Sector Guidance Note IPPC S5.01

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Guidance for the Incineration of Waste and Fuel Manufactured from or Including Waste

Integrated Pollution Prevention and Control (IPPC)

SEPA scottish environment protection agency

ENVIRONMENT AND HERITAGE SERVICE

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Table 0.1: Record of changes

Version	Date	Change	Template Version
Consultation	August 2001	Initial draft issue	V1
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Executive summary

Status of this Guidance

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

What is IPPC

Integrated Pollution Prevention and Control (IPPC) is a regulatory system that employs an integrated approach to control all environmental impacts of certain listed industrial activities. In the UK, the IPPC Directive is implemented through the English and Welsh, the Scottish, and the Northern Irish versions of the Pollution Prevention and Control (PPC) Regulations. It involves determination by the Regulator of the appropriate controls for those industries to protect all environmental media, through a single permitting process. To gain a PPC Permit, Operators have to demonstrate in their Applications, in a systematic way, that the techniques they are using or are proposing to use, do represent the use of Best Available Techniques (BAT) and meet certain other requirements, taking account of relevant local factors.

This Guidance and the BREFs

Much UK Technical Guidance on what is BAT is based on the "BAT Reference documents" ("BREFs") produced by the European Commission. BREFs are the result of exchanges of information between member states and industry, with most covering individual industrial sectors, and some ("horizontal" BREFs) covering cross-sectoral subjects. UK Technical Guidance Notes are designed to complement BREFs, and take into account information contained in relevant BREFs in setting out indicative BAT standards and expectations for England and Wales, Scotland and Northern Ireland.

The aims of this Guidance

The aim of this Guidance is to provide Operators and officers of the Regulator with advice on indicative standards of operation and environmental performance, relevant to the industrial sector concerned. It also aims (through linkage with the Permit Application Form template) to provide a clear structure and methodology for Operators to follow to ensure they address adequately all aspects of the PPC Regulations and relevant aspects of other environmental Regulations. Also, by expressing BAT techniques as clear indicative standards wherever possible, it aims to minimise the effort involved in the permitting of an installation (by both Operator and Regulator).

To further assist Operators in making Applications, separate, horizontal guidance is available on a range of topics such as noise, odour, waste minimisation, monitoring, calculating stack heights and so on. Most of this guidance is available free through the Environment Agency, SEPA or EHS (Northern Ireland) websites (see **References**).

Key environmental issues

In England and Wales, the Regulator's position on incineration is that:

- The Regulator believes that incineration has a role in waste management
- The Regulator considers that it may be appropriate for local authorities to include incineration in a
- particular strategy provided that:
  - it does not undermine waste management options higher up the waste hierarchy
  - it represents the Best Practicable Environmental Option (BPEO) for disposal taking into account the waste hierarchy
  - it forms a part of a regional or local strategy developed by one or more local authorities based on the need to minimise waste generation and to re-use, recycle, recover and dispose of waste in the nearest appropriate facility
  - it is consistent with the statutory requirement to establish an integrated and adequate network of waste disposal installations

The key environmental issues for this sector are:

Environmental Impact - An unacceptable environmental impact is considered unlikely for plants operating in compliance with the requirements of the Waste Incineration Directive. Ground level air quality and global warming potential are likely to have the highest significance.

Planning issues - Siting issues, which are the responsibility of the Local Authorities, and public concern are important factors for this sector.

European Legislation - The Waste Incineration Directive (2000/76/EC) sets stringent standards which need to be complied with by the majority of installations in this sector.

Feedstock Composition - The heterogeneous nature of many wastes makes feedstock preparation and the ability for installations to handle variable combustion conditions important parameters.

Residue handling and disposal - The nature of solid residues produced by incineration makes their handling on site an important consideration. Where these residues can be treated suitably to produce an aggregate for construction work, these residues can be promoted further up the hierarchy of waste disposal options.

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1 Introduction

The status and aims of this Guidance

This Guidance has been produced by the Environment Agency for England and Wales, with the Scottish Environment Protection Agency (SEPA) and the Environment and Heritage Service (EHS) in Northern Ireland - each referred to as “the Regulator” in this document. Its publication follows consultation with industry, Government departments and non-governmental organisations.

It aims to provide Operators and the Regulator’s officers with advice on indicative standards of operation and environmental performance relevant to the industrial sector concerned, to assist the former in the preparation of applications for PPC Permits and to assist the latter in the assessment of those Applications (and the setting of a subsequent compliance regime). The use of techniques quoted in the guidance and the setting of emission limit values at the benchmark values quoted in the guidance are not mandatory, except where there are statutory requirements from other legislation. However, the Regulator will carefully consider the relevance and relative importance of the information in the Guidance to the installation concerned when making technical judgments about the installation and when setting Conditions in the Permit, any departures from indicative standards being justified on a site-specific basis.

The Guidance also aims (through linkage with the Application Form or template) to provide a clear structure and methodology for Operators to follow to ensure they address all aspects of the PPC Regulations and other relevant Regulations, that are in force at the time of writing. Also, by expressing the Best Available Techniques (BAT) as clear indicative standards wherever possible, it aims to minimise the effort required by both Operator and Regulator to apply for and issue, respectively, a Permit for an installation.

This Guidance is aimed at Installations defined as Waste Incinerators within the Waste Incineration Regulations. Guidance on the requirements for co-incineration installations is contained in the guidance notes for the sector within which the co-incinerator is operating. Additional guidance will be made available as a supplemental note to such Guidance to describe the additional requirements on such installations introduced by the need to comply with the Waste Incineration Directive.

This Guidance is aimed primarily at Waste Incineration Installations regulated in England and Wales under Part A(1) of the PPC regime by the Environment Agency. Alternative Guidance will be available for installations operated as A(2) Installations in England and Wales, regulated by the Local Authority. There is no separation of PPC activities into A(1) and A(2) in Scotland and Northern Ireland, and the Regulators there will use this Guidance for all Part A PPC activities involving Waste Incineration.

The PPC Regulations and Waste Incineration Regulations require the operators of existing Waste Incinerators to apply for a PPC/WID Permit (or Variation to an existing Permit) between 1 January 2005 and 31 March 2005. The requirements of the Waste Incineration Directive (WID) for those plants which are within its scope have to be complied with for existing plant from 28 December 2005, and for new plant from the beginning of their operation. Until the WID applies to these plant, there are other European Legislation requirements that have to be complied with, as implemented by extant UK Legislation. This Guidance is aimed specifically at New Waste Incineration Installations applying for PPC/WID Permits, and for Existing Waste Incineration Installations applying for PPC/WID Permits/ Variations in the first quarter of 2005. It also applies to incinerators which are outside the scope of WID and which are required to obtain PPC Permits. Where an Operator is considering making an Application for a Permit which he believes does not fall into these categories, he should take up immediate dialogue with the relevant Regulator.

1.1 Understanding IPPC

IPPC and the Regulations

Integrated Pollution Prevention and Control (IPPC) is a regulatory system that employs an integrated approach to control the environmental impacts of certain listed industrial activities. It involves determination by the Regulator of the appropriate controls for those industries to protect the environment, through a single permitting process. To gain a Permit, Operators have to demonstrate in their Applications, in a systematic way, that the techniques they are using or are proposing to use, are the Best Available Techniques (BAT) for their installation, and meet certain other requirements, taking account of relevant local factors.

The essence of BAT is that the techniques selected to protect the environment should achieve an appropriate balance between environmental benefits and the costs incurred by Operators. However, whatever the costs involved, no installation may be permitted where its operation would cause significant pollution.

IPPC operates under **The Pollution Prevention and Control Regulations** (for equivalent legislation in Scotland and N Ireland see **Appendix 1**). The three regional versions of the PPC Regulations implement in the UK the EC Directive on IPPC (96/61/EC). Further information on the application of IPPC/PPC, together with Government policy and advice on the interpretation of the English & Welsh Regulations, can be found in **IPPC: A Practical Guide** published by the Department for Environment, Food and Rural Affairs (Defra). Equivalent guidance on the Scottish Regulations is provided in **PPC Regulations: A Practical Guide (Part A Activities)**, published by the Scottish Executive and SEPA. The Department of the Environment, Northern Ireland has published equivalent guidance on its Regulations.

Installation based, NOT national emission limits

The BAT approach of IPPC differs from regulatory approaches based on fixed national emission limits (except where General Binding Rules or Standard Permits are issued). The legal instrument that ultimately defines BAT is the Permit, and Permits can only be issued at the installation level.

Indicative BAT Standards

Indicative BAT standards are laid out in national guidance (such as this) and, where relevant, should be applied as a minimum unless a different standard (including a stricter one) can be justified for a particular installation. BAT includes the technical components, process control, and management of the installation given in Section 2, and the benchmark levels for emissions identified in Section 3. Departures from those benchmark levels can be justified at the installation level by taking into account the technical characteristics of the installation concerned, its geographical location and the local environmental conditions.

Some industrial sectors for which national guidance is issued are narrow and tightly defined, whilst other sectors are wide and diffuse. This means that where the guidance covers a wide variety of processes, and individual techniques are not described in detail, the techniques (and their associated emission levels) which might constitute BAT for a particular operation, are more likely to differ, with justification, from the indicative BAT standards than would be the case for a narrow, tightly-defined sector.

BAT and EU limits or conditions

If any mandatory EU emission limits or conditions are applicable, they must be met as a minimum, even where Bat for the installation would not by itself require such standards.

BAT and EQS

The BAT approach complements, but differs fundamentally from, regulatory approaches based on Environmental Quality Standards (EQS). Essentially, BAT requires measures to be taken to prevent emissions - and measures that simply reduce emissions are acceptable only where prevention is not practicable. Thus, if it is economically and technically viable to reduce emissions further, or prevent them altogether, then this should be done irrespective of whether or not EQSs are already being met. The BAT approach 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 emissions from industrial activities and their impact. The BAT approach first considers what emission prevention can reasonably be achieved (covered by Sections 2 and 3 of this Guidance) and then checks to ensure that the local environmental conditions are secure (see **Section 4** of this Guidance and also Guidance Note **IPPC Environmental Assessments for BAT**). The BAT approach is therefore the more precautionary one because the release level achieved may be better than that simply required to meet an EQS.

Conversely, if the application of indicative BAT might lead to a situation in which an EQS is still threatened, a more effective technique is required to be BAT for that installation. The Regulations allow for expenditure beyond indicative BAT where necessary, and, ultimately, an installation will only be permitted to operate if it does not cause significant pollution.

Further advice on the relationship between BAT, EQSs and other related standards and obligations is given in **IPPC: A Practical Guide**, its Scottish equivalent, and also in Section 3.

Assessing BAT at the sector level

The assessment of indicative BAT takes place at a number of levels. At the European level, the European Commission issues a “BAT reference document” (BREF) for each main IPPC sector. It also issues “horizontal” BREFs for a number of general techniques which are relevant across a series of industrial sectors. The BREFs are the result of an exchange of information between regulators, industry and other interested parties in Member States. Member States should take them into account when determining BAT, but they are allowed flexibility in their application. UK Sector Guidance Notes like this one take account of information contained in relevant BREFs and set out current indicative standards and expectations in the UK. At national level, techniques that are considered to be BAT should represent an appropriate balance of costs and benefits for a typical, well-performing installation in the sector concerned. They should also be affordable without making the sector as a whole uncompetitive, either within Europe or world-wide.

The BREF production programme is in progress, but is not yet complete. The BREF for the Waste Incineration sector is expected to be published in 2004. The indicative standards laid down in this Note are therefore based on Best Available Techniques Not Entailing Excessive Cost (“BATNEEC”) standards from the IPC Technical Guidance Note for the Waste Incineration sector, S2 5.01, and the Waste Incineration Directive. When the BREF for this sector is adopted by the Commission, this Guidance Note will be reviewed and, if appropriate, revised.

Assessing BAT at the installation level

When assessing applicability of sectoral indicative BAT standards at the installation level, departures may be justified in either direction. Selection of the technique which is most appropriate may depend on local factors and, where the answer is not self-evident, an installation-specific assessment of the costs and benefits of the available options will be needed. The Regulator’s guidance **IPPC Environmental Assessments for BAT** and its associated software tool may help with the assessment. Individual installation or company profitability (as opposed to profitability of the relevant sector as a whole) is not a factor to be considered, however.

In the assessment of BAT at the installation level, the cost of improvements and the timing or phasing of that expenditure, are always factors to be taken into account. However, they should only be major or decisive factors in decisions about adopting indicative BAT where:

- the installation’s technical characteristics or local environmental conditions can be shown to be so different from those assumed in the sectoral assessment of BAT described in this guidance, that the indicative BAT standards may not be appropriate; or
- the BAT cost/benefit balance of an improvement only becomes favourable when the relevant item of plant is due for renewal/renovation (e.g. change to a different design of furnace when the existing furnace is due for a rebuild). In effect, these are cases where BAT for the sector can be expressed in terms of local investment cycles; or
- a number of expensive improvements are needed. In these cases, a phasing programme may be appropriate - as long as it is not so drawn out that it appears to be rewarding a poorly performing installation.

In summary, departures by an individual installation from indicative BAT for its sector 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 the basis of individual company profitability, or if significant pollution would result. Further information on this can be found in **IPPC: A Practical Guide** and **IPPC Part A(1) Installations: Guide for Applicants**, or the equivalent Scottish Guidance.

Innovation

The Regulators encourage the development and introduction of innovative techniques that advance indicative BAT standards criteria, i.e. techniques which have been developed on a scale which reasonably allows implementation in the relevant sector, which are technically and economically viable and which further reduce emissions and their impact on the environment as a whole. One of the main aims of the PPC legislation is continuous improvement in the overall environmental performance of installations as a part of progressive sustainable development. This Sector Guidance Note describes the indicative BAT standards at the time of writing but Operators should keep up-to-date with improvements in technology - and this Guidance note cannot be cited as a reason for not introducing better available techniques. The technical characteristics of a particular installation may also provide opportunities not foreseen in the Guidance, and as BAT is determined at the installation level (except in the case of General Binding Rules (GBRs)), it is a requirement to consider these even where they go beyond the indicative Standards.

New installations

Indicative BAT standards apply, where relevant, to both new and existing installations, but it will be more difficult to justify departures in the case of new installations (or new activities in existing installations) - and for new activities, techniques which meet or exceed indicative BAT requirements should normally be in place before operations start.

Existing installations - standards

For an existing installation, it may not be reasonable to expect compliance with indicative BAT standards immediately if the cost of doing so is disproportionate to the environmental benefit to be achieved. In such circumstances, operating techniques that are not at the relevant indicative BAT standard may be acceptable, provided that they represent what is considered BAT for that installation and otherwise comply with the requirements of the Regulations. The determination of BAT for the installation will involve assessment of the technical characteristics of the installation and local environmental considerations, but where there is a significant difference between relevant indicative BAT and BAT for an installation, the Permit may require further improvements on a reasonably short timescale.

Existing installations - upgrading timescales

Where there are departures from relevant indicative BAT standards, Operators of existing installations will be expected to have upgrading plans and timetables. Formal timescales for upgrading will be set as Improvement Conditions in the Permits. See **Section 1.4.2** for more details.

1.2 Making an application

For the issue of a Permit a PPC Application has to:

- address the issues in Sections 2 and 3 of this guidance;
- assess the environmental impact described in Section 4 (and for England and Wales also in **Environmental Assessment and Appraisal of BAT (IPPC H1)**);
- demonstrate that the proposed techniques are BAT for the installation.

In practice, many PPC Applications have contained far more information than is needed for determination, yet have not addressed the areas that are most important - and this has led to extensive requests for further information. In an attempt to focus application responses to the areas of concern to the Regulator, Application forms (templates) have been produced by the Environment Agency, by SEPA and by EHS in N Ireland. In addition, as the dates for application have approached, the operators in most industrial sectors in England and Wales have been provided with Compact Discs (CDs) which contain all relevant Application Forms and Assessment tools, technical and administrative guidance, BREFs, and the charging scheme (known as EPOPRA), hyper-linked together for ease of use.

It is intended that there will be such a CD for Operators in the Waste Incineration sector in England and Wales. The tools and advice on the CD will help to steer the operator through the Application process, define much more closely the level of detail required in the Application and aim to make the process of calculating impact assessment much simpler. The CD will contain a modified Application Form which will guide the applicant through the additional questions needed to be answered to be able to demonstrate that the Waste Incineration Directive requirements will be adhered to.

For Applications where there are existing IPC Authorisations or Waste Management Licences, the previous applications may provide much of the information for the PPC Application. However, where the submitted Application refers to information supplied previously, fresh copies will have to be submitted with the PPC Application - though for issues where there is a tendency for frequent changes of detail (for example, information about the management systems), it will generally be more appropriate simply to refer to the information in the Application and keep available for inspection on site, up-to-date versions of those documents.

For further advice see **IPPC Part A(1) Installations: Guide for Applicants (for England and Wales)** or PPC Part A Installations: Guide for Applicants (for Scotland) or the equivalent Northern Ireland guide for Applicants.

1.3 Installations covered

This Guidance relates to installations containing the activities listed below, as described in Part A(1) of Schedule 1 to the **The Pollution Prevention and Control Regulations**. The schedules of listed activities are slightly different in Scotland and Northern Ireland so for their equivalent Regulations see **Appendix 1**

The installation will also include **associated activities** which have a technical connection with the main activities and which may have an effect on emissions and pollution, as well as the main activities described above. These may involve activities such as:

- the storage and handling of raw materials;
- the storage and despatch of finished products, waste and other materials;
- the control and abatement systems for emissions to all media;
- waste treatment or recycling.

Environment Agency advice on the composition of English or Welsh installations and which on-site activities are to be included within it (or them) is given in its guidance document **IPPC Regulatory Guidance Series No.5 - Interpretation of "Installation" in the PPC Regulations**. Operators are advised to discuss the composition of their installations with the Regulator before preparing their Applications.

The definition of "incineration plant" (that is, plant which is subject to the Waste Incineration Directive) is set out in the interpretation note to section 5.1 of Part 1 of Schedule 1 to the PPC Regulations. "Incineration plant" includes "the site and the entire incineration plant including all incineration lines, waste reception, storage, on-site pre-treatment facilities, waste-fuel and air supply systems, boiler, facilities for the treatment or storage of residues and waste water, stack, devices and systems for controlling incineration operations recording and monitoring incineration conditions. "Note that 'pre-treatment' here means the dedicated treatment of waste to make it suitable for the type of listed incineration activity e.g. dewatering of sewage sludge for a sewage sludge incinerator or the shredding of waste for a fluidised bed incinerator. The definition of "incineration plant" is taken directly from the Directive and is intended to ensure that PPC Permits for such plant deliver all of the relevant Directive requirements. The word "site" in this definition is interpreted as "the site on which activities relating to waste incineration as defined above are carried out" rather than the entire site in which the operation is located. This means that other waste disposal or recovery activities or other PPC activities carried out on the entire "site" (as defined in IPPC RGS No 5, Note 4.4.3) which are not part of the incineration activity are NOT included in the definition of the incineration listed activity given above, and consequently may either be directly associated activities to the incineration activity or, if they are not (for example because they are not technically connected), require separate permitting or waste licensing or exemption. If activities that would normally constitute PPC directly associated activities fall within the scope of the "incineration plant" as defined for WID, they form part of the listed activity and should not be treated as separate directly associated activities in the application or the Regulator's determination.

1.3.1 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 SI 2000 No. 1973 as amended by the Waste Incineration (England and Wales) Regulations SI 2002 No. 2980, under the following sections:

5.1(a) - The incineration of hazardous waste in an incineration plant.

5.1(b) - Unless carried out as part of any other Part A(1) activity, the incineration of hazardous waste in a co-incineration plant.

5.1(c) - The incineration of non-hazardous waste in an incineration plant with a capacity of 1 tonne or more per hour.

5.1(d) - Unless carried out as part of any other activity in this Part, the incineration of hazardous waste in a plant which is not an incineration plant or a co-incineration plant.

5.1(e) - Unless carried out as part of any other activity in this Part, the incineration of non-hazardous waste in a plant which is not an incineration plant or a co-incineration plant but which has a capacity of 1 tonne or more per hour.

Within Scotland there are no A(1) or A(2) activities. All WID activities will be designated Part A. Section 5.1 of Schedule 1 to the Pollution Prevention & Control (Scotland) Regulations 2000 was amended by the Waste Incineration (Scotland) Regulations 2003 and follows broadly the definitions outlined in this section.

Within Northern Ireland there are no A(1) or A(2) activities. All WID activities will be designated Part A. Section 5.1 of Schedule 1 to the Pollution Prevention and Control Regulations (NI) 2003 was amended by the Waste Incineration Regulations (NI) 2003 and follows broadly the definitions outlined in this section.

However, there may be differences and applicants should refer to the appropriate Regulations or speak to the local Regulator.

It is important to note that the Regulations give detailed guidance on the interpretation of the sections outlined above and the definitions of incineration and co-incineration plant. This guidance makes it clear, for example, that thermal pre-treatment methods such as plasma processing, pyrolysis and gasification are covered by the definition of incineration if any of the substances produced from the activity is subsequently incinerated.

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. These may 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

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 wastewater.

Advice is available on the extent of the physical site which is contained within the installation - for example, for England and Wales advice about split sites is given in IPPC Part A(1) Installations: Guide for Applicants. Operators are advised to discuss this issue with the Regulator prior to preparing their application.

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, and
- other relevant guidance notes issued under EPA 90
- 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)
- guidance on waste management (e.g. Guidance on Clinical Waste Management) plants

1.3.2 Activities NOT covered by this note

This note provides guidance where the **primary purpose** of the installation is the destruction of wastes in incinerators. There are many situations where waste or waste derived fuel is burned as a substitute for, or in addition to, primary fuel in the course of a manufacturing a material product or generating energy. For example, waste oil is sometimes burned in power stations, and waste solvents or tyres may be burned in a cement works.

Such activities are defined as co-incineration, and are covered in sector 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**.

Guidance produced by Defra, "Directive 2000/76/EC On The Incineration Of Waste", may be useful to Operators in understanding how the WID applies in such situations.

1.4 Timescales

1.4.1 Permit review periods

Permits are likely to be reviewed as follows:

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

However, where discharges of Groundwater List I or List II substances have been permitted, or where there is disposal of any matter that might lead to an indirect discharge of any Groundwater List I or II substance, a review must be carried out within four years as a requirement of the Groundwater Regulations.

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

1.4.2 Upgrading timescales for existing plant

Existing installation timescales

Existing installation timescales

Unless subject to specific conditions elsewhere in the Permit, upgrading timescales will be set in the Improvement Programme of the Permit, having regard to the criteria for improvements in the following two categories:*Standard "good-practice" requirements, such as, management systems, waste, water and energy audits, bunding, housekeeping measures to prevent fugitive or accidental emissions, good waste-handling facilities, and adequate monitoring equipment.* Many of these require relatively modest capital expenditure and so, with studies aimed at improving environmental performance, they should be implemented as soon as possible and generally well within 3 years of issue of the Permit.*Larger, more capital-intensive improvements, such as major changes to reaction systems or the installation of significant abatement equipment.* Ideally these improvements should also be completed within 3 years of Permit issue, particularly where there is considerable divergence from relevant indicative BAT standards, but where justified in objective terms, longer time-scales may be allowed by the Regulator.

Local environmental impacts may require action to be taken more quickly than the indicative timescales above, and requirements still outstanding from any upgrading programme in a previous permit should be completed to the original time-scale or sooner. On the other hand, where an activity already operates to a standard that is close to an indicative requirement a more extended time-scale may be acceptable. Unless there are statutory deadlines for compliance with national or international requirements, the requirement by the Regulator for capital expenditure on improvements and the rate at which those improvements have to be made, should be proportionate to the divergence of the installation from indicative standards and to the environmental benefits that will be gained.

The Operator should include in the Application a proposed programme in which all identified improvements (and rectification of clear deficiencies) are undertaken at the earliest practicable opportunities. The Regulator will assess BAT for the installation and the improvements that need to be made, compare them with the Operator's proposals, and then set appropriate Improvement Conditions in the Permit

For existing plants which are within the scope of the Waste Incineration Directive, the plant should be upgraded to be compliant with the requirements of that Directive by 28 December 2005 at the latest. In cases where the plant is currently regulated under an IPC Authorisation, the Operator should consider with the regulator whether the steps required to carry out any required upgrading would represent a relevant change under IPC and hence require to make an application for an IPC Variation.

1.5 Key issues

In England and Wales, the Regulator's position on incineration is that:

- The Regulator believes that incineration has a role in waste management

The Regulator considers that it may be appropriate for local authorities to include incineration in a particular strategy provided that:

- It does not undermine waste management options higher up the waste hierarchy
- It represents the Best Practicable Environmental Option (BPEO) for disposal taking into account the waste hierarchy
- It forms a part of a regional or local strategy developed by one or more local authorities based on the need to minimise waste generation and to re-use, recycle, recover and dispose of waste in the nearest appropriate facility
- It is consistent with the statutory requirement to establish an integrated and adequate network of waste disposal installations

The key issues for the waste incineration sector are related to the perceived environmental and health impact and the siting of installations. Other important issues include the presence of specific European legislation covering the sector, the range of feedstocks to be incinerated and the techniques used for handling and disposal of residues.

1.5.1 Environmental impact

Existing incinerators are regulated to conditions imposing stringent standards under the IPC Regime. The operators of such incinerators will be required to comply with the requirements of the Waste Incineration Directive by the relevant date unless the incinerator is excepted from the requirements of the WID. The potential environmental impacts of most significance are likely to be on ground level air quality, which aspects should be addressed particularly in the Operator's assessment of environmental impact.

