carcinogenic, mutagenic or teratogenic properties in or via the aquatic environment (including substances which have those properties which would otherwise be in list II);

(e) mercury and its compounds;

(f) cadmium and its compounds;

(g) mineral oils and hydrocarbons;

(h) cyanides.

2. A substance is not in list I if it has been determined by the Agency to be inappropriate to list I on the basis of a low risk of toxicity, persistence and bioaccumulation.

List II

1.-(1) A substance is in list II if it could have a harmful effect on groundwater and it belongs to one of the families or groups of substances:

(a) the following metalloids and metals and their compounds:

Zinc	Tin	Copper
Barium	Nickel	Beryllium
Chromium	Boron	Lead
Uranium	Selenium	Vanadium
Arsenic	Cobalt	Antimony
Thallium	Molybdenum	Tellurium
Titanium	Silver	

(b) biocides and their derivatives not appearing in list I;

(c) substances which have a deleterious effect on the taste or odour of groundwater, and compounds liable to cause the formation of such substances in such water and to render it unfit for human consumption;

(d) toxic or persistent organic compounds of silicon, and substances which may cause the formation of such compounds in water, excluding those which are biologically harmless or are rapidly converted in water into harmless substances;

(e) inorganic compounds of phosphorus and elemental phosphorus;

(f) fluorides;

(g) ammonia and nitrites

(2) A substance is also in list II if-

(a) it belongs to one of the families or groups of substances set out in paragraph 1(1) above;

(b) it has been determined by the Agency to be inappropriate to list I under paragraph 1(2); and

(c) it has been determined by the Agency to be appropriate to list II having regard to toxicity, persistence and bioaccumulation.

3.-(1) The Secretary of State may review any decision of the Agency in relation to the exercise of its powers under paragraph 1(2) or 2 (2).

3.-(2) The Secretary of State shall notify the Agency of his decision following a review under sub-paragraph (1) above and it shall be the duty of the Agency to give effect to that decision.

4.- The Agency shall from time to time publish a summary of the effect of its determinations under this Schedule in such manner as it considers appropriate and shall make copies of any such summary available to the public free of charge.

2.5 Handling of Wastes Produced

This section relates to the management of wastes ***produced at the installation***. This will mainly comprise ash. BAT for incoming waste (feedstock) management is covered in Section 2.3.1.

The normal nature and source of the waste from each activity is given in Section 2.3 and will be confirmed in detail in the Operator's response to Section 3.1 (emissions inventory).

In general the waste streams produced comprise:

- Bottom ash (approx. 25% by weight and 10% by volume of input for a modern MWI);
- Fly ash;
- Air pollution control residues (commonly combined with fly ash and then approx. 2.5% by weight of waste input for a modern MWI);
- Rejected feedstock wastes (chemical or physical incompatibility e.g. large objects);
- Recovered waste fractions e.g. steel and aluminium extracted from ash, or MRF recyclables

Application Form Question 2.5

Characterise and quantify each waste stream and describe the proposed measures for waste management storage and handling.

With the Application the Operator should:

1. identify and quantify the waste streams;
2. identify the current or proposed handling arrangements;
3. describe the current or proposed position with regard to the techniques below or any others which are pertinent to the installation;
4. demonstrate that the proposals are BAT, by confirming compliance with the indicative requirements, by justifying departures (as described in Section 1.2 and in the Guide for Applicants) or alternative measures.

Indicative BAT Requirements

BAT for waste handling

1. A system should be maintained to record the quantity, nature, origin and where relevant, the destination, frequency of collection, mode of transport and treatment method of any waste which is disposed of or recovered.
2. Wherever practicable, waste should be segregated and the disposal route identified which should be as close to the point of production as possible.
3. Records should be maintained of any waste that is sent off-site (Duty of Care).
4. Storage areas should be located away from watercourses and sensitive boundaries e.g. adjacent to areas of public use and protected against vandalism.
5. Storage areas should be clearly marked and signed and containers should be clearly labelled.
6. The maximum storage capacity of storage areas should be stated and not exceeded. The maximum storage period for containers should be specified.
7. Appropriate storage facilities should be provided for special requirements such as for substances that are flammable, sensitive to heat or light etc., and incompatible waste types should be kept separate.
8. Containers should be stored with lids, caps and valves secured and in place. This also applies to emptied containers.
9. Storage containers, drums etc. should be regularly inspected.
10. Procedures should be in place to deal with damaged or leaking containers.
11. All appropriate steps to prevent emissions (e.g. liquids, dust, VOCs and odour) from storage or handling should be taken (see Sections 2.3.11, 2.3.12 and 2.3.13).

Cont.

Techniques specific to this sector

BAT for waste handling (cont.)

12. **Bottom ash handling:** Where ash is handled dry, the method must ensure that dust does not become airborne. This may be achieved by the quality of the containment and/or by dust suppression sprays. Dust suppression sprays should be limited to ensure they moisten and agglomerate the surface of the ash without leading to run-off or a leachate problem, and should use recovered water where available.

    Where handled wet, the ash should be held at an intermediate point to ensure that it is fully drained before it is transferred to skips or otherwise leaves the site, so that water will not drain off the ash either during transport or at final disposal. All water drained should be returned to the quench tank. Where installations have an ash hopper, the water should be pumped back. These conditions are less imperative where the ash is relatively benign, such as that which disposal on to the surface of land is permitted.

    All ash transport containers should be covered.

    Adequate cleaning equipment, such as a vacuum cleaner, should be provided and maintained, to clean up promptly any spilled ash. With clinical waste ash, in particular, any such vacuum cleaner should be fitted with an absolute filter. The dry sweeping of spillages is not acceptable.

13. **Fly ash and APC residues:** These two wastes are commonly combined within the process and produced as a single stream. Both present potential hazards that may be minimised through careful storage, handling and transportation, whether alone or in combination.

    Fly ash should be stored and transported in a manner that prevents fugitive dust releases. During silo and container filling, displaced air should be ducted to suitable dust arrestment equipment. Apart from the minor use of dust suppression sprays (using recovered water where available), dry materials should be kept dry to avoid the formation of leachates. Dry residues for disposal should be handled in sealed containers such as tankers for large quantities or “big-bags” (1 m^3) for smaller installations.

14. **Rejected Feedstock:** Efforts should be made to minimise the delivery of waste that cannot be processed at the facility (unless an appropriate authorisation is in place to permit the transfer of the waste). This will include up-stream waste management, provision of information regarding the types of waste acceptable and in some cases audit of waste suppliers procedures.

    Despite these efforts some wastes will still be included with other wastes and delivered to the installation. Techniques should therefore be adopted for the inspection of the waste. These techniques should reflect

    - the nature of the waste (including any potential additional hazards that might arise from waste inspection that may limit or prevent inspection)
    - the history of the particular installation in respect of loads and sources of loads which may require special attention
    - the ability of the installation to treat the waste and its operational design envelope (including any pre-treatment / waste mixing carried out)

    Provision should be made for the safe storage of rejected loads in a designated area with contained drainage, preferably under cover. Procedures should be in place for dealing with such loads to ensure that they are safely stored and despatched for onward disposal. Storage times should be minimised.

    Examples of loads which have caused difficulties at some plants have included:

    - Large quantities of PVC window frames (high HCl loading)
    - Large quantities of plaster board (high sulphur loading)
    - Large quantities of excessively wet waste (high moisture, low CV)
    - Large quantities of iodine or mercury (particularly at HWIs)
    - Some wastes containing wire which may jam loading systems or grates e.g. whole tyres, sprung mattresses or sofas
    - Large wastes that are not suited to incineration e.g. engine blocks

15. **Recovered Waste Fractions:** Provision should be made for the storage of all recovered fractions. The storage provided should take account of the general guidance given in this section.

2.6 Waste Recovery and Disposal

This section deals with the recovery and disposal of wastes ***produced by*** the installation. Section 2.2.2 summarises the main techniques for minimising waste arising at the installation (these are also outlined in Section 2.3 where applicable to particular activities)

Where waste production cannot (by the application of BAT) be avoided, the options will be for the recovery of the waste or its disposal.

The Regulations require the Regulator, in setting Permit conditions, to take account of certain general principles including that the installation in question should be operated in such a way that “waste production is avoided in accordance with Council Directive 75/442/EEC on waste; and where waste is produced it is recovered, or where this is technically or economically impossible it is disposed of, while avoiding or reducing the impact on the environment”. The objectives of the National Waste Strategies should also be considered.

In order to meet this requirement the Regulator needs Operators to provide the information below.

Application Form Question 2.6

Describe how each waste stream is proposed to be recovered or disposed of; and if you propose any disposal, explain why recovery is technically and economically impossible and describe the measures planned to avoid or reduce any impact on the environment.

With the Application the Operator should:

1. describe, in respect of each waste stream produced by the installation, whether the waste in question is to be recovered or disposed of, and if a disposal option is planned, to justify why recovery is “technically and economically impossible” together with “the measures planned to avoid or reduce any impact on the environment”;
2. include in the description, the Operator’s view as to whether waste disposal is likely to be restricted by the implementation of the Landfill Directive;
3. describe the current or proposed position with regard to the techniques below or any others which are pertinent to the installation;
4. demonstrate that the proposals are BAT, by confirming compliance with the indicative requirements, by justifying departures (as described in Section 1.2 and in the Guide for Applicants) or alternative measures;

Indicative BAT Requirements – waste disposal/ recovery

BAT for waste minimisation, recovery or disposal

1. Unless agreed with the Regulator to be inappropriate, the Operator should provide a detailed assessment identifying the best practicable environmental options for dealing with the waste produced at the installation. For existing activities, this may be carried out as an improvement condition to a time scale to be approved by the Regulator.
2. The Operator should compare their proposed (or actual for existing installations) practice with that described in the BPEO assessment and justify any departures from the BPEO, whilst demonstrating that BAT for the prevention and treatment of wastes has been adopted.
3. Because ash will often be the major waste produced, in their BPEO the Operator should considering at least the following:
   - opportunities for bottom ash recycling e.g. bottom ash use as aggregate;
   - opportunities for fly ash re-use e.g. as a neutralising agent (care must be taken to avoid remobilisation of pollutants).
4. The Operator shall regularly audit the waste disposal /recovery routes to ensure their waste is being properly dealt with.

2.7 Energy

BAT for energy efficiency under the PPC Regulations will be satisfied provided the Operator meets the following conditions:

either

- the Operator meets the basic energy requirements in Sections 2.7.1 and 2.7.2 below and is a participant to a Climate Change Agreement (CCA) or Trading Agreement with the government

or

- the Operator meets the basic energy requirements in Sections 2.7.1 and 2.7.2 below and the further sector-specific energy requirements in Section 2.7.3 below.

Note that even where a Climate Change Agreement or Trading Agreement is in place, this does not preclude the consideration of energy efficiency as part of an integrated assessment of Best Available Techniques in which it may be balanced against other emissions.

Further guidance is given in the Energy Efficiency Guidance Note (Ref. 13).

2.7.1 Basic energy requirements (1)

Application Form
Question 2.7 (part 1)

Provide a breakdown of the energy consumption and generation by source and the associated environmental emissions.

The requirements of this section are basic, low cost, energy standards which apply whether or not a Climate Change Agreement or Trading Agreement is in force for the installation.

With the Application the Operator should:

1. **provide the following Energy consumption information:**

   Energy consumption information should be provided in terms of delivered energy and also, in the case of electricity, converted to primary energy consumption. For the public electricity supply, a conversion factor of 2.6 should be used. Where applicable, the use of factors derived from on-site heat and/or power generation, or from direct (non-grid) suppliers should be used. In the latter cases, the Applicant shall provide details of such factors. Where energy is exported from the installation, the Applicant should also provide this information. An example of the format in which this information should be presented is given in Table 2-8 below. The Operator should also supplement this with energy flow information (e.g. "Sankey" diagrams or energy balances) showing how the energy is used throughout the process.

   (Note that the Permit will require energy consumption information to be submitted annually)

Table 2.8 - Example breakdown of delivered and primary energy consumption

Energy source	Energy consumption		
	Delivered, MWh	Primary, MWh	% of total
Electricity*			
Gas			
Oil			
Other (Operator to specify)			

* specify source.

2. **provide the following Specific Energy Consumption information**

   The Operator should define and calculate the specific energy consumption of the activity (or activities) based on primary energy consumption for the products or raw material inputs which most closely match the main purpose or production capacity of the installation. The Operator should provide a comparison of Specific Energy Consumption against any relevant benchmarks available for the sector.

3. **provide associated environmental emissions**

   This is dealt with in the Operator's response to Section 3.1.

2.7.2 Basic energy requirements (2)

Application Form Question 2.7 (part 2)

Describe the proposed measures for improvement of energy efficiency.

The requirements of this section are basic, low cost, energy standards which apply whether or not Climate Change Agreement or Trading Agreement is in force for the installation.

With the Application the Operator should:

1. describe the current or proposed position with regard to the **basic, low cost energy requirements** below, and provide justifications for not using any of the techniques described;

2. provide an energy efficiency plan which appraises the costs and benefits of different energy options as described below.

Basic Energy Requirements

1. ***Operating, maintenance and housekeeping measures*** should be in place in the following areas, according to the checklists provided in Appendix 2 of the IPPC Energy Efficiency Guidance Note, where relevant:
   - air conditioning, process refrigeration and cooling systems (leaks, seals, temperature control, evaporator/condenser maintenance);
   - operation of motors and drives;
   - compressed gas systems (leaks, procedures for use);
   - steam distribution systems (leaks, traps, insulation);
   - space heating and hot water systems;
   - lubrication to avoid high friction losses;
   - boiler maintenance e.g. optimising excess air;
   - other maintenance relevant to the activities within the installation.

2. ***Basic, low cost, physical techniques*** should be in place to avoid gross inefficiencies; to include insulation, containment methods, (e.g. seals and self-closing doors) and avoidance of unnecessary discharge of heated water or air (e.g. by fitting simple control systems).

3. ***Building services energy efficiency techniques*** should be in place to deliver the requirements of the Building Services Section of the Energy Efficiency Guidance Note. For energy-intensive industries these issues may be of minor impact and should not distract effort ***from*** the major energy issues. They should nonetheless find a place in the programme, particularly where they constitute more than 5% of the total energy consumption.

4. ***Provide an energy efficiency plan*** which:
   - identifies all techniques relevant to the installation, including those listed below and in Section 2.7.3;
   - identifies the extent to which these have been employed;
   - prioritises the applicable techniques according to the appraisal method provided in the Energy Efficiency Guidance Note which includes advice on appropriate discount rates, plant life etc.;
   - identifies any techniques that could lead to other adverse environmental impacts, thereby requiring further assessment (e.g. according to methodology, see Ref. 5).

   Where other appraisal methodologies have been used, state the method, and provide evidence that appropriate discount rates, asset life and expenditure (£/t) criteria have been employed.

   This should be submitted in a summary format similar to the example below, together with supporting information from any appraisal procedure carried out. The plan is required to ensure that the Operator has considered all relevant techniques. **However, where a Climate Change Agreement or Trading Agreement is in place the Regulator will only enforce implementation of those measures in categories 1-3 above**.

Cont.

Table 2.9 - Example Format for Energy Efficiency Measures

Energy efficiency option	NPV £k	CO_2 savings (tonnes)		NPV/CO_2 saved £/tonne	Priority* for implementation
		annual	lifetime		
7MW CHP plant	1,372	13,500	135,000	10	high
High efficiency motor	0.5	2	14	35	medium
Compressed air	n/a	5	n/a	n/a	immediate

* Indicative only, based on cost/benefit appraisal:

Where a Climate Change Agreement or Trading Agreement is in place, the Energy Efficiency Plan should be submitted as an improvement condition to a timescale to be agreed with the Regulator but in any case within the timescale given in Section 1.1.

5. ***Energy management techniques*** should be in place, according to the requirements of Section 2.1 noting, in particular, the need for monitoring of energy flows and targeting of areas for reductions.

Indicative BAT Requirements

BAT for energy

1. ***Operating, maintenance and housekeeping measures*** should be in place, according to the checklists provided in Appendix 3 of the Energy Efficiency Guidance Note, in the following areas as applicable:
   - air conditioning, process refrigeration and cooling systems (leaks, seals, temperature control, evaporator/condenser maintenance);
   - operation of motors and drives;
   - compressed gas systems (leaks, procedures for use);
   - steam distribution systems (leaks, traps, insulation);
   - space heating and hot water systems;
   - lubrication to avoid high friction losses;
   - boiler maintenance e.g. optimising excess air;
   - other maintenance relevant to the activities within the installation.
2. ***Basic, low cost, physical techniques*** should be in place to avoid gross inefficiencies; to include insulation, containment methods, (e.g. seals and self-closing doors) and avoidance of unnecessary discharge of heated water or air (e.g. by fitting simple control systems).
3. ***Building services*** energy efficiency techniques should be in place to deliver the requirements of the Building Services Section of the Energy Efficiency Guidance Note. For energy-intensive industries these issues may be of minor impact and should not distract effort ***from*** the major energy issues. They should nonetheless find a place in the programme, particularly where they constitute more than 5% of the total energy consumption.
4. ***Energy management techniques*** should be in place, according to the requirements of Section 2.1 noting, in particular, the need for monitoring of energy flows and targeting of areas for reductions.

2.7.3 Further energy efficiency requirements

Application Form Question 2.7 (part 3)

Describe the proposed measures for improvement of energy efficiency……(only where the installation is not the subject of a Climate Change Agreement or Trading Agreement).

Where there is no Climate Change Agreement or Trading Agreement in place, the Operator should demonstrate the degree to which the further energy efficiency measures identified in the implementation plan, including those below, have been taken into consideration for this sector and justify where they have not.

With the Application the Operator should:

1. identify which of the measures below are applicable to the activities, and include them in the appraisal for the energy efficiency plan in Section 2.7.2.

2. describe the current or proposed position with regard to the techniques below, or any others which are pertinent to the installation;

3. demonstrate that the proposals are BAT, by confirming compliance with the indicative requirements, by justifying departures (as described in Section 1.2 and in the Guide for Applicants) or alternative measures;

4 demonstrate compliance with the requirements of WID that *"any heat generated from the incineration or co-incineration process [is] recovered as far as practicable".* This guidance (and particularly the indicate BAT requirements outlined below) should be taken into account when justifying on a site specific basis what is "*as far as practicable"*

Indicative BAT Requirements

BAT for energy

The following techniques should be implemented where they are judged to be BAT based on a cost/benefit appraisal according to the methodology provided in Appendix 4 of the Energy Efficiency Guidance note (Ref. 13).