The extensive closure and rebuilding of MWIs and CWIs over the last few years mean that existing plant is performing to modern standards which have the potential to be upgraded relatively easily and quickly to comply with WID. For those which will not be able to upgrade appropriately, it is anticipated that closure will occur resulting in potential expansion of capacity elsewhere.

1.5.2 Planning Issues

The siting of Waste Incinerators is controlled under the Land Use Planning regime by the Planning Authorities (Local Authorities). The Planning Authorities are likely to give permission for new incinerators only as part of a wider scheme which is consistent with the Government's Strategy for Waste Disposal, which includes among its objectives the recovery of materials in preference to incineration. While the siting issue is not directly relevant to the determination of a PPC Application or the issue of a PPC Permit, the Regulator and Local Authority are both Statutory Consultees on each other’s determination process, and information is exchanged between the two Competent Authorities. Operators are advised that provision of information under both regimes as early as possible and, where possible, over the same time frame will ease both of the determination processes in many cases. The Regulator would welcome such parallel application to ensure that issues of common interest could be addressed at an early stage in the project development.

In contrast to the permitting of many waste disposal facilities, it is NOT a requirement for the determination of a PPC Application for a Waste Incinerator that Planning Permission has been obtained from the Planning Authority.

1.5.3 European Community legislation applying to Waste Incineration

The incineration of waste is subject to a number of European Directives. Each of the Directives contains Articles which define the scope of the Directive and its provisions. 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 Directions by the Secretary of State or relevant Minister (DOE in Northern Ireland). Once the enabling legislation has been passed the appointed Regulator is required to enforce the requirements of the Directive as advised by Government.

The Directives discussed here have been given force by a number of Regulations and Directions to Regulators, and it is an important part of regulation that the requirements introduced by such legislation are delivered as part of the PPC Regime.

It should be noted that the legislation provides that the requirements of the Directive are delivered as a minimum. Other aspects of the PPC Regime (for example, the use of BAT) may result in Permit conditions which are included to deliver greater environmental protection than that specified as a minimum under the Directives.

The Waste Incineration Directive (WID, 2000/76/EC) implemented by the Waste Incineration Regulations (S.I. 2002 No. 2980) and SoS Guidance to regulators will apply to the majority of Installations in which waste is incinerated by 28 December 2005 at the latest. Defra has produced "Guidance on: Directive 2000/76/EC On The Incineration Of Waste" which describes the scope of the Waste Incineration Directive, how it is implemented within England and Wales and what the main duties of the operator and the regulator comprise. The standards set out in the current guidance note take direct account of the Directive and the Defra Guidance (as well as other relevant legislation). The WID is implemented in Scotland by the Waste Incineration (Scotland) Regulations 2003 (S.S.I. 2003 No. 170) and in Northern Ireland by the Waste Incineration Regulations (Northern Ireland) 2003 (Statutory Rule No. 390).

Further discussion of the WID follows below.

Historically, three directives in addition to the WID have been applied specifically to some waste incineration activities:

Existing Municipal Waste Incinerators Directive 89/429/EEC and New Municipal Waste Incinera-

tors Directive 89/369/EEC

These Directives set the current European legislative baseline standards for existing MWIs. Conditions to deliver the requirements of these Directives are already contained in existing IPC Authorisations or PPC Permits for MWIs. Any new applications for a PPC Permit for a MWI will be treated as a new Plant for the Waste Incineration Directive, in which case the requirements of the WID will supersede the requirements of these Directives. These Directives will be repealed from 28 December 2005 by virtue of Article 20 of the WID. It is not considered likely that Applicants will make an Application for a New Permit or Variation to an existing Authorisation or Permit which will be subject to the requirements of these Directives instead of those of the WID.

Hazardous Waste Incineration Directive 94/67/EC

The Hazardous Waste Incineration Directive (HWID) sets the current European legislative baseline standards for existing HWIs. Conditions to deliver the requirements of this Directive are already contained in existing IPC Authorisations or PPC Permits for HWIs and Hazardous Waste Co-incinerators. Any new applications for a PPC Permit for a HWI will be treated as a new Plant for the Waste Incineration Directive, in which case the requirements of the WID will supersede the requirements of this Directive. Where the operator of an existing waste incineration installation wishes to start burning hazardous waste for the first time before 28 December 2004, it is possible that the requirements of the HWID may apply as an interim until the requirements of the WID are applied. In such circumstances, the Applicant is advised to discuss this situation with the Regulator. The HWID will be repealed from 28 December 2005 by virtue of Article 20 of the WID. It is not considered likely that Applicants will make an Application for a New Permit or Variation to an existing Authorisation or Permit which will be subject to the requirements of this Directive instead of those of the WID.

Since it is envisaged that all new Applications for PPC Permits (other than those specifically excluded from the WID) will be required to comply with the requirements of the WID instead of these three Directives, it is proposed not to cover the specific requirements of these Directives any further in the Guidance Note. Where an operator is of the view that one or other of these Directives should apply to his installation, he is advised to make urgent contact with the Regulator.

Waste Incineration Directive 2000/76/EC

The WID applies where solid or liquid waste is incinerated in incineration or co-incineration plant, with the exception of excluded plant as defined in the WID Article 2. Incineration plant is plant dedicated to the thermal treatment of wastes, which includes incineration of waste by oxidation as well as other thermal treatment processes such as pyrolysis, gasification or plasma processes insofar as the substances produced by the thermal treatment are subsequently incinerated (WID Article 3(4)). Co-incineration plant is 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 waste is thermally treated for disposal. If co-incineration takes place in such a way that the main purpose of the plant is not the generation of energy or production of material products but rather the thermal treatment of waste, the plant shall be regarded as an incineration plant. (WID Article 3(5)).

Excluded plant (WID Article 2) comprises experimental plants used for research, development and testing in order to improve the incineration process which treat less than 50 tonnes per year of waste, and plants burning only the following wastes:

- Vegetable waste from agriculture and forestry
- Vegetable waste from the food processing industry, if the heat is recovered
- Fibrous vegetable waste from virgin pulp production and for production of paper from pulp, if it is co-incinerated at the place of production and the heat is recovered
- Wood waste with the exception of wood waste which may contain halogenated organic compounds or heavy metals as a result of treatment with wood preservatives or coating, and which includes in particular such wood waste originating from construction and demolition waste
- Cork waste

- Radioactive waste
- Animal carcasses as regulated by Directive 90/667/EEC without prejudice to its further amendments. (This includes regulation by the State Veterinary Service (SVS) under the Animal By-Products Regulation 2003 (ABPR).)
- Waste resulting from the exploration for, and the exploitation of, oil and gas resources from off-shore installations and incinerated on board the installation.

In practice, this means that the WID will apply to Municipal Waste Incinerators (MWI), Clinical Waste Incinerators (CWI), Hazardous (Chemical) Waste Incinerators (HWI), Sewage Sludge Incinerators (SSI), Drum Incinerators (DI) and Animal Remains Incinerators, as well as co-incinerators burning these materials. Pyrolysis and gasification plants and Plasma Processes treating the same wastes will be subject to WID if one or more of the products is subsequently incinerated, either on or off-site.

Where fuel derived from waste (RDF) is burned on a co-incinerator to produce energy, legal interpretation suggests that all such materials are likely to remain waste until recovery is completed (i.e. combustion takes place). The WID will therefore apply to such operation.

Animal Carcase Incinerators (ACI) burning whole carcases only will be excluded from the WID but will still be covered by the PPC Regulations where relevant throughput limits apply.

Where the Operator of a plant incinerating waste is of the view that the WID does not apply to his operation, he is recommended to take up contact with the Regulator to confirm this view.

Guidance concerning Co-incineration of waste will be included where relevant in the Sector Guidance Notes for the relevant sector. The remainder of this Sector Guidance Note will deal with Waste Incinerators only, as defined in the PPC Regs S 5.1 A(1).

In all cases that are subject to the WID, existing installations must comply with WID standards as a minimum from 28 December 2005 at the latest (subject to certain derogations, of which some are time limited, as described in the WID).

Interpretation of the directive is complex and it is recommended that this is discussed with the Regulator well before an application is submitted.

1.5.4 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. 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 exceedances of emission limits.

1.5.5 Residues handling and disposal

The purpose of an incinerator is to maximise the safe destruction of 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 residues produced. Residues are in the form of grate or bottom ash, fly ash, residues from the air pollution control (APC) equipment and, in some cases, residues from the wastewater treatment plant. 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 hazardous wastes (e.g. APC residues). All installations must make adequate provision for the on-site management of these residues.

1.6 Summary of releases

Releases to the environment commonly associated with the activities covered by this Guidance Note are listed in Table 1.1 below:

Table 1.1: 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:												
Hazardous waste	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Clinical waste	Y	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		A
Waste storage and heating Note1,2	AL						AWL	WL	WL	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.

1.7 Technical Overview

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 and technology employed, to recover energy from that waste.

Incineration Plant is interpreted in the Waste Incineration Regulations 2002 (implementing the WID) as “. any stationary or mobile technical unit and equipment dedicated to the thermal treatment of wastes with or without recovery of the combustion heat generated. This includes the incineration by oxidation of waste as well as other thermal treatment processes such as pyrolysis, gasification or plasma processes in so far as the substances resulting from the treatment are subsequently incinerated....”. Thermal treatment processes for waste (in the UK, this means currently predominantly pyrolysis and gasification processes) are therefore covered by the definition of incineration if the substances produced are subsequently incinerated, and this is taken to mean either on-site or off-site by a third party. (In the event that none of the substances produced are subsequently incinerated, then the installation would not be described as a waste incineration plant, although it might still require a Permit under PPC within another industrial sector.)

Common process stages

Although technologies (e.g. grate, hearth and abatement plant design differences) differ depending upon the precise nature of the feedstock, 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, e.g. ash
- combustion control, e.g. air staging, NO_x 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 plants differ from this general layout in that they include respectively an oxygen-free or 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 over the next 10 to 20 years as alternatives to landfill are sought for wastes that cannot practicably be reduced or recycled.

Clinical waste incinerators (CWI)

CWIs provide for the disposal of healthcare wastes arising typically from hospitals, veterinary and dental practices, and pharmaceutical research plants. Many clinical wastes will be hazardous wastes, including those classified as H9 HW because of the presence on infectious 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, for example to heat the hospital or other buildings at which the incinerator is located, thus saving on primary fuels.

Hazardous waste incinerators (HWI) (Chemical Waste Incinerators - ChWI)

Hazardous waste incinerators provide a means of disposal for hazardous and other 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 (Often known as High Temperature Incinerators - HTI). Where Hazardous Wastes are Incinerated in existing plant, the Hazardous Waste Incineration Directive (HWID) must already be complied with, and will remain so until the WID takes effect on the site.

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 processes must adopt the very highest technological and management standards, as must co-incineration processes burning similar hazardous wastes.

Sewage sludge incinerators (SSI)

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.

Animal carcass and animal remains incinerators (ACI)

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.

Installations burning only animal carcasses are presently excluded from the Waste Incineration Directive (WID) but must comply with other specific legislation - in particular, the EC Animal By-Products Regulation which is implemented in the UK by the Animal By-Products Regulations 2003 (SI 2003 No. 1482) (ABPR). Installations that burn other animal remains (including MBM and tallow) do fall within WID from the dates specified.

Drum incinerators (DI)

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

1.8 Economics

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 waste 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. 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.

Commercial scale pyrolysis and gasification 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. scrap tyres, some sewage sludge and wood wastes. These variants 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. Technology providers are currently demonstrating UK operational plant for clinical and municipal waste.

1.8.1 Sub-sector specific information

Municipal waste incineration sub-sector

Municipal waste disposal is paid for 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. Planning requirements are in the majority of cases likely to restrict the development of plant with very large throughput (>500 kte/annum).

Financial support for energy from waste projects has been obtained by some projects under the Government's non fossil fuels / renewable energy programmes. The rules covering the availability of such financial support are complex, but are likely to be available only for the recovery of energy from the biodegradable fraction of industrial and municipal waste and only where such energy recovery would not undermine the waste hierarchy.

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

Clinical waste sub-sector

The potential inability of a number of smaller CWIs (regulated under EPA90 and PPC Part B) to be upgraded to comply with the requirements of the WID may lead to their closure. This may improve the economics of the remaining, compliant processes and act as a driver for their expansion or augmentation by new plants. The previous upgrading of some CWIs to meet the standards of the HWID in 2000, (in order to allow them to incinerate small quantities of certain non-exempt hazardous wastes) is likely to mean that these activities will have the least difficulty in meeting the standards of WID.

Hazardous (Chemical) waste sub-sector

There is reported to be a lack of buoyancy on the market for Merchant Incinerators. Competition within the sector and with the co-incineration of liquid wastes in cement kilns may be responsible for some recent closures.

In-house HWIs 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 WID do not apply to the incineration of waste gases other than those resulting from the thermal treatment of wastes, although BAT will apply in all cases.

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. Sludge pelletisation for use as fuel, sludge treatment for use as fertiliser and other thermal waste treatments are alternative means of disposal.

The choice of disposal option will be based on a variety of factors including cost and availability of alternatives. Disposal of sludge by incineration will be required to meet the standards by WID.

Animal carcass and animal remains sub-sectors

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.

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.

2 Techniques for pollution control

To assist Operators and the Regulator's officers in respectively making and determining applications for PPC Permits, this section summarises the indicative BAT requirements (i.e. what is considered to represent BAT for a reasonably efficiently operating installation in the sector). The indicative BAT requirements may not always be absolutely relevant or applicable to an individual installation, when taking into account site-specific factors, but will always provide a benchmark against which individual Applications can be assessed.

Summarised indicative BAT requirements are shown in the "BAT boxes", the heading of each BAT box indicating which BAT issues are being addressed. In addition, the sections immediately prior to the BAT boxes cover the background and detail on which those summary requirements have been based. Together these reflect the requirements for information laid out in the Regulations, **so issues raised in the BAT box or in the introductory section ahead of the BAT box both need to be addressed in any assessment of BAT.**

Although referred to as indicative BAT requirements, they also cover the other requirements of the PPC Regulations and those 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 PPC permitting. Where EU Directives such as the Waste Incineration Directive and the Large Combustion Plant Directive are implemented through the PPC regime, the requirements of these Directives may also be included.

For further information on the status of indicative BAT requirements, see **Section 1.1** of this guidance or **Guidance for applicants**.

It is intended that all of the requirements identified in the BAT sections, both the explicit ones in the BAT boxes and the less explicit ones in the descriptive sections, should be considered and addressed by the Operator in the Application. Where particular indicative standards are not relevant to the installation in question, a brief explanation should be given and alternative proposals provided. Where the required information is not available, the reason should be discussed with the Regulator before the Application is finalised. Where information is missing from the Application, the Regulator may, by formal notice, require its provision before the Application is determined.

When making an Application, the Operator should address the indicative BAT requirements in this Guidance Note, but also use the Note to provide evidence that the following basic principles of PPC have been addressed:

- The possibility of preventing the release of harmful substances by changing materials or processes (see **Section 2.1**), preventing releases of water altogether (see **Section 2.2.2**), and preventing waste emissions by reuse or recovery, have all been considered, and
- Where prevention is not practicable, that emissions that may cause harm have been minimised and no significant pollution will result.

This approach should assist Applicants to meet the requirements of the Regulations to describe in the Applications 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, leakage or malfunction.

2.1 In-process controls

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 2.1.1.1**)
- waste charging (see **Section 2.1.2**)
- furnace types (see **Section 2.1.3**)
- furnace requirements (see**Section 2.1.4**)
- dump stacks and by-passes (see **Section 2.1.5**)
- cooling systems (local pollution prevention aspects) (see **Section 2.1.6**)
- boiler design (see **Section 2.1.7**)

Abatement technology for releases to air and water can be found under **Section 2.2.1** and **Section 2.2.2**.

2.1.1 Incoming waste and raw materials 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 use of pre-treatment

UK legislation implementing 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.

The prevention of waste production at the installation is considered in Section **Section 2.4.2**. The management of wastes produced is considered in **Section 2.5** and **Section 2.6**. Selection of raw materials and material composition is considered in **Section 2.4.1**.

2.1.1.1 Incoming waste and raw material management requirements applicable to all existing incineration processes

Indicative BAT requirements for all existing incineration processes	
1	Where the WID applies **WID Article 5(2)** requires the Operator to have a system to determine the mass of each category of waste, if possible according to the European Waste Catalogue (EWC) prior to accepting the waste at the incineration plant.
2	There are specific WID requirements for the delivery and reception of wastes at incineration plant. These are likely to represent BAT for existing installations when they become subject to the PPC regime. There are specific requirements in respect of checking of statutory documentation, and a general duty to "take all reasonable 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.
3	Waste **pre-treatment** should be carried out to the degree necessary to reduce variations in feed composition and to control emissions within ELVs and to prevent unnecessary waste production.
4	A high standard of **housekeeping** should be maintained in all areas with suitable equipment provided and maintained to clean up spilled materials.
5	**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.
6	Uncontained, odorous or potentially **odorous** waste should be stored inside buildings with suitable odour control e.g. by maintaining buildings storing odorous material at a negative pressure with the extracted air used as the combustion air, automatic or restricted size doorways. A high level of management control and use of best practice will be expected. An odour management system should be in place.
7	**Fire fighting** provisions in accordance with the requirements of Local Fire Officers are required, especially for MWI reception bunkers, CWI storage and for chemical wastes.
8	**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. Tanks and silos should normally be bunded to prevent the loss of substances which could cause harm to the environment, as described in S 2.2.5.
9	**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)).

2.1.1.2 Municipal waste management

Indicative BAT requirements for municipal waste management (Sheet 1 of 2)

1 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 maximise the homogeneity of waste fed to the incinerator.
- Inspection procedures should be used to ensure any wastes which would prevent operation of the incinerator in compliance with its permit are removed and placed in a designated storage area pending removal.
- Waste may then be transferred to the feed chute e.g. by a grab crane.
- Where the waste is not pre-treated or sorted, smaller grab loads should be used on a more frequent basis to allow for greater waste inspection.

2 Where dust emissions from the received waste need to be controlled, 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 used in the process as far as practicable, for example in the ash quench stage.

3 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 if odourous releases are likely to give reasonable cause for annoyance as may be demonstrated by local complaints.
- 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 should 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, if odour management is not effective, waste shall be diverted away from the site and consideration given to the removal of the waste already stored on site. It would be expected that such a consideration would form a part of the odour management plan.
- 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 permitted limit, and must be confined to the designated areas.

4 Where dust emission needs to be controlled, 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.

Indicative BAT requirements for municipal waste management (Sheet 2 of 2)

Pre-treatment of municipal waste

5 Preferred practice for raw municipal waste may include the removal of large bulky items. The extraction of recyclable material and shredding of the remaining waste might be justified 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.

6 A particle size reduction system may be essential for controlled operation of **fluidised bed incinerators**. However, there have been reports of significant operational problems (including high maintenance costs and fires) with front-end **materials recycling facilities** (MRFs) handling raw mixed municipal waste. Applications will be expected to demonstrate that the proposed pre-treatment system represents BAT for the particular installation.

7 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 recyclable materials 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.

2.1.1.3 Hazardous waste management

Indicative BAT requirements for hazardous waste management (Sheet 1 of 2)

1 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)

2 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.

3 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.

4 For **merchant incinerators**, WID Articles 5(3), 5(4) and 5(5) require systems to 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
  - document checks; and
  - sampling where appropriate. Samples should be kept for at least 1 month after incineration. Small scale compatability 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.

5 For **in-house incinerators**, WID Articles 5(6) allows slightly relaxed procedures to be in place if the same level of protection can be demonstarted.

Pre-treatment of hazardous waste

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

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

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

Indicative BAT requirements for hazardous waste management (Sheet 2 of 2)

Storage of hazardous wastes

9 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.)

10 **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 permit 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

11 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.

12 **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:

13 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. (see also **Section 2.2.4**).

2.1.1.4 Clinical waste management

Indicative BAT requirements for clinical waste management (Sheet 1 of 2)	
1	The Regulator has issued guidance (See **Ref 11**) 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.
2	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, as required by WID Article 5(3) and 5(4).
3	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.
4	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 / **management of identified waste types** to blend the feed and/or large pre-charging feed hoppers to facilitate mixing.
5	Waste is ideally handled in locked, readily cleanable, wheeled containers which are opened only 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. Manual handling of individual plastic bags of clinical waste should be minimised.
6	**PVC** containers are a major source of HCl emissions. The main method available to reduce the formation of HCl from this source is to avoid using PVC containers for the waste.
7	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 duct 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.
8	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.

Indicative BAT requirements for clinical waste management (Sheet 2 of 2)	
9	**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). For England and Wales, specific guidance on storage times is contained in reference: Technical guidance on clinical waste management facilities. Where appropriate, clinical waste may need to be stored in refrigerated conditions.

2.1.1.5 Animal waste management

Indicative BAT requirements - animal waste management

Animal carcass incineration

1 Installations burning only animal carcasses* (or segmented animal carcasses where transport or feeding of whole carcasses is impractical) are excluded from the requirements of WID, but remain subject to PPC if throughputs are as defined in the Regulations. ACI Installations excluded from the WID will be subject to ABPR, which is regulated by the State Veterinary Service. (* Where residues generated within the incineration process are recycled to the ACI burning whole carcases, the ACI will remain exempt from the requirements of the WID).

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

3 Odours can be treated in a variety of ways. Containment and treatment are strongly preferred methods. 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.

4 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.

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

6 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.

7 Disinfectants and detergents should be chosen based on the following criteria:

- the chemical composition of the materials where relevant, particularly where there is an associated environmental impact
- the quantities used
- environmental impact where known e.g. degradability, bioaccumulation potential, toxicity to relevant species
- availability of practicable alternative materials that have a lower environmental impact

Indicative BAT requirements - animal waste management	
8	PVC packaging should be avoided to prevent additional chlorine loading on the incinerator. The Regulator views that the incineration of immediate packaging in which animal carcases are wrapped (e.g. for pets) will not make a non-WID ACI subject to the WID, provided that: the amount of packaging is the minimum necessary and is only for prevention of spillages or for health and safety reasons; and it is demonstrated to the satisfaction of the Regulator that no additional harm to human health or the environment is caused by the presence of the packaging. The incineration of more general packaging would make the plant subject to WID.
	Other Animal Waste Incineration (including MBM)
9	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 WID Articles 5(1) and 5(2) in respect of incoming waste handling, delivery and reception.
10	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.
11	Security of stored wastes is particularly important in respect of meat arising from culls to prevent theft.
12	MBM handling should take account of its potentially dusty nature. 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.
13	Where MBM (or other wastes) have been stored for considerable periods it is likely that compaction will have taken place. In these cases it should be stored in agitated silos to prevent agglomeration. 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.
14	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.
15	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.

2.1.1.6 Sewage sludge management

Indicative BAT requirements for sewage sludge management

1 Sewage sludge should be de-watered to produce a sludge cake of sufficiently low 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 may minimise problems of visible plume. Where an operator proposes not to operate autogeneously, the application should indicate how energy efficiency, achievement of ELVs and ease of furnace control will be affected by not so operating.

2 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 small quantities of ash or the addition of chemicals such as calcium hydroxide, ferric sulphate, ferric chloride or aluminium chlorohydrate.

3 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 (normally using waste heat from elsewhere in the process), to reduce the water content and minimise the supplementary fuel requirements.

4 The effluent from de-watering cannot be discharged directly to controlled waters without treatment. The usual practice would be to return it to the sewage treatment works (STW). 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. Treatment prior to release to the STW may allow for more efficient overall reduction in releases, particularly where persistent substances are encountered.

5 Where treatment is required solids removal may be achieved using flocculents and efficient settlement by lamella settlement or similar 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.

6 Odour 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.

2.1.1.7 Drum incineration management

Indicative BAT requirements for drum incineration management	
1	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.
2	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 2.1.4**) only when burning chlorinated wastes. Under these circumstances a strict waste segregation scheme will be necessary.
3	Where contents cannot be verified the drums must be segregated and analysed to ensure that the plant has the capability and is licensed to burn them.
4	Permits should limit both the quantity of drums to be held and the maximum period for which they can be held prior to incineration.
5	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
6	Attention should be given to ensuring the impervious nature of the storage areas and that the drainage and water treatment arrangements are adequate.
7	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.
8	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.
9	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. The time between opening and incineration should be kept to the minimum consistent with ensuring that the drums are adequately drained.

2.1.2 Waste charging

Indicative BAT requirements - waste charging (Sheet 1 of 3)

Legislative obligations and generic requirements for waste charging

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

2 The WID Article 6(3) requires that: "Incineration and co-incineration plants shall have and operate an automatic system to prevent waste feed:

- at start-up, until the [required] temperature …has been reached
- whenever the [required] temperature … is not maintained
- Whenever the continuous emission monitors … show that any emission limit value is exceeded due to disturbances or failures of the purification devices."

3 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 for a period of time in excess of the limits set within the WID.

4 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.

5 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 WID.

Charging rates

6 Charging rates outside the installation design capacity can 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 in place to ensure that the designed 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.

Pyrolysis and gasification

7 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.

Hazardous (Chemical) waste

8 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 below the flash point of the liquid.

Indicative BAT requirements - waste charging (Sheet 2 of 3)

9 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.

10 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).

Municipal waste and clinical waste

11 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.

12 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.

13 Where 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. Where the feed chute is choke fed to act as a seal, it may not always be possible to close the doors during normal operation, in which case it may be necessary to empty the feed chute through the incinerator before the doors can be closed.

14 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 2.1.4**).

15 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.

16 The WID Article 6(7) requires that infectious clinical waste should be placed straight in the furnace, without first being mixed with other categories of waste and without direct handling.

Sewage sludge

17 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.

Drum incineration

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

19 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.

Indicative BAT requirements - waste charging (Sheet 3 of 3)	
20	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.
21	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 2.1.4.
	Animal carcases and animal remains
22	When 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 temperature of the secondary chamber and the negative pressure of the primary chamber (e.g. by increasing draught), is of critical importance during charging. Continuous feeding of macerated meat or the use of a ram feeder enables a sealed charging system to be used and is considered to be BAT.

2.1.3 Furnace types

2.1.3.1 Introduction

This Guidance Note divides the technical guidance on furnaces into 2 sections; **this section describes the furnace designs available** while Section 2.1.4 deals with the design and performance requirements for BAT. More detailed descriptions of furnace types may be found in the literature.

Table 2.1: Summary of Combustion Technology Application for a Range of Wastes

Combustion Technologies – known to be or have been used in the UK: "UK" – suitable or likely to be: "S"	Waste Type					
	Hazardous	Clinical	RDF	Municipal	Sewage sludge	Animal carcass
Fixed hearth						UK
Fixed stepped hearth		UK		UK		
Moving grate (normally sloping and stepped)		UK	UK	UK		
Pulsed hearth	S (Note 1)	UK		S		S
Rotary kiln	UK	UK	S	S	S	UK
Fluidised bed (note 2)			UK	UK	UK	
Liquid injection	UK				S	

Table 2.1: Summary of Combustion Technology Application for a Range of Wastes

Combustion Technologies – known to be or have been used in the UK: "UK" – suitable or likely to be: "S"	Waste Type					
	Hazard-ous	Clinical	RDF	Municipal	Sewage sludge	Animal carcass
Semi pyrolytic	UK	UK	S	S		S
Gasification (note 2)	UK	UK	S	S	S	S
Pyrolysis (note 2)	UK	UK	UK	UK	S	S
Cyclonic combustors						
Gas incinerators	UK					
Drum incinerators	UK					

Notes:

1. For mainly solid chemical wastes.
2. May be suitable only for selected / pre-treated waste fractions.

2.1.3.2 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.

2.1.3.3 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.

2.1.3.4 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 2.1.4.1**).

2.1.3.5 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.

2.1.3.6 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 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. The generation of fine particles can be reduced using a partial rotation (reciprocating) kiln.

2.1.3.7 Fluidised bed incinerators

Fluidised beds are suitable only 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
- lower temperature leads to low NO_x formation
- 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 burn-out

MWI fluidised beds are 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 on some plant.

2.1.3.8 Starved air (semi-pyrolytic) incinerators

See also (**Section 2.1.3.13**). 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 NO_x, VOCs and CO. The relatively low combustion airflow results in low entrainment of particulate in the flue gas.

2.1.3.9 Cyclonic combustion

Cyclonic combustion techniques, for the destruction of organic wastes, were reported upon as an emerging technique in earlier guidance on incineration. 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.

2.1.3.10 Liquid injection incinerators

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.

2.1.3.11 Gas incinerators

The incineration of waste gases (unless the gas arises from the thermal treatment of waste) is 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. In some applications, the use of 3-bed Regenerative Thermal Oxidisers with purge valves has been shown to overcome the gas by-pass problem, and such equipment is used in the flexible packaging and film coating industries. Flameless devices are not generally suitable where there is a significant particulate burden.

2.1.3.12 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.

2.1.3.13 Gasification installations incinerating waste

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 (**BAT Review**).

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 which are gasified, 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/Nm^3, 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 is sealed to contain the gases produced
- the materials of construction are 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. Use of enriched air or oxygen will increase the gas CV (10 to 15 MJ/Nm^3) due to the reduced concentration 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 any of the solid or liquid products) produced is subsequently combusted, the installation will be subject to the requirements of the WID.

There are four main categories of gasification plant:

- **Rotating kiln** similar to rotary kiln incinerators except that they operate under sub -stoichiometric conditions.

- **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.
- **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.
- **Other systems** are reported to be available but there is little information on design and performance.

2.1.3.14 Pyrolysis installations incinerating waste

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 (**BAT Review**).

Pyrolysis is the thermal degradation of a material in the 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 °C. The heat breaks complex molecules into simpler ones that 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°C) 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:

- **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.
- **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.
- **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.
- **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 of 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

The Defra WID Guidance makes it clear that the Regulator cannot give any derogation from this requirement. However, it does emphasise that TOC is Total **Organic** Carbon, and that elemental carbon in char is to be excluded from this TOC analysis. If, having made allowance for the elemental carbon present, the 3% TOC would be exceeded, the WID will require further processing of the char such that the residues ultimately produced for disposal meet the 3% TOC standard. This additional processing may, for example, involve the use of a water gas reactor or further incineration.

The subsequent combustion of a product of pyrolysis (whether the solid, liquid or gaseous product) will mean that 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 sufficiently homogeneous, and the gas produced is 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.

In some configurations, a pyrolysis operation has been followed by a gasification operation on the pyrolysed products with reported benefits for control and reduced environmental releases.

2.1.4 Furnace requirements

Indicative BAT requirements for furnace requirements (Sheet 1 of 3)

1 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.

Legislative obligations

2 European directives already set **minimum** standards for operating conditions of municipal and hazardous waste incinerators. The 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 (WID Article 6(1)). 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 (WID Article 6(1)). WID Article 6(4) allows for derogation of these requirements where such derogations can be justified within BAT and achieving the overall aims of the WID.
- There should be at least 6% oxygen in the combustion gases at existing installations subject to MWID and HWID until 28 December 2005 after which they become regulated under WID. WID does not specify oxygen concentrations for the combustion gases. It should however be noted that BAT requires sufficiently oxidising conditions at the final combustion stage to provide for good combustion, and the Operator will be required to demonstrate this in his application. In many situations, the BAT oxygen concentration is likely to be about 6%.
- Incinerators must be provided with auxiliary burners to achieve and maintain the required temperatures (WID Article 6(3)).
- 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 2.1.4.1**) (WID Article 11(3)).
- Residues (ash) shall be minimised in their amount and harmfulness (WID Article 9).
- Incinerator slag and bottom ashes shall not exceed 3% TOC (excluding elemental carbon) or 5% LOI (dry weight) (WID Article 6(1)).
- Installations should not give rise to significant ground level air pollution (WID Article 6(5)).

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

Grates and primary air

4 Residence time of the waste in the furnace should be long enough to ensure adequate burnout (see also **Section 2.5**), and should be controllable.

5 Primary air supply should be controllable, and where there are separate zones in the grate(s) should be separately controllable between the zones.

6 Generally, designs which increase turbulence in the Primary Combustion Chamber reduce NO_x formation, secondary air requirements and overall flue gas volumes.

Indicative BAT requirements for furnace requirements (Sheet 2 of 3)

7 For most designs of furnace (fluidised beds may be an exception), primary air should be controlled both to minimise NO_x production and minimise velocities and the entrainment of particulate (see **Section 2.2.1.2**). Starved air systems can be very effective in controlling these while maintaining low levels of CO (see **Section 2.2.1.2**).

8 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.

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

Combustion chambers, secondary air system designs

10 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.

11 Gas temperature in the primary zone and at the entry and exit points 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 2.1.2**) 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 continuous emission monitors show exceedances of the permitted emission limit values

Supplementary burners and fuels:

12 Supplementary burners must be provided at all incineration installations in order to secure and maintain the required combustion temperatures (WID Article 6(1)).

- 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 shall be used to trigger the supplementary burners and to prevent additional waste feed until the required temperature is re-established

13 WID Article 6(1) requires that supplementary fuels used in such burners should be of a type which produce release levels no worse than those from burning gas oil, as defined by Directive 75/716/EEC (as amended), liquefied gas or natural gas.

14 Supplementary fuels that are wastes or waste derived may only be used as support fuel if:

- Combustion temperatures are greater than those outlined in the table below (or any other temperature specified in the Permit where the WID derogation has been invoked); this effectively means that waste derived fuels cannot be used for start-up, but may be used for maintaining temperatures above the minimum.

Indicative BAT requirements for furnace requirements (Sheet 3 of 3)

15 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 operator to decide and justify.

16 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 2.2**, 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** (WID Article 6(1)). The temperature is to be measured near the inner wall or at another representative point proposed in the Application and approved by the Regulator as part of the Permit.

17 These **temperatures** should be maintained during operation and at the end of an incineration cycle and for as long as combustible waste is in the combustion chamber (WID Article 6(1)).

18 **Other operating conditions** than those specified in bullets 16 - 17 above may be acceptable provided that it can be clearly demonstrated by the Operator to the satisfaction of the Regulator that the release limits will be met and the proposed process represents BAT for the installation (WID Article 6(4)).

Table 2.2: Furnace gas temperatures

Process	Minimum temperature °C
Hazardous waste (if the halogenated organic substances content exceeds 1% expressed as chlorine)	1100
Hazardous waste (if the halogenated organic substances content does not exceed 1% expressed as chlorine)	850
Municipal waste	850
Clinical waste	850
Animal carcasses	850
Sewage Sludge	850
Drum recovery (Figure in brackets if residual contained waste is hazardous waste with an halogenated organic substances content exceeding 1% expressed as chlorine)	850 (1100)

2.1.4.1 Validation of combustion conditions

The WID (Article 11(3)) 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 **BAT Review**. This guidance summarises some of the key issues and highlights BAT. In an Application, the operator will be expected to:

- Demonstrate that the design selected can meet the combustion requirements outlined in this guidance (**Section 2.1.4**) and in relevant European legislation.
- 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.
- Confirm the worst case combustion conditions under which the validations will be carried out.

Indicative BAT requirements combustion validation (Sheet 1 of 2)

1 At the **design stage** and for the application Operators should:

- Use Computerised Fluid Dynamics (CFD) where practical 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 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 including waste type etc.

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.
- 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 Monitoring of process variables in **Section 2.10**).

3 At some **existing installations** it may not be possible to carry out the measurements as specified 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, 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 not be practicable at existing installations.

Indicative BAT requirements combustion validation (Sheet 2 of 2)	
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 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 resetting where support burners are located provided they maintain temperature above the required level. • ·Would require resetting 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 or such longer period as may be appropriate for the specific design, waste types or mode of operation
6	For more detailed guidance on validation methodologies refer to **Ref 22**.

2.1.4.2 Measuring oxygen levels

Indicative BAT requirements for measuring oxygen levels	
1	The WID does not specify a minimum oxygen content for the combustion gas, although a BAT demonstration will be needed to ensure that sufficiently oxidising conditions are present to enable adequate combustion to take place. In practice, this is likely to mean that an oxygen level of about 6% will be required. The Regulator views that this oxygen level should be reported on a wet basis. (Zirconia based techniques measure the wet level whereas extractive systems measure the dry levels).
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 2.1.4.3**) the larger the margin of excess oxygen must be.

2.1.4.3 Combustion control

Indicative BAT requirements 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 often caused by sudden conflagrations of the non-homogeneous wastes and take place in the order of seconds. Fast response measuring/control systems (such as CO or oxygen sensors) must be used to avoid emission spikes (particularly of CO and unburned hydrocarbons).
5	Operators should demonstrate e.g. by reference to existing plants of the same configuration, 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 micro-second 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 to improve air supply response time 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. This has been used for merchant ChWI in the US and Germany with significant reductions in the number of high CO events • provision of excess capacity in the air supply ductwork upstream of the jets (by use of higher pressure fans) and use of a damper opening behind the jets. On opening of the dampers, there will be an immediate increase in air flow through the jets which may provide a much faster response than that obtained by simply controlling the fan speed.

2.1.4.4 Issues for the 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 coincinerators should be determined by reference to the appropriate sector guidance.

Because BAT for the incineration of a particular waste will be dependent upon the characteristics of that waste, a dedicated charging mechanism, furnace, abatement system and monitoring train is likely to be BAT unless very low proportions of alternative waste types are proposed to be included. Where incineration of different types of waste is proposed, the Application will need to demonstrate that the control and operation of the installation is BAT.

Where incineration of different types of waste in parallel incinerators uses combined abatement, the design should address the reduction in stack efflux velocity when either incineration line is not operating and monitoring at locations that may allow calculation of separate emission limit values for each line. It will not be acceptable to combine the flue gases from both lines to achieve dilution to meet emission limits.

The incineration of some types of clinical waste is possible in MWIs or ACIs, although such mixing would render an ACI otherwise burning only whole carcases subject to WID. Where CW is proposed to be burned in a MWI, the Application will need to address the effect that this might have on the recycling possibilities for the product ashes.

Indicative BAT requirements for the combined incineration of different waste types

1 WID Article 6(7) requires that Infectious clinical waste (H9) is placed straight in the furnace without first being mixed with other waste, and without direct handling.

2 Generally, more innocuous waste (e.g. Class E waste as defined in Technical Guidance on Clinical Waste Management Facilities, see **Waste management references**), which is suitable for landfill, may be burned in a well designed and run MWI or ACI, provided:

- 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

2.1.4.5 Flue gas recirculation (FGR)

Indicative BAT requirements for flue gas recirculation

1 Operators of all incineration plants are expected to consider whether FGR should be used for NO_x control. Operators should provide a justification of the NO_xcontrol techniques to be used by comparison with alternative techniques. The comparison should include options using and not using FGR. The justification should at least address the points below:

- 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.
- FGR typically 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.
- Higher re-circulation rates may give rise to corrosion. At lower levels this is not expected to be significant enough to prevent the routine use of this emission prevention technique.
- 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.
- The costs of retrofitting FGR may be prohibitive for existing plant owing to the space required for the ducting and other factors (heat removal and throughput). Such situations will be assessed on a site specific basis.
- 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 BAT in many situations. The use of the two techniques in combination also reduces reagent consumption for SNCR. The abatement of NO_x using SNCR and other techniques (e.g. SCR) is discussed further in **Section 2.2.1**.

2.1.5 Dump stacks and by-passes

Dump stacks may be included in the design as a safety feature but should only operate for safety reasons or where a heat removal system has failed, and the downstream gas cleaning plant will otherwise be damaged. In general, it 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 does not operate as part of normal, planned operation. Operational frequencies greater than once per year are unlikely to be acceptable. When a dump stack or emergency bypass operates this may be considered to be a period of “abnormal operation” and the process should be reduced or closed down (Ref. WID Article 13). If the release of particulates exceeds 150 mg/m^3 or the half-hourly CO or TOC ELVs are exceeded, the plant should be shut down immediately.

Start-up and shutdown should normally be achieved without any releases from the dump stack. An abatement system bypass, linking to the main stack (or auxiliary stack / release point where linkage to the main stack is impractical) may be operated on start-up where this has been authorised and is necessary to prevent damage to abatement plant.

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.

An Impact Assessment of releases to air during abnormal conditions should be demonstrated using Guidance Note **IPPC Environmental Assessments for BAT** and the associated software.

2.1.6 Cooling systems (local pollution prevention aspects)

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

2.1.6.1 Cooling systems types

Cooling systems are mainly required at incineration installations for:

- condensing steam 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 2.3: 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

Indicative BAT requirements for cooling systems (Sheet 1 of 2)

Discharge of cooling tower water

1 Where evaporative cooling towers are used, biocides lead to 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.

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.

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)

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 minimised, and Applications should consider the meteorological conditions under which visible plumes may be formed.

Indicative BAT requirements for cooling systems (Sheet 2 of 2)

Releases to land

5 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.

6 On final disposal, incineration of the cooling tower timber in the installation may only be carried out if it has been specifically authorised. The Application will need to have demonstrated that such disposal is BAT.

7 Other wastes may include sludges from effluent treatment plant associated with cooling water treatment and recirculation and intake screen washings. All such wastes should be stored securely pending transfer for disposal. On site incineration may be carried out only if specifically authorised.

2.1.7 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 Article 6(6) of 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 that this requirement is fulfilled at many installations.

Indicative BAT requirements for boiler design (Sheet 1 of 2)

Minimising dioxin production by boiler design and operation:

1 Slow rates of combustion gas cooling should be avoided to minimise the potential for the de novo formation of dioxins and furans.

2 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 2.2.1.2**). Some references indicate that dioxin de novo synthesis may commence at temperatures as high as 600 °C.

3 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 involve maximising the 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

Indicative BAT requirements for boiler design (Sheet 2 of 2)	
4	A balance must be maintained, to ensure that these design measures are not made at the expense of a major effect on boiler efficiency.
5	**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 an on-line sootblower. 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 2.1.1**), uniform waste feed (see **Section 2.1.2**) and good primary and secondary air control (**Section 2.1.4**) • additives to prevent sodium and potassium depositing (mixed success) • on-line cleaning by: – boiler tube rapping, by striking the tubes (limited success) or lifting and dropping whole banks of tubes (limited experience) – continuously allowing steel shot to fall through the tubes (applied successfully to economiser sections), and – steam or compressed air soot blowing, or • off-line cleaning
6	NO_x reduction techniques may also help to minimise dioxin emissions (see **Section 2.2.1.2** and **Section 2.1.4.5**).
	Minimising releases to water from boilers:
7	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.
8	Water treatment and de-ionisation plant effluent usually comprise 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.
9	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.
10	All these liquors should be neutralised or treated on- or off-site to produce an acceptable waste before discharge or disposal to a licensed facility. Alternatively, it may be justified as BAT to incinerate these residues in the incinerator.

2.1.8 Environmental Performance Indicators

Benchmark values in this guidance are typically presented as concentrations (e.g. mg/l, mg/Nm^3). Concentrations are the traditional basis for setting emission limits in permits as they are good indicators of unit operation performance but they have limitations. Thus, for England and Wales, the Environment Agency is developing complementary "Environmental Performance Indicators" that could help to target regulatory effort on the most important environmental issues.

Environmental Performance Indicators involve using emission data to:

- Normalise for the scale of process operation - to benchmark the emissions from installations that have different sizes and product mixes (e.g. quantity of emitted pollutant per unit of production).
- Calculate "Environmental Burdens" - using equivalency factors to determine the significance of emissions in terms of recognised environmental impacts.

Consideration is being given to a range of Environmental Performance Indicators, including:

For Air:

Stratospheric Ozone Depletion,

Global Warming (both from the installation and from imported power),

Photochemical Ozone Creation,

Airborne Acidification.

For Water:

Acidification,

Oxygen Demand,.

Eutrophication.

For Waste:

Waste Hazard Score (from H1),

Waste Disposal Score (from H1).

For raw materials:

Water use (potable and non-potable).

For hazardous substances:

Environmental Health,

Human Health.

In the absence of any guidelines for the calculation of Environmental Performance Indicators, there are no indicative BAT requirements. However, Operators in England or Wales should demonstrate to the Environment Agency that they have their own methods of monitoring and benchmarking their environmental performance and show how these are used to drive environmental improvements.

The choice of Environmental Performance Indicators is left to Operators but they should give consideration to the issues that are listed above. The H1 database tool is advocated as providing a simple solution.

In future the Environment Agency may recommend specific methodologies for calculating Environmental Burden and/or normalising for scale. Research projects are currently under way to develop these systems.

2.2 Emissions control

2.2.1 Abatement of point source emissions to air

2.2.1.1 Nature of the emissions to air

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

2.2.1.2 Control of point source emissions to air

Abatement technology should be selected such that the emission limit requirements of European legislation are complied with **as a minimum**. Operators will be required to demonstrate that their techniques correspond to the use of BAT as well as meeting these standards.

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 Regulator (**IPPC Environmental Assessments for BAT**) 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 application.

- Abatement techniques are described in this section; if there is doubt, the degree of detail required should be established in pre-application discussions. Information required in a Permit application includes:
  - A description of the abatement equipment for the activity.
  - The identification of the main chemical constituents of the emissions and assessment of the fate of these chemicals in the environment using **IPPC Environmental Assessments for BAT**.
  - 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 exceedances 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.
- Demonstrate that an appropriate assessment of vent and chimney heights has been made. Guidance is given in **IPPC Environmental Assessments for BAT**.

- Recognise that the chimney or vent may also be an emergency emission point under certain circumstances. 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 for the control of point-source emissions to air

1 The benchmark values for point source emissions to air listed in **Section 3.2.1** should be achieved unless alternative values are justified and agreed with the Regulator.

2 The main chemical constituents of the emissions should be identified, including VOC speciation where practicable.

3 Vent and chimney heights should be assessed for dispersion capability and an assessment made of the fate of the substances emitted to the environment (see **Section 4**).

Control of visible particulate plumes

4 Even where particulate benchmarks are already met, the aim should be to avoid visible emissions. However, because plume visibility is extremely dependent on the particle size and reflectivity, the angle of the light, and the sky background, it is accepted that, even when BAT is employed and very low emissions are being achieved, some plumes may still be visible under particular conditions.

Control of visible condensed water plumes

5 The need to minimise water vapour plumes should always be considered as, in addition to possible local visual amenity issues, in severe cases, plumes can cause loss of light, fogging, icing of roads, etc. High moisture content can also adversely affect plume dispersion so, where practicable, water content of the exhaust stream should be reduced. Ideally, the exhaust should be discharged at conditions of temperature and moisture content that avoid saturation under a wide range of meteorological conditions, including cold damp conditions.

6 The use of **primary energy** to reduce a plume simply because it is visible is not considered BAT. However, it may be appropriate to use **waste or recovered heat**, for example, heat in a gas stream prior to wet scrubbing can be used for re-heating the exhaust stream after scrubbing by means of a gas-gas heat exchanger. The use of energy for exhaust gas re-heat should be balanced against the benefits gained.

Particulate matter

7 **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.

8 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 line maintenance.

Indicative BAT requirements for the control of point-source emissions to air

9 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.

10 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 and other problems.

11 **Ceramic filters** provide an alternative where high temperature filtration is required, although their use has generally been limited to smaller plant owing to the larger gas volumes (and hence filtration plant capacity required) at higher temperatures. Mechanical failures have been encountered with some ceramic elements but smaller designs using mineral based binders have been more successful. Fabric filters are reported to be less susceptible to “blinding”.

12 **Electrostatic precipitators (EPs)**, either wet or dry, are not capable of abating particulate to the same extent as fabric filters and are not normally considered adequate on their own. EPs do however have the advantage of low pressure drops which may result in lower energy demand 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 have a reduced effect 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.

13 **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 heavy metals) and may represent 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 environmental assessment.

14 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 waste heat being an acceptable source, but with the use of additional imported energy sources unlikely to represent BAT.

Oxides of nitrogen

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

Primary NO_x measures

16 **Fuel Selection**. There are not likely to be opportunities to reduce fuel NO_x in this sector. For wastes that are nitrogen rich (e.g. sewage sludge), operators will need to pay particular attention to the techniques for NO_x reduction outlined below.

17 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 when used with separate chambers.

18 Where support burners are used (supplementary firing) or where liquid wastes are burned in a burner, the use of low NO_x burners is BAT.

Indicative BAT requirements for the control of point-source emissions to air

19 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.

20 **Combustion Chamber Design** - Fluidised bed combustors (FBC) operate at relatively lower combustion temperatures than other systems. They can therefore produce less thermal NO_x 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 the wastes 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 NO_x reductions of combining FBC and feed preparation must therefore be weighed against these potential difficulties for heterogeneous waste types.

21 Where the WID ELVs 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 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 selective non catalytic reduction 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.

22 In some designs, the distribution of refractory within the furnace chamber can be modified to create a more uniform temperature gradient for NO_x control.

23 **Air Control – primary and secondary** - High excess air at the combustion stage can increase NO_x 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).

24 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 species), while not being excessive which would result in higher NO_x production. This may include the distribution of ports whereby the air is admitted.

25 In some designs, the use of tertiary air injection has resulted in a more uniform temperature gradient in the combustion zone with benefit for control of both NO_x and CO.

26 The use of water sprays to control peak temperatures may be beneficial in reducing NO_x formation.

27 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

28 **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 NO_x prevention are relevant to the subsequent combustion of the products that result from the earlier “reaction” stages.

Indicative BAT requirements for the control of point-source emissions to air

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

30 **Temperature Control** Temperatures must meet the requirements of Article 6(1) of the WID (850 °C minimum or 1100 °C minimum where hazardous waste contains greater than 1% w/w halogenated organics (as chlorine) is being incinerated), although Article 6(4) allows lower temperatures to be employed if the WID ELVs are complied with and the quantity of residues and its pollutant content are not increased. 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.

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

32 **Flue Gas Recirculation** provides an effective means of NO_x 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 NO_x control (see below) and may increase overall energy recovery by retaining heat from stack gases. Retrofits at existing plants may prove expensive or impractical due primarily to the space required for ducting.

Secondary NO_x measures

33 Secondary measures should be considered **after** the application of primary NO_x 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 NO_x, which in turn will reduce reagent consumption during secondary treatment stages.

Selective non catalytic reduction (SNCR)

34 **Injection of NH_2-X compounds** into the furnace reduces NO_x emissions by chemically reducing it to nitrogen and water. It is also reported to inhibit dioxin formation. Ammonia and urea injection are suitable and either may represent 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).

35 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.

36 Where SNCR is used for NO_x abatement, the Regulator will ask for monitoring of ammonia and N_2O monitoring with or without specified limits.

Selective catalytic reduction (SCR)

37 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^oC. SCR technology can also reduce VOCs, CO and dioxin emissions

38 SCR is a proven technology in the waste incineration sector, where NO_x emissions of below 70mg/m^3 are achieved.

Indicative BAT requirements for the control of point-source emissions to air

39 The additional costs of SCR are derived mainly from the energy requirements of achieving the required temperature range after the other abatement plant. Low temperature SCR techniques have been developed that avoid this and it is claimed that the costs are of the same order as SNCR.

40 All applications must therefore include in their cost benefit assessment consideration of the use of SCR, SNCR or neither, and justify the selection focusing particularly upon the potential for reduced energy efficiency with SCR owing to gas re-heat and the improved NO_x destruction compared to SNCR.