Specific Energy Consumption

1. The Operator should define and calculate the specific energy consumption of the activity (or activities) based on primary energy consumption for the products or raw material inputs which most closely match the main purpose or production capacity of the installation. The Operator should provide a comparison of Specific Energy Consumption against any relevant benchmarks available for the sector. This information should be submitted annually.

Energy efficiency techniques

2. The following techniques may reduce energy consumption or increase energy recovery and thereby reduce both direct (heat and emissions from on-site generation) and indirect (emissions from a remote power station) emissions. The extent of their use should be justified in the application:
   - Use of the heat generated for electricity generation for on site or off-site use is expected for the majority of new installations. At existing plant the capital expenditure and logistics (e.g. availability of an outlet for the electricity generated) may remain prohibitive;
   - Use of higher efficiency electrical generation technology e.g. gas turbines or engines;
   - Use of steam from boilers in on-site or off site applications;
   - Use of waste heat for CHP or district heating (potential to increase overall thermal efficiencies from approx. 20% to 75%);
   - Use of waste heat for preheating combustion air, boiler feed water or plume reheat;;
   - Effective furnace insulation and construction to retain heat e.g. refractory linings;;
   - Maintaining steady plant capacity to prevent downtime e.g. through provision of supplementary firing with primary fuel, or waste pre-treatment;
   - The use of flue gas re-circulation (primarily for NOx reduction) may have the additional benefit of increasing plant energy efficiency (see also Sections 2.3.4.8 - FGR and 2.3.8.3 - Control of point source emissions to air);

Cont.

BAT for energy (cont.)

- Effective maintenance of heat exchangers to maintain high heat transfer
- Prevention of uncontrolled air ingress by providing and maintaining seals
- Ensuring plant layout avoids pumping and heavy transfer where possible
- Use of ion exchange in stead of high pressure membrane filtration for boiler (and other water) treatment

3. Irrespective of whether a Climate Change Agreement or Trading Agreement is in place, where there are other BAT considerations involved, such as:
   - the choice of fuel impacts upon emissions other than carbon e.g. sulphur in fuel;
   - where the potential minimisation of waste emissions by recovery of energy from waste conflicts with energy efficiency requirementsl
   - where the nature of the waste is such that the primary concern of safe waste disposal may be jeopardised by additional energy recovery (e.g. the need for rapid cooling to prevent *de novo* dioxin generation – see Section 2.3.7 - Boiler design, 2.3.8.3 - Control of point source releases to air, and 2.3.4 - Furnace requirements.

   the Operator should provide justification that the proposed or current situation represents BAT.

Sub-Sector specific issues

4. ***Municipal waste incineration***
   - Steam should be generated for either direct use or electricity generation
   - Where electricity only is generated at least 9MW of electricity should be recovered per 100,000 tonnes of annual waste throughput
   - Waste heat should be recovered unless to do so can be demonstrated not to represent BAT (this will require cost justification). All opportunities for CHP and district heating should be explored.
   - The siting of plant near to potential or actual energy users will aid the maximisation of recovery potential. Consideration should be given to joint venture projects wherever possible.
   - If waste heat is not recovered, in order to enable any future waste heat use to be capitalised upon, pass-out valves should be provided

5. ***Hazardous waste incineration***
   - There are likely to be opportunities for internal energy saving using combustion generated heat via exchange systems
   - The incineration of higher concentrations of halogenated or highly thermally stable wastes or highly variable waste streams will e able to justify lower levels of energy recovery on the grounds that safe incineration is the primary purpose. Indeed proposals to recover energy from such wastes will need to demonstrate that this will not give rise to higher levels of polluting emissions.
   - Low CV waste streams (e.g. typically aqueous or inorganic wastes) are also less likely to merit significant measures to recover energy on account of the low potential recovery, unless supported by high supplementary fuel firing.
   - Consistent high CV waste streams offer significant energy recovery potential that should be maximised. This may involve steam or electricity generation and is particularly likely to be worth of consideration where high quantities are incinerated.
   - Where the installation is situated on or near other potential energy users there may be possibilities for provision of process steam or heating.

6. ***Clinical waste incineration***
   - Installations will generally be expected to generate steam for local use or electricity generation
   - Lack of 24 hour operation in some cases may mean the revenues for exportation schemes will be less favourable.
   - Where hazardous wastes are incinerated, the issues relating to safe destruction made above for HWIs should be considered.

Cont

7. ***Sewage sludge incineration***

- There would appear to be considerable scope for energy recovery by means of electricity generation and heat provision at sewage sludge incineration sites owing to:
  - The high CV of some (dried) sewage sludges;
  - The likelihood in many cases of a consistent feedstock;
  - High demand for electrical power for pumping operations at the treatment works;
  - Potential use of heat for process heating;
  - Land availability for integrated systems and CHP (e.g. gas from anaerobic digesters may be used as a fuel, balanced with natural gas integrating with post steam turbine incinerator waste heat).
- There may be energy recovery gains to be made from using pyrolysis or gasification if high efficiency electricity generating equipment can be utilised (and emission limits met).

8. ***Animal remains and animal carcass incineration***

- Installations will generally be expected to generate steam for local use or electricity generation;
- Lack of 24 hour operation in some cases may mean the revenues for exportation schemes will be less favourable;
- Rural locations may make it more difficult to find energy outlets.

9. ***Refuse derived fuel installations***

- Levels of energy efficiency are expected to be the high for the sector because the relatively consistent fuel should provide stable operational conditions;
- Electricity generation is anticipated in all cases (and / or steam raising);
- CHP and district heating should be provided (unless excessively costly);
- Integration with other energy users is expected for all new installations.

10. ***Pyrolysis and gasification installations***

- Installations may be able to increase electrical generation through the use of gas turbine or engine generation technology (provided emission limits can be met);
- All products (solid chars, oils and fuel gas), which will not be used as a primary product (rather than a fuel) should have their energy potential maximised rather than be disposed of:
  - Char may be combusted or its energy released using a water gas reactor;
  - Oils may be combusted;
  - Fuel gas may be combusted.

11. ***Co-incineration installations***

- Refer to energy aspects detailed in sector specific guidance.

2.8 Accidents and their Consequences

Guidance

IPPC requires as a general principle that necessary measures should be taken to prevent accidents which may have environmental consequences, and to limit those consequences. This section covers general areas of any installation operations which have the potential for accidental emission.

Some installations will also be subject to the Control of Major Accident Hazards Regulations 1999 (COMAH) (see Appendix 2 for equivalent legislation in Scotland and Northern Ireland). There is an element of overlap between IPPC and COMAH and it is recognised that some systems and information for both regimes may be interchangeable.

The COMAH regime applies to major hazards. For accident aspects covered by COMAH, reference should be made to any reports already held by the Regulator. However, the accident provisions under IPPC may fall beneath the threshold for major accident classification under COMAH and therefore consideration should be given to smaller accidents and incidents as well. Guidance (see Ref. 18), prepared in support of the COMAH Regulations may also be of help to IPPC Operators (whether or not they are covered by the COMAH regime), in considering ways to reduce the risks and consequences of accident.

General management requirements are covered in Section 2.1. For accident management, there are three particular components:

- **identification of the hazards** posed by the installation/activity;
- **assessment of the risks** (hazard x probability) of accidents and their possible consequences;
- implementation of **measures to reduce the risks** of accidents, and contingency plans for any accidents that occur.

Application Form Question 2.8

Describe your documented system that you proposed to be used to identify, assess and minimise the environmental risks and hazards of accidents and their consequences.

With the Application the Operator should:

1. provide the accident management plan described in the indicative BAT requirements below describing the current or proposed position with regard to the techniques listed below or any others which are pertinent to the installation;
2. demonstrate that the proposals are BAT, by confirming compliance with the indicative requirements, by justifying departures (as described in Section 1.2 and in the Guide for Applicants) or alternative measures;
3. identify any issues which may be critical.

Indicative BAT Requirements

BAT for control of accidents

1. A structured accident management plan should be submitted to the Regulator which should:

   a. ***identify the hazards*** to the environment posed by the installation. Particular areas to consider may include, but should not be limited to, the following:
   - transfer of substances (e.g. loading or unloading from or to vessels);
   - overfilling of vessels;
   - failure of plant and/or equipment (e.g. over-pressure of vessels and pipework, blocked drains);
   - failure of containment (e.g. bund and/or overfilling of drainage sumps);
   - failure to contain firewater;
   - making the wrong connections in drains or other systems;
   - preventing incompatible substances coming into contact;
   - unwanted reactions and/or runaway reactions;
   - emission of an effluent before adequate checking of its composition has taken place;
   - steam main issues;
   - vandalism.

Cont.

BAT for control of accidents (cont.)

b. ***Assess the risks*** - having identified the hazards, the process of assessing the risks can be viewed as addressing six basic questions:

1. what is the estimated probability of their occurrence? (Source frequency);
2. what gets out and how much? (Risk evaluation of the event);
3. where does it get to? (Predictions for the emission – what are the pathways and receptors?);
4. what are the consequences? (Consequence assessment – the effects on the receptors);
5. what are the overall risks? (Determination of the overall risk and its significance to the environment);
6. what can prevent or reduce the risk? (Risk management – measures to prevent accidents and/or reduce their environmental consequences).

The depth and type of assessment will depend on the characteristics of the installation and its location. The main factors which should be taken into account are:

- the scale and nature of the accident hazard presented by the installation and the activities;
- the risks to areas of population and the environment (receptors);
- the nature of the installation and complexity or otherwise of the activities and the relative difficulty in deciding and justifying the adequacy of the risk control techniques.

c. ***identify the techniques necessary to reduce the risks including:***

c1. the following techniques are relevant to most installations:

- an inventory should be maintained of substances, present or likely to be present, which could have environmental consequences if they escape. It should not be forgotten that many apparently innocuous substances can be environmentally damaging if they escape (e.g. a tanker of milk spilled into a watercourse could destroy its ecosystem). The Permit will require the Regulator to be notified of any changes to the inventory;
- procedures should be in place for checking raw materials and wastes to ensure compatibility with other substances with which they may accidentally come into contact;
- adequate storage arrangements for raw materials, products and wastes should be provided;
- to ensure that control is maintained in emergency situations, consideration should be given to process design alarms, trips and other control aspects, e.g. automatic systems based on microprocessor control and passing valve control, tank level readings such as ultrasonic gauges, high-level warnings and process interlocks and process parameters;
- preventative techniques, such as suitable barriers to prevent damage to equipment from the movement of vehicles, should be included as appropriate;
- appropriate containment should be provided, e.g. bunds and catchpots, building containment;
- techniques and procedures should be implemented to prevent overfilling of storage tanks (liquid or powder), e.g. level measurement, independent high-level alarms, high-level cut-off, and batch metering;
- installation security systems to prevent unauthorised access should be provided as appropriate and should include maintenance arrangements where necessary;
- there should be an installation log/diary to record all incidents, near-misses, changes to procedures, abnormal events and findings of maintenance inspections;
- procedures should be established to identify, respond to and learn from such incidents;
- the roles and responsibilities of personnel involved in accident management should be identified;

Cont.

BAT for control of accidents (cont.)

- clear guidance should be available on how each accident scenario should be managed, e.g. containment or dispersion, to extinguish fires or let them burn;
- procedures should be in place to avoid incidents occurring as a result of poor communication among operations staff during shift changes and maintenance or other engineering work;
- safe shutdown procedures should be in place;
- communication routes should be established with relevant authorities and emergency services both before and in the event of an accident. Post-accident procedures should include the assessment of harm caused and steps needed to redress this;
- appropriate control techniques should be in place to limit the consequences of an accident, such as oil spillage equipment, isolation of drains, alerting of relevant authorities and evacuation procedures;
- personnel training requirements should be identified and provided;
- the systems for the prevention of fugitive emissions are generally relevant (Sections 2.3.11 and 2.3.12) and in addition, for drainage systems:
  - procedures should be in place to ensure that the composition of the contents of a bund sump, or sump connected to a drainage system, are checked before treatment or disposal;
  - drainage sumps should be equipped with a high-level alarm or sensor with automatic pump to storage (not to discharge); there should be a system in place to ensure that sump levels are kept to a minimum at all times;
  - high-level alarms etc. should not be routinely used as the primary method of level control;
  -

c2. the following plus any other specific techniques identified as necessary to minimise the risks as identified in 1 and 2 above

- adequate redundancy or standby plant should be provided with maintenance and testing to the same standards as the main plant;
- process waters, site drainage waters, emergency firewater, chemically contaminated waters and spillages of chemicals should, where appropriate, be contained (see Section 3.4.1 for information regarding legislative obligations in this respect) and where necessary, routed to the effluent system, with provision to contain surges and storm-water flows, and treated before emission to controlled waters or sewer. Sufficient storage should be provided to ensure that this could be achieved. There should also be spill contingency procedures to minimise the risk of accidental emission of raw materials, products and waste materials and to prevent their entry into water. Any emergency firewater collection system should also take account of the additional firewater flows or fire-fighting foams. Emergency storage lagoons may be needed to prevent contaminated firewater reaching controlled waters (see Refs. 14 and 15);
- consideration should be given to the possibility of containment or abatement for accidental emissions from vents and safety relief valves/bursting discs. Where this may be inadvisable on safety grounds, attention should be focused on reducing the probability of the emission;

Sector specific techniques

c3. The following techniques are sector specific. Owing the site-specific nature of accident risk, and the breadth of waste types this guidance may relate to, they are neither comprehensive, nor applicable in all circumstances. They are therefore provided as a guide to the outcome of the systematic assessment outlined in the general guidance above:

Cont.

Table 2-10 - Accident Risks

Aspect	Consequence of Release	Controls
Waste storage failure	• Litter, • Contaminated land	• Secure storage • Containment e.g. sealed floors
Incoming waste or raw material handling / storage failure	• Spillage • overfilling • Putrefaction leading to odours / fire risk	• Liquid reagents in bunds • High level alarms • Incoming waste mixing and rapid processing • Fire detection and sprinkler operation
Waste charging failure	• Combustion conditions upset • Releases to air (e.g. CO)	• charging design / maintenance • Waste inspection
Furnace control failure	• Combustion conditions upset • Release to air? • Plant shut down?	• Waste feed quality control • Maintenance of air systems • Effective control parameter monitors
Residues handling / storage failure	• Contaminated land • Damage to aquatic systems • Potential releases to air	• Secure storage • Controlled or contained drainage
APC equipment failure e.g. power failure reagent shortage blockage damage to equipment	• Release of untreated combustion gases to air • Plant shutdown?	• Waste feed quality control • Emergency power for fans / pumps • Low level reagent alarms • Pump maintenance • Standby equipment provision (e.g. multiple smaller feed systems) • Key parameter monitoring e.g. filter pressure drop

BAT for control of accidents (cont.)

Abnormal Operating Conditions

The incineration directives (HWID / WID) recognise that, at the emission limit values set, the nature of waste is such that its incineration may, in some circumstances lead to short term exceedences of the emission standards set. It therefore makes provision for member states to set out conditions in respect of periods of abnormal operation. Abnormal operation is any circumstance that leads to the exceedence of any emission limit value.

The Agency is currently developing standard permit conditions to ensure that these requirements are implemented and that they reflect BAT.

BAT for abnormal operation

The operator should implement a programme of preventative maintenance and control to ensure that abnormal operation is avoided.

In the event of abnormal operation the operator shall:

1 reduce or close down operations as soon as practicable until normal operations can be restored.

2. initiate the shutdown sequence on those process lines (i.e. emission averaging is not permitted for multiple line plant) where the continuous emission monitors serving them indicate that:
   - any individual continuously monitored emission limit value has been exceeded for 4 hours or more consecutively, or
   - a part of the flue gas abatement system has failed and any individual continuously monitored emission limit value has been exceeded for 4 hours or more consecutively, or
   - any emission limit has been exceeded for more than 60 hours cumulatively in any one year.

3. immediately initiate the shutdown sequence if any of the continuous emission monitors indicates that the half-hourly emission limit values for releases to air are exceeded by more than 100%.

4. initiate the shutdown sequence if any emissions measurement equipment is out of service for more than 24-hours or such shorter time if any other relevant monitored parameter (i.e. a parameter that might be considered to be a surrogate e.g. sulphur dioxide for HCl or CO for VOCs) is in breach of its specified emission limit.

2.9 Noise and Vibration

Within this section "*noise*" should be taken to refer to "*noise and/or vibration*" as appropriate, detectable beyond the site boundary.

The PPC Regulations require installations to be operated in such a way that *"all the appropriate preventative measures are taken against pollution, in particular through the application of BAT*". The definition of pollution includes *"emissions which may be harmful to human health or the quality of the environment, cause offence to human senses or impair or interfere with amenities and other legitimate uses of the environment".* BAT is therefore likely to be similar, in practice, to the requirements of the statutory nuisance legislation, which requires the use of "best practicable means", to prevent or minimise noise nuisance.

In the case of noise, "offence to any human senses" can normally be judged by the likelihood of complaints, but in some cases it may be possible to reduce noise emissions still further at reasonable costs, and this may exceptionally therefore be BAT for noise emissions.

For advice on how noise and/or vibration related limits and conditions will be determined see *"IPPC Noise – Part 1 Regulation and Permitting",* (see Ref. 19).

Principal sources of noise on incineration plant are:

- induced draft fans;
- harmonics between induced draft fans and the chimney;
- primary and secondary air fans;
- vehicle noise;
- WHB safety relief valves;
- transformers;
- cooling towers - mainly noise from falling water but also fan noise;
- general mechanical handling such as dragging rather than lifting skips.

Application Form Question 2.9

Describe the main sources of noise and vibration (including infrequent sources); the nearest noise-sensitive locations and relevant environmental surveys which have been undertaken; and the proposed techniques and measures for the control of noise.

Information needed to determine BAT for noise and vibration

With the Application the Operator should:

1. provide the following information for ***each main source of noise and vibration*** that fall within the IPPC installation:
   - the source and its location on a scaled plan of the site;
   - whether continuous/ intermittent, fixed or mobile;
   - the hours of operation;
   - its description, (e.g. clatter, whine, hiss, screech, hum, bangs, clicks, thumps or tonal elements);
   - its contribution to overall site noise emission (categorise each as high, medium or low unless supporting data is available).

   A common sense approach needs to be adopted in determining which sources to include. The ones which need to be considered are those which may have environmental nuisance impact; e.g. a small unit could cause an occupational noise issue in an enclosed space but would be unlikely to cause an environmental issue. Conversely a large unit or a number of smaller units enclosed within a building could, for example, cause a nuisance if doors are left open. It must also be remembered that noise, which is not particularly noticeable during the day, may become more noticeable at night.

2. provide the information required in (1) for each source plus its times of operation for ***Infrequent sources of noise and vibration,*** not listed above that fall within the IPPC installation: (such as infrequently operated/ seasonal operations, cleaning/maintenance activities, on-site deliveries/collections/transport or out-of-hours activities, emergency generators or pumps and alarm testing),

Cont.

Information needed to determine BAT for noise and vibration (cont.)

3. identify ***the nearest noise-sensitive sites*** (typically dwellings, parkland and open spaces – schools, hospitals and commercial premises may be, depending upon the activities undertaken there) and any other points/boundary where conditions have been applied by Local Authority officers or as part of a planning consent, relating to:
   - (a) the local environment:
     - provide an accurate map or scaled plan showing grid reference, nature of the receiving site, distance and direction from site boundary;
   - (b) conditions/limits imposed which relate to other locations (i.e. boundary fence or surrogate for nearest sensitive receptor):
     - any planning conditions imposed by the Local Authority;
     - other conditions imposed by agreements, e.g. limits on operating times, technologies etc;
     - any requirements of any legal notices etc.
   - (c) the noise environment:
     - background noise level, if known (day/night/evening) $L_{A,90,T}$;
     - specific noise level (day/evening/night) $L_{A\,eq,T}$; and/or
     - ambient noise level (day/evening/night) $L_{A\,eq,T}$, as appropriate;
     - vibration data which may be expressed in terms of the peak particle velocity (ppv) in mm s^{-1} or the vibration dose value (VDV) in m $s^{-1.75}$.

   For noise these are given the meaning as defined in BS4142:1997 "Method for rating industrial noise affecting mixed residential and industrial areas", and to which reference should be made for a full description. For vibration, the appropriate standard is BS6472:1992 "Evaluation of human exposure to vibration in buildings1 to 80 Hz". In very general terms "background" is taken to be the equivalent continuous A-weighted noise remaining when the source under investigation is not operational averaged over a representative time period, T. The "ambient" level is the equivalent continuous A-weighted combination of all noise sources far and distant, including the source under investigation and "specific noise" is the equivalent continuous A-weighted noise level produced by the source under investigation as measured at a selected assessment point. Both are averaged over a time period, T. BS4142 gives advice on the appropriate reference periods. "Worst case" situations and impulsive or tonal noise should be accounted for separately and not "averaged out" over the measurement period.

4. provide ***details of any environmental noise measurement surveys,*** modelling or any other noise measurements undertaken relevant to the environmental impact of the site, identifying:
   - the purpose/context of the survey;
   - the locations where measurements were taken;
   - the source(s) investigated or identified;
   - the outcomes.

5. identify any specific local issues and proposals for improvements.

6. describe the current or proposed position with regard to the techniques below, any in Ref. 19 or any others which are pertinent to the installation

7. demonstrate that the proposals are BAT, by confirming compliance with the indicative requirements, by justifying departures (as described in Section 1.2 and in the Guide for Applicants) or alternative measures.

Indicative BAT Requirements

1. The Operator should employ basic good practice measures for the control of noise, including adequate maintenance of any parts of plant or equipment whose deterioration may give rise to increases in noise (eg maintenance of bearings, air handling plant, the building fabric as well as specific noise attenuation measures associated with plant, equipment or machinery).

2. In addition the Operator should employ such other noise control techniques to ensure that the noise from the installation does not give rise to reasonable cause for annoyance, in the view of the Regulator and, in particular should justify where either Rating Levels ($L_{Aeq,T}$) from the installation exceed the numerical value of the Background Sound Level ($L_{A90,T}$), or the absolute levels of 50dB L_{Aeq} by day or 45 by night are exceeded. Reasons why these levels may be exceeded in certain circumstances are given in Ref. 19.

Cont.

3. In some circumstances "creeping background" (see Ref. 19) may be an issue. Where this has been identified in pre-application discussions or in previous discussions with the Local Authority, the Operator should employ such noise control techniques as are considered to be appropriate to minimise problems of to an acceptable level within the BAT criteria.

4. Noise surveys, measurement, investigation (which can involve detailed assessment of sound power levels for individual items of plant) or modelling may be necessary for either new or existing installations depending upon the potential for noise problems. Operators may have a noise management plan as part of their management system. More information on such techniques is given in Part 2 of Ref. 19.

2.10 Monitoring

Mandatory minimum monitoring requirements for waste incineration are outlined in European Legislation (Ref. 25). These requirements **must** be met wherever this legislation applies. Operators who burn wastes or waste derived fuels should consult the Regulator at an early stage in order to discuss whether the standards of these directives will apply to their situation.

In general monitoring standards in the following Directives will apply:

- WID – standards apply to installations burning any waste or waste derived fuel (except those that are exempt from the Directive or are covered by HWID)
- HWID – standards apply to the incineration and co-incineration of hazardous wastes (in non-HWID exempt installations) until 28 December 2005 when WID will apply.

The Regulator takes the view that installations not covered by WID must also meet the standards required by WID unless the Operator can clearly demonstrate that to do so would be excessively costly.

This section describes monitoring and reporting requirements for emissions to all environmental media. Guidance is provided for the selection of the appropriate monitoring methodologies, frequency of monitoring, compliance assessment criteria and environmental monitoring.

Application Form Question 2.10

Describe the proposed measures for monitoring emissions including any environmental monitoring, and the frequency, measurement methodology and evaluation procedure proposed.

With the Application the Operator should:

1. describe the current or proposed position with regard to the monitoring requirements below or any others which are pertinent to the installation for “Emissions monitoring”, “Environmental monitoring”, “Process monitoring” (where environmentally relevant) and “Monitoring standards” employed;
2. provide, in particular, the information described in requirement 26 below;
3. provide justifications for not using any of the monitoring requirements described;
4. Identify shortfalls in the above information which the Operator believes require longer term studies to establish.
5. provide a direct comparison of their intended monitoring with the minimum requirements of the relevant European legislation – this should aim to clearly demonstrate compliance with Directive requirements.

Emissions monitoring

Emissions monitoring

The following monitoring parameters and frequency are normally appropriate in this sector. Generally, monitoring should be undertaken during commissioning, start-up, normal operation and shut-down unless the Regulator agrees that it would be inappropriate to do so.

Where effective surrogates are available they may be used to minimise monitoring costs unless specifically required by European legislation.

Where monitoring shows that substances are not emitted in significant quantities, consideration can be given to a reduced monitoring frequency unless specifically required by European legislation.

Monitoring and reporting of emissions to water and sewer

Emissions monitoring to water

1. European directives (WID & HWID) contain specific requirements in respect of the minimum standards for monitoring of releases to water. They also contain the criteria that will be used to demonstrate that the emission limit values so assessed are being complied with.

   Table 2-11 below outlines the requirements of the WID in respect of the monitoring of releases from installations generally and those arising from air pollution control devices in particular. Operators of installations falling with in the scope of WID must comply with these minimum standards. Operators of non-WID installations must justify departures from these standards:

Cont.

Table 2-11 Emissions monitoring to water

Parameter	Monitoring Type / Frequency	Method / Specification Ref(s)
pH	Continuous	CEN if available, ISO or national or international if not.
Temperature	Continuous	CEN if available, ISO or national or international if not.
Flow	Continuous	CEN if available, ISO or national or international if not.
Total suspended solids (as defined by 91/271/EEC)	Daily spot sample or Monthly flow proportional sample over 24 hours	CEN if available, ISO or national or international if not.
Hg and its compounds, expressed as Hg.	Monthly flow proportional sample over 24 hours	CEN if available, ISO or national or international if not.
Cd and its compounds, expressed as Cd.	Monthly flow proportional sample over 24 hours	CEN if available, ISO or national or international if not.
Tl and its compounds, expressed as Tl.	Monthly flow proportional sample over 24 hours	CEN if available, ISO or national or international if not.
As and its compounds, expressed as As.	Monthly flow proportional sample over 24 hours	CEN if available, ISO or national or international if not.
Pb and its compounds, expressed as Pb.	Monthly flow proportional sample over 24 hours	CEN if available, ISO or national or international if not.
Cr and its compounds, expressed as Cr.	Monthly flow proportional sample over 24 hours	CEN if available, ISO or national or international if not.
Cu and its compounds, expressed as Cu.	Monthly flow proportional sample over 24 hours	CEN if available, ISO or national or international if not.
Ni and its compounds, expressed as Ni.	Monthly flow proportional sample over 24 hours	CEN if available, ISO or national or international if not.
Zn and its compounds, expressed as Zn.	Monthly flow proportional sample over 24 hours	CEN if available, ISO or national or international if not.
Dioxins and Furans (TEQ)	Every 6 months, but every 3 months during the first year of operation.	CEN if available, ISO or national or international if not.

Notes:

1. *Monitoring should be carried out at the point where waste water is discharged off site and may therefore be carried out down stream of an effluent treatment plant.*
2. *For discharges of metals, SS and dioxins, WID requirements should be adhered to in respect of using mass balance calculation to demonstrate that releases to water attributable to air pollution control devices comply with the ELVs in the Directive.*
3. *pH, temperature and flow monitoring requirements apply to all off site discharges.*
4. *WID also contains requirements in respect of combined discharges and off site treatment plant that must be adhered to.*
5. *Up to date guidance on the actual technique that should be used for monitoring should be obtained from the Regulator.*

Cont.

Table 2-12 Processed effluent monitoring to water

2. In addition to consideration of the Directive requirements, monitoring of process effluents released to controlled waters and sewers should include at least:

Parameter	Monitoring frequency
Flow rate	Continuous and integrated daily flow rate
pH	Continuous
Temperature	Continuous
COD/BOD	Flow weighted sample or composite samples, weekly analysis, reported as flow weighted monthly averages
TOC	Continuous
Turbidity	Continuous
Dissolved oxygen	Continuous

NB *- other parameters specifically limited in the Permit should be monitored. The appropriateness of the above frequencies will vary depending upon the sensitivity of the receiving water and should be proportionate to the scale of the operations.*

BOD/ADt and COD/ADt should be established annually as an annual average.

Emissions monitoring to water (cont.)

3. In addition, the Operator should have a fuller analysis carried out covering a broad spectrum of substances to establish that all relevant substances have been taken into account when setting the release limits. This should cover the substances listed in Schedule 5 of the Regulations unless it is agreed with the Regulator that they are not applicable. This should normally be done at least annually.

4. Any substances found to be of concern, or any other individual substances to which the local environment may be susceptible and upon which the operations may impact, should also be monitored more regularly. This would particularly apply to the common pesticides and heavy metals. Using composite samples is the technique most likely to be appropriate where the concentration does not vary excessively.

Monitoring and reporting of emissions to air

Emissions monitoring to air

5. Continuous monitoring shall be used where it is required by legislation, where the releases are significant or where it is needed to maintain process control;

6. Gas flow should be measured to relate concentrations to mass releases;

7. To relate measurements to reference conditions, the following will need to be determined and recorded:
   - temperature and pressure;
   - oxygen, where the emissions are the result of a combustion process;
   - water vapour content, where the emissions are the result of a combustion process or any other wet gas stream. It would not be required where the water vapour content is unable to exceed 3% v/v or where dry gas measuring techniques are used for all pollutants.

8. Where appropriate, periodic visual and olfactory assessment of releases should be undertaken to verify that all final releases to air should be essentially colourless, free from persistent trailing mist, fume or droplets. Video records of stack emissions may help with the resolution of complaints and other investigations and should be adopted where concerns arise.

9. The monitoring requirements outlined in the WID are considered to represent BAT for this sector and should be referred to in respect of their detailed requirements. Installations that do not fall within the scope of WID will be expected to meet the standards outlined in WID except where the Operator can clearly demonstrate that to do so would not represent BAT.

Cont.

Table 2-13 Emissions monitoring to air

Table 2-13 below provides a summary of the monitoring requirements for releases to air:

Parameter	Frequency	Method / Specification Ref(s)
NO_x (NO and NO_2 expressed as NO_2)	Continuous	MCERTS Performance Standards for CEMs
CO	Continuous	MCERTS Performance Standards for CEMs
Total dust	Continuous	MCERTS Performance Standards for CEMs
VOC (expressed as TOC)	Continuous	MCERTS Performance Standards for CEMs
HCl	Continuous or Periodic (only where raw flue gas cannot exceed ELV) at same frequency as metals	MCERTS Performance Standards for CEMs and for periodic HCl see NCAS Technical Guidance (on BS EN1911)
HF	Continuous or Periodic (only where raw flue gas cannot exceed ELV, or where HCl ELVs are complied with) at same frequency as metals.	CERAM special publication 35, Recommendations of ISO/TC/146/SC1/WG14
SO_2	Continuous or Periodic (only where raw flue gas cannot exceed ELV) at same frequency as metals	MCERTS Performance Standards for CEMs
Cd + Tl	Periodic – 2 per year but every 3 months in first year of operation. Average value over sample period of between 30 minutes and 8 hours.	USEPA method 29 (CEN standard under development)
Hg	Periodic – 2 per year but every 3 months in first year of operation. Average value over sample period of between 30 minutes and 8 hours.	USEPA method 29 (CEN standard under development)
Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V	Periodic – 2 per year but every 3 months in first year of operation. Average value over sample period of between 30 minutes and 8 hours.	USEPA method 29 (CEN standard under development)
Dioxins and Furans (TEQ as per annexe II of the directive)	Periodic – 2 per year but one every 3 months in first 12 months of operation. Average value over sample period of between 6 and 8 hours. Determination in accordance with CEN standard.	CEN standard equates to BS EN1948 (parts 1-3)
Exhaust gas Oxygen concentration	Continuous	MCERTS Performance Standards for CEMs
Exhaust gas Pressure	Continuous	MCERTS Performance Standards for CEMs
Exhaust gas Temperature	Continuous	MCERTS Performance Standards for CEMs
Exhaust gas water content.	Continuous (not required if sampled exhaust gas is dried prior to analysis)	MCERTS Performance Standards for CEMs

Emissions monitoring to air (cont.)

10. Where not indicated in the table above, averaging periods and compliance criteria are those stated in the directive. Averaging periods are also included in Section 3.3 - Releases to air.

11. Although WID will eventually apply to installations burning hazardous waste, until this is the case, HWID applies. Guidance on the monitoring requirements of HWID is contained in Agency regulatory guidance of 14 July 1999.

12. Specific additional determinants may be required in relation to certain waste types as detailed below. In general this is because of the possible presence of particular substances in such waste derived fuels, and the need to demonstrate their fate in the process. The need for, scope and frequency of such additional monitoring should be reviewed in the light of the data obtained.

Cont.

Table 2-14 - Additional monitoring requirements for selected wastes

Waste	Additional extractive monitoring
Substitute liquid fuel	Pentachlorophenol
Tyres (whole or shredded)	Zinc PAHs, benzene, butadiene, styrene, HBr and chloromethane. These determinands are currently under review.
Refuse derived fuel	Zinc
Waste wood chips and sawdust	Pentachlorophenol Hexchlorocyclohexane (all isomers) Tributyl tin compounds
Sewage sludge	Zinc
Waste photographic emulsions e.g. X-ray film	Silver
Commercial waste (paper, cardboard, rags etc.)	Zinc
Any material containing organophosphates	Total phosphorous compounds

13. The readouts from continuous emission monitors should be processed using software that reports monitoring compliance information to enable direct comparison with the emission limit values specified relevant European legislation and in this guidance (see Section 3 - Emissions) i.e. the software should be capable of calculating half hourly, daily or other averages as appropriate.

14. At sites where there is significant public concern, the Regulator should be provided with the means for 24 hour remote access to real time and historical emissions readouts and reports. The information viewable by the regulator should include:
    - Real time CEM readout graphs
    - The most recently calculated average concentrations
    - Access to historical emissions and operational records
    - The cctv image of the stack emissions (where available)
    - Other key operational parameters e.g. furnace temperatures

It should be noted that providing this facility will not in any way absolve the responsibility of the Operator to undertake their own monitoring and reporting of emissions.

Monitoring and reporting of waste emissions

Emissions monitoring to land

15. Gate and fly ash are the main wastes produced at the installation. Separate guidance on the methods for securing representative ash samples is being produced by the Agency (Ref. 30). Samples should be taken in accordance with this protocol.

16. The scope of the analyses should:
    - Follow the specification in the protocol where indicated for particular sectors (e.g. animal remains incineration)
    - Provide sufficient information to fulfil the waste management duty of care (this should be agreed according to local circumstances but must address the legal principles involved)
    - Be selected according to the risks associated with the fate of that ash i.e. disposal of a consistent low leaching, stable ash at a highly engineered landfill is likely to require less rigorous testing than where it is recycled as an aggregate near a sensitive water course.
    - Take account of changes in waste input or operating regime that may influence ash composition.
    - Take account of any subsequent ash treatment / stabilisation stages i.e. the tests carried out in such circumstances may be less rigorous owing to the controls in place at the ash treatment site where a testing regime will itself fulfil the need to address subsequent disposal / recycling risks.

Cont.

Sampling frequencies for ash should be selected as follows:

- Bottom ash and fly ash - at least one sample tested every three months for the wider analysis as selected according to item 14 above.
- Bottom ash only:
  - one sample tested for Total Organic Carbon (TOC) at least every week during the initial period of testing (i.e. from day one of operation of new installations or from the date of implementation of this regime at existing installations
  - the frequency of TOC testing may be reduced by agreement with the Regulator, if there is consistent compliance with the required standard (WID standard is maximum 3% TOC w/w dry sample). The minimum frequency will be one every three months.

17. Operators should report the results of the tests carried out to the Regulator at least every 6 months. Individual non-compliance tests should be reported without delay and in accordance with permit requirements.