NO_x control: cost/benefit study

41 In England and Wales, Operators should provide a cost benefit study using the methodology in **IPPC Environmental Assessments for BAT**, 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

42 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 from 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

43 Fuel Selection. Start up and support fuels should be low in sulphur. Sulphur contents of below 0.2%w/w are commonly available, and by 2008 the maximum permitted sulphur content of oil will be 0.1%. During start up and shut down, Article 6(1) of the WID prohibits the use of 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.

44 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.

45 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.

46 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.

47 Waste Treatment. Waste selection or segregation 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.

Indicative BAT requirements for the control of point-source emissions to air

48 This can result in:

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

49 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 Operators 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.

50 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.

51 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). When determining the abatement plant design, sufficient over-capacity should be provided to allow for maintenance and the variable input resulting from waste heterogeneity.

52 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).

Secondary acid gas measures

53 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 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.

54 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. Merchant 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 2.4** below. Operators will be required to justify their selected technology by referring to the factors indicated.

Indicative BAT requirements for the control of point-source emissions to air

Alkaline Reagent Selection

55 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.

56 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.

57 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 ($NaHCO_3$)
- lime($Ca(OH)_2$)
- sodium hydroxide (NaOH)

58 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.

59 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 2.5**. Operators will be required to justify their selected technology by referring to the factors indicated.

60 Alkaline Reagent Dosing Control. Optimisation of the alkaline reagent dosing system is BAT. This is because a well optimised reagent dosing control system will:

- control acid gas emissions within emission limit values
- reduce consumption of reagent
- reduce production of alkaline residues

61 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 or SO_2 monitoring as a trigger - In some cases, fast response systems are set up for both HCl and SO_2 and control is exercised by the parameter giving the most sensitive response for the prevailing conditions
- 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
- 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 stand-by to maintain reagent feed

Indicative BAT requirements for the control of point-source emissions to air

Acid gas control: Cost/benefit study

62 Operators should provide a cost benefit study using the methodology in **IPPC Environmental Assessments for BAT** 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.

63 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

Carbon oxides (CO_2, CO) and VOCs

Carbon Dioxide:

64 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.

65 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 N_2O 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 reduce CO_2 release by other installations. This may be demonstrated 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:

66 Elevated CO emissions are indicative of poorly controlled combustion and may be indicative of elevated releases of other products of poor combustion.

67 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.

68 VOCs may be removed to some extent by means of wet scrubbing but they are liable to be released from solution.

69 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 2.1.4**): Securing consistent waste feed characteristics (e.g. CV, moisture) and feed rates (see **Section 2.1.2**).

Indicative BAT requirements for the control of point-source emissions to air

70 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 oxidised gases will require subsequent oxidative combustion prior to release.

71 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 WID and the relevant emission limit values.

Dioxins and furans

72 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 2.1.4**).

73 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 600 °C and 200 °C, although it is likely that the majority of de novo dioxin formation will occur in the range 450 °C to 200 °C. Where energy will be recovered, boiler design should consider this factor (see **Section 2.1.7**).

74 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 burning halogenated organic chemicals), 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).

75 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 adsorption and 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.

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

77 **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.

Metals

78 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 amalgam although some batteries may also contain Hg (and cadmium). Up-stream waste segregation should be encouraged where releases approach emission limits.

79 **Carbon injection** gives reliable and effective mercury reductions if Hg is a problem.

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

Indicative BAT requirements for the control of point-source emissions to air

Iodine and Bromine

81 When wet scrubber systems are used and plume colouration from iodine or bromine is a problem, sodium thiosulphate can be added to the scrubber to reduce iodine and bromine to the respective halogen hydride. This will result in an effluent stream requiring subsequent treatment.

Table 2.4: 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 be varied 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 Lower energy use Higher reliability	Reaction rates low therefore larger residence time required Higher solid residue production with lime based systems 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 Energy required for plume reheat

Table 2.5: 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	Efficient temperature range may be at upper end for use with bag filters – Leachable solid residues Bicarbonate more expensive	Often used at CWIs Not proven at large plant

2.2.2 Abatement of point source emissions to surface water and sewer

The WID sets minimum requirements in respect of:

- the design criteria for prevention of waste water releases
- maximum emission limits for releases to water arising from air pollution control devices (WID Article 8(3))

Following the use of techniques to reduce the production of pollutants it may be necessary for abatement techniques to be employed that will meet the emission limit value requirements of the WID, **as a minimum**. An Operator will be required to demonstrate in his application that BAT has been employed. It will not be sufficient to simply design a plant so as to meet the emission limit values of WID 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.

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

The nature and source of the emissions to surface water or sewer expected from each activity is given in previous sections and the inventory of emissions should be confirmed in detail in the Application.

As noted before, the primary consideration should always be to prevent releases of harmful substances to the aquatic environment, whether releases are direct or via a sewage treatment works, and only where prevention is not practicable should the release be minimised or reduced to the point where the emission is incapable of causing significant harm.

A wide variety of techniques is available for the control of releases to water or sewer, and the BREF on Common Waste Water and Waste Gas Treatment/ Management Systems in the Chemical Sector (see **Ref 1**) should be consulted. Section 3.3 of the BREF has details of available water treatment techniques and Section 4.3.1 contains recommendations on what might constitute BAT for a variety of treatment techniques for releases to water.

In addition to the BREF and the techniques noted below, guidance on cost-effective effluent treatment techniques can be found in **Releases to water references**.

Waste water can arise from the process, rain-water run-off where there is the potential for contamination, from storm water, from cooling water, from treating accidental releases of raw materials, products or waste materials, and from fire-fighting - and, where not insignificant, these should all be taken into account in the Application and in the Permit.

In addition to the various BREFs (**Ref 1**) and the techniques below, guidance on cost-effective effluent treatment techniques can be found in **Water efficiency references:**.

Good design should prevent the production of the majority of these effluents. 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.

Indicative BAT requirements for the control of effluent treatment (Sheet 1 of 2)

1 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 also **Section 2.4.3**)
- contamination risk of process or surface water should be minimised (see also **Section 2.2.5**)
- wherever possible, closed loop cooling systems should be used and procedures in place to ensure blow down is minimised
- where any potentially harmful materials are used measures should be taken to prevent them entering the water circuit

2 Consideration should be given to the use of filtration/osmosis or other techniques which allow the effluent water to be cleaned for release or, preferably, for return to the process. Particular consideration should be given to the fate of the concentrated residues of such techniques. These can often be returned to furnaces, evaporated, solidified, sent for incineration etc. Tankering of such residues off the site as waste, simply transfers the problem to another place unless they are sent to a facility with the genuine ability to recycle the materials.

3 If the pollutants in the wastewater are all readily biodegradable or the effluent contains only materials which are naturally occurring in much larger quantities in the receiving water, there may be justification for filtration/osmosis or similar techniques not being considered appropriate.

4 Where prevention is not possible, the emissions benchmarks given in **Section 3**, should be achieved.

5 Where effluent is treated off-site at a sewage treatment works the above factors still apply. In particular, it should be demonstrated:
- the treatment provided at the sewage treatment works is as good as would be achieved if the emission were treated on-site, based on reduction of load (not concentration) of each substance to the receiving water. (The **IPPC Environmental Assessments for BAT - H1 Software tool** will assist in making this assessment.)
- that action plans are appropriate to prevent direct discharge of the waste-waters in the event of sewer bypass, (via storm/emergency overflows or at intermediate sewage pumping stations) - for example, knowing when bypass is occurring, rescheduling activities such as cleaning or even shutting down when bypass is occurring.
- that a suitable monitoring programme is in place for emissions to sewer.

6 There must be an understanding of the main chemical constituents of the treated effluent (including the make-up of the COD and the presence of any substances of particular concern to the aqueous environment). The fate of these chemicals in the environment should be assessed.

7 As a minimum, all emissions should be controlled to avoid a breach of water quality standards (see **Section 3.2** and **Section 4.1**), but where another technique can deliver better results at reasonable cost it will be considered BAT and should be used (see **Section 1.1**). Unless reasonably self-evident, the EQS and BAT points should be demonstrated by calculations and/or modelling in the Application.

Indicative BAT requirements for the control of effluent treatment (Sheet 2 of 2)

8 Discharges of waste water resulting from the cleaning of exhaust gases discharged from incinerators subject to WID shall be limited as far as possible, at least in accordance with the ELVs set out in Annex IV of the WID. The ELVs apply at the point where such waste water is discharged from the incineration plant. Where the waste water is treated on site collectively with other waste water from other on-site sources, the operator shall make the measurements required by Article 11 of WID to allow a mass balance calculation as required by Article 8(5) of WID to be performed to demonstrate that the effective ELV for releases from the incineration plant have been complied with. Under no circumstances shall the dilution of waste water take place for the purposes of complying with the Annex IV ELV requirements of the WID.

Techniques for Treatment of Scrubber Liquors

9 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 lamella plates are used. 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 leachability in the residue. 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.
- 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. 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.

2.2.3 Point source emissions to groundwater

Groundwater protection legislation

The Groundwater Regulations for the UK came into force on 1 April 1999, and an IPPC Permit will be subject to the following requirements under these Regulations.

i. The Permit shall not be granted at all if it would allow the *direct discharge* of a List I substance (Regulation 4(1)) - except in very limited circumstances (see Notes 1 and 2, below).

ii. If the Permit allows the disposal of a List I substance or any activity that might lead to an *indirect discharge* 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. In any event, conditions to secure the 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 Environment Agency's policies on this, are outlined in the Environment Agency's document **Policy and Practice for the Protection of Groundwater**. This outlines the concepts of vulnerability and risk and the likely acceptability from the Regulator's viewpoint of certain activities within groundwater protection zones. These are categorised as:

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; and the composition and volume of waste to be disposed of; and the rate of planned disposal.

The Environment Agency has produced a series of maps for England and Wales, which provide a guide to potential groundwater vunerability. SEPA has produced some maps covering Scotland, and others are being developed. Updated groundwater vulnerability maps for Northern Ireland are being produced over the next 1 - 2 years, with some comment upon the vulnerability at individual sites provided, if requested. Source Protection Zones are intended to aid protection by defining annular zones around each major potable source, including springs, boreholes and wells, based on travel times.

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 (see **Appendix 2**)

Indicative BAT requirements for point source emissions to groundwater
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.

1 In general, there should be no permitted releases to groundwater of either a direct or indirect nature.

2 If such releases are to continue the requirements of the Regulations, as summarised above, must be complied with.

2.2.4 Control of fugitive emissions to air

On many installations fugitive or diffuse emissions may be more significant than point source emissions, and common examples of sources and causes are given in the BAT box below.

Common 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
- 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)
- use of poorly sealed waste charging systems
- accidental loss of containment from failed plant and equipment

As part of the Application the Operator should identify and, where possible quantify, significant fugitive emissions to air from all the specific relevant sources listed above, estimating the proportion of total emissions that are attributable to fugitive releases for each substance. Where there are opportunities for reductions, the Permit may require the updated inventory of fugitive emissions to be submitted.

Indicative BAT requirements for fugitive emissions to air (Sheet 1 of 2)

1 **Dust** - The following general techniques should be employed where appropriate:

- Covering of skips and vessels
- Avoidance of outdoor or uncovered stockpiles (where possible)
- Where dust creation is unavoidable, use of sprays, binders, stockpile management techniques, windbreaks and so on
- Regular wheel and road cleaning (avoiding transfer of pollution to water and wind blow)
- Closed conveyors, pneumatic or screw conveying (noting the higher energy needs), minimising drops. Filters on the conveyors to clean the transport air prior to release
- Regular housekeeping
- Enclosed silos (for storage of bulk powder materials) vented to fabric filters. The recycling of collected material should be considered under Section 2.6.
- Enclosed containers or sealed bags used for smaller quantities of fine materials
- Mobile and stationary vacuum cleaning.

Indicative BAT requirements for fugitive emissions to air (Sheet 2 of 2)

- Ventilation and collection in suitable abatement equipment.
- Closed storage with automatic handling system.
- Sealed charging system.

2 **VOCs**

- When transferring volatile liquids, the following techniques should be employed – subsurface filling via (anti-syphon) 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 (for example pressure/ vacuum valves) and, where relevant, should be fitted with knock-out pots and appropriate abatement equipment.
- Maintenance of bulk storage temperatures as low as practicable, taking into account changes due to solar heating etc.
- The following techniques should be used (together or in any combination) to reduce losses from storage tanks at atmospheric pressure:
  - Tank paint with low solar absorbency
  - Temperature control
  - Tank insulation
  - Inventory management
  - Floating roof tanks
  - Bladder roof tanks
  - Pressure/vacuum valves, where tanks are designed to withstand pressure fluctuations
  - Specific release treatment (such as adsorption condensation)

3 For Information on Odour, see **Section 2.2.6**.

2.2.5 Fugitive emissions to surface water, sewer and groundwater

As part of the Application, the Operator should identify and, where possible, quantify significant fugitive emissions to water, sewer or ground from all relevant sources, and estimate the proportion of total emissions that are attributable to fugitive releases for each of the main substances releases.

Some common examples of sources of fugitive releases to waters and their preventive measures are given in the BAT box below.

Indicative BAT requirements for fugitive emissions to water (Sheet 1 of 3)

1 For **subsurface structures**:

- establish and record the routing of all installation drains and subsurface pipework;
- identify all sub-surface sumps and storage vessels;
- engineer systems to minimise leakages from pipes and ensure swift detection if they do occur, particularly where hazardous (ie. Groundwater-listed) substances are involved;
- provide secondary containment and/or leakage detection for sub-surface pipework, sumps and storage vessels;

Indicative BAT requirements for fugitive emissions to water (Sheet 2 of 3)

- establish an inspection and maintenance programme for all subsurface structures, eg. pressure tests, leak tests, material thickness checks or CCTV

2 All sumps should:

- be impermeable and resistant to stored materials;
- be subject to regular visual inspection and any contents pumped out or otherwise removed after checking for contamination;
- where not frequently inspected, be fitted with a high level probe and alarm, as appropriate;
- be subject to programmed engineering inspection (normally visual, but extending to water testing where structural integrity is in doubt).

3 For **surfacing**:

- design appropriate surfacing and containment or drainage facilities for all operational areas, taking into consideration collection capacities, surface thicknesses, strength/reinforcement; falls, materials of construction, permeability, resistance to chemical attack, and inspection and maintenance procedures;
- have an inspection and maintenance programme for impervious surfaces and containment facilities;
- unless the risk is negligible, have improvement plans in place where operational areas have not been equipped with:
  – an impervious surface
  – spill containment kerbs
  – sealed construction joints
  – connection to a sealed drainage system

4 All **above-ground tanks** containing liquids whose spillage could be harmful to the environment should be bunded. For further information on bund sizing and design, see the **Releases to water references**. Bunds should:

- be impermeable and resistant to the stored materials;
- have no outlet (that is, 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 greater than 110 percent of the largest tank or 25 percent of the total tankage, whichever is the larger;
- 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;
- where possible, have tanker conection points within the bund, otherwise provide adequate containment;
- be subject to programmed engineering inspection (normally visual, but extending to water testing where structural integrity is in doubt).

5 **Storage areas for IBCs, drums, bags, etc,** should be designed and operated to minimise the risk of releases to the environment. In particular:

- Storage areas should be located away from watercourses and sensitive boundaries, (eg. those with public access) and should be protected against vandalism.
- Storage areas should have appropriate signs and notices and be clearly marked-out, and all containers and packages should be clearly labelled.
- Where spillage of any stored substance could be harmful to the environment, the area should be appropriately kerbed or bunded.

Indicative BAT requirements for fugitive emissions to water (Sheet 3 of 3)
• The maximum storage capacity of storage areas should be stated and not exceeded, and the maximum storage period for containers should be specified and adhered to. • Appropriate storage facilities should be provided for substances with special requirements (eg. flammable, sensitive to heat or light) and formal arrangements should be in hand to keep separate packages containing incompatible substances (both “pure” and waste). • Containers should be stored with lids, caps and valves secured and in place - and this also applies to emptied containers. • All stocks of containers, drums and small packages should be regularly inspected (at least weekly). • Procedures should be in place to deal with damaged or leaking containers.

2.2.6 Odour

In an Application for a Permit, the Operator should supply a level of detail in keeping with the risk of causing odour-related annoyance at sensitive receptors. Where an installation poses no risk of odour-related environmental impact because the activities are inherently non-odorous, a simple justification should normally suffice.

However, where odour could be a problem, the Operator should assess the situation carefully and supply the information as indicated below to demonstrate that BAT is being used:

- Information relating to sensitive receptors, in particular the type of receptor, location relative to the odour sources and an assessment of the impact of odorous emissions on those receptors. (This should normally be available before a Permit is issued, but where very detailed information has to be obtained the Operator may be able to secure an agreement to supply it as part of an Improvement Programme.)
- An overview of any complaints received, what they relate to (source/operation) and remedial action taken.
- The types and source of odorous substances used or generated, intentional and fugitive (unintentional) release points and monitoring undertaken.
- Actions taken to prevent or minimise
  – A description of the actions taken to prevent and/or minimise odour annoyance for each odour source.
  – A demonstration that the indicative BAT requirements are being complied with.
  – Identification of any circumstances or conditions which might compromise the ability to prevent or minimise odour annoyance, and a description of the actions that will be taken to minimise the impact.

There may be a requirement placed upon the Operator to provide some or all of this information in the form of an odour management statement.

The use of appropriate sections of H4 Horizontal Guidance for Odour - Part 1 (Regulation and Permitting) and Part 2 (Assessment and Control) is advised.

Indicative BAT requirements for odour control (Sheet 1 of 3)	
1	The requirements for odour control will be installation-specific and depend on the sources and nature of the potential odour. In general:

Indicative BAT requirements for odour control (Sheet 2 of 3)

2 Where odour can be contained, for example within buildings, the Operator should maintain the containment and manage the operations to prevent its release at all times.

3 Where odour releases are expected to be acknowledged in the Permit, (i.e. contained and treated prior to discharge or discharged for atmospheric dispersion):

- For existing installations, the releases should be modelled to demonstrate the odour impact at sensitive receptors. The target should be to minimise the frequency of exposure to ground level concentrations that are likely to cause annoyance.
- For new installations, or for significant changes, the releases should be modelled and it is expected that the Operator will achieve the highest level of protection that is achievable with BAT from the outset.
- Where there is no history of odour problems then modelling may not be required although it should be remembered that there can still be an underlying level of annoyance without complaints being made.
- Where, despite all reasonable steps in the design of the plant, extreme weather or other incidents are liable, in the view of the Regulator, to increase the odour impact at receptors, the Operator should take appropriate and timely action, as agreed with the Regulator, to prevent further annoyance (these agreed actions will be defined either in the Permit or in an odour management statement).

4 Where odour generating activities take place in the open, (or potentially odorous materials are stored outside) a high level of management control and use of best practice will be expected.

5 Where an installation releases odours but has a low environmental impact by virtue of its remoteness from sensitive receptors, it is expected that the Operator will work towards achieving the standards described in this Note, but the timescales allowed to achieve this might be adjusted according to the perceived risk.

On an Incinerator installation, odour may arise from:

- incoming waste handling; see the appropriate box in **Section 2.1.1**
- 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
- ash handling.

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 designated areas (all)
- ensuring that putrescible waste is incinerated within an appropriate timescale (MWI, CWI, ACI, SSI)
- refrigeration of such waste which is to be stored for longer than an appropriate 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)

Indicative BAT requirements for odour control (Sheet 3 of 3)

- 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

6 The use of these techniques should obviate the need for odour masking or counteractants.

Treatment of odour

7 The use of odorous air e.g. air from the waste handling area or air displaced from tanks, as furnace air is an ideal way of treating odours. The quantity of contaminated air that 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.

8 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. They are not suited to combustion gas treatment.

9 Scrubbing for odour control 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.

10 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 that needs to be treated or 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.

11 For a new plant it would normally be the case that the imposition of conditions achieving BAT also secures that no significant pollution (including odour) is caused.

12 Further guidance will be given in Odour Assessment and Control – Guidance for Regulators and Industry 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.

2.3 Management

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 formal environmental management systems (EMSs). An Operator with such a system will not only find it easier to meet the BAT requirements for management of the installation but also many of the technical/regulatory requirements listed in other Sections of this Guidance.

The Regulators recommend either certification to the ISO 14001 standard or registration under EMAS (EC Eco Management and Audit Scheme) (OJ L114, 24/04/01). Both certification and registration provide independent verification that the EMS conforms to an auditable standard. EMAS now incorporates ISO 14001 as the specification for the EMS element, and the Regulators consider that overall EMAS has a number of other benefits over ISO14001 - including a greater focus on environmental performance, a greater emphasis on legal compliance, and a public environmental statement. For further details about ISO 14001 and EMAS contact British Standards Institute (BSI) or the Institute of Environmental Management and Assessment (IEMA), respectively.

Whilst an effective EMS will help the Operator to maintain compliance with specific regulatory requirements and manage all significant environmental impacts, this section of the Guidance identifies only those EMS requirements that are not specifically covered elsewhere in the document. This Section should not, therefore, be taken to describe all of the elements of an effective environmental management system. The requirements below are considered to be BAT for IPPC, but they are the same techniques required by a formal EMS and so should be capable of delivering wide environmental benefits.

The European Commission has also set out its views on BAT and Environmental Management Systems in the form of standard text which will be included in all new and updated BREFs.

Indicative BAT requirements for management techniques (Sheet 1 of 3)

Operations and maintenance

1. Effective operational and maintenance systems should be employed on all aspects of the process whose failure could impact on the environment, in particular there should be:
   - documented procedures to control operations that may have an adverse impact on the environment
   - a defined procedure for identifying, reviewing and prioritising items of plant for which a preventative maintenance regime is appropriate
   - documented procedures for monitoring emissions or impacts
   - a preventative maintenance programme covering all plant, whose failure could lead to impact on the environment, including regular inspection of major ‘non productive’ items such as tanks, pipework, retaining walls, bunds ducts and filters
2. The maintenance system should include auditing of performance against requirements arising from the above and reporting the result of audits to top management.

Indicative BAT requirements for management techniques (Sheet 2 of 3)

Competence and training

3 Training systems, covering the following items, should be in place for all relevant staff which cover

- 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
- awareness of the need to report deviation from the Permit
- prevention of accidental emissions and action to be taken when accidental emissions occur

4 The skills and competencies necessary for key posts should be documented and records of training needs and training received for these post maintained.

5 The key posts should include contractors and those purchasing equipment and materials;

6 The potential environmental risks posed by the work of contractors should be assessed and instructions provided to contractors about protecting the environment while working on site.

7 Where industry standards or codes of practice for training exist (e.g. WAMITAB) they should be complied with.

Accidents/incidents/non-conformance

8 There should be an accident plan as described in **Section 2.8** which:

- identifies the likelihood and consequence of accidents
- identifies actions to prevent accidents and mitigate any consequences

9 There should be written procedures for handling, investigating, communicating and reporting actual or potential non-compliance with operating procedures or emission limits.

10 There should be written procedures for handling, investigating, communicating and reporting environmental complaints and implementation of appropriate actions.

11 There should be written procedures for investigating incidents, (and near misses) including identifying suitable corrective action and following up

Organisation

12 The following are indicators of good performance which may impact on the Regulator’s resources, but not all will necessarily be insisted upon as Permit conditions:

13 The company should adopt an environmental policy and programme which:

- includes a commitment to continual improvement and prevention of pollution;
- includes a commitment to comply with relevant legislation and other requirements to which the organisation subscribes; and
- identifies, sets, monitors and reviews environmental objectives and key performance indicators independently of the Permit.

14 The company should have demonstrable procedures (eg. written instructions) which incorporate environmental considerations into the following areas:

- the control of process and engineering change on the installation;
- design, construction and review of new facilities and other capital projects (including provision for their decommissioning);
- capital approval; and
- purchasing policy.

Indicative BAT requirements for management techniques (Sheet 3 of 3)	
15	The company should conduct audits, at least annually, to check that all activities are being carried out in conformity with the above requirements. Preferably, these should be independent.
16	The company should report annually on environmental performance, objectives and targets, and future planned improvements. Preferably, these should be published environmental statements.
17	The company should operate a formal Environmental Management System. Preferably, this should be a registered or certified EMAS/ISO 14001 system (issued and audited by an accredited certification body).
18	The company should have a clear and logical system for keeping records of, amongst others: • policies • roles and responsibilities • targets • procedures • results of audits • results of reviews

2.4 Raw Materials

This section covers the use of raw materials and water, and the techniques for both minimising their use and minimising their impact by selection. (Energy and fuels are covered under **Section 2.7**, Energy).

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

- reduce the usage of all raw materials and intermediates (**Section 2.4.2**)
- substitute less harmful materials, or those which can be more readily abated and when abated lead to substances that are more readily dealt with (**Section 2.4.1**)
- understand the fate of by-products and contaminants and their environmental impact (**Section 2.4.2**)

2.4.1 Raw materials selection

This section looks at the selection and substitution of raw materials and **Section 2.4.2** describes the techniques to minimise their use.

The process of selecting raw materials can present an opportunity to control emissions at source so, in this regard the range of raw material options should be carefully examined.

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
- Limestone, dolomite, calcium oxide, spongiacal lime – reagents 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 NO_x reduction
- Activated carbon, carbon filters, lignite and clays- reagents 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.
- MgSi – additive to reduce corrosion
- Others

The Application for a Permit should contain a list of the materials in use which have the potential for significant environmental impact, together with the following associated information:

- the chemical composition of the materials, where relevant,
- the quantities used
- the fate of the material (i.e. approximate percentages to each environmental medium and to the products)
- the environmental impact potential where known (e.g. degradability, bioaccumulation potential, toxicity to relevant species)
- any reasonably practicable alternative raw materials that may have a lower environmental impact (including, but not limited to, any alternatives described in the BAT requirements below) on the substitution principle; and

- justification of the continued

On many installations fugitive or diffuse emissions may be more significant than point source emissions, and common examples of sources and causes are given in the BAT box below.