18. Operators must state in their application the proposed treatment / recycling / disposal fate of the fly ash and grate ash produced. Operators should audit the disposal (or recycling) chain in order to satisfy the requirements of the waste management duty of care, and to ensure that the information that they have provided in their application remains current.

19. Operators should report to the Regulator the quantities and proportions of fly ash and bottom ash that have been sent for disposal or recycling at least every six months.

20. At least every year Operators should investigate and report to the Regulator the feasibility of increasing the proportion of recycling that is carried out. This should include an assessment of the economics of developing (on or off site) ash treatment facilities to promote recycling of the ash.

21. For all waste emissions the following should be monitored and recorded:
    - the physical and chemical composition of the waste;
    - its hazard characteristics;
    - handling precautions and substances with which it cannot be mixed;
    - where waste is disposed of directly to land, for example sludge spreading or an on-site landfill, a programme of monitoring should be established that takes into account the materials, potential contaminants and potential pathways from the land to groundwater surface water or the food chain.

Environmental monitoring (beyond the installation)

Environmental monitoring

22. The Operator should consider the need for environmental monitoring to assess the effects of emissions to controlled water, groundwater, air or land or emissions of noise or odour.

    Environmental monitoring may be required, e.g. when:
    - there are vulnerable receptors;
    - the emissions are a significant contributor to an Environmental Quality Standard (EQS) which may be at risk;
    - the Operator is looking for departures from standards based on lack of effect on the environment;
    - there is a need to validate modelling work.

    The need should be considered for:
    - groundwater, where the monitoring should be designed to characterise both quality and flow and take into account short and long-term variations in both. Monitoring will need to take place both up-gradient and down-gradient of the site;
    - surface water, where consideration will be needed for sampling, analysis and reporting for upstream and downstream quality of the controlled water;
    - air, including odour;
    - land contamination, including vegetation, and agricultural products;
    - assessment of health impacts;
    - noise.

Cont.

Where environmental monitoring is needed the following should be considered in drawing up proposals:

- determinands to be monitored, standard reference methods, sampling protocols;
- monitoring strategy, selection of monitoring points, optimisation of monitoring approach;
- determination of background levels contributed by other sources;
- uncertainty for the employed methodologies and the resultant overall uncertainty of measurement;
- quality assurance (QA) and quality control (QC) protocols, equipment calibration and maintenance, sample storage and chain of custody/audit trail;
- reporting procedures, data storage, interpretation and review of results, reporting format for the provision of information for the Regulator.

Guidance on air quality monitoring strategies and methodologies can be found in Technical Guidance Notes M8 and M9 (see Ref. 20), for noise (see Ref. 19) and for odour (see Ref. 22).

Specific environmental monitoring requirements which may be appropriate for this sector:

To water:

- Effluent treatment plant discharges to controlled waters;
- Cooling water discharges

To air:

- daily visual monitoring to air for smoke, dust, litter, vermin, plumes and daily olfactory odour monitoring, with more extensive monitoring if nuisance is occurring or appears likely (see Ref. 22).
- 24 hour time / date coded CCTV / video recordings of the chimney stack emissions should be kept for those sites where there is significant public concern / record of complaint. The camera should be positioned such that the recording provides a good representation of the view likely to be observed by complainants.
- All plants should record wind speed and direction data to assist with complaint investigation

To land:

Monitoring surveys will need to be established where sensitive soil systems or terrestrial ecosystems are at risk from indirect emission via the air (i.e. deposition related), or direct impacts of any on site waste storage and treatment operations.

To groundwater:

Groundwater sampling may be needed where:

- there is uncertainty about drainage systems, especially on older sites;
- there are deliberate discharges to groundwater;
- there are any other deposits to land.

Noise:

See Section 2.9, and Ref. 19.

Monitoring of process variables

Monitoring process variables

23. The following process variables have particular potential to influence emissions. Their monitoring and control is necessary to demonstrate BAT:
    - Waste feedstock composition should be analysed at a frequency and in a manner appropriate to the plant type concerned. The type and frequency of the analyses carried out should be selected with reference to the plant performance and the value that may be accrued from additional knowledge of the feedstock stream. Plants with a demonstrably wide operational envelope and good emission compliance record are less likely to require stringent measures are adopted in this respect.
    - Waste throughput should be recorded in such a way that it enable comparison with the design throughput. In addition, an hourly and annual throughput shall be recorded as a minimum.
    - Combustion temperature at the agreed 2 second residence time location;

Cont.

- Oxygen concentration at the outlet from the last combustion chamber
- differential pressure across bag filters can indicate filtration efficiency and bag blowouts.
- potential difference across the EP plates;
- reagent feed rates;
- upstream HCl concentration (to enable linkage to and automatic control of scrubbing medium dose rate);

24. Temperature monitoring is required for process monitoring and control and in order to demonstrate compliance with the required combustion temperatures (see Section 2.3.4 - Furnace requirements). The performance of temperature monitoring equipment varies depending upon its location in the process and the environment to which it is subjected. Table 2-15 below outlines the main factors relevant to the selection of temperature monitoring equipment.

Comparison of Gas Temperature Measurement Systems

Table 2-15 - Gas temperature measurement systems

Methods	Measures	Response Time	Equipment	Suitable for Measuring:		Comments
				Point	Bulk Mean	
Acoustic Pyrometry	Average over path	Instantaneous, continuous	Non-intrusive, permanent	Yes[1]	Yes	Good accuracy
Optical and Radiation Pyrometry	Average over path	Instantaneous, continuous	Viewing point	Yes[2]	Yes	Can suffer from "cold wall" and particle effects
Shielded Thermocouples	Gas temperature at point	Delayed response but can operate continuously	Permanent	Yes	Yes[3]	Negative bias. Can droop if orientated horizontally
Suction Pyrometers	Gas temperature at point	Instantaneous, periodically	Special probe for periodic working only	Yes	Yes[3]	Very accurate but needs manual attendance. Can be cumbersome
Heat Balance	Estimate of bulk mean gas temperature	Requires computations	Off-line, based on knowledge of operating parameters	No	Yes	Estimate only, but acceptable for bulk mean temperature estimation.

Notes:

1. *Can only deliver point data if several arrays are installed.*
2. *Only some systems can be focused.*
3. *Can deliver profile information only if several probes are used or traversing is undertaken.*

It can be seen that suction pyrometers offer the best performance and may be BAT in many situations. This will be particularly the case in respect of temperature validation work (see Section 2.3.4.4) where they should form at least the basis for the calibration and correction of other monitors.

Monitoring standards (standard reference methods)

Equipment standards MCERTS

The Environment Agency has introduced its Monitoring Certification Scheme (MCERTS) to improve the quality of monitoring data and to ensure that the instrumentation and methodologies employed for monitoring are fit for purpose. Performance standards have been published for continuous emissions monitoring systems (CEMs) and continuous ambient air quality monitoring systems (CAMs).

Other MCERTS standards are under development to cover:

- manual stack emissions monitoring;

Cont.

- portable emissions monitoring equipment;
- ambient air quality monitors;
- water monitoring instrumentation;
- data acquisition;
- Operators' own arrangements, such as for installation, calibration and maintenance of monitoring equipment, position of sampling ports and provision of safe access for manual stack monitoring.

25. As far as possible, Operators should ensure their monitoring arrangements comply with the requirements of MCERTS where available, e.g. using certified instruments and equipment, and using a registered stack testing organisation etc. Where the monitoring arrangements are not in accordance with MCERTS requirements, the Operator should provide justification and describe the monitoring provisions in detail. See Environment Agency Website (Ref. 20) for listing of MCERTS equipment

26. The following should be described in the application indicating which monitoring provisions comply with MCERTS requirements or for which other arrangements have been made:
    - monitoring methods and procedures (selection of Standard Reference Methods);
    - justification for continuous monitoring or spot sampling;
    - reference conditions and averaging periods;
    - measurement uncertainty of the proposed methods and the resultant overall uncertainty;
    - the proposed criteria for the assessment of non-compliance with Permit limits and details of monitoring strategy aimed at demonstration of compliance (this should comply with any relevant legislative requirements);
    - reporting procedures and data storage of monitoring results, record keeping and reporting intervals for the provision of information to the Regulator;
    - procedures for monitoring during start-up and shut-down and abnormal process conditions;
    - drift correction calibration intervals and methods (Note: systems without drift are available);
    - the accreditation held by samplers and laboratories or details of the people used and the training/competencies.

Standards for sampling and analysis

Sampling and analysis standards

27. The analytical methods given in Appendix 1 should be used. In the event of other substances needing to be monitored, standards should be used in the following order of priority:
    - Comité Européen de Normalisation (CEN);
    - British Standards Institution (BSI);
    - International Standardisation Organisation (ISO);
    - United States Environmental Protection Agency (US EPA);
    - American Society for Testing and Materials (ASTM);
    - Deutches Institute für Normung (DIN);
    - Verein Deutcher Ingenieure (VDI);
    - Association Française de Normalisation (AFNOR).

Further guidance on standards for monitoring gaseous releases relevant to IPC/IPPC is given in the Technical Guidance Note 4 (Monitoring) (see Ref. 20). A series of updated Guidance Notes covering this subject is currently in preparation. This guidance specifies manual methods of sampling and analysis which will also be suitable for calibration of continuous emission monitoring instruments. Further guidance relevant to water and waste is available from the publications of the Standing Committee of Analysts.

If in doubt the Operator should consult the Regulator.

2.11 De-commissioning

The IPPC application requires the preparation of a site report whose purpose, as described in more detail in Refs. 3 and 4 is to provide a point of reference against which later determinations can be made of whether there has been any deterioration of the site and information on the vulnerability of the site.

Application Form Question 2.11

Describe the proposed measures, upon definitive cessation of activities, to avoid any pollution risk and return the site of operation to a satisfactory state (including, where appropriate, measures relating to the design and construction of the installation).

With the Application the Operator should:

1. supply the site report;
2. describe the current or proposed position with regard to the techniques below or any others which are pertinent to the installation;
3. for existing activities, identify shortfalls in the above information which the Operator believes require longer term studies to establish.

Indicative BAT Requirements

BAT for decommissioning

1. **Operations during the IPPC Permit**

   Operations during the life of the IPPC Permit should not lead to any deterioration of the site if the requirements of the other sections of this and the specific sector notes are adhered to. Should any instances arise which have, or might have, impacted on the state of the site the Operator should record them along with any further investigation or ameliorating work carried out. This will ensure that there is a coherent record of the state of the site throughout the period of the IPPC Permit. This is as important for the protection of the Operator as it is for the protection of the environment. Any changes to this record should be submitted to the Regulator.

2. **Steps to be taken at the design and build stage of the activities**

   Care should be taken at the design stage to minimise risks during decommissioning. For existing installations, where potential problems are identified, a programme of improvements should be put in place to a timescale agreed with the Regulator. Designs should ensure that:

   - underground tanks and pipework are avoided where possible (unless protected by secondary containment or a suitable monitoring programme);
   - there is provision for the draining and clean-out of vessels and pipework prior to dismantling;
   - lagoons and landfills are designed with a view to their eventual clean-up or surrender;
   - insulation is provided which is readily dismantled without dust or hazard;
   - materials used are recyclable (having regard for operational or other environmental objectives).

3. **The site closure plan**

   A site closure plan should be maintained to demonstrate that, in its current state, the installation can be decommissioned to avoid any pollution risk and return the site of operation to a satisfactory state. The plan should be kept updated as material changes occur. Common sense should be used in the level of detail, since the circumstances at closure will affect the final plans. However, even at an early stage, the closure plan should include:

   - either the removal or the flushing out of pipelines and vessels where appropriate and their complete emptying of any potentially harmful contents;
   - plans of all underground pipes and vessels;
   - the method and resource necessary for the clearing of lagoons;
   - the method of ensuring that any on-site landfills can meet the equivalent of surrender conditions;
   - the removal of asbestos or other potentially harmful materials unless agreed that it is reasonable to leave such liabilities to future owners;

Cont.

BAT for decommissioning (cont.)

- methods of dismantling buildings and other structures, see Ref. 24 which gives guidance on the protection of surface and groundwater at construction and demolition-sites;
- testing of the soil to ascertain the degree of any pollution caused by the activities and the need for any remediation to return the site to a satisfactory state as defined by the initial site report.

(Note that radioactive sources are not covered by this legislation, but decommissioning plans should be co-ordinated with responsibilities under the Radioactive Substances Act 1993.)

For existing activities, the site closure plan may, if agreed with the Regulator, be submitted as an improvement condition.

2.12 Installation Wide Issues

In some cases it is possible that actions which benefit the environmental performance of the overall installation will increase the emissions from one Permit holder's activities. For example, taking treated effluent as a raw water supply will probably slightly increase emissions from that activity but could dramatically cut the total emissions from the whole installation.

Application Form Question 2.12

Where you are not the only Operator of the installation, describe the proposed techniques and measures (including those to be taken jointly by yourself and other Operators) for ensuring the satisfactory operation of the whole installation.

With the Application the Operator should:

1. where there are a number of separate Permits for the installation (particularly where there are different Operators), **identify** any installation wide issues and opportunities for further interactions between the Permit holders whereby the performance of the overall installation may be improved; and in particular
2. describe the current or proposed position with regard to the techniques below, or any others which are pertinent to the installation;

Indicative BAT Requirements

BAT across the whole installation

The possibilities will be both sector and site-specific, and include:

1. communication procedures between the various Permit holders; in particular those needed to ensure that the risk of environmental incidents is minimised;
2. benefiting from the economies of scale to justify the installation of a CHP plant;
3. the combining of combustible wastes to justify a combined waste-to-energy/CHP plant;
4. the waste from one activity being a possible feedstock for another;
5. the treated effluent from one activity being of adequate quality to be the raw water feed for another activity;
6. the combining of effluent to justify a combined or upgraded effluent treatment plant;
7. the avoidance of accidents from one activity which may have a detrimental knock-on effect on the neighbouring activity;
8. land contamination from one activity affecting another – or the possibility that one Operator owns the land on which the other is situated.

3 EMISSION BENCHMARKS

3.1 Emissions Inventory and Benchmark Comparison

Application Form Question 3.1

Describe the nature, quantities and sources of foreseeable emissions into each medium (which will result from the techniques proposed in Section 2).

With the Application the Operator should:

1. provide a table of significant emissions of substances (except noise, vibration, odour or heat which are covered in their respective sections) that will result from the proposals in Section 2 and should include, preferably in order of significance:
   - substance (where the substance is a mixture, e.g. VOCs or COD, separate identification of the main constituents or inclusion of an improvement proposal to identify them may be required);
   - source, including height, location and efflux velocity;
   - media to which it is released;
   - any relevant EQS or other obligations;
   - benchmark;
   - proposed emissions normal/max expressed, as appropriate (see Section 3.2), for:
     - mass/unit time;
     - concentration;
     - annual mass emissions.
   - statistical basis (average, percentile etc.);
   - notes covering the confidence in the ability to meet the benchmark values;
   - if intermittent, the appropriate frequencies;
   - plant loads at which the data is applicable;
   - whether measured or calculated (the method of calculation should be provided).

   The response should clearly state whether the emissions are current emission rates or those planned following improvements, and should cover emissions under both normal and abnormal conditions for:

   - point source emissions to surface water, groundwater and sewer;
   - waste emissions (refer to Sections 2.5 and 2.6 - Waste Management);
   - point source emissions to air;
   - significant fugitive emissions to all media, identifying the proportion of each substance released which is due to fugitives rather than point source releases;
   - abnormal emissions from emergency relief vents, flares etc.;
   - indirect and direct emission of carbon dioxide associated with energy consumed or generated.

   Emissions of carbon dioxide associated with energy use should be broken down by energy type and, in the case of electricity, by source e.g. public supply, direct supply or on site generation. Where energy is generated on site, or from a direct (non-public) supplier, the Operator should specify and use the appropriate factor. Standard factors for carbon dioxide emissions are provided in the Energy Efficiency Guidance Note.

   Where VOCs are released, the main chemical constituents of the emissions should be identified. The assessment of the impact of these chemicals in the environment will be carried out as in response to Section 4.1.

   For waste, emissions relate to any wastes removed from the installation, or disposed of at the installation under the conditions of the Permit, e.g. landfill. Each waste should have its composition determined and the amounts expressed in terms of cubic metres or tonnes per month.

   A suitable table on which to record this information is provided in the electronic version of this Guidance Note.
2. compare the emissions with the benchmark values given in the remainder of this Section;
3. where the benchmarks are not met, revisit the responses made in Section 2 as appropriate (see Section 1.2) and make proposals for improvements or justify not doing so.

3.2 The Emission Benchmarks

Introduction to emission benchmarks

Guidance is given in section 3.3 on release concentrations achieved for key substances for each sub-sector and a benchmark emission limit value. The mandatory release limits specified in European legislation for various incineration plants are included and must be met as a minimum where they apply.

The "reported ranges" provide a measure of current performance against the required standards. At new installations it may be possible for releases at the lower end of the reported range to be achieved. Existing installations should operate to the lowest practicable figure taking into account the BAT criteria. Where they apply, installations that cannot meet the minimum standards met by European legislation will not be permitted to operate.

3.2.1 Emissions to air associated with the use of BAT

Emissions quoted as averages are based upon continuous monitoring or are averaged over the period of the sampling as specified, during the period of operation. Care should always be taken to convert benchmark and proposed releases to the same reference conditions for comparison. To convert measured values to reference conditions, see Technical Guidance Note M2 (Ref. 20) for more information

Limits in Permits should always reflect the averaging periods stated. Additional limits may be set for mean or median values over long or short periods. The periods and limits selected should reflect:

- the manner in which the emission may impact upon the environment;
- likely variations which will arise during operation within BAT;
- possible failure modes and their consequences;
- the capabilities of the monitoring and testing system employed.

For any additional, non-legislative limits that are not specified in this guidance, where emissions are expressed in terms of concentrations and where continuous monitors are employed, it is recommended that limits are defined such that:

- not more than one calendar monthly average during any rolling twelvemonth period shall exceed the benchmark value by more than 10%;
- not more than one half hour period* during any rolling 24 hour period shall exceed the benchmark value by more than 50%.

* for the purpose of this limit half hourly periods commence on the hour and the half hour.