- use of any substance for which there is a less hazardous alternative (e.g. on the basis of impact on product quality) to show that the proposed raw materials are therefore BAT.

Indicative BAT requirements for raw materials selection

1. The Operator should maintain a list of raw materials and their properties as noted above.
2. The Operator should have procedures for the regular review of new developments in raw materials and for the implementation of any suitable ones with an improved environmental profile.
3. The Operator should have quality-assurance procedures for controlling the impurity content of raw materials.
4. The Operator should complete any longer-term studies needed into the less polluting options and should make any material substitutions identified.

2.4.1.1 Reagent selection

The following raw material substitution criteria should be applied where appropriate.

Table 2.6: Raw material substitution criteria

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.
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.

2.4.1.2 Waste to be incinerated

This section deals with the influence that the composition of the waste that is fed to the incineration installation has upon BAT.

Indicative BAT requirements for waste to be incinerated	
1	Applicants must identify and consider the variability of the waste in terms of likely composition, handling and combustion characteristics. Article 5 of WID sets minimum requirements for waste characterisation.
2	The Applicant should demonstrate that his 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.

2.4.2 Waste minimisation audit (minimising the use of raw materials)

The options for waste recovery and recycling are covered in **Section 2.6**. Waste avoidance/ minimisation, and the use of clean technologies, is a theme which runs throughout **Section 2.1** and **Section 2.2**. This section deals with the systematic approach to look for other opportunities.

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 term waste minimisation, from basic housekeeping through statistical measurement, to 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, for example staff suggestion schemes
- monitoring of materials' usage and reporting against key performance measures

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

See the **Waste minimisation support references** for detailed information, guides and case studies on waste minimisation techniques.

Indicative BAT requirements for waste minimisation audits (Sheet 1 of 2)
Identify the raw and auxiliary materials, other substances and water that they propose to use.

1 The Operator should carry out a waste minimisation audit at least every 4 years. If an audit has not been carried out in the 2 years prior to submission of the Application for a Permit and the details made known at the time of that application, then the first audit shall take place within 2 years of the issue of the Permit. The methodology used and an action plan for reducing the use of raw materials should be submitted to the Regulator within 2 months of completion of the audit. The audit should be carried out as follows:

2 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

- process mapping
- materials mass balance
- action plan

3 The use and fate of raw materials and other materials, including by-products, solvents and other support materials, such as fuels, catalysts and abatement agents, should be mapped onto a process flow diagram (see the **Waste minimisation support references**). This should be achieved by using data from the raw materials inventory 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.

4 Using this information, opportunities for improved efficiency, changes in process and waste reduction should be generated and assessed. An action plan should then be prepared for implementing improvements to a timescale approved by the Regulator.

Feedstock Homogeneity

5 Improving feedstock homogeneity 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.

6 Operators should consider the following techniques for improving feedstock heterogeneity:

- upstream waste management
- procedures for removal of problem wastes
- on or off site waste treatment / mixing

Furnace Conditions

7 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 with the correct temperature, residence time and sufficient turbulence are the key to securing this.

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

- burnout in the furnace should achieve less than 3% TOC or 5% LOI (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

Gas Treatment Conditions

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

Indicative BAT requirements for waste minimisation audits (Sheet 2 of 2)
Identify the raw and auxiliary materials, other substances and water that they propose to use.

10 Operators should consider at least the following techniques:
- alkaline reagent recycle
- wet scrubbing
- optimisation of reagent dosing and reaction conditions

Waste Management

11 Operators should consider at least the following techniques:

12 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.
- Consideration should be given to separation of APC residues from other fly ash residues collected in particulate abatement plant.

13 Further guidance on each of these techniques may be found in **Section 2.1**.

2.4.3 Water use

Reasons for reducing water use

Water use should be minimised as part of BAT for the reduction of emissions to water and it should also be commensurate with the prudent use of water as a natural resource.

Reducing water use is normally a valid environmental (and economic) aim in itself, but any water passing through an industrial process is generally degraded so there will usually be an increase in pollutant load. The benefits to be gained from reducing water input include:
- reducing the size of (a new) treatment plant, thereby supporting the BAT cost-benefit justification of better treatment;
- cost savings where water is purchased from another party;
- cost savings where water is disposed of to another party;
- associated benefits within the process, such as reduced energy requirements for heating and pumping, and reduced dissolution of pollutants leading in turn to reduced sludge generation in the effluent treatment plant (and consequent disposal costs).

The use of a simple mass balance for water use should help to reveal where reductions can be made.

Advice on cost-effective measures for minimising water can be found in the **Water efficiency references:**.

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.

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.

Indicative BAT requirements for minimisation of water use (Sheet 1 of 4)
Identify the raw and auxiliary materials, other substances and *water* that they propose to use

1 The Operator should carry out a regular review of water use (water efficiency audit) at least every 4 years. If an audit has not been carried out in the 2 years prior to submission of the application and the details made known at the time of the application, then the first audit should take place within 2 years of the issue of the Permit.
- Flow diagrams and water mass balances for the activities should be produced.
- Water-efficiency objectives should be established, with constraints on reducing water use beyond a certain level being identified (which usually will be usually installation-specific).
- Water pinch techniques should be used in the more complex situations such as chemical plant, to identify the opportunities for maximising reuse and minimising use of water (see the **Water efficiency references:**).

2 Within 2 months of completion of the audit, the methodology used should be submitted to the Regulator, together with proposals for a time-tabled plan for implementing water reduction improvements for approval by the Regulator.

3 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 that has a lower water-quality requirement
- In particular, if uncontaminated roof and surface water cannot be used in the process, it should be kept separate from other discharge streams, at least until after the contaminated streams have been treated in an effluent treatment system and been subject to final monitoring.

4 Measures should be in place to minimise the risk of contamination of surface waters or groundwater by fugitive releases of liquids or solids (see **Section 2.2.5**).

5 The water-quality requirements associated with each use should be established, and the scope for substituting water from recycled sources identified and input into the improvement plan.

6 Less contaminated water streams, such as cooling waters, should be kept separate from more contaminated streams where there is scope for reuse - though possibly after some form of treatment.

7 Most wastewater streams will however need some form of treatment (see **Section 2.2.2** for techniques) but for many applications, the best conventional effluent treatment can produces a water that is usable in the process directly or when mixed with fresh water. Though treated effluent quality can vary, it can often be recycled selectively - used when the quality is adequate, discharged when the quality falls below that which the system can tolerate.

8 In particular, the cost of membrane technology continues to reduce, and they can be applied to individual process streams or to the final effluent from the effluent treatment plant, as appropriate. In some applications in some Sectors, they can supplement (or possibly completely replace) the ETP plant so that most water is recyclable and there is a greatly reduced effluent volume. Where the remaining, possibly concentrated, effluent stream is sufficiently small - and particularly where waste heat is available - further treatment by evaporation can lead to zero aqueous effluent. Where appropriate, the Operator should assess the costs and benefits of using membrane techniques to minimise water usage and effluent discharge.

Indicative BAT requirements for minimisation of water use (Sheet 2 of 4)
Identify the raw and auxiliary materials, other substances and *water* that they propose to use

9 Water usage for cleaning and washing down should be minimised by:
- vacuuming, scraping or mopping in preference to hosing down;
- reusing wash water (or recycled water) where practicable;
- using trigger controls on all hoses, hand lances and washing equipment.

10 Fresh water consumption should be directly measured and recorded regularly at every significant usage point - ideally on a daily basis.

Benchmarks for water consumption

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

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

13 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.

14 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. 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.

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

16 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.

17 Where water is abstracted for indirect cooling and returned to a water course, only the net water loss (due to evaporation and leakage) should be included in the water consumption figure.

18 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

Indicative BAT requirements for minimisation of water use (Sheet 3 of 4)
Identify the raw and auxiliary materials, other substances and *water* that they propose to use

19 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. 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 homogeneity) 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

20 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
  - possible 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 or for demineralisation plants
- 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)
  - recycling the hot seal water
  - 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

Indicative BAT requirements for minimisation of water use (Sheet 4 of 4)
Identify the raw and auxiliary materials, other substances and *water* that they propose to use

- – filtering and cooling seal water with injected fresh water prior to re-use in the pumps (65% reduction potential)
- 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.

Recycling of water

21 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.

22 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.

23 In some cases effluent treatment produces 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.

2.5 Waste handling

As the response to the requirement for an emissions inventory in the Application for a Permit, the nature and source of the waste from each activity should be listed in detail - though where there are a very large number of relatively small streams, some aggregation of similar and relatively insignificant waste streams may be appropriate.

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 2.1.1**.

The normal nature and source of the waste from each activity will be confirmed in detail in the Operator's response to **Section 3.1**.

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 recyclable materials

Indicative BAT requirements for waste handling Characterise and quantify each waste stream and describe the proposed measures for waste management, storage and handling.	
1	A system should be in place and maintained which records the quantity, nature and origin of any waste that is disposed of or recovered - and also, where relevant, the destination, frequency of collection, mode of transport and treatment method for those wastes.
2	Wastes should be segregated wherever practicable, and the disposal routes identified. Disposal should be as near to the point of generation as is practicable.
3	Records should be maintained of any waste sent off-site (Duty of Care).
4	Appropriate steps should be taken to prevent all emissions from waste storage and handling (e.g. liquid or solid spillage, dust or VOC emission, and odour) (see **Section 2.2.4**, **Section 2.2.5** and **Section 2.2.6**).
5	Where the WID applies to the incineration plant, Article 9 requires that appropriate tests shall be carried out to establish the physical and chemical characteristics and the polluting potential of the different incineration residues prior to determining the routes for disposal or recycling of the residues. These tests shall include at least the total soluble fraction and the heavy metals soluble fraction of the residues.
6	**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.

Indicative BAT requirements for waste handling
Characterise and quantify each waste stream and describe the proposed measures for waste management, storage and handling.

7 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 for which disposal on to the surface of land is permitted.

8 All ash transport containers should be covered where this is necessary to comply with the Duty of Care provisions of Waste Management Licensing (Environmental Protection Act 1990, Section 34) which imposes a duty on the waste transporter to prevent the escape of waste.

9 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.

10 **Fly ash and APC residues:** These two wastes are commonly combined within the process and produced as a single stream. Segregation of these streams may allow the individual streams to be reused or recycled, and operators should consider the benefits of such segregation. Both present potential hazards that may be minimised through careful storage, handling and transportation, whether alone or in combination.

11 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 FIBCs or “big-bags” (1 m^3) for smaller installations.

12 Ash recovered from the boiler (“Boiler Ash”) will, depending on the design, have properties similar to either the bottom ash or fly ash. In most installations, a BAT judgement (taking into account ash properties and the layout of the installation) will be made as to whether the boiler ash should be combined with the bottom ash or fly ash.

13 **Rejected Feedstock:** Efforts should be made to minimise the delivery of waste that cannot be processed at the facility (unless an appropriate license 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.

14 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)

15 Where discrete loads are received, 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.

Indicative BAT requirements for waste handling
Characterise and quantify each waste stream and describe the proposed measures for waste management, storage and handling.

16 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 and CWIs)
- 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

17 **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

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.

Waste avoidance (minimisation) at source is addressed in detail in **Section 2.1** and related issues are addressed in the sections on abatement techniques (see **Section 2.2**). The specific requirement for a waste minimisation audit is noted in **Section 2.4.2**.

To meet these requirements, Operators should provide the Regulator with the information requested in point 2 below.

Indicative BAT requirements for waste recovery or disposal	
1	Waste should be recovered, unless it is technically or economically impractical to do so.
2	Where waste must be disposed of, the Operator should provide a detailed assessment identifying the best environmental options for waste disposal - unless the Regulator agrees that this is unnecessary. For existing disposal activities, this assessment may be carried out as an improvement condition to a timescale to be approved by the Regulator.
3	The Operator should compare his proposed (or actual for existing installations) practice with that described in **IPPC Environmental Assessments for BAT** and justify any departures, whilst demonstrating that BAT for the prevention and treatment of wastes has been adopted.
4	Because ash will often be the major waste produced, the Operator should consider potential uses e.g. • 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)
5	Where disposal occurs, the operator should justify why recovery is technically or economically not feasible.
6	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 Section 2.7.1 and Section 2.7.2 below and is a participant to a Climate Change Agreement (CCA) or a Direct Participant Agreement (DPA) within the Emissions Trading Scheme.

or

- the Operator meets the basic energy requirements in Section 2.7.1 and Section 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 Direct Participant Agreement is in place, this does not preclude the consideration of energy efficiency (including those identified in Section 2.7.3) as part of an integrated assessment of BAT where they impact on other emissions, e.g. where:

- the choice of fuel impacts upon emissions other than carbon, e.g. sulphur in fuel
- the minimisation of waste by waste-to-energy does not maximise energy efficiency, e.g. by Combined Heat and Power (CHP)
- the most energy-intensive abatement leads to the greatest reduction in other emissions

Further guidance is given in the guidance note **H2 Energy efficiency for IPPC**.

2.7.1 Basic energy requirements (1)

The BAT requirements of this section are basic low-cost energy standards that apply whether or not a CCA or DPA is in force for the installation.

Indicative BAT requirements for basic energy requirements (1): Provide a breakdown of the energy consumption and generation by source and the associated environmental emissions.	
1	The Operator should provide the energy consumption information, shown in the table below, 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 Operator should provide details of such factors. Where energy is exported from the installation, the Operator should also provide this information. All this information should be submitted in the application (in England and Wales the H1 software tool should be used to produce this information). The Operator should also provide energy flow information (such as “Sankey” diagrams or energy balances) showing how the energy is used throughout the process.
2	The Operator should provide the following Specific Energy Consumption (SEC) information. Define and calculate the SEC of the activity (or activities) based on primary energy consumption for the products or raw material inputs that most closely match the main purpose or production capacity of the installation. Provide a comparison of SEC against any relevant benchmarks available for the sector. (See Energy Efficiency Guidance)

Indicative BAT requirements for basic energy requirements (1):
Provide a breakdown of the energy consumption and generation by source and the associated environmental emissions.

3 The Operator should provide associated environmental emissions. This is dealt with in the Operator's response to the emissions inventory using the H1 software tool.

Table 2.7: 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.

2.7.2 Basic energy requirements (2)

The BAT requirements of this section are basic low-cost energy standards that apply whether or not a CCA or DPA is in force for the installation.

Indicative BAT requirements for basic energy requirements (2) (Sheet 1 of 2)
Describe the proposed measures for improvement of energy efficiency.

1 **Operating, maintenance and housekeeping measures** should be in place in the following areas, where relevant: (Indicative checklists of appropriate measures are provided in Appendix 2 of the guidance note **H2 Energy efficiency for IPPC**.)

- 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 operation and 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. These should include insulation, containment methods, (such as seals and self-closing doors), and avoidance of unnecessary discharge of heated water or air (e.g. by fitting simple control systems such as timers and sensors).

Indicative BAT requirements for basic energy requirements (2) (Sheet 2 of 2)
Describe the proposed measures for improvement of energy efficiency.

3 **Energy-efficient building services** should be in place to deliver the requirements of the Building Services section of the guidance note **H2 Energy efficiency for IPPC**. For energy-intensive industries these issues may be of minor impact and should not distract effort from the major energy issues, but they should nonetheless find a place in the programme, particularly where they constitute more than 5 percent of the total energy consumption.

4 **Energy management techniques** should be in place, according to the requirements of **Section 2.3** noting, in particular, the need for monitoring of energy flows and targeting of areas for reductions.

5 **An energy efficiency plan** should be provided that:

- identifies all techniques relevant to the installation, including those listed above and in **Section 2.7.3**, that are applicable to the installation
- estimates the CO_2 savings that would be achieved by each measure over its lifetime
- and, in the case where the activities are NOT covered by a CCA or DPA; provides information on the equivalent annual costs of implementation of the technique, the costs per tonne of CO_2 saved and the priority for implementation. A procedure is given in the Energy Efficiency Guidance Note.

6 An example format of the energy efficiency plan is shown in **Table 2.8**.

Table 2.8: Example format for energy efficiency plan

ALL APPLICANTS			ONLY APPLICANTS WITHOUT CCA		
Energy efficiency measure	CO_2 savings (tonnes)		Equivalent Annual Cost (EAC) £k	EAC/CO_2 saved £/tonne	Date for implementation
	Annual	lifetime			

The Energy Efficiency Guidance Note provides an appraisal methodology. If Operators use other appraisal methodologies they should state the method in the Application, and provide evidence that appropriate discount rates, asset life and expenditure (£/t) criteria have been employed.

The energy efficiency plan is required to ensure that the Operator has considered all relevant techniques. However, where a CCA or DPA is in place the Regulator will only enforce implementation of those measures in categories 1-3 above.

2.7.3 Further energy-efficiency requirements

Indicative BAT requirements for further energy-efficiency requirements (Sheet 1 of 3)
Climate Change Agreement for Trading Agreement.

1 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 Guidance Note **H2 Energy efficiency for IPPC**.

Energy supply techniques

2 The following techniques should be considered:

- use of Combined Heat and Power (CHP)
- generation of energy from waste
- use of less polluting fuels

3 The Operator should provide justification that the proposed or current situation represents BAT, irrespective of whether or not a CCA or DPA is in place, where there are other BAT considerations involved, eg.:

- the choice of fuel impacts upon emissions other than carbon dioxide, eg. sulphur dioxide;
- the potential for practical energy recovery from waste conflicts with energy efficiency requirements.

4 Where there is an on-site combustion plant other guidance is also relevant. For plants greater than 50MW, Operators should consult the IPC guidance on power generation (reference IPC S2 1.01 Combustion Processes: Large boilers and furnaces 50MW(th) and over and supplement IPC S3 1.01 Combustion Processes). Operators of plant of 20-50MW should consult the Local Authority Air Pollution Control guidance. On IPPC installations this guidance will be generally applicable to plant under 20MW also. (All are available from the **EA website**).

Specific energy consumption

5 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

6 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.

Indicative BAT requirements for further energy-efficiency requirements (Sheet 2 of 3)
Climate Change Agreement for Trading Agreement.

- 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 NO_x reduction) may have the additional benefit of increasing plant energy efficiency (see also **Section 2.1.4.5** and **Section 2.2.1.2**).
- 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 instead of high pressure membrane filtration for boiler (and other water) treatment.

7 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 requirements
- 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 2.1.7**, **Section 2.2.1.2**, and **Section 2.1.4**

8 The Operator should provide justification that the proposed or current situation represents BAT.

Sub-sector specific issues

9 **Municipal waste incineration**

- Steam should be generated for either direct use or electricity generation.
- Where electricity only is generated 5 - 8 MW of electricity should be recoverable per 100,000 tonnes of annual waste throughput depending on waste composition.
- 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 maximising of recovery potential. Consideration should be given to joint venture projects wherever possible.
- If waste heat is not recovered, provision should be made for future installation e.g. the provision of tie-ins.

10 **Hazardous waste incineration**

- There are likely to be opportunities for internal energy saving using combustion generated heat via exchange systems e.g. to re-heat gases.
- The incineration of higher concentrations of halogenated or highly thermally stable wastes or highly variable waste streams will be 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 by compromising the use of the correct temperature widows.
- Where HWIs operate with consistent high CV waste streams, the significant energy recovery potential should be maximised. This may involve steam or electricity generation and is particularly likely to be worthy 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.

Indicative BAT requirements for further energy-efficiency requirements (Sheet 3 of 3)
Climate Change Agreement for Trading Agreement.

11 **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 export schemes will be less favourable.
- Where hazardous wastes are incinerated, the issues relating to safe destruction made above for HWIs should be considered.

12 **Sewage sludge incineration**

- There appears 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).

13 **Animal remains and animal carcass incineration**

- Lack of 24 hour operation in some cases may mean the revenues for exportation schemes will be less favourable and energy recovery may not be economic.
- Rural locations may make it more difficult to find energy outlets.

14 **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 by combustion.

2.8 Accidents

This section covers accidents and their consequences. It is not limited to major accidents but includes spills and abnormal operation.

Some installations will also be subject to the Control of Major Accident Hazards Regulations 1999 (COMAH) (see **Appendix 1** for equivalent legislation in Scotland and Northern Ireland). IPPC and COMAH can sometimes overlap, and some systems and information may be usable for either regime.

The COMAH regime applies to major hazards, and for accident scenarios covered by COMAH , Operators may refer in the Application to any COMAH reports already held by the Regulator. However, the accident provisions under IPPC also cover those which are below the classification threshold for major accidents under COMAH, so Operators need to consider smaller accidents and abnormal operation scenarios as well. Guidance prepared in support of the COMAH Regulations (see the **COMAH guides**), may also help IPPC Operators in considering ways to reduce the risks and consequences of accidents - whether or not they are covered by the COMAH regime.

General management requirements are covered in **Section 2.3**. 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 do occur

Indicative BAT requirements for accidents and abnormal operations (Sheet 1 of 4) Describe your documented system that you propose to be used to identify, assess and minimise the environmental risks and hazards of accidents and their consequences.	
1	A formal structured accident management plan should be in place which covers the following aspects:
2	**A - Identification of the hazards** to the environment posed by the installation using a methodology akin to a Hazop study. Areas to consider should include, but should not be limited to, the following: • transfer of substances (eg. filling or emptying of vessels); • overfilling of vessels; • emissions from plant or equipment (eg. leakage from joints, over-pressurisation of vessels, blocked drains); • failure of containment (eg. physical failure or overfilling of bunds or drainage sumps); • failure to contain firewaters; • wrong connections made in drains or other systems; • incompatible substances allowed to come into contact; • unexpected reactions or runaway reactions; • release of an effluent before adequate checking of its composition; • failure of main services (eg. power, steam, cooling water); • operator error; • vandalism.

Indicative BAT requirements for accidents and abnormal operations (Sheet 2 of 4)
Describe your documented system that you propose to be used to identify, assess and minimise the environmental risks and hazards of accidents and their consequences.

3 **B - assessment of the risks**. The hazards having been identified, the process of assessing the risks should address six basic questions:

- how likely is the particular event to occur (source frequency)?
- what substances are released and how much of each (risk evaluation of the event)?
- where do the released substances end up (emission prediction - what are the pathways and receptors)?
- what are the consequences (consequence assessment – what are the effects on the receptors)?
- what are the overall risks (determination of overall risk and its significance to the environment)?
- what can prevent or reduce the risk (risk management – measures to prevent accidents and/or reduce their environmental consequences)?

4 The depth and type of assessment will depend on the characteristics of the installation and its location. The main factors to take 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 of the activities and the relative difficulty in deciding and justifying the adequacy of the risk-control techniques

5 Typical accident scenarios are shown in **Table 2.9**.

6 **C - identification of the techniques necessary to reduce the risks.** The following techniques are relevant to most installations:

- there should be an up-to-date inventory of substances, present or likely to be present, which could have environmental consequences if they escape. This should include apparently innocuous substances that can be environmentally damaging if they escape (for example, a tanker of milk spilled into a watercourse can destroy its ecosystem). The Permit will require the Regulator to be notified of any significant changes to the inventory.
- procedures should be in place for checking and handling raw materials and wastes to ensure compatibility with other substances with which they may accidentally come into contact.
- storage arrangements for raw materials, products and wastes should be designed and operated to minimise risks to the environment.
- there should be automatic process controls backed-up by manual supervision, both to minimise the frequency of emergency situations and to maintain control during emergency situations. Instrumentation will include, where appriopriate, microprocessor control, trips and process interlocks, coupled with independent level, temperature, flow and pressure metering and high or low alarms.
- physical protection should be in place where appropriate (eg. barriers to prevent damage to equipment from the movement of vehicles).
- there should be appropriate secondary containment (eg. bunds, catchpots, building containment).
- techniques and procedures should be in place to prevent overfilling of tanks - lliquid or powder - (eg. level measurement displayed both locally and at the central control point, independent high-level alarms, high-level cut-off, and batch metering).
- where the installation is situated in a floodplain, consideration should be given to techniques which will minimise the risk of the flooding causing a pollution incident or making one worse.
- security systems to prevent unauthorised access should be provided where appropriate.

Indicative BAT requirements for accidents and abnormal operations (Sheet 3 of 4)
Describe your documented system that you propose to be used to identify, assess and minimise the environmental risks and hazards of accidents and their consequences.

- there should be formal systems for the logging and recording of all incidents, near-misses, abnormal events, changes to procedures and significant findings of maintenance inspections.
- there should be procedures for responding to and learning from incidents, near-misses, etc.
- the roles and responsibilities of personnel involved in in incident management should be formally specified.
- clear guidance should be available on how each accident scenario might best be managed (eg. containment or dispersion, to extinguish fires or to let them burn).
- procedures should be in place to avoid incidents occurring as a result of poor communications between staff at shift change or during maintenance or other engineering work.
- safe shutdown procedures should be in place.
- communication channels with emergency services and other relevant authorities should be established, and available for use in the event of an incident. Procedures should include the assessment of harm following an incident and the steps needed to redress this
- appropriate control techniques should be in place to limit the consequences of an accident, such as isolation of drains, provision of oil spillage equipment, alerting of relevant authorities and evacuation procedures.
- personnel training requirements should be identified and training provided.
- the systems for the prevention of fugitive emissions are generally relevant (**Section 2.2.4** and **Section 2.2.5**) 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 with a sensor and 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 and similar back-up instruments should not be used as the primary method of level control.
- duplicate or standby plant should be provided where necessary, with maintenance and testing to the same standards as the main plant;
- spill contingency procedures should be in place to minimise accidental release of raw materials, products and waste materials and then to prevent their entry into water.
- process waters, potentially contaminated site drainage waters, emergency firewater, chemically-contaminated waters and spillages of chemicals should be contained and, where necessary, routed to the effluent system and treated before emission to controlled waters or sewer. Sufficient storage should be provided to ensure that this can be achieved. Any emergency firewater collection system should take account of the additional firewater flows and fire-fighting foams, and emergency storage lagoons may be needed to prevent contaminated firewater reaching controlled waters (see the **Releases to water references**).
- consideration should be given to the possibility of containment or abatement of 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.