For any additional non-legislative limits that are not specified in this guidance, where spot tests are employed:

- the half hour limit above shall be applied over the period of the test;
- the mean of three consecutive tests taken during a calendar year shall not exceed the benchmark value by more than 10%.

3.2.2 Emissions to water associated with the use of BAT

Wastewater treatment systems can maximise the removal of metals using precipitation, sedimentation and filtration. The reagents used for precipitation will be defined by the mix of metals present, and may include hydroxide, sulphide or a combination of both. Concentrated effluents should be pre treated before discharge into the final effluent treatment system, and techniques such as electrolysis, reverse osmosis and metal removal using ion exchange systems may need to be employed. Water discharges should be kept to a minimum by using closed cycle cooling systems and by maximising the reuse of treated process water.

Where automatic sampling systems are employed, limits must comply with European legislation and if this is not jeopardised, may be defined such that:

- not more than 5% of samples shall exceed the benchmark value.

Where spot samples are taken:

- no spot sample shall exceed the benchmark value by more than 50%.

3.2.3 Introduction to Standards and obligations

In addition to meeting the requirements of BAT, and any mandatory release concentration (and process operation) specifications in European legislation, there are other national and international standards and obligations which must either be safeguarded through the IPPC Permit or, at least, taken into account in setting Permit conditions. This is particularly the case for any EC based EQSs. The most likely of these to be relevant in this sector are referred to below. **The extracts from standards are, however, quoted for ease of reference; the relevant and most up to date standards should be consulted for the definitive requirements.**

EC based EQ Standards

IPPC: A Practical Guide (see Ref. 3) explains how these should be taken into account and contains an annex listing the relevant standards. (See Appendix 2 for equivalent legislation in Scotland and Northern Ireland). They can be summarised as:

Mandatory incineration and co-incineration Standards

The standards are currently in a transitional stage. Directive 2000/76/EC is likely to be the most relevant the installations covered by this note. Some of the older Directives contain standards that are likely to be improved upon when using BAT or BATNEEC.

- **Directive 2000/76/EC on the incineration of waste.**

  This Directive will replace the other incineration directives and set requirements for the majority of incineration plant burning wastes. Reference should be made to the Directive regarding the scope to various plants and the dates when the obligations it contains must be complied with. The standards in this guidance incorporate the requirements of this Directive where applicable.
- **Directive 94/67/EC on the incineration of hazardous waste**

  This Directive will apply to the incineration and co-incineration of specified hazardous wastes until replaced by 2000/76/EC. The standards in this guidance incorporate the requirements of this Directive where applicable.
- **Directive 89/429/EEC on the prevention of air pollution from existing municipal waste incineration plants**

  This Directive sets minimum mandatory standards for "existing" (see directive for definition) municipal waste incinerators and will be replaced by 2000/76/EC. The Agency is of the opinion that BAT / BATNEEC requirements now go beyond the requirements of this Directive.
- **Directive 89/369/EEC on the prevention of air pollution from new municipal waste incineration plants**

  This Directive sets minimum standards for "new" (see directive for definition) municipal waste incinerators and will be replaced by 2000/76/EC. The Agency is of the opinion that BAT / BATNEEC requirements now go beyond the requirements of this Directive.

Air Quality

- Statutory Instrument 1989 No 317, Clean Air, The Air Quality Standards Regulations 1989.
- Statutory Instrument 1997 No 3043, Environmental Protection, The Air Quality Regulations 1997.

Water Quality

- Directive 76/464/EEC on Pollution Caused by Dangerous Substances Discharged to Water contains two lists of substances. List I relates to the most dangerous, and standards are set out in various daughter Directives. List II substances must also be controlled. Annual mean concentration limits for receiving waters for List I substances can be found in SI 1989/2286 and SI 1992/337 the Surface Water (Dangerous Substances Classification) Regulations. Values for List II substances are contained in SI 1997/2560 and SI 1998/389. Daughter Directives cover EQS values for mercury, cadmium, hexachlorocyclohexane, DDT, carbon tetrachloride, pentachlorophenol, aldrin, dieldrin, endrin, isodrin, hexachlorobenzene, hexachlorobutadiene, chloroform,1,2-dichloroethane, trichloroethane, perchloroethane and trichlorobenzene.
- Other waters with specific uses have water quality concentration limits for certain substances. These are covered by the following Regulations:
  - SI 1991/1597 Bathing Waters (Classification) Regulations;
  - SI 1992/1331 and Direction 1997 Surface Waters (Fishlife) (Classification) Regulations;
  - SI 1997/1332 Surface Waters (Shellfish) (Classification) Regulations;
  - SI 1996/3001 The Surface Waters (Abstraction and Drinking Water) (Classification) Regulations.

Future likely changes include:

- Some air and water quality standards may be replaced by new standards in the near future.

Other standards and obligations

Those most applicable to this sector are:

- Large Combustion Plant Directive;
- Reducing Emissions of VOCs and Levels of Ground Level Ozone: a UK Strategy;
- Water Quality Objectives – assigned water quality objectives to inland rivers and water courses (ref. Surface (Rivers Ecosystem) Classification);
- The UNECE convention on long-range transboundary air pollution;

- The Montreal Protocol;
- The Habitats Directive (see Section 4.3).

3.2.4 Units for benchmarks and setting limits in Permits

Releases can be expressed in terms of:

- "**concentration**" (e.g. mg/l or mg/m^3) which is a useful day-to-day measure of the effectiveness of any abatement plant and is usually measurable and enforceable The total flow must be measured/controlled as well;
- "**specific mass release**" (e.g. kg/ tproduct or input or other appropriate parameter) which is a measure of the overall environmental performance of the plant (including the abatement plant) compared with similar plants elsewhere;
- "**absolute mass release**" (e.g. kg/hr, t/yr) which relates directly to environmental impact.

When endeavouring to reduce the environmental impact of an installation, its performance against each of these levels should be considered, as appropriate to the circumstances, in assessing where improvements can best be made.

When setting limits in Permits the most appropriate measure will depend on the purpose of the limit. It may also be appropriate to use surrogate parameters which reflect optimum environmental performance of plant as the routine measurement, supported by less frequent check-analyses on the final concentration. Examples of surrogate measures would be the continuous measurement of conductivity (after ion-exchange treatment) or total carbon (before a guard-column in activated carbon treatment) to indicate when regeneration or replacement is required.

In all cases, where European legislation applies, suitable limits should be set that enable direct comparison of installation performance against the relevant legislative standard.

3.2.5 Statistical basis for benchmarks and limits in Permits

Conditions in Permits can be set with percentile, mean or median values over yearly, monthly or daily periods, which reflect probable variation in performance. In addition absolute maxima can be set.

Where there are known failure modes, which will occur even when applying BAT, limits in Permits may be specifically disapplied but with commensurate requirements to notify the Regulator and to take specific remedial action.

For Water: UK benchmarks or limits are most frequently 95 percentile concentrations or absolute concentrations, (with flow limited on a daily average or maximum basis).

For Air: benchmarks or limits are most frequently expressed as daily averages or, typically 95% of hourly averages.

In all cases, where European legislation applies, suitable standards should be set that enable direct comparison of installation performance against the relevant legislative standard.

3.2.6 Reference conditions for releases to air

The reference conditions of substances in releases to air from point sources are stated in European legislation. They are:

Incineration plants

- temperature 273 K (0°C), pressure 101.3 kPa (1 atmosphere), 11% oxygen, dry gas.

Waste Oil Incinerators

- temperature 273 K (0°C), pressure 101.3 kPa (1 atmosphere), 3% oxygen, dry gas.

Co-incinerators

- refer to HWID or WID as appropriate.

These reference conditions relate to the benchmark release levels given in this Note and care should always be taken to convert benchmark and proposed releases to the same reference conditions for comparison. The Permit may employ different reference conditions if they are more suitable for the process in question, but the standards of European legislation must be included to enable direct comparison.

To convert measured values to reference conditions see Technical Guidance Note M2 (Ref. 20) for more information.

3.3 Releases to Air

The incineration of waste is subject to a number of European Directives. This section outlines the standards required by those directives in respect of releases to air. In addition to the legislative standards, the use of BAT may result in additional emission reductions.

3.3.1 Introduction to the European Directive Emission Limits

Where an installation falls within the scope of a particular Directive, the standards set by that Directive apply ***as a minimum***. In some circumstances the use of BAT may result in tighter controls.

Each of the Directives contains sections which define the scope of the directive and its provisions. The interpretation of the scope of a particular directive will depend upon legal interpretation of the Directive.

National governments have the responsibility for implementing the enabling legislation that brings European Directives into force, and for appointing an appropriate Regulator. The enabling legislation generally takes the form of Regulations or Direction by the Secretary of State. Once the enabling legislation has been passed the appointed Regulator is required to enforce the requirements of the Directive as advised by Government.

At the time of writing this guidance, the “new” waste incineration directive or WID (2000/76/EC), whilst in force at a European level, remains to be implemented by means of national legislation. For the purposes of this guidance the requirements of the Directive itself have therefore been considered. Any subsequent implementing legislation will need to be taken into account in due course.

The WID is of particular relevance because it will repeal earlier directives on municipal and hazardous waste incineration, and in replacing them, substantially broaden the scope of installations that will be effected by European Legislation**. There will be very few installations that burn waste that do not fall within the scope of WID.** The Agency intends to produce separate “Regulatory Guidance” which will outline the scope and application of WID in more detail.

It is **important** that Operators of existing installations and those who propose any new installation **contact the Agency at an early stage** to discuss this matter if:

- They intend to burn any waste
- They intend to burn any fuel derived from waste

3.3.2 Waste Incineration Directive 2000/76/EC

The Waste Incineration Directive has been developed to fill the gaps between existing Directives on municipal waste incineration and hazardous waste incineration. The existing Directives dealing with municipal and hazardous waste incineration will be repealed on 28 December 2005, five years after the Waste Incineration Directive comes into force. The Agency intends to issue detailed regulatory guidance on the Directive to assist in interpretation, and provide links as appropriate to this guidance.

Implementation provisions are:

- for new plant: shall comply with this Directive from 28 December 2002;
- for existing plant: shall comply with this Directive no later than 28 December 2005.

Co-incineration plants which start co-incinerating waste not later than 28 December 2004, are to be regarded as existing co-incineration plants. The emission limit values for co-incineration plants are not included here – readers should refer to the Directive and to the sector specific guidance.

The emission limit values for incineration plants falling within WID are summarised in Table 3-1. Readers should consult the Directive for full details.

Table 3-1 - Waste Incineration Directive Annex V: air emission limit values (ELV)

Pollutant	Directive Requirement		
	ELV (mg/m^3 unless stated)*	Averaging / Monitoring Period	Monitoring Frequency
Total Dust	10	Daily average	Continuous
Total Dust	30	100% ½ hourly averages	
Total Dust	10	97% ½ hourly averages	
VOCs (as TOC)	10	Daily average	Continuous
VOCs (as TOC)	20	100% ½ hourly averages	
VOCs (as TOC)	10	97% ½ hourly averages	
HCl	10	Daily average	Continuous
HCl	60	100% ½ hourly averages	(periodic may be used where emission *cannot* exceed ELV)
HCl	10	97% ½ hourly averages	
HF	1	Daily average	Continuous
HF	4	100% ½ hourly averages	(periodic may be used where emission cannot exceed ELV or where HCl ELVs complied with)
HF	2	97% ½ hourly averages	
SO_2	50	Daily average	Continuous
SO_2	200	100% ½ hourly averages	(periodic may be used where emission cannot exceed ELV)
SO_2	50	97% ½ hourly averages	
NOx (nitrogen monoxide and nitrogen dioxide expressed as nitrogen dioxide)	200	Daily average	Continuous
NOx (as above)	400	100% ½ hourly averages	
NOx (as above)	200	97% ½ hourly averages	
CO	50	Daily average	Continuous
CO	150	95% of 10min averages	
CO	100	100% of ½ hourly averages	
Cd and Tl	total 0.05	All average values over the sample period (30 minutes to 8 hours) to be less than these limits	Periodic – 2 per year but one every 3 months during the first year of operation.
Hg	0.05		
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V	total 0.5		
Dioxins and furans	0.1 ng/m^3 TEQ	CEN method (EN 1948, parts 1, 2 and 3) sample period 6 to 8 hours	Periodic – 2 per year but one every 3 months during the first year of operation.

Notes:

1. * reference conditions: 273 K, 101.3 kPa, 11% O_2, dry gas.
2. ELVs apply at all times when waste is being burned (except for CO during start-up and shut down)
3. The ELVs for metals include solid, gaseous and vapour forms as well as their compounds.
4. TEQ should be calculated as described in annexe I of the Directive
5. The Directive provides for certain derogations in respect of NOx and particulate emissions from existing plants. These are not generally expected to be applicable in the UK as BAT will achieve the required ELV.
6. The Agency will generally apply the 100%ile limits for both daily and ½ hourly ELVs.
7. Derogation from the above CO ELVs is available for fluidised beds up to $100mg/m^3$ as an hourly average.
8. The Waste Incineration Directive goes beyond emission limit values. Permits will also be required to include an extensive range of conditions to ensure high operational standards.
9. Monitoring techniques should be CEN or where not available, national or international standards. Further guidance is given in Section 2.10.

3.3.3 Hazardous Waste Incineration Directive 94/67/EC

The Hazardous Waste Incineration Directive (HWID) was implemented in the UK early 1998 by a combination of Secretary of State Direction and Regulations (SI1998 No.767). A Regulatory Guidance Note issued 14 July 1999, and other supplementary guidance on clinical waste incineration, provides detailed guidance and is available from the Agency on request.

When hazardous waste is burned, this directive must be complied with, until superseded by WID (see Section 3.3.2 above).

The Directive recognises the burning of hazardous waste in plants not intended primarily for that purpose, such as cement and lime kilns. The Directive requires that if more than 40% of the heat input to a kiln is supplied by fuel classified as hazardous waste under Article 2(1), then the requirements in table 3-2 must be applied. Operators should note that the hazardous waste list has been revised (Ref. 2000/532/EC), which may have the effect of extending the scope of the HWID. Further amendments to the list are planned to take effect by 1 January 2002.

If the heat obtained from burning hazardous waste is 40% or less of the total kiln heat input at any time then, in accordance with Annex II of the Directive, the emission limit values in Table 3-2 only apply to that portion of the exhaust gases generated by combustion of the waste. Overall emission limit values are based on pro-rating between the limits in Table 3-2, any existing authorised kiln limits based on the exhaust gas flows resulting from incinerating the waste and the flows from the kiln process when fired on non-hazardous waste fuels.

Table 3-2 - Hazardous Waste Incineration Directive: Emission limit values

Substance	Emission limits (mg/m^3)* Daily average	Emission limits (mg/m^3)* Half hourly average	Monitoring requirements	Compliance conditions**
Particulates***	10	30 (10)	continuous	Daily averages to be less than these limits; and either all 30 min averages over a year to be less than limits; or 97% of 30 min averages over a year to be less than bracketed limits
VOCs as carbon***	10	20 (10)	continuous	
HCl***	10	60 (10)	continuous	
HF***	1	4 (2)	spot where HCl can be used as a surrogate	
SO_2***	50	200 (50)	continuous	
CO	50	100 (150)	continuous	Daily averages to be less than these limits; and either all 30 min averages in 24 hours to be less than limits; or 95% of 10 min averages over a year to be less than bracketed limits
	New plants	**Existing plants**		
Cd and Tl in total***	0.05	0.1	Every 2 months for the first year of operation, then twice per year	All average values over the sample period (30 minutes to 8 hours) to be less than these limits
Hg***	0.05	0.1		
Pb, Cr, Cu, Mn, Ni, As, Sb, Co, V and Sn in total***	0.5	1		
Dioxins TEQ (ng/m^3)	0.1	0.1		CEN method (EN 1948, parts 1,2 and 3) sample period 6 to 8 hours

* Reference conditions are dry, temperature 273 K, pressure 101.3 kPa, 11% oxygen

** Permits usually specify half-hourly limits as all 30-minute averages over a year to be less than limits.

*** Measurements of these pollutants shall not be necessary, provided that the Permit allows the incineration of only those hazardous wastes which cannot cause average values of those pollutants higher than 10% of the emission limit values. This is important for plants burning low chlorine or low sulphur wastes.

The Directive requirements go beyond air emission limit values. Regulators are required to:

- specify types/ quantities of hazardous waste which can be used in the process;
- set conditions for delivery/ receipt of wastes;
- set operating conditions such as minimum temperature, residence time, % oxygen;
- monitor releases as specified in the Directive.

In addition, where the hazardous waste provides 40% or less of the thermal input to the process, the Permit shall specify the minimum and maximum flow rates of hazardous wastes, minimum and maximum calorific values and the maximum concentration of pollutants, for example PCB, PCP, chlorine, fluorine, sulphur and heavy metals.

Existing Municipal Waste Incinerators Directive 89/429/EEC

Whilst setting the current European legislative baseline standards for all existing MWIs, the emission limits and other requirements specified in this directive are no longer considered to reflect the application of BAT (or BATNEEC). All installations are required to meet the standards of the "new" WID from 28 December 2005 at the latest.

New Municipal Waste Incinerators Directive 89/369/EEC

Whilst setting the current European legislative baseline standards for all existing MWIs, the emission limits and other requirements specified in this directive are no longer considered to reflect the application of BAT (or BATNEEC). All installations are required to meet the standards of the "new" WID from 28 December 2005 at the latest.

Other applicable Standards and obligations

(Extracts from standards are quoted for ease of reference. The relevant standards should be consulted for the definitive requirements)

Statutory Instrument 1989 No 317, *Clean Air, The Air Quality Standards Regulations 1989* gives limit values in air for nitrogen dioxide.

Statutory Instrument 1997 No 3043, *Environmental Protection, The Air Quality Regulations 1997* gives air quality objectives to be achieved by 2005 for nitrogen dioxide

The UNECE convention on long-range transboundary air pollution - Negotiations are now underway which could lead to a requirement further to reduce emissions of NO_x.

Statutory Instrument 1989 No 317, *Clean Air, The Air Quality Standards Regulations 1989* gives limit values in air for suspended particulates.

Statutory Instrument 1997 No 3043, *Environmental Protection, The Air Quality Regulations 1997* gives air quality objectives to be achieved by 2005 for PM_{10}

Statutory Instrument 1989 No 317, *Clean Air, The Air Quality Standards Regulations 1989* gives limit values in air for sulphur dioxide.