7 Where the WID applies, Article 8 (7) requires that storage capacity shall be provided for contaminated rainwater run-off from the incineration plant site or for contaminated water arising from spillages or fire-fighting operations. This storage capacity shall be adequate to ensure that such waters can be tested and treated before discharge where necessary.

Indicative BAT requirements for accidents and abnormal operations (Sheet 4 of 4)
Describe your documented system that you propose to be used to identify, assess and minimise the environmental risks and hazards of accidents and their consequences.

Abnormal operating conditions

8 Abnormal releases are covered by Article 13 of WID.

9 The Regulator is currently developing standard permit conditions to ensure that these requirements are implemented and that they reflect BAT.

Table 2.9: Accident scenarios for Waste Incinerators

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	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	Waste feed quality control Emergency power for fans / pumps Low level reagent alarms Pump maintenance Stand-by equipment provision (e.g. multiple smaller feed systems) Key parameter monitoring e.g. filter pressure drop

2.9 Noise

Within this section “noise” should be taken to refer to “noise and/or vibration” as appropriate, detectable beyond the site boundary.

Where noise issues are likely to be relevant, the Operator will be required, in the Application, to provide information on the following: (for more details see **H3 Part 1 Noise**)

- the main sources of noise and vibration that will fall within the IPPC installation and also on Infrequent sources of noise and vibration
- the nearest noise-sensitive sites
- conditions/limits imposed under other regimes
- the local noise environment
- any environmental noise measurement surveys, modelling or any other noise measurements
- any specific local issues and proposals for improvements.

The level of detail supplied should be in keeping with the risk of causing noise-related annoyance at sensitive receptors.

Where an installation poses no risk of noise-related environmental impact because the activities undertaken are inherently quiet, this should be justified and no further information relating to noise need normally be supplied. It should, however, be remembered that there can still be an underlying level of annoyance without complaints being made.

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 that 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. It is understood that raw material handling can generate noise where glass is being recycled or broken up. It is suggested that consideration be given to the use of sonic booths or sound proofing to control the generation of noise where such activities are being carried out.

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 **H3 Part 1 Noise**

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

Indicative BAT requirements for noise and vibration
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.

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 (for example, bearings, air handling plant, the building fabric, and specific noise attenuation kit associated with plant or machinery).

2 The Operator should employ such other noise control techniques necessary to ensure that the noise from the installation does not give rise to reasonable cause for annoyance, in the view of the Regulator. In particular, the Operator should justify where Rating Levels ($L_{Aeq,T}$) from the installation exceed the numerical value of the Background Sound Level ($L_{A90,T}$).

3 Further justification will be required should the resulting field rating level ($L_{AR,TR}$) exceed 50 dB by day and a facade rating level exceed 45 dB by night, with day being defined as 07:00 to 23:00 and night 23:00 to 07:00.

4 In some circumstances "creeping background" (i.e. creeping ambient) 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 appropriate to minimise problems to an acceptable level within the BAT criteria.

5 Noise surveys, measurements, investigations (e.g. on sound power levels of individual items of plant) or modelling may be necessary for either new or for existing installations, depending upon the potential for noise problems. Where appropriate, the Operator should have a noise management plan as part of its management system.

2.10 Monitoring

This section describes monitoring and reporting requirements for emissions to all environmental media. Guidance is provided for selecting the appropriate monitoring methodologies, frequency of monitoring, compliance-assessment criteria and environmental monitoring.

The WID (Articles 10 and 11, and Annex III) set mandatory minimum monitoring requirements for waste incineration plant within the scope of WID.

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.

The Regulator takes the view that installations not covered by WID should also meet the standards required by WID unless the Operator can clearly demonstrate that to do so would be excessively costly.

2.10.1 Emissions monitoring

Indicative BAT requirements for emissions monitoring
Describe the proposed measures for monitoring emissions, including any environmental monitoring, and the frequency, measurement methodology and evaluation procedure proposed.

1 Where the WID does not apply to a waste incineration activity, the general considerations outlined in paragraphs 2 - 6 below may be applicable if it can be demonstrated that it would be excessively costly to comply with the WID's mandatory monitoring requirements. Where the WID does apply to a waste incineration activity, the more prescriptive requirements of the remainder of this BAT Box apply.

2 Monitoring should generally be undertaken during all phases of operation (i.e. commissioning, start-up, normal operation and shutting-down) unless the Regulator agrees that it is inappropriate.

3 Continuous monitoring and recording (or at least sampling in the case of water) are likely to be required under the following circumstances:
- Where the potential environmental impact is significant or the concentration of substance varies widely.
- Where a substance is abated continuous monitoring of the substance is required to show the performance of the abatement plant. For example continuous monitoring of dust is needed after a fabric filter to show the effectiveness of the filter and indicate when maintenance is needed, or sampling BOD from an effluent treatment plant.
- Where other control measures are required to achieve satisfactory levels of emission (e.g. material selection).

4 Where effective surrogates are available, they may be used with the agreement of the Regulator (and without prejudice to legal requirements) to minimise monitoring costs.

5 Where monitoring shows that substances are not emitted in significant quantities, it may be reasonable to reduce the monitoring frequency.

Indicative BAT requirements for emissions monitoring (Continued)
Describe the proposed measures for monitoring emissions, including any environmental monitoring, and the frequency, measurement methodology and evaluation procedure proposed.

Monitoring and reporting of emissions to air

6 The WID (Article 10) contains specific requirements in respect of the minimum standards for monitoring of releases to air. Article 11 contain the criteria that must be used to demonstrate that compliance with the emission limit values so assessed is demonstrated.

7 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. In particular, the species required by the WID to be continuously monitored are: NO_X, CO, Dust, TOC, HCl, HF and SO_2.

8 Gas flow should be measured to relate concentrations to mass releases.

9 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 measurement is required for all emissions to allow correction back to dry basis unless techniques are used which directly monitor the dry concentration.

10 At least 2 measurements per year are required for dioxins and furans, and heavy metals. In the first year of operation, monitoring is required every 3 months. Directions and guidance from Defra require that dioxin-like PCBs and a range of PAHs are also subject to monitoring, and it is likely to be the Regulator’s conclusion that such monitoring should be carried out with the same frequency as that for dioxin monitoring set out in the WID. Once sufficient data is available, a decision can be made on the future of this requirement.

11 The following PAHs should be monitored and results reported on the same frequency as for dioxins and dioxin-like PCBs:
- Anthanthrene
- Benzo[a]anthracene
- Benzo[b]fluoranthene
- Benzo[k]fluoranthene
- Benzo(b)naph(2,1-d)thiophene
- Benzo(c)phenanthrene
- Benzo[ghi]perylene
- Benzo[a]pyrene
- Cholanthrene
- Chrysene
- Cyclopenta(c,d)pyrene
- Dibenzo[ah]anthracene
- Dibenzo[ai]pyrene
- Fluroranthene
- Indo[1,2,3-cd]pyrene
- Napthalene

12 Continuous monitoring for HF may be omitted if gas cleaning is carried out for HCl to the extent that the ELV for HCl is not being exceeded. In this case, periodic measurements as described above may be substituted.

Indicative BAT requirements for emissions monitoring (Continued)
Describe the proposed measures for monitoring emissions, including any environmental monitoring, and the frequency, measurement methodology and evaluation procedure proposed.

13 Continuous monitoring for HCl, HF and SO_2 may be omitted and replaced by periodic monitoring as described above if the operator can prove that under no circumstances can the release of these substances exceed the ELV.

14 Where appropriate, periodic visual and olfactory assessment of releases should be undertaken to ensure that all final releases to air should be essentially colourless, free from persistent trailing mist or fume and free from droplets. Video records of stack emissions may help with the resolution of complaints and other investigations and should be adopted where concerns arise.

15 The monitoring requirements outlined in 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 represent excessive cost. In some cases, the Regulator may require an operator to monitor and report releases at a frequency higher than the WID requires where it is considered BAT so to do.

16 **Table 2.12** provides a summary of the monitoring requirements for releases to air.

17 Where not indicated in **Table 2.12**, averaging periods and compliance criteria are those stated in the WID.

18 Specific additional determinands may be required in relation to certain waste types. In general this is because of the possible presence of particular substances in such wastes, 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.

19 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 in relevant European legislation and in this guidance (see **Section 3**) i.e. the software should be capable of calculating half hourly, daily and other averages as appropriate.

20 At sites where there is significant public concern, the Operator may choose to provide the means for 24 hour remote access to real time and historical emissions readouts and reports e.g. via a Web-Site. The information viewable could include:

- 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

21 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 to the Regulator as detailed in the Permit.

Monitoring and reporting of emissions to water and sewer

22 The WID (Article 10) contains specific requirements in respect of the minimum standards for monitoring of releases to water produced from the cleaning of exhaust gases from incineration plant. Article 11 contains the criteria that must be used to demonstrate that compliance with the emission limit values so assessed is demonstrated.

Indicative BAT requirements for emissions monitoring (Continued)
Describe the proposed measures for monitoring emissions, including any environmental monitoring, and the frequency, measurement methodology and evaluation procedure proposed.

23 Article 8(2) requires that discharges to the aquatic environment of such waste water is limited as far as practicable, at least to the ELVs set out in Annex IV of WID. Guidance from Defra requires that dioxin-like PCBs and a range of PAHs are also subject to monitoring, and it is likely to be the Regulator's conclusion that such monitoring should be carried out with the same frequency as that for dioxin monitoring set out in the WID.

24 The ELVs referred to in the WID apply at the point where the waste water is discharged from the incineration plant. Where the waste water is treated at an ETP either on site or off-site collectively with other sources of waste water, Article 8(4) or (5) requires the operator to take measurements of the incinerator gas cleaning waste water stream and all other waste water streams prior to entry to the ETP and on the discharge from the ETP. These should be used to enable a mass balance calculation to be made to determine what part of the final emission to the environment can be attributed to the waste water arising from gas cleaning, and to demonstrate that compliance with the ELVs has not been attained by dilution.

25 Operators will need to demonstrate that they have systems in place to ensure that the functioning of the automated monitoring equipment for emissions to water shall be subject to control and an annual surveillance test, and that calibration is carried out by means of parallel measurements with the reference methods at least every 3 years. (Article 10(3)).

26 **Table 2.10** summarises requirements of WID in respect of the monitoring of releases from installations in which the exhaust gas cleaning system generates waste water. In other cases, the operator should propose monitoring techniques and demonstrate that they represent BAT taking into account the WID standards and the requirements outlined in paragraphs 2 - 6 above.

27 In addition to consideration of the Directive requirements, monitoring of process effluents released to controlled waters and sewers should include at least the parameters shown in **Table 2.11**.

28 An analysis covering a broad spectrum of substances should be carried out to establish that all relevant substances have been taken into account for the purpose of setting emission limits. It should cover the substances listed in Schedule 5 of the Regulations unless it is agreed with the Regulator that they are not applicable. The need to repeat such tests will depend upon the variability in the process and, for example, the potential for contamination of raw materials.

29 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.

30 In some sectors there may be releases of substances that are more difficult to measure and whose capacity for harm is uncertain, particularly when combined with other substances. "Whole effluent toxicity" monitoring techniques can therefore be appropriate to provide direct measurements of harm, for example, direct toxicity assessment. See **Section 2.2.2**.

Monitoring and reporting of waste emissions

31 Bottom and fly ash are likely to be the main wastes produced at the installation. Separate guidance on the methods for securing representative ash samples is available from the Regulator in the form of an Ash Sampling Protocol. Samples should be taken in accordance with this protocol.

Indicative BAT requirements for emissions monitoring (Continued)
Describe the proposed measures for monitoring emissions, including any environmental monitoring, and the frequency, measurement methodology and evaluation procedure proposed.

32 Operators must state in their application the proposed treatment / recycling / disposal fate of the fly ash and bottom 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.

33 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.

34 At least every four years, 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.

35 For waste emissions, the following should be monitored and recorded:
- physical and chemical composition of the waste
- hazard characteristics
- handling precautions and substances with which it should not be mixed
- a monitoring programme taking into account the materials, potential contaminants and potential pathways from the land to groundwater, surface water and the food chain where waste is disposed of directly to land (for example, sludge spreading or an on-site landfill)

Table 2.10: Effluent discharge monitoring requirements and primary methods

Parameter	Monitoring type / frequency	Method specification Ref.)
pH	Continuous	BS 1647-2:1984
Temperature	Continuous	Traceable to national standards
Flow	Continuous	BS 3680 series
Total suspended solids (as defined by 91/271/EEC)	Daily spot sample or Monthly flow proportional sample over 24 hours	BS EN 872:1996
Mercury and its compounds, expressed as mercury (Hg)	Monthly flow proportional sample over 24 hours	BS EN 13506:2002
Cadmium and its compounds, expressed as cadmium (Cd)	Monthly flow proportional sample over 24 hours	BS ISO/DIS 17294-1, 2
Thallium and its compounds, expressed as thallium (Tl)	Monthly flow proportional sample over 24 hours	BS ISO/DIS 17294-1, 2
Arsenic and its compounds, expressed as arsenic (As)	Monthly flow proportional sample over 24 hours	BS EN ISO 11969:1996
Lead and its compounds, expressed as lead (Pb)	Monthly flow proportional sample over 24 hours	BS EN ISO 11885:1997
Chromium and its compounds, expressed as chromium (Cr)	Monthly flow proportional sample over 24 hours	BS EN ISO 11885:1997
Copper and its compounds, expressed as copper (Cu)	Monthly flow proportional sample over 24 hours	BS EN ISO 11885:1997
Nickel and its compounds, expressed as nickel (Ni)	Monthly flow proportional sample over 24 hours	BS EN ISO 11885:1997
Zinc and its compounds, expressed as zinc (Zn)	Monthly flow proportional sample over 24 hours	BS EN ISO 11885:1997

Table 2.10: Effluent discharge monitoring requirements and primary methods

Parameter	Monitoring type / frequency	Method specification Ref.)
Dioxins and Furans (I-TEQ)	Every 6 months, but every 3 months during the first year of operation	USEPA Method 1613
Other pollutants - PAH	As appropriate based on site specific assessment	USEPA Method 0610
Other pollutants - Dioxin-like PCBs	As appropriate based on site specific assessment	USEPA Methods 0680, 1668

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.

Table 2.11: Processed effluent monitoring to water

Parameter	**Monitoring frequency**
COD/BOD	Flow weighted sample or composite samples, weekly analysis, reported as flow weighted monthly averages
TOC	Continuous
Turbidity	Continuous
Dissolved oxygen	Continuous

Notes:

1. 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.
2. BOD and COD should be established annually as an annual average.

Table 2.12: Air emissions monitoring methods

Parameter	Frequency	Method/Specification	WID Ref.
NO_x (NO and NO_2 as NO_2)	Continuous (provided emission limits are set) SRM, extractive	ISO 10849: 1996 BS ISO 11564: 1998/ Corr. 2000(wet-chemical method) ISO 10849: 1996 (instrumental method) (a CEN method is being developed)	11.2(a) Annexe V Annexe III
CO	Continuous SRM, extractive	ISO 12039: 2001 ISO 12039: 2001 (a CEN method is being developed)	11.2(a) Annexe V Annexe III
Total dust	Continuous Extractive	BS ISO 10155:1995/Corr 2002 BS EN 13284-1	11.2(a) Annexe V Annexe III
VOC (expressed as TOC)	Continuous SRM, extractive	BS EN 12619: 1999 (low concentrations) (a CEN standard is under development to supplement BS EN 12619) BS EN 12619: 1999 (low concentrations)	11.2(a) Annexe V Annexe III
HCl	Continuous or, Extractive (only where raw flue gas cannot exceed ELV)	MCERTS Performance Standards for CEMs For extractive HCl NCAS Technical Standard 15_01 BS EN1911:1998, parts 1-3	11.2(a) Annexe V Annexe III 11.6
HF	Continuous or, Extractive (providing treatment stages for HCl ensure ELV for HCl is complied with or where raw flue gas cannot exceed ELV)	CERAM special publication 35, Recommendations of ISO/TC/146/SC1/WG14, draft standard ISO-CD 15713 US EPA Method 26A	11.2(a) Annexe V Annexe III 11.4 11.6
SO_2	Continuous or SRM, extractive (only where raw flue gas cannot exceed ELV)	BS 6069-4.4:1992 (ISO 7935) BS ISO 11632: 1989/Corr 1998 or BS ISO 6069-4.1: 1990 (ISO 7934) Note 1 (a CEN method is being developed)	11.2(a) Annexe V Annexe III
Cd + Tl	SRM, extractive	USEPA method 29 (a CEN method is being developed)	11.2(c) 11.7 Annexe V Annexe III

Table 2.12: Air emissions monitoring methods

Parameter	Frequency	Method/Specification	WID Ref.
Hg	SRM, extractive	BS EN 13211:2001	11.2(c) 11.7 Annexe V Annexe III
Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V	SRM, extractive	USEPA method 29 (a CEN method is being developed)	11.2(c) 11.7 Annexe V Annexe III
Dioxins and Furans (TEQ as per Annexe I of the Directive)	SRM, extractive	CEN standard equates to BS EN1948 1997, parts 1-3	11.2(c) 11.7 Annexe V Annexe III Annexe I
Dioxin like PCBs (TEQ as per WHO standards for dioxin equivalence)	SRM, extractive	CEN standard equates to BS EN1948 1997, parts 1-3	11.2(c)
PAHs (To be reported as individual species)	Extractive	BS ISO 11338-1 (2003), Stationary source emissions - Determination of gas and particle-phase polycyclic aromatic hydrocarbons - Part 1: Sampling BS ISO 11338-2 (2003), Stationary source emissions - Determination of gas and particle-phase polycyclic aromatic hydrocarbons -Part 2: Sample preparation, clean-up and determination	11.2(c)
Gas flow	Automated method for the determination of the volume flow rate of gas streams in ducts.	BS ISO 14164: 1999	
Combustion chamber gas temperature	Continuous (Temperature measured near the inner wall or agreed representative point)	MCERTS Performance Standards for CEMs	11.2(b)
Exhaust gas oxygen concentration	Continuous Note: Verification of oxygen content required under “most unfavourable conditions” (Article11(3))	ISO 12039:2001 MCERTS Performance Standards for CEMs	11.2(b) 11.3
Exhaust gas pressure	Continuous	MCERTS Performance Standards for CEMs	11.2(b)
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) Extractive	MCERTS Performance Standards for CEMs BS 1756-4 or US EPA Method 4	11.2(b) 11.5
Gas velocity	Extractive	BS 1042 Part 2.1: 1977 (ISO 3966) or ISO 10780 Note 2	

Notes:

1. This method is not recommended if sulphur trioxide is present, or if ammonia and/or volatile sulphates are present at a concentration more than 5% by volume.

2. ISO 10780 is recommended, unless there is a sound reason to justify the use of BS 1042-2.1

2.10.2 Environmental monitoring (beyond the installation)

Indicative BAT requirements for environmental monitoring (beyond the installation) (Sheet 1 of 2)
Describe the proposed measures for monitoring emissions, including any environmental monitoring, and the frequency, measurement methodology and evaluation procedure proposed.

1 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.

2 Environmental monitoring may be required, for example, when:
- there are vulnerable receptors
- the emissions are a significant contributor to an Environmental Quality Standard (EQS) that may be at risk
- the Operator is looking for departures from standards based on lack of effect on the environment;
- to validate modelling work.

3 The need should be considered for:
- groundwater, where it 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

4 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 Regulation

5 Guidance on air quality monitoring strategies and methodologies can be found in **Monitoring Guidance**.

Indicative BAT requirements for environmental monitoring (beyond the installation) (Sheet 2 of 2)
Describe the proposed measures for monitoring emissions, including any environmental monitoring, and the frequency, measurement methodology and evaluation procedure proposed.

Specific environmental monitoring requirements which may be appropriate for this sector:

6 **To water:**

- Effluent treatment plant discharges to controlled waters and sewers.
- Cooling water discharges.

7 **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.
- 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.

8 **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.

2.10.3 Monitoring of process variables

Indicative BAT requirements for monitoring of process variables
Describe the proposed measures for monitoring emissions, including any environmental monitoring, and the frequency, measurement methodology and evaluation procedure proposed.

1 The WID requires the monitoring of the following process variables:

- Waste feedstock composition should be analysed at a frequency and in a manner appropriate to the plant type concerned, as required by WID Article 5. 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 that stringent measures are adopted in this respect.
- Waste throughput should be recorded in such a way that it enables comparison with the design throughput. In addition, an hourly and annual throughput shall be recorded as a minimum, as required by WID Article 5.
- Combustion temperature at the agreed control location, as required by WID Article 6.
- Oxygen concentration at the outlet from the last combustion chamber.
- Water vapour measurement for all emissions to allow correction back to dry basis unless techniques are used which directly monitor the dry concentration.

2 The following process variables have particular potential to influence emissions. Their monitoring and control is necessary to demonstrate BAT:

- Differential pressure across bag filters which can indicate filtration efficiency and bag blow-outs.
- Potential difference across the EP plates in Electrostatic Precipitators.
- Reagent feed rates.
- Upstream HCl concentration (to enable linkage to and automatic control of scrubbing medium dose rate).

3 Temperature monitoring is required for process monitoring and control and in order to demonstrate compliance with the required combustion temperatures (see **Section 2.1.4**). The performance of temperature monitoring equipment varies depending upon its location in the process and the environment to which it is subjected. **Table 2.13** outlines the main factors relevant to the selection of temperature monitoring equipment.

4 It can be seen from **Table 2.13** 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 2.1.4.1**) where they should form at least the basis for the calibration and correction of other monitors.

Table 2.13: Comparison of 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

Table 2.13: Comparison of gas temperature measurement systems

Methods	Measures	Response time	Equipment	Suitable for measuring:		Comments
				Point	Bulk mean	
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 deliver point data only 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.

2.10.4 Monitoring standards (Standard Reference Methods)

The Environment Agency's Monitoring Certification Scheme (MCERTS) - Background

For England and Wales, the Environment Agency has established its Monitoring Certification Scheme (MCERTS) to deliver quality environmental measurements. MCERTS provides for the product certification of monitoring systems (for example, instruments, analysers and equipment), the competency certification of personnel and the accreditation of laboratories under the requirements of European and International standards. MCERTS has been developed to reflect the growing requirements for regulatory monitoring to meet European and International standards. It brings together relevant standards into a scheme that can be easily accessed by key stakeholders, such as manufacturers, operators, regulators and test houses. Eventually, MCERTS will be extended to include all regulatory monitoring activities. Technical Guidance Notes M1 and M2 are key reference documents underpinning MCERTS for stack-emission monitoring.

The Agency has published MCERTS performance standards for continuous emissions monitoring systems (CEMs), ambient air quality monitoring systems (CAMs), the chemical testing of soils, water monitoring instrumentation and manual stack emissions monitoring. Other MCERTS standards are under development to cover portable emissions monitoring equipment, data acquisition and operators' own arrangements, such as installation, calibration and maintenance of monitoring equipment.

The legal context of MCERTS

Some European Directives, such as the WID, specify that monitoring and related activities such as calibration must be performed to CEN standards or, if CEN standards are not available, to ISO, national or other international standards which provide data of a suitable quality. As MCERTS is based on international standards - primarily CEN standards - MCERTS is a means of demonstrating compliance with applicable standards. Furthermore, MCERTS for CEMs provides test data to demonstrate that the monitoring equipment meets the uncertainty specifications specified in, for example, Annex III of the WID, and therefore demonstrates compliance with the QAL1 requirements of a new standard, EN14181 as described in **Section 2.10.4.1**.

MCERTS for CEMs

There are three elements to MCERTS for CEMs, which are:

- performance specifications for CEMs, drawn from international standards such as BS EN 12619 for total organic carbon (TOC);
- performance evaluation of CEMs, based on international standards including specific standards for CEMs (such as BS EN 12619), and test standards such as ISO 9169 and BS EN ISO/IEC 17025;
- product certification based on BS EN 45011.

Product certification assures that the manufacturing of CEMs is reproducible and that manufacturers take into account the impact of design changes to CEMs, assuring that any such changes to certified equipment do not degrade the performance below the MCERTS performance standards.

When selecting CEMs for plant, the certified range and determinands are important. For example, the CEMs for incinerators should have MCERTS certification for the determinands specified in the WID, as well as peripheral determinands such as oxygen and moisture if the CEMs measure emissions on a wet basis.

Regarding certified ranges, the range should not be greater than 1.5x the daily average ELV. For example, **Table 2.14** below shows some examples of daily average emission limit values for key determinands and the applicable certified ranges. One exception to this rule is for hydrogen fluoride measurements, where the ELV is 1 mg/m3. In the case of HF, certified ranges up to 5 mg/m3 are acceptable. Certified ranges may be smaller than those based on a 1.5x multiplier of the ELV, since it has been demonstrated that CEMs proven over low ranges typically perform more than acceptably over high ranges. However, the converse is not necessarily true.

Table 2.14: Some applicable certified MCERTS ranges for incineration

Determinand	Daily average ELV (mg/m3)	Applicable minimum certified range (mg/m3)
Nitrogen oxides (as NO2)	200	300
Sulphur dioxide (SO2)	50	75
Carbon monoxide (CO)	50	75
Total dust	10	15
Hydrogen chloride (HCl)	10	15
Total organic carbon (TOC)	10	15

MCERTS and the German type-approval scheme

Germany operates a type-approval scheme for CEMs, whereby the testing is typically performed by TÜV laboratories and the approval is issued by the German Federal Environment Agency, the Umweltbundesamt (UBA). As there are similarities between MCERTS and the UBA schemes, UBA and the Agency cooperated in 2002 to align their respective schemes so that future testing and certification could provide for mutual recognition.

This mutual recognition also means that there is a fast-track scheme for equipment approved in one country and requiring certification in the other. The fast-track scheme means reduced performance evaluations due to mutual recognition of previous testing and certification. This has meant that some CEMs type-approved in Germany have been through the fast-track process and are now MCERTS certified as well.

CEN is currently developing an international standard for the performance evaluation and certification of CEMs. This standard is based on the aligned Anglo-German scheme.

MCERTS for manual stack monitoring

MCERTS for manual stack-emission monitoring is split into two components - the certification of personnel and the accreditation of organisations. MCERTS requires stack-emission monitoring organisations to be accredited by the United Kingdom Accreditation Service (UKAS) to ISO/IEC 17025 and the MCERTS performance standard for organisations. It provides an application of EN ISO/IEC 17025 in the specific field of measurement of air emissions from stacks and covers:

- ethical requirements for independence and environmental awareness;
- use of MCERTS certified personnel;
- selection of appropriate methods following international standards;
- method implementation;
- estimation of measurement uncertainty;
- use of appropriate equipment;
- planning of a sampling measurement campaign including provisions for a site review, risk assessment and a site-specific protocol;
- reporting of results;
- participation in proficiency-testing schemes.

The standard does not provide a sectorial application for analytical laboratory methods but does specify that any methods shall be accredited to the requirements of EN ISO/IEC 17025.

The MCERTS personnel competency standard defines the standards for certifying stack-emission monitoring personnel as competent based on experience, training and examination. The standard provides for two levels of personal competency, defined as L1 and L2. The first level, L1, covers the main requirements for all personnel wishing to demonstrate competence in stack emissions monitoring whilst the second level, L2, defines further requirements for managing emissions monitoring campaigns. There are also supplementary endorsements for each level, known as Technical Endorsements (TEs). There are currently five TEs in operation while a sixth is being developed to cover calibration requirements, as specified within EN 14181. The five current TEs are:

- TE1 - Particulate monitoring by isokinetic sampling techniques
- TE2 - Multi-phase sampling techniques
- TE3 - Gases/vapours by manual techniques
- TE4 - Gases/vapours by instrumental techniques
- TE5 - Particle-size fractionation by isokinetic sampling techniques

Monitoring personnel can be certified at either L1 or L2 whether or not they work within an MCERTS accredited organisation, although the latter must have MCERTS certified personnel at both the L1 and L2 levels. In order to comply with the requirements of EN 14181, all organisations performing SRMs on incinerators must be MCERTS accredited.

MCERTS and PPC applications for permits

The following should be described in the application, indicating which monitoring provisions comply with MCERTS requirements or where 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
- criteria for the assessment of non-compliance with Permit limits and details of monitoring strategy aimed at demonstration of compliance
- 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
- the accreditation held by samplers and laboratories or details of the people used and the training/ competencies

2.10.4.1 Quality assurance for CEMs

During 2004, CEN will publish a new standard entitled “EN 14181, Quality assurance of automated measuring systems (AMS)”. Shortly afterwards, the UK will adopt this standard as BS EN 14181, after which it must be used for all applicable installations. This standard will apply where EU Directives require it - for example, it will apply to all incineration and co-incineration installations which are within the scope of the WID. The scope of EN 14181 is restricted to quality assurance (QA) of the AMS, and does not include QA of the data collection and recording system of the plant.

The standard describes the procedures needed to assure that an AMS (known as CEMs in the UK) is capable of meeting the uncertainty requirements on measured values given by legislation - e.g. EU Directives or national legislation. EN 14181 defines three different quality assurance levels known as QAL 1, QAL 2 and QAL 3, plus an annual surveillance test (AST). The requirements of each of these are as follows:

QAL 1 - Uncertainty of the AMS before installation

- QAL 1 defines the procedures to demonstrate that an AMS will meet the uncertainty requirements specified in applicable EU Directives before the AMS is installed in the installation. For example, the WID specifies the uncertainty requirements in Annex III. The uncertainty of the AMS is determined using the procedures specified in another related standard, “BS EN ISO 14956, Air quality - Evaluation of the suitability of a measurement procedure by comparison with a required measurement uncertainty.” This standard makes use of performance test data produced during type-testing, i.e. MCERTS test data.

QAL 2 - Quality assurance of installation

- QAL 2 describes a procedure to calibrate the AMS and determine the variability of the measured values obtained by an SRM (with a known uncertainty) which is suitable for the validation of an AMS following its installation. The SRM, in order to comply with the requirements of EU Directives such as Annex III of the WID, must be a CEN standard or, if there is no CEN standard available, an ISO, national or other international standard capable of providing data of an equivalent quality.
- The test organisation which performs the SRM must be accredited to BS EN ISO/IEC 17025 and the appropriate SRM standards, or recognised by the Regulator. In England and Wales, the Environment Agency is using MCERTS for manual stack monitoring as a means of recognition of competence.
- During QAL 2, the test organisation must take at least 15 concurrent measurements of the SRM and AMS spread over at least 3 days, with suitable intervals between each measurement. The data is then used to determine a regression line and calibration function, followed by a variability test to determine if the uncertainty of the AMS still complies with relevant Directive requirements following installation.

- If the AMS does not meet the uncertainty requirements specified in the relevant Directive, the operator must then take corrective action to remedy this. The Directive may require the QAL 2 test to be performed at defined times - For example, the WID requires the test to be performed every three years and after major services or other major changes. The latter includes changes of fuel: for example, if the calibration function was determined for a cement kiln burning a mixture of coal and secondary liquid fuel (SLF), a new calibration may be required if a new material (e.g. tyres) were used instead of the SLF.
- QAL 2 also defines a number of functional tests.

QAL 3 - Quality assurance during operation

- The QAL 3 procedure defines the necessary steps to demonstrate the required quality of the measurements during the normal operation of an AMS, by checking that the precision and zero and span characteristics are consistent with those determined during QAL 1.

Annual surveillance test (AST)

- The AST is a reduced QAL 2 test. The AST is designed to assure that the AMS continues to function correctly, that its performance remains valid and that the calibration function and variability remain as previously determined. In order to verify the calibration function, a qualified test organisation performs at least five repetitions of an SRM. If the calibration function is no longer valid, then a full QAL 2 test must be performed. The table below outlines the tests and checks required during the QAL 2 and AST procedures.

Table 2.15: Summary of QAL 2 and AST requirements

Activity	QAL 2		AST	
	Extractive AMS	Non-extractive AMS	Extractive AMS	Non-extractive AMS
Alignment and cleanliness		X		X
Sampling system	X		X	
Documentation and records	X	X	X	X
Serviceability	X	X	X	X
Leak test	X		X	
Zero and span check	X	X	X	X
Linearity			X	X
Interferences			X	X
Zero and span drift (Audit)			X	X
Response time	X	X	X	X
Report	X	X	X	X

Indicative BAT requirements for monitoring standards (Standard Reference Methods)
Describe the proposed measures for monitoring emissions, including any environmental monitoring, and the frequency, measurement methodology and evaluation procedure proposed.

1 As far as possible, Operators should ensure their monitoring arrangements comply with the requirements of MCERTS where available, for example using certified instruments and equipment, and using a stack testing organisation accredited to MCERTS standards. Where the monitoring arrangements are not in accordance with MCERTS requirements, the Operator should provide justification and describe the monitoring provisions in detail. See **www.mcerts.net** for future information on MCERTS and a listing of MCERTS equipment.

Sampling and analysis standards

2 Standards should be selected in the order of priority as given in the IPPC Bureau's Reference Document on the General Principles of Monitoring. This order is:
- Comitee Europeen de Normalisation (CEN)
- International Standardisation Organisation (ISO)

3 If the substance cannot be monitored using CEN or ISO standards then a method can be selected from any one of the following
- American Society for Testing and Materials (ASTM)
- Association Francaise de Normalisation (AFNOR)
- British Standards Institution (BSI)
- Deutsches Institute fur Normung (DIN)
- United States Environmental Protection Agency (US EPA)
- Verein Deustcher Ingenieure (VDI)

4 If the substance cannot be monitored using any of the standards above then other methods may be adapted for use, following the requirements for validation in ISO 17025. For stack emission monitoring the following occupational methods may be adapted:
- Methods for the Determination of Hazardous Substances (MHDS) series published by the Health and Safety Executive (HSE)
- National Institute for Occupational Safety and Health (NIOSH)
- Occupational Safety and Health Administration (OSHA)

5 The intended application of the standard method must always be taken into account. For example, a CEN method may be less suitable than another less-rigorously validated standard method if the application is not one for which the CEN method was developed.

6 Operators should be expected to be able to demonstrate compliance with the above hierarchy and validate use of non-standard methods, in-house designed/developed methods, standard methods used outside their intended scope and modifications of standard methods to confirm that these methods are fit for purpose.

7 Further guidance on standards for monitoring gaseous releases relevant to IPC/IPPC is given in the **Monitoring Guidance**. A series of updated Guidance Notes covering this subject is being prepared. This guidance specifies manual methods of sampling and analysis that 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.

8 If in doubt the Operator should consult the Regulator.

2.11 Closure

The PPC Regulations require an Applicant to submit a site report, describing the condition of the site, as part of the application. Guidance on this is in Annex C of the Guide for Applicants (see **IPPC Part A(1) Installations: Guide for Applicants (England and Wales)**) or Guidance for SEPA Staff On Land and Groundwater Considerations for PPC Part A Installations (Scotland) (see **PPC Part A Installations: Guide for Applicants (Scotland)**).

Indicative BAT requirements for closure (Sheet 1 of 2)
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 measures relating to the design and construction of the installation, where appropriate).

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 that 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
- methods of dismantling buildings and other structures, see **Closure references** which gives guidance on the protection of surface and groundwater at construction and demolition-sites

Indicative BAT requirements for closure (Sheet 2 of 2)
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 measures relating to the design and construction of the installation, where appropriate).

- 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

4 For existing activities, the Operator should complete any detailed studies, and submit the site-closure plan 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** (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.)

2.12 Installation issues

In some cases it is possible that actions that 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.

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

Indicative BAT requirements for installation wide issues
Where you are not the only Operator of the installation, describe the proposed techniques and measures (including those to be taken by yourself and other Operators) for ensuring the satisfactory operation of the whole installation.

1 The Operator should consider possibilities for minimising environmental impact to the environment as a whole, by operating together with other Permit holders. Possibilities include:
- Communication procedures between the various Permit-holders; in particular those needed to ensure that the risk of environmental incidents is minimised.
- Benefiting from the economies of scale to justify the installation of a CHP plant.
- The combining of combustible wastes to justify a combined waste-to-energy/CHP plant.
- The waste from one activity being a possible feedstock for another.
- The treated effluent from one activity being of adequate quality to be the raw water feed for another activity.
- The combining of effluent to justify a combined or upgraded effluent-treatment plant.
- The avoidance of accidents from one activity that may have a detrimental knock-on effect on the neighbouring activity.
- 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

The Regulations require the Applicant to describe the nature, quantities and sources of foreseeable emissions into each medium. This will be done by completing the inventory of emission and consumption in the H1 software tool. The information required is as follows.

Provide a table of significant emissions of substances (except noise, vibration, odour and heat which are covered in their respective sections) that will result from the proposals and should include, preferably in order of significance:

- substance (where the substance is a mixture, for example, VOCs or COD, separate identification of the main constituents or inclusion of an improvement proposal to identify them)
- 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 for:
  - mass/unit time
  - concentration
  - annual mass emissions
- statistical basis (average, percentile etc.)
- notes covering the Operators confidence in his 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
- point-source emissions to air
- significant fugitive emissions to all media, identifying the proportion of each substance released that is due to fugitives rather than point-source releases
- abnormal emissions from emergency relief vents, flares and the like
- 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, for example, 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 guidance note **H2 Energy efficiency for IPPC**.

Where VOCs are released, the main chemical constituents of the emissions should be identified.

For waste, emissions relate to any wastes removed from the installation, or disposed of at the installation under the conditions of the Permit, for example, 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.

Indicative BAT requirements for emission benchmarks
Describe the nature, quantities and sources of foreseeable emissions into each medium (which will result from the techniques proposed in Section 2).

1. The Operator should compare the emissions with the benchmark values given in the remainder of this Section.
2. Where the benchmarks are not met, the Operator should revisit the responses made in Section 2 as appropriate and make proposals for improvements or justify not doing so as part of the BAT assessment.
3. Where an incinerator is covered by the Waste Incineration Directive, the Standards and Obligations contained in that Directive must be complied with by the date on which the Directive applies to the installation - Introduction of improvement proposals to achieve the Directive requirements by a date later than the compliance date is not permitted (For existing plants, the latest possible date for compliance is 28 December 2005).

3.2 Emission benchmarks

Introduction to emission benchmarks

Guidance is given below on release concentrations or mass release rates achievable for key substances using the best combination of techniques. These BAT-based benchmarks are not mandatory release limits and reference should be made to Section 1 and the Guide for Applicants regarding their use.

Statutory standards and obligations (in particular those resulting from WID) may set concentration or mass release limits which are different from those indicated by BAT at an installation and/or the BAT-based benchmarks. Guidance is given also on these standards and obligations in the following sections.

Where different values are obtained from BAT-based benchmarks and statutory standard and obligation limits, the value which results in the lower emission should be considered to be the emissions benchmark.

Under no circumstances may an installation specific assessment of ELV result in a release limit for an installation which exceeds a maximum release limit specified in a relevant statutory obligation.

3.2.1 Emissions to air associated with the use of BAT

The following section is general guidance on how ELVs for releases to air should be derived. Where statutory obligations set different frequencies, durations or criteria for compliance with the limits, these obligations shall supersede the general considerations given below. Plants subject to WID requirements therefore have different derivation criteria as described later in this section.

The emissions quoted below are daily averages based upon continuous monitoring during the period of operation. See **Section 3.2.6** for the standard conditions that should be applied. 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 the **Monitoring Guidance** for more information. The benchmarks given do not take sampling, analytical errors, or uncertainties into account. These will be considered when setting an ELV for a Permit.

Limits in Permits 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

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 twelve month 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)

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%

Where the WID standards have to be applied, the following paragraphs outline the specific requirements of the Directive:

WID Annex V requires that emissions measured by Continuous Emission Monitors (CEMs) are reported as half-hourly averages and daily average values (obtained from the half-hourly averages) for Particulates, TOC, HCl, HF, SO_2, and NO_x. This is interpreted by the Regulator as discrete half-hour averages and discrete daily averages of the half-hourly values, normally commencing at mid-night daily. Where an Operator proposes to use a different basis for commencement of the half-hourly and/or daily average, he should justify it in his application. Emissions measured by Continuous Emission Monitors (CEMs) are reported as 10 minute averages and daily average values for CO. Periodic measurements of heavy metal releases should be sampled over a minimum period of 30 minutes and a maximum period of 8 hours. Periodic measurements of dioxin and furan releases should be sampled over a minimum period of 6 hours and a maximum period of 8 hours. The Regulator is likely to require that monitoring of dioxin-like PCBs and PAHs is carried out over the same time period as for dioxins and furans.

WID Article 11(10) defines compliance with the ELVs being achieved as:

- None of the daily average values exceed the ELVs for Particulates, TOC, HCl, HF, SO_2, or NO_x listed in Annex V (a)
- 97% of the daily average values do not exceed the ELV for CO listed in Annex V (e)
- Either: None of the half-hourly average values exceed the ELVs for Particulates, TOC, HCl, HF, SO_2, or NO_x listed in Annex V (b) Column A;
- Or: 97% of the half-hourly average values exceed the ELVs for Particulates, TOC, HCl, HF, SO_2, or NO_x listed in Annex V (b) Column B.
- None of the periodic measurements of heavy metal release or dioxin and furan release exceed the ELVs set out in Annex V (c) and (d)
- The provisions of Annex V (e), second indent relating to CO releases, are met.

The half-hourly averages and the 10-minute averages referred to above shall be determined within the effective operating time (excluding the start-up and shut-down periods if no waste is being incinerated) from the measured values after having subtracted the value of the confidence interval specified in point 3 of Annex III. This will generate the validated half-hourly reading, which should be reported.

The daily average value shall be obtained from the validated half-hourly average.

To obtain a valid daily average, no more than 5 half-hourly average values may be discarded in any day due to malfunction or maintenance of the continuous measurement system. No more than 10 daily average values may be discarded in any year due to malfunction or maintenance of the continuous measurement system.

3.2.2 Emissions to water associated with the use of BAT

The following section is general guidance on how ELVs for releases to water should be derived. Where statutory obligations set different frequencies, durations or criteria for compliance with the limits, these obligations shall supersede the general considerations given below. Plants subject to WID requirements therefore have different derivation criteria as described later in this section.

Wastewater treatment systems can maximise the removal of metals using precipitation, sedimentation and possibly filtration. The reagents used for precipitation may be hydroxide, sulphide or a combination of both, depending on the mix of metals present. It is also practicable in many cases to re-use treated water.

Where automatic sampling systems are employed, limits 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%

Where the WID standards have to be applied, the following paragraphs outline the specific requirements of the Directive:

Article 11(14) of WID requires that continuous monitoring of pH, temperature and flow is required.

Article 11(14) of WID requires that spot daily sampling or daily flow proportional representative sampling over a 24 hour period is carried out for suspended solids.

Article 11(14) of WID requires that, where waste water arises from gas cleaning, flow proportional representative sampling over a 24 hour period is carried out monthly for the heavy metals and their compounds listed in WID Annex IV.

Article 11(14) of WID requires that measurements for dioxins and furans are carried out every 6 months, although measurements shall be carried out at least once every 3 months during the first year of operation.

WID Article 11(16) defines compliance with the ELVs being achieved as:

- For suspended solids, 95% and 100% of the measured values do not exceed the respective ELVs as set out in WID Annex IV
- For heavy metals, no more than 1 measurement per year exceeds the ELV (or, if the Permit foresees more than 20 samples per year, no more than 5% of such samples) set out in WID Annex IV
- For dioxins and furans, none of the measurements exceeds the ELV set out in WID Annex IV

3.2.3 Standards and obligation

For this current guidance on Waste Incineration, the WID has particular importance, and must be complied with for plants covered by its scope in addition to the requirement to comply with BAT:

- **Directive 2000/76/EC** on the incineration of waste
  This Directive will replace the other Municipal and Hazardous Waste Incineration Directives and sets requirements for the majority of incineration plant burning wastes. Reference should be made to the Directive regarding the scope for various plants and the dates when the obligations it contains must be complied with. The benchmarks and standards in this guidance incorporate the requirements of this Directive where applicable.

In addition to meeting the requirements of BAT, there are other national and international standards and obligations that 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.

EC-based EQ standards

IPPC: A Practical Guide explains how these should be taken into account and contains an annex listing the relevant standards. (See **Appendix 1** for equivalent legislation in Scotland and Northern Ireland). They can be summarised as follows:

Air quality

- Statutory Instrument 2000 No.928, Air Quality (England) Regulations 2000 gives air quality objectives to be achieved by:
  - 2005 for nitrogen dioxide
  - 2004 for SO2 and PM10
  - 2003 for CO, 1,3-butadiene and benzene
  - in two stages for lead by 2004 and 2008 respectively
- Statutory Instrument 2002 No. 3043 The Air Quality (England) (Amendment) Regulations 2002, which sets a tighter objective for CO and a longer-term objective for benzene to be achieved by 2010.

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

Other standards and obligations

Those most frequently applicable to most sectors are:

- Hazardous Waste Incineration Directive
- Waste Incineration Directive.
- Solvent Emissions Directive.
- Large Combustion Plant Directive.

- Reducing Emissions of VOCs and Levels of Ground Level Ozone: a UK Strategy (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).
- 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 (negotiations are now underway which could lead to a requirement further to reduce emissions of NOx and VOCs. A requirement to further reduce SO2 emissions from all sources has been agreed. The second Sulphur protocol (Oslo, 1994) obliges the UK to reduce SO2 emissions by 80% (based on 1980 levels) by 2010).
- The Montreal Protocol.
- The Habitats Directive (see **Section 4.3**).
- Sulphur Content of Certain Liquid Fuels Directive 1999/32/EC (from 1 January 2003, the sulphur content of heavy fuel oil must not exceed 1% except when it is burnt in plants fitted with SO2 abatement equipment. Sulphur levels in gas oil must not exceed 0.2% from 1 July 2000, and 0.1% from the start of 2008.)

3.2.4 Units for benchmarks and setting limits in permits

Releases can be expressed in terms of:

- **“concentration”** (for example mg/l or mg/m3), 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”** (for example, kg/ product 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”** (for example, 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.

The emission level figures given in this chapter are based on average figures, not on maximum, short-term peak values, which could be expected to be higher. The emission levels given are based on a typical averaging period of not less than 30 minutes and not greater than 24 hours.

Where statutory obligations set different frequencies, durations or criteria for compliance with the limits, these obligations shall supersede the general considerations given above.

3.2.5 Statistical basis for benchmarks and limits in permits

Where statutory obligations set different frequencies, durations or criteria for compliance with the limits, these obligations shall supersede the general considerations given below. In particular, where the WID applies, the ELVs for releases to air are expressed as daily averages and half-hour averages, and in the latter case compliance may be demonstrated when 97% of the measured values do not exceed the relevant ELV.

Conditions in Permits can be set with percentile, mean or median values over annual, 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 percent of hourly averages.

3.2.6 Reference conditions for releases to air

The reference conditions of substances in releases to air from point-sources are:

WID Article 11(8) requires that the results of measurements made to verify compliance with the ELVs should be standardised at the following conditions:

- Temperature 273 K
- Pressure 101.3 kPa
- Dry Gas
- 11% oxygen where wastes are incinerated in air. WID Annex VI defines the formula to calculate the emission concentration at the standard percentage oxygen concentration as $E_s = E_m * (21-O_s)/(21-O_m)$, where E_s = calculated emission concentration at the standard percentage oxygen concentration, E_m = measured emission concentration, O_s = standard oxygen concentration and O_m = measured oxygen concentration. Where hazardous waste is being burned and abatement plant is provided for gas cleaning, standardisation with respect to oxygen concentration shall be carried out only if the oxygen concentration measured over the same period as the pollutant concerned exceeds the relevant standard oxygen content.
- Where wastes are incinerated in an oxygen-enriched atmosphere, the standard oxygen concentration may be laid down by the Regulator to take account of the special circumstances in the individual case. The Operator will need to justify the standard oxygen concentration he proposes as part of his application. Where hazardous waste is being burned and abatement plant is provided for gas cleaning, standardisation with respect to oxygen concentration shall be carried out only if the oxygen concentration measured over the same period as the pollutant concerned exceeds the relevant standard oxygen content.

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 the **Monitoring Guidance** for more information.

3.2.7 Emission benchmarks for Waste Incinerators

Taking into account the guidance on BAT and the obligations imposed by legislation, this section details the benchmarks for releases from Waste Incinerators. **Table 3.1** gives the emission limit value benchmarks for releases to air. **Table 3.2** gives the emission limit value benchmarks for releases to water.water.