Statutory Instrument 1997 No 3043, *Environmental Protection, The Air Quality Regulations 1997* gives air quality objectives to be achieved by 2005 for sulphur dioxide

The UNECE convention on long-range transboundary air pollution. Under this Convention, a requirement further to reduce SO_2 emissions *from all sources* has been agreed. The second Sulphur Protocol (Oslo, 1994) obliges the UK to reduce SO_2 emissions by 80% (based on 1980 levels) by 2010.

"Reducing Emissions of VOCs and Levels of Ground Level Ozone: A UK Strategy" was published by the Department of the Environment in October 1993. It sets out how the Government expects to meet its obligations under the UNECE VOCs Protocol to reduce its emissions by 30% (based on 1988 levels) by 1999, including the reductions projected for the major industrial sectors. Although Pulp and Paper is included in the "other miscellaneous industries" sector, no specific reduction targets are stated.

The UNECE convention on long-range transboundary air pollution - Negotiations are now under way which could lead to a requirement further to reduce emissions of VOCs.

3.3.4 Municipal waste incinerators

Standards and obligations for MWIs

- Existing installations must meet the requirements of the *current* municipal waste incineration directives (the 1989 directives) as an absolute minimum. It is unlikely that operation to this standard will be acceptable, as the use of BAT will result in improved environmental performance.
- All existing installations must comply with WID standards as a minimum from 28 December 2005 at the latest.
- All new plants must comply with WID standards as a minimum with immediate effect.
- Although compliance with WID standards will be taken to indicate that BAT is in use, Operators will be required to demonstrate why further emission reductions cannot be achieved through the use of BAT. This will be particularly the case at larger throughput plant, or where local environmental conditions require installation pollutant contributions to background levels are further reduced.

Benchmark emission values

Substance(s)	Currently reported (mg/m^3 unless stated)	Benchmark ELV	Comments
Total particulate	1 - 28	WID	Bag filters are capable of meeting WID standard. Wet scrubbing or EP are not adequate on their own
VOCs (as TOC)	<1 - <8	WID	Combustor design and combustion control important.
HCl	1 - 98	WID	Optimisation of alkaline dosing by upstream HCl monitoring and feed forward dosing control or extensive waste selection/ pre-treatment required to control short term peaks avoid excessive alkaline reagent dosing wet systems may meet standard but effluent treatment required. Waste pre-treatment may be required to prevent peaks
HF	0.1 – 2.8	WID	See measures under HCl
SO_2	<3 - 479	WID	See measures under HCl
NOx (NO and NO_2 as NO_2)	276 - 479	WID	Some existing plant will require upgrade. Combustor and grate design and combustion control important. FGR likely to be BAT for all new plant and existing plant except where high retrofit costs. Fluid bed may offer advantages with treated waste feeds SNCR (urea or ammonia) required to guarantee ELVs. All (particularly new) plant must justify why SCR and ELV of 100mg/m3 is not BAT.
NH_3		10 mg/m^3 daily avg. 20 mg/m^3 1/2hr avg.	Not covered by European legislation. Limits to be applied to control slip from NOx control systems
N_20		30 mg/m^3 avg. over 8 hr sample period	Not covered by European legislation. Limits to be applied to control slip from NOx control systems
CO	3 - 198	WID	Combustor design and combustion control important. Charging systems need control
Cd and Tl	0.02 – 0.12	WID	Avoid excessive furnace temperatures Barrier filtration required to control particulate bound metals.
Hg	0.005 – 0.08	WID	Carbon injection required.
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V	0.04 – 0.53	WID	Avoid excessive furnace temperatures Barrier filtration required to control particulate bound metals
Dioxins and furans	0.01 – 0.14 ng/m3	WID	Combustor design and combustion control important. FGR likely to be BAT for all new plant and existing plant except where high retrofit costs. Carbon injection required. Use of SCR to be considered in BAT assessment. Use of catalytic filter bags to be considered in BAT assessment

Note: 1. Quoted performance figures may not be directly comparable owing to different averaging periods.

3.3.5 Clinical waste incinerators

Standards and Obligations for CWIs

- Where hazardous wastes are burned existing installations must meet the requirements HWID as an absolute minimum.
- All existing installations must comply with WID standards as a minimum from 28 December 2005 at the latest.
- All new plants must comply with WID standards as a minimum with immediate effect as BAT
- Although compliance with WID standards will be taken to indicate that BAT is in use, Operators will be required to demonstrate why further emission reductions cannot be achieved through the use of BAT. This will be particularly the case at larger throughput plant, or where local environmental conditions require installation pollutant contributions to background levels are further reduced.

Benchmark emission values

Substance(s)	Currently reported (mg/m^3 unless stated)	Benchmark ELV	Comments
Total particulate	5 (daily) – 20 (half hour)	WID / HWID	See comments for MWIs Ceramic filters may provide an alternative to fabric for smaller plant where higher temperate filtration required
VOCs (as TOC)	5 (daily) – 10(half hour)	WID / HWID	See comments for MWIs Good secondary combustion required if semi-pyrolytic primary stages used
HCl	5 (daily) – 30 (half hour)	WID / HWID	See comments for MWIs HCl peak loading and variation generally less than MWIs Avoid use of PVC waste packaging Dry scrubbing with reagent recycle can also be BAT
HF	0.5 (daily) – 2 (half hour)	WID /HWID	See comments for HCl
SO_2	20 (daily) – 50 (half hour)	WID /HWID	See comments for HCl
NOx (NO and NO_2 as NO_2)	100 (daily average)	WID	Relatively smaller plant size and lower NOx emission concentrations than MWIs Improvements achieved by abatement beyond WID unlikely to be BAT Staged combustion may assist to reduce NOx formation
NH_3		10 mg/m^3 daily avg. 20 mg/m^3 1/2hr avg.	Not covered by European legislation. Limits to be applied to control slip from NOx control systems
N_20		30 mg/m^3 avg. over 8 hr sample period	Not covered by European legislation. Limits to be applied to control slip from NOx control systems
CO	20 (daily) – 100 (10 min)	WID / HWID	See comments for MWIs Good secondary combustion required if semi pyrolytic primary stages used
Cd and Tl	0.02	WID / HWID	See comments for MWIs
Hg	0.02	WID / HWID	See comments for MWIs May be opportunities to reduce Hg loading by up stream waste control
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V	0.2	WID / HWID	See comments for MWIs
Dioxins and furans	0.05 ng/m3	WID / HWID	See comments for MWIs

Note: 1. Quoted performance figures may not be directly comparable owing to different averaging periods.
3. Performance figures derived form plant upgrade guarantees

3.3.6 Chemical waste incinerators

This section relates to dedicated chemical, hazardous waste incinerators. The standards applicable to other installations that co-incinerate hazardous wastes are covered in Section 3.3.12.

Standards and Obligations for ChWIs

- Existing installations must meet the requirements HWID as an absolute minimum.
- Existing installations must comply with WID standards from 28 December 2005 at the latest.
- New plants must comply with HWID and WID standards as a minimum with immediate effect.
- Although compliance with HWID (or WID) standards will be taken to indicate that BAT is in use, Operators will be required to demonstrate why further emission reductions cannot be achieved through the use of BAT. This will be particularly the case at larger throughput plant, or where local environmental conditions require installation pollutant contributions to background levels are further reduced.

Benchmark emission values

Substance(s)	Currently reported (mg/m^3 unless stated)	Benchmark ELV	Comments
Total particulate	1 – 4	WID / HWID	Multi stage scrubbers may achieve ELVs Bag filtration may require gas reheat
VOCs (as TOC)	< 2	WID / HWID	High temperatures ensure good VOC destruction
HCl	0.2 – 2	WID / HWID	Multi stage scrubbers achieve low emissions to air
HF	0.02 – 2	WID /HWID	See HCl
SO_2	0.1 – 1	WID /HWID	See HCl
NOx (NO and NO_2 as NO_2)	125 – 240	WID	Low throughputs mean NOx unlikely to represent significant pollution problem Achieving WID emission ELV may require additional controls (WID exemption only applies to plants burning ONLY hazardous waste)
NH_3		10 mg/m^3 daily avg. 20 mg/m^3 1/2hr avg.	Not covered by European legislation. Limits to be applied to control slip from NOx control systems
N_20		30 mg/m^3 avg. over 8 hr sample period	Not covered by European legislation. Limits to be applied to control slip from NOx control systems
CO	1 – 71	WID / HWID	Low ELVs achieved Short term concentrations in WID may require attention
Cd and Tl	0.001 – 0.024	WID / HWID	
Hg	0.001 – 1	WID / HWID	Care required where high input concentrations may arise
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V	0.02 - 0.5	WID / HWID	
Dioxins and furans	0.0007 – 0.03 ng/m3	WID / HWID	exceptionally low emission levels now achieved SCR, C injection and catalytic filter bags may offer further improvement where not employed.

Note: 1. Quoted performance figures may not be directly comparable owing to different averaging periods.

3.3.7 Sewage sludge incinerators

Standards and Obligations for SSIs

- All existing installations must comply with WID standards as a minimum from 28 December 2005 at the latest.
- All new plants must comply with WID ELVs as a minimum with immediate effect. With the exception of NOx where this is derived from high fuel nitrogen and the relevant WID ELV cannot be achieved by means of primary measures on their own. Where this is the case exemption may be authorised until 28 December 2002.
- Although compliance with WID standards will be taken to indicate that BAT is in use, Operators will be required to demonstrate why further emission reductions cannot be achieved through the use of BAT. This will be particularly the case at larger throughput plant, or where local environmental conditions require installation pollutant contributions to background levels are further reduced.

Benchmark emission values

Substance(s)	Currently reported (mg/m^3 unless stated)	Benchmark ELV	Comments
Total particulate	1.5 – 25	WID	EPs or bag filters appear capable of meeting ELVs Wet scrubbers on their own not sufficient Fluidised beds require grit arrestment (cyclones?)
VOCs (as TOC)	1.4 – 28.6	WID	Temperatures and residence time needs to be sufficient to burn off VOCs generated from this high organic waste
HCl	0.7 – 17	WID	Not generally problematic
HF	<0.1 – 2.5	WID	Not generally problematic
SO_2	12.3 – 250	WID	May be some difficulty where high sulphur feedstock Elimination of sulphur from feedstock where possible may help e.g. Sulphates used for precipitation of sludges Wet caustic scrubbing used in some cases
NOx (NO and NO_2 as NO_2)	119 – 709	WID	High fuel nitrogen may lead to difficulties in reaching ELVs Unlikely to be BAT for existing plant to upgrade to WID standards before WID deadline. Use of fluidised beds may help reduce thermal NOx addition
NH_3		10 mg/m^3 daily avg. 20 mg/m^3 1/2hr avg.	Not covered by European legislation. Limits to be applied to control slip from NOx control system
N_20		30 mg/m^3 avg. over 8 hr sample period	Not covered by European legislation. Limits to be applied to control slip from NOx control system
CO	5 – 100	WID	Combustor design and combustion control important. Charging systems need control to ensure consistent feed Fluidised beds must achieve at least 100mg/m3 as an hourly average.
Cd and Tl	0.001 – 0.05	WID	Metals loading in sludge may be elevated in industrial catchments – prevention of large point discharges to upstream sewer may be cost effective in some cases Particulate reduction techniques will reduce metals emissions e.g. filtration techniques
Hg	<0.01 – 0.05	WID	Metals loading in sludge may be elevated in industrial catchments – prevention of large point discharges to upstream sewer may be cost effective in some cases Carbon injection may be required
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V	0.08 – 0.5	WID	Metals loading in sludge may be elevated in industrial catchments – prevention of large point discharges to upstream sewer may be cost effective in some cases
Dioxins and furans	0.015 – 0.1ng/m3	WID	Emissions of dioxins and furans generally very low Carbon injection and other techniques may be applicable

Note: 1. Quoted performance figures may not be directly comparable owing to different averaging periods.

3.3.8 Animal carcass and animal remains incinerators

Standards and Obligations for ACIs

Although exempted from WID, BAT for all new animal carcass incinerators will be to meet emission limit values detail in WID from the first day of operation. However, it is possible that NOx. emissions higher than WID will be BAT owing to relatively high fuel nitrogen levels and the costs of NOx abatement. This should not prevent the use or primary NOx measures at the combustion stage.

All animal remains incinerators (e.g. MBM, SRM) and any animal carcass incinerators that burn anything other than animal carcasses will be covered by WID:

- All existing installations must comply with WID standards as a minimum from 28 December 2005 at the latest.
- All new animal remains incinerators must comply with WID standards as a minimum with immediate effect.

Benchmark emission values

Substance(s)	Currently reported (mg/m^3 unless stated)	Benchmark ELV	Comments
Total particulate	<25	WID (see comments column)	Non WID plants are expected to achieve at least **25mg/m^3** as a daily average and must justify why WID standard is not achieved
VOCs (as TOC)		WID (see comments column)	Non WID plants are expected to achieve at least **20mg/m^3** as a daily average and must justify why WID standard is not achieved
HCl		WID (see comments column)	Non WID plants are expected to achieve at least **30mg/m^3** as a daily average and must justify why WID standard is not achieved
HF		WID	Non WID plants are also expected to achieve **WID standards**
SO_2	Some short term peaks of 300 to 1000	WID (see comments column)	Sulphur loading may be significant and require higher alkaline reagent dose rates. Non WID plants are expected to achieve WID daily average and at least 300mg/m^3 half-hour average.
NOx (NO and NO_2 as NO_2)	200 - 300	WID (see comments column)	Non WID plants are expected to achieve at least 300mg/m^3 as a daily average and must justify why WID standard is not achieved
NH_3		10 mg/m^3 daily avg. 20 mg/m^3 1/2hr avg.	Not covered by European legislation. Limits to be applied to control slip from NOx control system
N_20		30 mg/m^3 avg. over 8 hr sample period	Not covered by European legislation. Limits to be applied to control slip from NOx control system
CO		WID (see comments column)	Non WID plants are expected to achieve at least 150mg/m^3 as a half-hour average and 50 mg /m^3 as a daily average, and must justify why WID standards cannot be achieved.
Cd and TI		WID	Non WID plants are also expected to achieve **WID standards** **Metals levels in feed stock very low.**
Hg		WID	Non WID plants are also expected to achieve **WID standards** **Metals levels in feed stock very low.**
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V		WID	Non WID plants are also expected to achieve **WID standards** **Metals levels in feed stock very low.**
Dioxins and furans	0.1 – 1.0 ng/m3	WID (see comments column)	Non WID plants are also expected to achieve WID standards Carbon injection and other techniques may be applicable to meet 0.1ng/m3.

Note: 1. Quoted performance figures may not be directly comparable owing to different averaging periods.

3.3.9 Drum incinerators

Standards and Obligations for DIs

These installations burn hazardous wastes and therefore fall within the control of HWID. The quantities of the hazardous materials actually combusted is likely to be far lower than those in dedicated HWIs and the process more likely to be of a batch nature.

- Existing installations must meet the requirements HWID as an absolute minimum.
- Existing installations must comply with WID standards from 28 December 2005 at the latest.
- New plants must comply with HWID and WID standards as a minimum with immediate effect.
- Although compliance with HWID (or WID) standards will be taken to indicate that BAT is in use, Operators will be required to demonstrate why further emission reductions cannot be achieved through the use of BAT. This will be particularly the case at larger throughput plant, or where local environmental conditions require installation pollutant contributions to background levels are further reduced.

Benchmark emission values

Substance(s)	Currently reported (mg/m^3 unless stated)	Benchmark ELV	Comments
Total particulate	20 – 26	WID / HWID	Compliance with HWID / WID must be achieved Similar issues arising with DIs as HWIs (see above)
VOCs (as TOC)	1 – 9	WID / HWID	Compliance with HWID / WID must be achieved Similar issues arising with DIs as HWIs (see above)
HCl	21 – 29	WID / HWID	Compliance with HWID / WID must be achieved Similar issues arising with DIs as HWIs (see above)
HF	1 – 2	WID /HWID	Compliance with HWID / WID must be achieved Similar issues arising with DIs as HWIs (see above)
SO_2	3 – 10	WID /HWID	Compliance with HWID / WID must be achieved Similar issues arising with DIs as HWIs (see above)
NOx (NO and NO_2 as NO_2)		WID	Compliance with HWID / WID must be achieved Similar issues arising with DIs as HWIs (see above)
NH_3		10 mg/m^3 daily avg. 20 mg/m^3 1/2hr avg.	Not covered by European legislation. Limits to be applied to control slip from NOx control system
N_20		30 mg/m^3 avg. over 8 hr sample period	Not covered by European legislation. Limits to be applied to control slip from NOx control system
CO	205	WID / HWID	Compliance with HWID / WID must be achieved Similar issues arising with DIs as HWIs (see above)
Cd and Tl		WID / HWID	Compliance with HWID / WID must be achieved Similar issues arising with DIs as HWIs (see above)
Hg		WID / HWID	Compliance with HWID / WID must be achieved Similar issues arising with DIs as HWIs (see above)
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V	0.6 – 0.9	WID / HWID	Compliance with HWID / WID must be achieved Similar issues arising with DIs as HWIs (see above) Paint on drums may lead to higher loading
Dioxins and furans	0.13 ng/m3	WID / HWID	Compliance with HWID / WID must be achieved Similar issues arising with DIs as HWIs (see above)

Note: 1. Quoted performance figures may not be directly comparable owing to different averaging periods.

3.3.10 Pyrolysis and gasification plants

Standards and Obligations for pyrolysis and gasification

Pyrolysis and gasification processes only avoid obligations arising under the WID if they do not combust the products created i.e. solid char, liquids or the gas evolved. In the majority of cases, in order to make use of the energy and raw material potential of the products created, and to minimise waste production, BAT is likely to determine that the products will be combusted and hence WID apply. In some specific cases all of the products may go on to some subsequent non-fuel (non-combustion) use as a raw material – in this case WID would not apply.

For installations falling within the scope of WID:

- All existing installations must comply with WID standards as a minimum from 28 December 2005 at the latest.
- All new plants must comply with WID standards as a minimum with immediate effect.
- Although compliance with WID standards will be taken to indicate that BAT is in use, Operators will be required to demonstrate why further emission reductions cannot be achieved through the use of BAT. The generally smaller size (and hence mass emission rates) of these installations is likely to mean that, provided directive emission limits can be met, process contributions to background pollution levels will be low.

For installations not falling within WID, their purpose will be to capture the products for subsequent (non-combustion) use as a raw material in another process. Significant releases to air are not therefore anticipated. BAT techniques should be selected for process containment. Appropriate guidance may be found within the chemicals sector guidance on similar issues. ***Note:*** *It is not known whether any installations of this type exist. It would appear likely that they would be required to include some means of gas flaring as a safety measure, in which case WID would apply.*

Benchmark emission values

These emission values relate to the subsequent combustion stage of a pyrolysis or gasification installation.

The range of reported emissions is generally wide for this sector. This reflects

- the range of waste types burned
- the rage of combustion technologies used (i.e. boilers, engines, gas turbines)
- the relatively early stage of development of some applications (the figures are often derived from pilot trials and research rather than commercially operating plant)
- the consequently limited and non-standardised published emissions data.

Further details of the available data may be found in the BAT report on waste pyrolysis and gasification.

Substance(s)	Currently reported (mg/m^3 unless stated)	Benchmark ELV	Comments
Total particulate	0.01 – 106	WID	In general compliance with WID can be achieved
VOCs (as TOC)	5 – 10000	WID	Similar comments to those for CO below apply Engines appear to have the most difficulty achieving low emission levels. Emissions using waste derived products generally higher than primary fuels Effective residence time for engines and turbines may need increasing to allow burnout
HCl	0.2 – 49	WID	WID emission levels likely to be achievable using similar gas cleaning equipment to incinerators Peak smoothing may be achieved through the combustion of the effectively pre-treated fuels produced Higher halogen (x) content fuels will evolve more HX
HF	0.1 – 5	WID	See comments for HCl
SO_2	1 – 200	WID	See comments for HCl
NOx (NO and NO_2 as NO_2)	5 – 470	WID	Similar emission levels to incineration plants achieved Similar NOx abatement to incinerators required to meet WID (SNCR, SCR) Pyrolysis oil may give NOx at upper end of range shown
NH_3		10 mg/m^3 daily avg. 20 mg/m^3 1/2hr avg.	Not covered by European legislation. Limits to be applied to control slip from NOx control system Fuel gas cleaning may be required
N_20		30 mg/m^3 avg. over 8 hr sample period	Not covered by European legislation. Limits to be applied to control slip from NOx control system
CO	2.5 – 100	WID	Boilers and gas turbines may achieve levels below 10mg./m^3 and 50 mg/m^3 respectively Higher emissions (1000mg/m^3+) found with unabated engines where catalytic converters may achieve <100 mg/m3 Turbine load and fuel air ration will effect CO production
Cd and Tl	0.0007 – 0.09	WID	Performance similar to incineration plant achievable
Hg	0.002 – 0.09	WID	Performance similar to incineration plant achievable
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V	0.005 – 0.07	WID	Performance similar to incineration plant achievable
Dioxins and furans	0.001 – 1.2	WID	Performance similar to incineration plant Little data for engines and gas turbines Combustion control, residence time, rapid cooling from 450 – 200 °C and carbon injection may assist.

Note: 1. Quoted performance figures may not be directly comparable owing to different averaging periods.

3.3.11 Refuse derived fuel

This section deals with the burning of refuse derived fuels in dedicated plant. The co-incineration of refuse derived fuels is dealt with in Section 3.3.12 - Co-incineration.

Standards and Obligations for RDF

Legal interpretation suggests that all refuse derived fuels are likely to be considered wastes and therefore WID will apply. The similarity of techniques and economics of the waste derived fuel sector is likely to give rise to conclusions regarding BAT emission levels (and techniques) that are similar to those of the "waste" sector.

Benchmark emission values

Substance(s)	Currently reported (mg/m^3 unless stated)	Benchmark ELV	Comments
Total particulate	15 – 100	WID	Use of filtration techniques should enable compliance with WID across a range of RDF types
VOCs (as TOC)	<11	WID	Close combustion control required to avoid excursions where waste feed characteristics are variable (e.g. improved oxygen monitoring, waste feed and air trimming) WID achievable through the use of BAT
HCl	5 – 167	WID	WID ELVs should be achievable using alkaline reagent injection. Short term fluctuations should be less of a problem owing to greater homogeneity of treated fuel. Higher acid content (or forming) RDFs will need greater absorbent dosing or wet systems.
HF	<1.3	WID	See HCl
SO_2	149 – 400	WID	See HCl
NOx (NO and NO_2 as NO_2)	100 – 250	WID	Close combustion control required to avoid excursions where waste feed characteristics are variable (e.g. improved oxygen monitoring, waste feed and air trimming) WID achievable through the use of BAT Fluidised beds achieve low NOx levels.
NH_3		10 mg/m^3 daily avg. 20 mg/m^3 1/2hr avg.	Not covered by European legislation. Limits to be applied to control slip from NOx control system
N_20		30 mg/m^3 avg. over 8 hr sample period	Not covered by European legislation. Limits to be applied to control slip from NOx control system
CO	80 – 141	WID	Close combustion control required to avoid excursions where waste feed characteristics are variable (e.g. improved oxygen monitoring, waste feed and air trimming) WID achievable through the use of BAT
Cd and Tl	0.06 - 0.1	WID	Techniques to reduce particulate will also reduce metals
Hg	0.03 - 0.1	WID	Carbon injection required
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V	0.27	WID	Techniques to reduce particulate will also reduce metals
Dioxins and furans	0.01 – 1.0	WID	Combustion control, residence time, rapid cooling from 450 – 200 °C and carbon injection may assist.

Note: 1. Quoted performance figures may not be directly comparable owing to different averaging periods.

3.3.12 Co-incinerators

Different definitions of co-incineration plants are given in HWID and WID – these are outlined below.

Operators must demonstrate in their application that they will comply with the relevant provisions of the directives. Applications should refer to the directives (and any guidance issued by the Regulator) and should include calculations to show the emission limit required by the relevant directive along with a justification for its selection at BAT.

HWID Co-incinerators:

The HWID definition will only be used for those plants falling under HWID until such a time as they fall within WID.

HWID includes co-incinerators within the definition of incinerators by including

"plants burning [hazardous] wastes as a or additional fuel in any industrial process":

This definition therefore includes incinerators that burn some hazardous waste with non- hazardous waste as well as other industrial plants that burn some hazardous wastes with non waste fuels.

HWID includes emission limits that must be met. It also describes how emission limits should be calculated in situations where less than 40% of the heat raised in the process arises from the combustion of hazardous waste.

The Agency has issued guidance on how these ELVs should be calculated 9an other aspects of HWID applied) in a Regulatory Guidance Note (on the Incineration of Hazardous Waste dated14 July 1999).

In general compliance with the standards indicated in the directive will indicate that the BAT is being used. However a justification should be provided that details why further emission limit reductions cannot be achieved through the use of BAT.

WID Co-incinerators:

The WID definition of "co-incineration plant" is:

"any stationary or mobile plant whose main purpose is the generation of energy or the production of material products and;

- *which uses waste as a regular or additional fuel; or*
- *in which the waste is thermally treated for the purpose of disposal"*

This therefore includes installations that burn any amount of hazardous or non-hazardous waste along with non-waste derived fuels. Because the same emission limits apply to the burning of hazardous and non-hazardous wastes, the situation where some hazardous waste is burned with non-hazardous wastes only has relevance in respect of the temperature at which it must be burned and other aspects such as documentation and control of incoming waste (see Section 2.3.1 - Incoming waste handling).

The Agency intends to issue separate "regulatory guidance" on the application of the WID to co-incineration plant.

The key aspects are:

- where the purpose of the co-incineration has become the thermal treatment of the waste (rather than the production of energy or products) the plant is regarded as an incineration plant and the emission limits for incineration plant apply in full
- where more than 40% of the heat release comes from the incineration of hazardous waste the emission limits for incineration plant apply in full
- special provisions are included for cement kilns , combustion plants and other industrial sectors
- pro-rata emission limits may be applied in some cases, whilst in others single limits apply.
- Rules for the determination of emission limits are included

In general compliance with the standards indicated by the directive will indicate that the BAT is being used. However a justification should be provided that details why further emission limit reductions cannot be achieved through the use of BAT.

3.4 Releases to Water

This section outlines the emission limit and generic requirements arising from European legislation. The techniques that represent BAT for the control of releases to water are outlined in

- Section 2.3.10 - Abatement of point source emission to surface water and sewer
- Section 2.3.12 - Control of fugitive emissions to surface water, sewer and ground water

Incinerators often do not produce large volumes of water for disposal. In many cases the use of the techniques outlined in this guidance (see Section 2.2.3 - Water use) will result in the elimination of discharges to water.

The main releases to water that can arise from incineration installations are:

- Air abatement equipment (e.g. wet scrubbers);
- Boiler blow-down;
- Cooling water discharges;
- Road drainage;
- Incoming waste handling areas;
- Raw material storage areas;
- Ash and other residue handling areas;
- On-site effluent treatment.

In general, good design should prevent the production of the majority of these effluents from being produced (see Sections 2.3.10 and 2.3.12).

3.4.1 Standards and obligations for releases to water

Both HWID and WID contain provisions in respect of discharges to water. The following paragraphs outline the main requirements and provide guidance on how they may be fulfilled using BAT. Further guidance on the requirements of the Directives can be found in Agency guidance on their implementation.

3.4.1.1 HWID requirements:

The Agency has issued Regulatory Guidance on the application of HWID. This section outlines the basic requirements.

1 Discharges to the aquatic environment must be limited as far as possible

2 Relevant Community, National and Local legislation must be respected when setting release levels

3 Discharges of heavy metals, dioxins and furans to water must be smaller in mass than those to air

4 Sites and associated waste storage areas should be designed an operated in such a manner as to prevent the release of polluting substances into soil and groundwater

5 Storage capacity to be provided for rainwater run-off and for contaminated water arising from spillages and fire fighting operations. The storage capacity should be sufficient to allow for such waters to be tested and treated prior to discharge where necessary.

3.4.1.2 WID requirements:

The Agency intends to produce guidance on the application of WID, which should be referred to when available. This section provides an outline of that guidance.

Emission limit values

Article 8 of the Directive sets specific **emission limit values** for water discharges derived from air pollution control equipment (e.g. wet scrubbers or wet EPs), (see Section 3.4.2 below for further guidance).

General requirements

Article 8(7) also sets out some more **general requirements** in respect of the design and operation of plant such that sites as a whole "…prevent unauthorised and accidental release of polluting substances into soil, surface water or ground water..".

This applies to all potential sources of pollution on the site, not just to the releases form air pollution control equipment. BAT will normally fulfil the Directive requirements (see Sections 2.3.10 and 2.3.12).

Storage capacity

The Directive specifically states that "…**storage capacity** shall be provided for contaminated rainwater run-off from the… site or for contaminated water arising from spillage or fire fighting operations."

In the context of this requirement, "contaminated rainwater" should also be taken to include all areas where there is reasonable risk of contamination by the installation. This would normally exclude roof water, access road drainage and office or other ancillary operations, where the risk of contamination is likely to be minimal.

In general, contamination of rainwater and spillages should be avoided using BAT, (see Sections 2.3.10 and 2.3.12).

A **risk assessment** process should be used to determine the volume of storage that is required to contain firewater.

At **new sites** it is likely that it will be possible for site drainage to be engineered such that complete containment is provided. This may include, for example, the use of bunding, or the routing of drainage to a holding tank or an on site effluent treatment plant using an emergency valve.

At **existing plants** the cost of civil works and land availability may present significant difficulties. In such cases it will still be necessary for the operator to comply with the Directive. Whilst ***adequate*** storage must be provided, in reaching a decision on the actual size of containment required the risk assessment should, in particular, take account of the following factors:

- use of BAT to avoid rainwater contamination;
- average peak rainfall rates (one per year event average);
- existing drainage capability or concerns;
- adequacy of fire prevention and detection measures (advice from Fire Brigade may be required);
- use of BAT for spill prevention / containment;
- cost of additional storage provision;
- advice from Agency water pollution control officers;
- Sensitivity of receiving medium (e.g. local sewer or nature reserve?);;
- Availability of additional off site holding capacity;
- ability to "test and treat before discharge where necessary" (see below).

Article 8(7) also states that "…The storage capacity shall be adequate to ensure that such waters can be **tested and treated** before discharge where necessary."

This effectively means that where the drainage of such effluents will be to soil, surface or groundwater, suitable provision must be made for complete containment to allow for assessment prior to release. This may include the use of road tankers brought in to deal with effluent, or the provision of an effluent treatment plant with sufficient buffer capacity to allow adequate time for relevant testing and treatment. The tests required will depend on the nature of the ETP, and its ability to treat the pollutants arising.

3.4.2 Legislative emission limit values

This section contains details of the minimum emission limit values that arise from the WID.

It is ***important*** to stress that, while they represent the minimum performance criteria in respect of effluents arising at incineration installations (particularly those effluents arising form air pollution control devices), ***they DO NOT represent BAT for discharges form the site***.

BAT emission limit values for discharges from the site will need to be selected following consideration of the guidance on techniques given in Sections 2.3.10 and 2.3.12 and other cross sector guidance on effluent treatment.

Annexe IV of WID lists the emission limit values for discharge of water (controlled waters or sewer) from air pollution control devices. The point at which they apply, and how combined effluents should be dealt with are also included in the Directive

- The operational control parameters of pH temperature and flow apply to all effluents (including scrubber discharges), whereas
- the ELVs for suspended solids, metals and dioxins only apply where air pollution control liquors are discharged (alone or in combination with other effluents).

The table below gives the ELVs and monitoring requirements.

Directive Emission limits into Water

Parameter	Emission Limit Value	Directive Monitoring Requirements
Total suspended solids as defined by Directive 91/271/EEC	*95%<30mg/l and 100%<45mg/l*	*Spot daily sample or 24-hour flow proportional*
Mercury and its compounds, expressed as mercury mg/l (from APC effluents)	0.03	Monthly 24-hour flow proportional sample
Cadmium and its compounds, expressed as cadmium mg/l (from APC effluents)	0.05	Monthly 24-hour flow proportional sample
Thallium and its compounds, expressed as thallium mg/l (from APC effluents)	0.05	Monthly 24-hour flow proportional sample
Arsenic and its compounds, expressed as arsenic mg/l (from APC effluents)	0.15	Monthly 24-hour flow proportional sample
Lead and its compounds, expressed as lead mg/l (from APC effluents)	0.2	Monthly 24-hour flow proportional sample
Chromium and its compounds, expressed as chromium mg/l (from APC effluents)	0.5	Monthly 24-hour flow proportional sample
Copper and its compounds, expressed as copper mg/l (from APC effluents)	0.5	Monthly 24-hour flow proportional sample
Nickel and its compounds, expressed as nickel mg/l (from APC effluents)	0.5	Monthly 24-hour flow proportional sample
Zinc and its compounds, expressed as Zinc mg/l (from APC effluents)	1.5	Monthly 24-hour flow proportional sample
Total Dioxins and furans (as TEQ) ng/l (from APC effluents)	0.3	6 monthly 24-hour flow proportional sample
pH range	Site specific	continuous
Temperature °C	Site specific	continuous
Flow l/s	Site specific	continuous

Notes:

1. Total suspended solids limits apply as spot daily samples OR monthly 24hr flow proportional sample.
2. Limits for metals apply as 24hr flow proportional samples. Only 1 sample per year **OR** 5% of annual samples (where more than 20 samples are taken) may exceed the limits stated above.
3. Temperature, flow and pH limits to be measured and applied continuously.

4 IMPACT

4.1 Assessment of the Impact of Emissions on the Environment

The Operator should assess that the emissions resulting from the proposals for the activities/installation will provide a high level of protection for the environment as a whole, in particular having regard to EQSs. etc, revisiting the techniques in Section 2 as necessary (see Section 1.2).

Application Form Question 4.1

Provide an assessment of the potential significant environmental effects (including transboundary effects) of the foreseeable emissions.

With the Application the Operator should:

1. provide a description, including maps as appropriate, of the receiving environment to identify the receptors of pollution. The extent of the area may cover the local, national and international (e.g. transboundary effects) environment as appropriate.
2. identify important receptors which may include: areas of human population including noise or odour-sensitive areas, flora and fauna (i.e. Habitat Directive sites, special areas of conservation, Sites of Special Scientific Interest (SSSI or in Northern Ireland, ASSI) or other sensitive areas), soil, water, i.e. groundwater (water below the surface of the ground in the saturation zone and in direct contact with the ground and subsoil) and watercourses (e.g. ditches, streams, brooks, rivers), air including the upper atmosphere, landscape, material assets and the cultural heritage.
3. identify the pathways by which the receptors will be exposed (where not self evident).
4. carry out an assessment of the potential impact of the total emissions from the activities on these receptors. Ref. 5 provides a systematic method for doing this and will also identify where modelling needs to be carried out, to air or water, to improve the understanding of the dispersion of the emissions. The assessment will include comparison (see IPPC A Practical Guide (Ref. 3) and (Section 3.2) with:
   - community EQS levels;
   - other statutory obligations;
   - non-statutory obligations;
   - environmental action levels (EALs) and the other environmental and regulatory parameters defined in Ref. 5.

   in particular, it will be necessary to demonstrate that an appropriate assessment of vent and chimney heights has been made to ensure that there is adequate dispersion of the minimised emission(s) to avoid exceeding local ground-level pollution thresholds and limit national and transboundary pollution impacts. This should be based on the most sensitive receptor, be it human health, soil or terrestrial ecosystems.

   for this sector, where higher emission concentrations are expected during shorter averaging periods (e.g. half hourly averages) these should be used as the input parameters for short term modelling assessments, with the lower longer term (typically daily average) concentrations used for predicting longer term impacts. A conservative approach should be adopted, such that impacts may reliably be expected to be less than those expected. An estimate of the degree of this overestimation may be included provided that its derivation is clearly explained along with any other relevant uncertainties.

   where appropriate the Operator should also recognise the chimney or vent as an emergency emission point and understand the likely behaviour. Process upsets or equipment failure giving rise to abnormally high emission levels over short periods should be assessed. Even if the Applicant can demonstrate a very low probability of occurrence, the height of the chimney or vent should nevertheless be set to avoid any significant risk to health. The impact of fugitive emissions can also be assessed in many cases.

   consider whether the responses to Sections 2 and 3 and this assessment adequately demonstrate that the necessary measures have been taken against pollution, in particular by the application of BAT, and that no significant pollution will be caused. Where there is uncertainty about this, the measures in Section 2 should be revisited as appropriate to make further improvements.