Table 3.1: Benchmark emission limit values for releases to air

Parameters	Emission Limit Values*				Frequency requirements
	Units	½ Hour average – 100% compliance (or figure in brackets – ½ Hour average – 97% compliance unless otherwise specified)	Average of ½ Hour averages over a 24-hour day (100% compliance unless specified)	Periodic	
Particulate matter	mg/m³	30 (10)	10	N/A	CEM# and bi-annual spot
	ACIs not subject to WID are expected to achieve 95% compliance with 25 (as an hourly average). In current operation, some recently-built mass burn MWIs are able to operate at a daily average of 5, while some CWis (depending on waste burned) can operate at a daily average of 2 @				
VOCs (as Total Organic Carbon – TOC)	mg/m³	20 (10)	10	N/A	CEM# and bi-annual spot
	ACIs not subject to WID are expected to achieve 95% compliance with 20 (as an hourly average). In current operation, some recently-built mass burn MWIs are able to operate at a daily average of 5, while some CWis (depending on waste burned) can operate at a daily average of 5. A multi-stage process using separate pyrolyser, gasifier and thermal oxidiser has operated with daily average releases of <1 when burning CW @				
Hydrogen chloride	mg/m³	60 (10)	10	N/A	CEM# and bi-annual spot
	ACIs not subject to WID are expected to achieve 95% compliance with 30 (as an hourly average). In current operation, a multi-stage process using separate pyrolyser, gasifier and thermal oxidiser has operated with daily average releases of 10 when burning CW @				
Hydrogen fluoride	mg/m³	4 (2) (or N/A)	1 (or N/A)	N/A (or 4)	CEM# and bi-annual spot (or if HCl is abated and the plant is compliant for HCl: periodic extractive sampling only with 6-monthly sampling {3-monthly in first 12 months of operation}. Extractive sample is average over sample period of ½ - 8 hours)

Table 3.1: Benchmark emission limit values for releases to air (Continued)

Parameters	Emission Limit Values*				Frequency requirements
	Units	½ Hour average – 100% compliance (or figure in brackets – ½ Hour average – 97% compliance unless otherwise specified)	Average of ½ Hour averages over a 24-hour day (100% compliance unless specified)	Periodic	
Carbon monoxide	mg/m^3	100 (150 for 95% of 10-minute averages))	50 (97% over a year)	N/A	CEM# and bi-annual spot
	ACIs not subject to WID are expected to achieve 95% compliance with 100 (as a 10 minute average). In current operation, some recently-built mass burn MWIs are able to operate at a daily average of 20, while some CWis (depending on waste burned) can operate at a daily average of 25. A multi-stage process using separate pyrolyser, gasifier and thermal oxidiser has operated with daily average releases of 6 when burning CW @				
Sulphur dioxide	mg/m^3	200 (50)	50	N/A	CEM# and bi-annual spot
	In current operation, a recently-built fluidised bed MWI is able to operate at a daily average of 30, while some CWis (depending on waste burned) can operate at a daily average of 35. A multi-stage process using separate pyrolyser, gasifier and thermal oxidiser has operated with daily average releases of 5 when burning CW @				
NO_x (NO and NO_2 expressed as NO_2) – Existing plant > 6 t/h or new plant	mg/m^3	400 (200)	200	N/A	CEM# and bi-annual spot
	ACIs not subject to WID are expected to achieve 95% compliance with 350 (as an hourly average). In current operation, a multi-stage process using separate pyrolyser, gasifier and thermal oxidiser has operated with daily average releases of 40 when burning CW @				
NO_x (NO and NO_2 expressed as NO_2) – Existing plant < 6 t/h or new plant	mg/m^3	N/A	400	N/A	CEM# and bi-annual spot
Nitrous oxide (N_2O)~	mg/m^3	^	^	^	CEM# and bi-annual spot
	In current operation, a multi-stage process using separate pyrolyser, gasifier and thermal oxidiser has operated with daily average releases of 2 when burning CW @				
Ammonia~	mg/m^3	^	^	^	CEM# and bi-annual spot
Cadmium and thallium and their compounds (total)	mg/m^3	N/A	N/A	0.05	6-monthly sampling (3-monthly in first 12 months of operation) Average value over sample period of ½ - 8 hours)
Mercury and its compounds	mg/m^3	N/A	N/A	0.05	
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V and their compounds (total)	mg/m^3	N/A	N/A	0.5	

Table 3.1: Benchmark emission limit values for releases to air (Continued)

Parameters	Emission Limit Values*				Frequency requirements
	Units	½ Hour average – 100% compliance (or figure in brackets – ½ Hour average – 97% compliance unless otherwise specified)	Average of ½ Hour averages over a 24-hour day (100% compliance unless specified)	Periodic	
Dioxins and furans – I-TEQ	ng/m^3	N/A	N/A	0.1 (Non-WID ACIs - 1.0)	6-monthly sampling (3-monthly in first 12 months of operation) Average value over sample period of 6 - 8 hours)
Dioxins and furans – WHO-TEQ	ng/m^3	N/A	N/A	^	
Dioxin-like PCBs	ng/m^3	N/A	N/A	^	
PAHs	ng/m^3	N/A	N/A	^	

* Reference conditions: Temperature 273K, pressure 101.3 kPa, 11% O2 (except when burning waste oil only – 3%), dry gas.

CEM – Continuous emission monitoring

~ For plants using SNCR or SCR to limit NOx releases

^ Monitoring results to be reported for first year of operation – ELV to be set based on results. In some cases, for example where protection of the local environment so dictates, the Regulator may set an ELV from the outset.

@ In operation, many plants outperform their ELVs, giving rise to operational performance levels that are below their ELVs. For example, if the HCl ELV is 10 mg/m^3, it would be typical for a technology to be guaranteed to 7 - 8 mg/m^3, with a typical p[lant performance of 1 - 5 mg/m^3. It is important to recognise that this difference between plant performance and ELV may be significant.

Table 3.2: Benchmark emission limit values for releases to water

Parameters	Units	Emission Limit Values	Frequency requirements
Total suspended solids (from APC effluents) as defined in Directive 91/271/EEC	mg/l	<30 (95% of measurements) <45 (100% of measurement)	Spot daily sample or 24-hour flow proportional on a daily basis
Mercury and its compounds expressed as mercury (from APC effluents)*	mg/l	0.03	24-hour flow proportional sample on a daily basis
Cadmium and its compounds expressed as cadmium (from APC effluents)*	mg/l	0.05	24-hour flow proportional sample on a daily basis
Thallium and its compounds expressed as thallium (from APC effluents)*	mg/l	0.05	24-hour flow proportional sample on a daily basis
Arsenic and its compounds expressed as arsenic (from APC effluents)*	mg/l	0.15	24-hour flow proportional sample on a daily basis
Lead and its compounds expressed as lead (from APC effluents)*	mg/l	0.2	24-hour flow proportional sample on a daily basis
Chromium and its compounds expressed as chromium (from APC effluents)*	mg/l	0.5	24-hour flow proportional sample on a daily basis
Copper and its compounds expressed as copper (from APC effluents)*	mg/l	0.5	24-hour flow proportional sample on a daily basis

Table 3.2: Benchmark emission limit values for releases to water

Parameters	Units	Emission Limit Values	Frequency requirements
Nickel and its compounds expressed as nickel (from APC effluents)*	mg/l	0.5	24-hour flow proportional sample on a daily basis
Zinc and its compounds expressed as zinc (from APC effluents)*	mg/l	1.5	24-hour flow proportional sample on a daily basis
Total dioxins and furans (as I-TEQ) (from APC effluents)	mg/l	0.3	24-hour flow proportional sample on a daily basis
Total dioxins and furans (as WHO-TEQ) (from APC effluents)	mg/l	^	24-hour flow proportional sample on a daily basis
pH range #		Site specific	
Temperature #	°C	Site specific	Continuous
Flow #	l/s	Site specific	Continuous

* Limits for metals apply as 24-hour proportional flow samples. Only 1 sample per year or 5% of annual samples (where more than 20 are taken) may exceed the stated limits.

Parameters to be measured and limits to be applied continuously.

^ Monitoring results to be reported for first year of operation – ELV to be set based on results

4 Impact

4.1 Impact assessment

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 EQS etc, revisiting the techniques in Section 2 as necessary. The use of **IPPC Environmental Assessments for BAT**, and the IPPC Environmental Assessments for BAT software tool, and the other tools on the Application CD, will lead the Applicant through the process.

The depth to which the impact assessment should go should be discussed with the Regulator. For some low risk sites the requirements may be reduced.

Indicative BAT requirements for impact assessment (Sheet 1 of 2)
Provide an assessment of the potential significant environmental effects (including trans-boundary effects) of the foreseeable emissions.

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 (for example, 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 (that is, Habitat Directive sites, special areas of conservation, Sites of Special Scientific Interest (SSSI or in Northern Ireland ASSI) or other sensitive areas), soil, water, that is groundwater (water below the surface of the ground in the saturation zone and in direct contact with the ground and subsoil) and watercourses (for example, 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. **IPPC Environmental Assessments for BAT** 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**) with:
- community EQS levels
- other statutory obligations
- non-statutory obligations
- environmental action levels (EALs) and the other environmental and regulatory parameters defined in **IPPC Environmental Assessments for BAT**

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, based on the most sensitive receptor, be it human health, soil or terrestrial ecosystems.

Indicative BAT requirements for impact assessment (Sheet 2 of 2) Provide an assessment of the potential significant environmental effects (including trans-boundary effects) of the foreseeable emissions.
6 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.
7 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.
8 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 Waste Management Licensing Regulations

Indicative BAT requirements for waste management licensing regulations

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.

1 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 and Northern Ireland, see **Appendix 1**.)

2 The 'relevant objectives', contained in paragraph 4, Schedule 4 of the Waste Management Licensing Regulations 1994 (SI 1994/1056 as amended), are as follows:

- ensuring the waste is recovered or disposed of without endangering human health and without using processes 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;
- implementing, so far as material, any plan made under the plan-making provisions.

3 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 briefly to consider each of these objectives individually and provide a comment on how they are being addressed by your proposals. It is also necessary to ensure that any places of special concern that could be affected, such as SSSIs, are identified and commented upon although, again, these may have been addressed in your assessment for BAT, in which case a cross-reference may suffice.

4 Operators should identify any development plans made by the local planning authority, including any local waste plan and Waste Strategy 2000, and comment on the extent to which the proposals accord with the contents of any such plan (see also **Section 2.6**).

4.3 The Habitats Regulations

Indicative BAT requirements for the habitats regulations 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 purpose of the Conservation (Natural Habitats etc.) Regulations 1994 (SI 1994/2716)

1 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 1**). 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.

2 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.

3 Information on the location of European sites and their conservation objectives is available from:

- English Nature (01733 455000), **www.english-nature.org.uk**
- Countryside Council for Wales (01248 385620), **www.ccw.gov.uk**
- Scottish Natural Heritage (0131 447 4784), **www.snh.org.uk**
- Joint Nature Conservation Committee (01733 866852), **www.jncc.gov.uk**
- Environment and Heritage Service, Northern Ireland (02890254754), **www.ehsni.gov.uk**

4 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.

5 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. Equivalent information can also be accessed via the SEPA web site **http://www.sepa.org.uk**, 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.

Ref 1 *IPPC Reference Document on Best Available Techniques for various sectors* European Commission **http://eippcb.jrc.es**

Ref 2 *The Pollution Prevention and Control Act (1999)* (**www.hmso.gov.uk**).

Ref 3 *The Pollution Prevention and Control Regulations* (SI 2000 No. 1973) as amended by the Waste Incineration (England and Wales) Regulations 2002. SI2002 No. 2980 (**www.hmso.gov.uk**).

Ref 4 *IPPC: A Practical Guide* (for England and Wales) (or equivalents in Scotland and Northern Ireland) **www.defra.gov.uk/environment/ppc/ippcguide/index.htm**

Ref 5 Guidance for applicants

• *IPPC Part A(1) Installations: Guide for (Applicants England and Wales)* (includes Preparation of a Site Report in a Permit Application) (**EA website**).

• *PPC Part A Installations: Guide for Applicants (Scotland)* (Guidance for SEPA staff on land and groundwater considerations) **Guidance for SEPA staff on land and groundwater considerations**

• *IPPC Regulatory Guidance Series No.5 - Interpretation of "Installation" in the PPC Regulations* **www.environment-agency.gov.uk**

Ref 6 Assessment methodologies:

• *E1 BPEO Assessment Methodology for IPC*

• *IPPC Environmental Assessments for BAT* H1

Ref 7 Waste minimisation support references

• *Environment Agency web site*. Waste minimisation information accessible via: **www.environment-agency.gov.uk/subjects/waste/131528**

• *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 Envirowise and the BOC Foundation (a software tool designed for small and medium businesses.). Available free from The Environmental Helpline (tel: 0800 585794)

• *ENVIROWISE*. A joint DTI/DEFRA 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. ENVIROWISE is accessible via a FREE and confidential helpline (tel: 0800 585794) or via the web site **www.envirowise.gov.uk**

• *Increased Profit Through Improved Materials Additions*: Management/Technical Guide, ENVIROWISE, 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 on-line searching and on CD-ROM. Short enquiries are free (tel: 01235 463162)

• *Waste Minimisation* – Institution of Chemical Engineers Training Package E07. Basic course which contains guide, video, slides, OHPs etc. (tel: 01788 578214)

• *BIO-WISE - profiting through industrial biotechnology.* A DTI programme providing free advice and information about how biotechnology can be used within manufacturing industry. Case studies, guides website and Helpline 0800 432100. **dti.gov.uk/biowise** (leather guide GG237 and case study 11

Ref 8 Water efficiency references:

• *Simple measures restrict water costs*, ENVIROWISE, GC22

• *Effluent costs eliminated by water treatment*,ENVIROWISE, GC24

• *Saving money through waste minimisation*: Reducing water use, ENVIROWISE, GG26

• *ENVIROWISE Helpline* 0800 585794

• *Optimum use of water for industry and agriculture dependent on direct abstraction: Best practice manual*. R&D technical report W157, Environment Agency (1998), WRc Dissemination Centre, Swindon (tel: 01793 865012)

• *Cost-effective Water Saving Devices and Practices* ENVIROWISE GG067

• *Water and Cost Savings from Improved Process Control* ENVIROWISE GC110

• *Tracking Water Use to Cut Costs* ENVIROWISE GG152

Ref 9 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

• 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

Ref 10 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**)

• *Pollution Prevention Guidance Note – Above-ground oil storage tanks*, PPG 2, Environment Agency, gives information on tanks and bunding which have general relevance beyond just oil (**EA website**)

• *Construction of bunds for oil storage tanks*, Mason, P. A, Amies, H. J, Sangarapillai, G. Rose, 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 on-line purchase)

• *Policy and Practice for the Protection of Groundwater* (PPPG) (**EA website**)

• *Choosing Cost-effective Pollution Control* ENVIROWISE GG109

• *Cost-effective Separation Technologies for Minimising Wastes and Effluents* ENVIROWISE GG037

• *Cost-effective Membrane Technologies for Minimising: Wastes and Effluents* ENVIROWISE GG044

Ref 11 Waste management references

• *Investigation of the criteria for, and guidance on, the landspreading of industrial wastes* – final report to the DEFRA, the Environment Agency and MAFF, May 1998

• *Technical Guidance on Clinical Waste Management Facilities* May 2003 Environment Agency

Ref 12 Energy references

• *(Interim) Energy Efficiency Guidance,*(available as draft Horizontal Guidance Note IPPC H2) (**www.environment-agency.gov.uk)**

Ref 13 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*, DEFRA, 1999, ISBN 753501 X, available from the Stationery Office

Ref 14 Monitoring Guidance

• *MCERTS approved equipment* link via **www.environment-agency.gov.uk/business/mcerts**

• *M1 Sampling requirements for monitoring stack emissions to air from industrial installations (2002)*

• *M2 Monitoring of Stack Emissions to Air*

• *M18 Standards for water quality and effluent monitoring*

• *Direct Toxicity Assessment for Effluent Control* Technical Guidance (2000), UKWIR 00/TX/02/07

Ref 15 Closure references

• *Working at Construction and Demolition-sites* (PPG 6) (**EA website**)

Ref 16 Directives

• *Hazardous waste incineration Directive* (1994/67/EC)

• *Waste incineration Directive* (2000/76/EC)

• *Large Combustion Plant Directives* (1988/609/EEC)

• *Habitats Directive* (92/43/EC)

• *Landfill Directive* 1999/31/EC O. J. L182 16.07.1999

• *Urban Waste Water Directive* 1999/271/EEC O. J. L182 30.05.1991

Ref 17 Air Dispersion

• *Guidelines on Discharge Stack Heights for Polluting Emissions,* HMIP Technical Guidance Note (Dispersion) D1, 1993, ISBN 0-11-752794-7 **www.tso.co.uk/bookshop**; (or **www.environment-agency.gov.uk** for summary only)

Ref 18 Fire Fighting

• *BS 5908: Code of Practice for Fire Precautions in the Chemical and Allied Industries*

• *PPG 18 - Managing Fire-water and major spillages,* Environment Agency Pollution Prevention Guidance Note (see Ref 10)

Ref 19 Volatile Organic Compounds

• *The Categorisation of Volatile Organic Compounds,*1995 HMIP Research Report No DOE/HMIP/RR/95/009 (**www.environment-agency.gov.uk**)

Ref 20 Noise References

• *H3 Part 1*

Ref 21 Incineration

• *Guidance on Directive 2000/76/EC On The Incineration of Waste* Defra **www.defra.gov.uk**

Ref 22 BAT Review

• *Review of BAT for New Waste Incineration Issues. Technical Report P4-100/TR - AEA Technology report for the Environment Agency:*
Part 1: Waste Pyrolysis and Gasification Issues
Part 2: Validation of Combustion Conditions
Part 3: New IPPC Considerations.
Environment Agency R&D Dissemination Centre, WRc, Frankland Rd., Swindon WILTS SN5 8YF - e-mail: publications@wrcplc.co.uk

Abbreviations

ACI	Animal Carcass Incinerator
APC	Air Pollution Control
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
BATNEEC	Best Available Techniques not entailing excessive costs
BFB	Bubbling Fluidised Bed
BOD	Biochemical Oxygen Demand
BPEO	Best Practicable Environmental Option
BSE	Bovine Spongiform Encephalitis
BSI	British Standards Institute
CAM	Ambient Air Quality Monitoring System
CCA	Climate Change Agreement
CCTV	Closed Circuit Television
CDs	Compact Discs
CFB	Circulating Fluidised Bed
CFD	Computerised Fluid Dynamics
ChWI	Chemical Waste Incinerator
COD	Chemical Oxygen Demand
CV	Calorific Value
CWI	Clinical Waste Incinerator
DI	Drum Incinerator
DPA	Direct Participant Agreement
EC	European Community
EHS	Northern Ireland Environment and Heritage Service
ELV	Emission Limit Value
EMAS	EC Eco-Management and Audit Scheme
EMS	Environmental Management System
EP	Electrostatic Precipitator
EPA90	Environmental Protection Act 1990
EQS	Environmental Quality Standard
ETP	Effluent treatment plant
EU	European Union
FBC	Fluidised Bed Combustor
FGR	Flue Gas Recirculation
GBR	General Binding Rules
GWP	Global Warming Potential
HSE	Health and Safety Executive
HWI	Hazardous Waste Incinerator
HWID	Hazardous Waste Incineration Directive
IEMA	Institute of Environmental Management and Assessment
IPC	Integrated Pollution Control
IPPC	Integrated Pollution Prevention and Control
ISO	International Standards Organisation
ITEQ	International Toxicity Equivalents
LOI	Loss On Ignition
MBM	Meat and Bone Meal
MCERTS	Monitoring Certification Scheme
MRF	Materials Recycling Facility
MWI	Municipal Waste Incinerator
PAH	Poly Aromatic Hydrocarbon
PPC	Pollution Prevention and Control
PVC	PolyVinyl Chloride
RDF	Refuse Derived Fuel
SCR	Selective Catalytic Reduction
SEC	Specific Energy Consumption

SEPA	Scottish Environment Protection Agency
SLF	Secondary Liquid Fuel
SNCR	Selective Non-Catalytic Reduction
SPA	Special Protection Area
SSI	Sewage Sludge Incinerator
SSSI	Site of Special Scientific Interest
STW	Sewage Treatment Works
TMT	Trimercapto-s-triazine tri-sodium salt
TOC	Total Organic Carbon
TSS	Suspended solids
VOC	Volatile organic compounds
WAMITAB	Waste Management Industry Training and Advisory Board
WHB	Waste Heat Boiler
WID	Waste Incineration Directive

Appendix 1: Equivalent legislation in Wales, Scotland & Northern Ireland

The legislation referred to in the text is that for England. The following are the equivalents for Scotland, Wales and Northern Ireland.

Table 4.1: Equivalent legislation

England	Wales	Scotland	Northern Ireland
PPC Regulations (England and Wales) 2000, SI 2000 No.273 (as amended)	As England	PPC (Scotland) Regulations 2000, SSI 2000 No.323 (as amended)	PPC (NI) Regulations 2003, SR 2003 No.323
SI:1994 1056: Waste Management Licensing Regulations	As England	As England	SR 2003 No. 493: The Waste Management and Licensing Regulations (NI) 2003
The Water Resources Act 1991	As England	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 1995 No. 3146: The Air Quality Standards (Amendments) Regulations 1995 SI 2002 No. 3043 The Air Quality (England) (Amendment) Regulations 2002	As England SI 2002 No. 3182 (W.298) The Air Quality (Amendment) (Wales) Regulations 2002	As England SSI 2002 No. 297 The Air Quality (Scotland) Amendment Regulations 2002	SR 1990 No.145: The Air Quality Standards Regulations (Northern Ireland) 1990 SR1996 No.23: The Air Quality Standards (Amendments) Regulations (Northern Ireland) 1996
SI 2000 No.928: The Air Quality (England) Regulations 2000 SI 2002 No. 3117 The Air Quality Limit Values (Amendment) Regulations 2002	SI 2000 No.1940 (W.138): The Air Quality (Wales) Regulations 2000 SI 2002 No. 3183 (W.299) The Air Quality Limit Values (Wales) Regulations 2002	SSI 2000/97: The Air Quality (Scotland) Regulations SSI 2002 No. 566 The Air Quality Limit Values (Scotland) Amendment Regulations 2002	No NI equivalent
SI 2001 No.2315: The Air Quality Limit Values Regulations 2001	SI 2001 No.2683 (W.224): The Air Quality Limit Values (Wales) Regulations 2001	SSI 2001 No.224: The Air Quality Limit Values (Scotland) Regulations 2001	SI 2002 No.94: The Air Quality Limit Values (Northern Ireland) Regulations 2002
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)	As England	SI 1990/126: Surface Water (Dangerous Substances) (Classification) (Scotland) Regulations	Surface Waters (Dangerous Substances) (Classification) Regulations 1998. Statutory Rules of Northern Ireland 1998 No 397
SI 1991 No.1597: Bathing Waters (Classification) Regulations 1991	As England	SI 1991 No.1609: Bathing Waters (Classification) (Scotland) Regulations 1991	The Quality of Bathing Water Regulations (NI) 1993

Table 4.1: Equivalent legislation

England	Wales	Scotland	Northern Ireland
SI 1997 No.1331: The Surface Waters (Fishlife) (Classification) Regulations 1997	As England	SI 1997 No.2471 (S.163): The Surface Waters (Fishlife) (Classification) (Scotland) Regulations 1997	The Surface Water (Fishlife) (Classification) Regulations (NI) 1997
SI 1997 No.1332: The Surface Waters (Shellfish) (Classification) Regulations 1997	As England	SI 1997 No.2470 (S.162): The Surface Waters (Shellfish) (Classification) (Scotland) Regulations 1997	The Surface Water (Shellfish) (Classification) Regulations (NI) 1997
SI 1994 No.2716: The Conservation (Natural Habitats, etc) Regulations	As England	As England	Conservation (Natural Habitats etc) Regulations (Northern Ireland) 1995
SI 1999 No.743: Control of Major Accident Hazards Regulations (COMAH) 1999	As England	As England	SR 2000 No.93: Control of Major Accident Hazards Regulations (Northern Ireland) 2000
SI 1998 No.2746: The Groundwater Regulations 1998	As England	As England	SR 1998 No.401. The Groundwater Regulations (Northern IrelandI) 1998
SI 2002 No.2980: The Waste Incineration (England and Wales) Regulations 2002	As England	SSI 2003 No.170 : The Waste Incineration (Scotland) Regulations 2003	SR 2003 No.390: The Waste Incineration Regulations (Northern IrelandI) 2003

Appendix 2: Groundwater Regulations 1998 Schedule of listed substances and recommendations for List I (DEFRA)

List I

1.-(1) Subject to the sub paragraph 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 that may form such compounds in the aquatic environment

(b) organotin compounds

(c) substances that possess carcinogenic, mutagenic or teratogenic properties in or via the aquatic environment (including substances that have those properties that would otherwise be in List II)

(d) mercury and its compounds

(e) cadmium and its compounds

(f) mineral oils and hydrocarbons

(g) cyanides.

1.-(2) A substance is not in List I if it has been determined by the Regulator to be inappropriate to List I on the basis of a low risk of toxicity, persistence and bioaccumulation.

List II

2.-(1) A substance is in List II if it could have a harmful effect on groundwater and it belongs to one of these 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 that have a harmful 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 that 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 nitrates.

2.-(2) A substance is also in List 2 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 Regulator to be inappropriate to List I under paragraph 1(2); and

(c) it has been determined by the Regulator to be in inappropriate to List II having regard to toxicity, persistence and bioaccumulation.

3.-(1) The Secretary of State or Scottish Ministers may review any decision of the Regulator in relation to the exercise of its powers under the paragraphs above.

3.-(2) The Secretary of State or Scottish Minister shall notify the Regulator of his decision following a review under List 1 sub paragraph 1 above and it shall be the duty of the Regulator to give effect to that decision.

4.- The Regulator 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.

List of substances recommended to be confirmed as List I

- as recommended by the Joint Agency Groundwater Directive Advisory Group.

Aldrin	Diuron
Atrazine	Endosulfan
Azinphos-ethyl	Fenitrothion
Bromoxynil (as Bromoxynil-phenol)	Fenthion
Bromoxynil octanoate	Heptachlor
Cadmium	Hexachlorobenzene
2-Chloroaniline	Hexachlorobutadiene (HCBD)
Chlorobenzene	Hexachlorocyclohexane
Chlordane	Hexachloroethane
Chloro-2,4-dinitrobenzene	Hexachloronorbornadiene
Chlorfenvinphos	Hexaconazole
4-Chloro-3-methylphenol	3-Iodo-2-proponyl n-butyl carbamate (IPBC)
Chloro-2-nitrobenzene	Linuron
Chloro-3-nitrobenzene	Malathion
Chloro-4-nitrobenzene	Mercury
2-Chlorophenol	Mevinphos
Chlorothalonil	Oxydemeton-methyl
2-Chlorotoluene	Parathion
a-Chlorotoluene	Parathion-methyl
Chlorpyrifos	Pentachlorobenzene
Coumaphos	Pentachloroethane
Cypermethrin	Pentachlorophenol (PCP)
DDT	Permethrin
Demeton	Propanil
Diazinon	Simazine
Dibutyl bis(oxylauroyl)tin	Tetrabutyltin
Dichlofluanid	1,2,4,5-Tetrachlorobenzene

Dichloroaniline

1,2-Dichlorobenzene

1,3-Dichlorobenzene

1,4-Dichlorobenzene

Dichloronitrobenzene (all isomers)

2,4-Dichlorophenol

1,3-Dichloropropene

Dichlorprop

Dichlorvos

Dicofol

Dieldrin

Dimethoate

Tetrachloroethylene

Triazophos

Tributyl tin oxide (TBTO)

Tributyl-phosphate

Trichlorfon

1,2,4-Trichlorobenzene

Trichloroethylene

Trichlorophenol (all isomers)

Trifluralin

Triphenyl tin oxide (TPTO)

Triphenyl-phosphate