5. where the same pollutants are being emitted by more than one permitted activity on the installation the Operator should assess the impact both with and without the neighbouring emissions.

4.2 The Waste Management Licensing Regulations

Application Form
Question 4.2

Explain how the information provided in other parts of the application also demonstrates that the requirements of the relevant objectives of the Waste Management Licensing Regulations 1994 have been addressed, or provide additional information in this respect.

In relation to activities involving the disposal or recovery of waste, the Regulators are required to exercise their functions for the purpose of achieving the relevant objectives as set out in Schedule 4 of the Waste Management Licensing Regulations 1994. (For the equivalent Regulations in Scotland, see Appendix 2. In Northern Ireland there are no equivalent regulations at the time of writing. Contact EHS for further information.)

The relevant objectives, contained in paragraph 4, Schedule 4 of the Waste Management Licensing Regulations 1994 *(SI 1994/1056 as amended)* are extensive, but will only require attention for activities which involve the recovery or disposal of waste. Paragraph 4 (1) is as follows:

a) *"ensuring the waste is recovered or disposed of without endangering human health and without using process or methods which could harm the environment and in particular without:*

risk to water, air, soil, plants or animals; or

causing nuisance through noise or odours; or

adversely affecting the countryside or places of special interest;

b) *implementing, as far as material, any plan made under the plan-making provisions".*

The application of BAT is likely to already address risks to water, air, soil, plants or animals, odour nuisance and some aspects of effects on the countryside. It will, however, be necessary for the Operator to briefly to consider each of these objectives individually and provide a comment on how they are being addressed by the proposals. It is also necessary to ensure that any places of special concern which could be affected, such as SSSIs, are identified and commented upon although, again, these may have been addressed in the assessment for BAT, in which case a cross-reference may suffice.

Operators should identify any development plans made by the local planning authority, including any waste local plan, and comment on the extent to which the proposals accord with the contents of any such plan (see Section 2.6).

4.3 The Habitats Regulations

Application Form
Question 4.3

Provide an assessment of whether the installation is likely to have a significant effect on a European site in the UK and if it is, provide an assessment of the implications of the installation for that site, for the purposes of the Conservation (Natural Habitats etc) Regulations 1994 (SI 1994/2716).

Your response should cover all relevant issues pertinent to your installation, including those below. In doing so you should justify your proposals against any indicative requirements stated.

An application for an IPPC Permit will be regarded as a new plan or project for the purposes of the Habitats Regulations (for the equivalent Regulations in Scotland and Northern Ireland see Appendix 2). Therefore, Operators should provide an initial assessment of whether the installation is likely to have a significant effect on any European site in the UK (either alone or in combination with other relevant plans or projects) and, if so, an initial assessment of the implications of the installation for any such site. The application of BAT is likely to have gone some way towards addressing the potential impact of the installation on European sites and putting into place techniques to avoid any significant effects. The Operator should provide a description of how the BAT assessment has specifically taken these matters into account, bearing in mind the conservation objectives of any such site.

European sites are defined in Regulation 10 of the Habitats Regulations to include Special Areas of Conservation (SACs); sites of community importance (sites that have been selected as candidate SACs by member states and adopted by the European Commission but which are not yet formally classified); and Special Protection Areas (SPAs). It is also Government policy (set out in PPG 9 on nature conservation) that potential SPAs and candidate SACs should be considered to be European sites for the purposes of Regulation 10.

Information on the location of European Sites and their conservation objectives is available from

- English Nature (01733 455000), http://www.english-nature.org.uk
- Countryside Council for Wales (01248 385620), http://www.ccw.gov.uk
- Scottish Natural Heritage (0131 447 4784), http://www.snh.org.uk
- Joint Nature Conservation Committee (01733 866852), http://www.jncc.gov.uk
- Environment and Heritage Service, Northern Ireland, http://www.ehsni.gov.uk

The Regulator will need to consider the Operator's initial assessment. If it concludes that the installation is likely to have a significant effect on a European site, then the Regulator will need to carry out an “appropriate assessment” of the implications of the installation in view of that site's conservation objectives. The Regulations impose a duty on the Regulator to carry out these assessments so it cannot rely on the Operator's initial assessments. Therefore the Regulator must be provided with any relevant information upon which the Operator’s assessment is based.

Note that in many cases the impact of the Habitats Regulations will have been considered at the planning application stage, in which case the Regulator should be advised of the details.

REFERENCES

For a full list of available Technical Guidance see Appendix A of the *Guide for Applicants* or visit the Environment Agency Website http://www.environment-agency.gov.uk. Many of the references below are being made available free of charge for viewing or download on the Website. The same information can also be accessed via the SEPA web site http://www.sepa.org, or the NIEHS web site www.ehsni.gov.uk. Most titles will also be available in hard copy from The Stationery Office (TSO). Some existing titles are not yet available on the Website but can be obtained from TSO.

1. The Pollution Prevention and Control Act (1999) (www.legislation.hmso.gov.uk).
2. The Pollution Prevention and Control Regulations (SI 1973 2000) (www.legislation.hmso.gov.uk).
3. IPPC: A Practical Guide (for England and Wales) (or equivalents in Scotland and Northern Ireland) (www.environment.detr.gov.uk).
4. IPPC Part A(1) Installations: Guide for Applicants (includes Preparation of a Site Report in a Permit Application) (EA Website).
5. Assessment methodologies:
   - E1 BPEO Assessment Methodology for IPC
   - IPPC Environmental Assessments for BAT (in preparation as H1)
6. Management system references:
   - Sector specific
7. Waste minimisation support references:
   - Environment Agency web site. Waste minimisation information accessible via: www.environment-agency.gov.uk/epns
   - Waste Minimisation – an environmental good practice guide for industry (helps industry to minimise waste and achieve national environmental goals). Available free to companies who intend to undertake a waste reduction programme (tel 0345 33 77 00)
   - Profiting from Pollution Prevention – 3Es methodology (emissions, efficiency, economics). Video and A4 guide aimed at process industries. Available from Environment Agency, North East region (tel 0113 244 0191, ask for regional PIR)
   - Waste Minimisation Interactive Tools (WIMIT). Produced in association with the ETBPP and the BOC Foundation (a software tool designed for small and medium businesses.). Available free from The Environmental Helpline (tel 0800 585794)
   - Environmental Technology Best Practice Programme – ETBPP. A joint DTI/DETR programme, with over 200 separate case studies, good practice guides, leaflets, flyers, software tools and videos covering 12 industry sectors, packaging, solvents and the generic areas of waste minimisation and cleaner technology. The ETBPP is accessible via a FREE and confidential helpline (tel 0800 585794) or via the web site www.etsu.com/etbpp/
   - ETBPP, Increased Profit Through Improved Materials Additions: Management/Technical Guide, GG194/195
   - Waste Management Information Bureau. The UK's national referral centre for help on the full range of waste management issues. It produces a database called Waste Info, which is available for online searching and on CD-ROM. Short enquiries are free (tel 01235 463162)
   - Institution of Chemical Engineers Training Package E07 – Waste Minimisation. Basic course which contains guide, video, slides, OHPs etc. (tel 01788 578214)
8. Water efficiency references:
   - ETBPP, Simple measures restrict water costs, GC22
   - ETBPP, Effluent costs eliminated by water treatment, GC24
   - ETBPP, Saving money through waste minimisation: Reducing water use, GG26
   - ETBPP Helpline 0800 585794
9. Environment Agency (1998) Optimum use of water for industry and agriculture dependent on direct abstraction: Best practice manual. R&D technical report W157, WRc Dissemination Centre, Swindon (tel 01793 865012)
10. Releases to air references:
    - BREF on Waste Water and Waste Gas Treatment.
    - A1 Guidance on effective flaring in the gas, petroleum etc industries, 1993, ISBN 0-11-752916-8
    - A2 Pollution abatement technology for the reduction of solvent vapour emissions, 1994, £5.00, 0-11-752925-7
    - A3 Pollution abatement technology for particulate and trace gas removal, 1994, £5.00, 0-11-752983-4
    - Landfill gas flaring
    - Part B PG1/3 Boilers and Furnaces 20-50 MW net thermal input (ISBN 0-11-753146-4-7)
    - Part B PG1/4 Gas Turbines 20-50 MW net thermal input (ISBN 0-11-753147-2)

11. Releases to water references:
    - BREF on Waste Water and Waste Gas Treatment
    - A4 Effluent Treatment Techniques, TGN A4, Environment Agency, ISBN 0-11-310127-9 (EA website)
    - Environment Agency, Pollution Prevention Guidance Note – Above-ground oil storage tanks, PPG 2, gives information on tanks and bunding which have general relevance beyond just oil (EA website)
    - Mason, P. A, Amies, H. J, Sangarapillai, G. Rose, Construction of bunds for oil storage tanks, Construction Industry Research and Information Association (CIRIA), Report 163, 1997, CIRIA, 6 Storey's Gate, Westminster, London SW1P 3AU. Abbreviated versions are also available for masonry and concrete bunds (www.ciria.org.uk online purchase)
12. Dispersion Methodology Guide D1 (EA website - summary only)
13. IPPC Energy Efficiency Guidance Note (the consultation version, available on the website should be used until the final version is published)
14. BS 5908: Code of Practice for Fire Precautions in the Chemical and Allied Industries
15. Environment Agency, Pollution Prevention Guidance Note – Pollution prevention measures for the control of spillages and fire-fighting run-off, PPG 18, gives information on sizing firewater containment systems (EA website)
16. Investigation of the criteria for, and guidance on, the landspreading of industrial wastes – final report to the DETR, the Environment Agency and MAFF, May 1998
17. Agency guidance on the exemption 7 activity (proposed)
18. COMAH guides
    - A Guide to the Control of Major Accident Hazards Regulations 1999, Health and Safety Executive (HSE) Books L111, 1999, ISBN 0 07176 1604 5
    - Preparing Safety Reports: Control of Major Accident Hazards Regulations 1999, HSE Books HS(G)190, 1999
    - Emergency Planning for Major Accidents: Control of Major Accident Hazards Regulations 1999, HSE Books HS(G)191, 1999
    - Guidance on the Environmental Risk Assessment Aspects of COMAH Safety Reports, Environment Agency, 1999 (EA website)
    - Guidance on the Interpretation of Major Accidents to the Environment for the Purposes of the COMAH Regulations, DETR, 1999, ISBN 753501 X, available from the Stationery Office
19. Assessment and Control of Environmental Noise and Vibration from Industrial Activities (joint Regulator's guidance in preparation)
20. Monitoring Guidance (EA website)
    - M1 Sampling facility requirements for the monitoring of particulates in gaseous releases to atmosphere, March 1993, £5.00, ISBN 0-11-752777-7
    - M2 Monitoring emissions of pollutants at source January 1994, £10.00, ISBN 0-11-752922-2
    - M3 Standards for IPC Monitoring Part 1: Standards, organisations and the measurement infrastructure, August 1995, £11.00, ISBN 0-11-753133-2
    - M4 Standards for IPC Monitoring Part 2 : Standards in support of IPC Monitoring, revised 1998
    - MCERTS approved equipment link via http://www.environment-agency.gov.uk/epns "Guidance for Business and Industry";
    - Direct Toxicity Assessment for Effluent Control: Technical Guidance (2000), UKWIR 00/TX/02/07.
21. The Categorisation of Volatile Organic Compounds, DOE Research Report No DOE/HMIP/RR/95/009 (EA website)
22. Odour Assessment and Control – Guidance for Regulators and Industry (joint agencies guidance in preparation)
23. "Policy and Practice for the Protection of Groundwater" (PPPG) (EA website)
24. Working at Construction and Demolition-sites (PPG 6) (EA website)
25. Waste Incineration Directive 2000/76/EC - details to be added
26. The Hazardous Waste Incineration Directive 94/67/EC - details to be added
27. Waste Strategy for England and Wales 2000- details to be added
28. Clinical Waste Plant Capacity Estimates - details to be added
29. BAT Report - Review of IPC Technical Guidance for Chapter 5 and 1.3c Vol1 March 2000
30. Environment Agency Guidance on the Methods for Securing Representative Ash Samples - details to be added

DEFINITIONS

BAT	Best Available Techniques – see *IPPC A Practical Guide* or the Regulations for further definition
BAT Criteria	The criteria to be taken into account when assessing BAT, given in Schedule 2 of the PPC Regulations
BOD	Biological Oxygen Demand
BREF	BAT Reference Document
CEM	Continuous Emissions Monitoring
CHP	Combined heat and power plant
COD	Chemical Oxygen Demand
EMS	Environmental Management System
ETP	Effluent treatment plant
ITEQ	International Toxicity Equivalents
MCERTS	Monitoring Certification Scheme
NIEHS	Northern Ireland Environment and Heritage Service
SAC	Special Areas of Conservation
SECp	Specific Energy consumption
SEPA	Scottish Environmental Protection Agency
SPA	Special Protection Area
TSS	Suspended solids
TOC	Total Organic Carbon
VOC	Volatile organic compounds

Further sector specific acronyms to be added

APPENDIX 1 - SOME COMMON MONITORING AND SAMPLING METHODS

Table A1-1 - Continuous monitoring techniques for the incineration of waste and fuel manufactured from and including waste

Pollutant	Suitable technique	Comments on best practice
O_2	Paramagnetic Zirconia probe Electrochemical	The choice of analyser offering the best performance depends on the availability of MCERTS certified analysers that have undergone field tests at a similar installation. There is no evidence indicating that a particular type of sensor or system offers unique advantages over other systems or that cross-stack systems outperform the extractive ones. Gas parameters such as temperature, humidity dust loading or the presence of interfering substances must be taken into consideration and assessed whether they are within the range at which a particular system has been certified. For the instruments certified under MCERTS there is sufficient information on individual performance characteristics to be able to quantify the measurement uncertainty. The relevant calculations should be conducted in accordance with GUM (see note below*).
CO	Non Dispersive Infra-Red (NDIR)	
SO_2	In situ and extractive NDIR analysers Extractive UV fluorescence analyser FTIR- Fourier transform analyser IR-GFC Gas filter correlation analyser In situ and extractive NDUV analyser. Differential optical absorption analyser (DOAS)	
NO_x	In situ and extractive NDIR analyser In situ and extractive NDUV analyser IR-GFC Gas filter correlation analyser FTIR- Fourier transform analyser Chemiluminescent analyser Differential optical absorption analyser (DOAS)	As above
PM	Cross-duct opacity analyser Triboelectric analyser Back-scatter analyser	As above. Triboelectric systems may be affected by moisture. Moisture levels should not exceed the levels at which the equipment has been certified.
HC	Extractive Flame Ionisation Detector (FID)	As above
HCl	Gas Filter Correlation Infra-Red (GFC IR); Fourier Transform Infra-Red (FTIR); Differential Optical Absorption (DOAS) Tunable diode laser (TDL) Ion mobility spectrometry (IMMS)	As above
HF	Extractive potentiometric	As above
Metals	Continuous ICP MS sensor	Continuous metals monitoring system based on inductively coupled plasma sensor is in existence but there are no commercially available models yet.

***Note:** Measurement uncertainty is defined as total expanded uncertainty at 95% confidence interval calculated in accordance with the Guide to the Expression of Uncertainty in Measurement (GUM), ISBN 92-67-10188-9, 1st Ed., Geneva, Switzerland, ISO 1993.

APPENDIX 2 - EQUIVALENT LEGISLATION IN SCOTLAND & NORTHERN IRELAND

The legislation referred to in the text is that for England and Wales. The following are the equivalents for Scotland and Northern Ireland.

Table A.2.1 - Equivalent Legislation

England and Wales	Scotland	Northern Ireland
PPC Regulations (England and Wales) 2000	PPC (Scotland) Regulations 2000; SI 200/323	
Waste Management Licensing Regulations SI:1994 1056	Waste Management Licensing Regulations SI:1994 1056	No NI equivalent
The Water Resources Act 1991	COPA 1974 (S30A-30E equiv. to Part III WRA91) Natural Heritage (Scotland) Act 1991(Part II equiv. to Part I WRA91)	The Water (NI) Order 1999
SI 1989 No 317: Clean Air, The Air Quality Standards Regulations 1989	SI 1989/317: Clean Air, The Air Quality Standards Regulations 1989	The Air Quality Standards Regulations (Northern Ireland) 1990. Statutory Rules of Northern Ireland 1990 No 145
SI 1997 No 3043: Environmental Protection, The Air Quality Regulations 1997	SSI 2000/97 The Air Quality (Scotland) Regs	No NI equivalent
SI 1989 No 2286 and 1998 No 389 the Surface Water (Dangerous Substances Classification) Regulations. (Values for List II substances are contained in SI 1997/2560 and SI 1998/389)	SI 1990/126 Surface Water (Dangerous Substances) (Classification) (Scotland) Regs	Surface Waters (Dangerous Substances) (Classification) Regulations 1998. Statutory Rules of Northern Ireland 1998 No 397 SI1991/1597:
SI 1991/1597: Bathing Waters (Classification) Regs.	SI 1991/1609 Bathing Waters (Classification) (Scotland) Regs	The Quality of Bathing Water Regulations (NI) 1993
SI 1992/1331 and Direction 1997 Surface Waters (Fishlife) (Classification) Regs.	SI 1997/2471 Surface Waters (Fishlife) (Classification) Regs	The Surface Water (Fishlife) (Classification) Regulations (NI) 1997
SI1997/1332 Surface Waters (Shellfish) (Classification) Regs.	SI 1997/2470 Surface Waters (Shellfish) (Classification) Regs	The Surface Water (Shellfish) (Classification) Regulations (NI) 1997
SI1994/2716 Conservation (Natural Habitats etc) Regulations 1994	SI 1994/2716 Conservation (Natural Habitats etc) Regs	Conservation (Natural Habitats etc) Regulations (Northern Ireland) 1995
Control of Major Accident Hazards Regulations 1999 (COMAH)	SI 1999/743 Control of Major Accident Hazards Regs	Control of Major Accident Hazard Regulations (Northern Ireland) 2000