Sector Guidance Note I P P C S5.06

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Guidance for the Recovery and Disposal of Hazardous and Non Hazardous Waste

Integrated Pollution Prevention and Control (IPPC)

ENVIRONMENT AND HERITAGE SERVICE

Environment Agency

Addendum to S5.06

Guidance for the Treatment and Transfer of Hazardous Waste

Background

This document 'Guidance for the Recovery and Disposal of Hazardous and Non Hazardous Waste S5.06' was published in 2004, two years before the adoption of the Waste Treatments Bref. Despite this, the requirements of the Waste Treatments Bref mostly mirror those of S5.06. Some of the legislation and referenced guidance has been amended since S5.06 was published and users naturally reference the amending legislation.

Applicability of S5.06

S5.06 was drafted and published when there was parallel 'Best Practice Guidance' for waste management licensed activities[1]. With the advent of the Environmental Permitting regulations, new 'Waste Operation' permits referenced S5.06 where relevant and the 'Best Practice Guidance' was withdrawn. Fundamental revisions to waste management legislation (ie. the Hazardous Waste Regulations requires that Best Available Techniques' (BAT) is used for mixing of hazardous waste and the implementation of the Waste Hierarchy) has more closely aligned 'installations' and 'waste operations'. As the principle objective is to prevent accidents and minimise their consequences BAT generally equates to 'appropriate measures', with the only notable exception of Energy Efficiency.

Current Position

Regulated facilities or exempt facilities that transfer or treat hazardous waste are expected to meet the requirements of S5.06, whether they are allocated to the 'Hazardous Waste Sector' or another sector.

Implementation of Industrial Emissions Directive (IED)

The implementation of the IED will see the continued use of S5.06, EPR 5.07 (clinical waste) and the Waste Treatments Bref as the initial points for defining 'appropriate measures'. The development of the revised Bref may re-define BAT at some point in the future. Once the revised Bref is adopted we will have 4 years to implement any changes.

Commissioning Organisation

[1] Best Practice Guidance – Recovery and Disposal of Hazardous and Non-Hazardous Waste (Other than by Incineration and Landfill)

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Table 0.1: Record of changes

Version	Date	Change	Template Version
Consultation	July 2001	Draft for internal consultation	
External consultation 2a	October 2001	Amended following internal consultation	
Issue 2	June 2002	Changes following external consultation. Styling changes	V2
Issue 3	October 2003	Changes following external consultation.	V3
Issue 4	December 2004	Changes following external consultation -publish version	V4
Issue 5	May 2013	Changes following the introduction of IED	V5

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Executive summary

This guidance has been produced by the Environment Agency for England and Wales and the Northern Ireland Environment and Heritage Service (EHS). Together these are 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 the environmental impacts of certain industrial activities. It involves determining the appropriate controls for industry to protect the environment through a single Permitting process. To gain a Permit, Operators will have to show that they have systematically developed proposals to apply the Best Available Techniques (BAT) and meet certain other requirements, taking account of relevant local factors.

This Guidance and the BREF

This UK Guidance for delivering the PPC (IPPC) Regulations in this sector is based on the draft BAT Reference document BREF produced by the European Commission. The BREF is the result of an exchange of information between member states and industry. The quality, comprehensiveness and usefulness of the draft BREF is acknowledged. This guidance is designed to complement the BREF and is cross-referenced to it throughout. It takes into account the information contained in the draft BREF and lays down the indicative standards and expectations in the UK (England and Wales and Northern Ireland). The reader is advised to have access to the BREF.

The aims of this Guidance

The aims of this Guidance are 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
- minimise the effort by both Operator and Regulator in the permitting of an installation by expressing the BAT techniques as clear indicative standards
- improve the consistency of applications by ensuring that all relevant issues are addressed
- increase the transparency and consistency of regulation by having a structure in which the Operator's response to each issue, and any departures from the standards, can be seen clearly and which enables applications to be compared

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

key environmental issues

The key environmental issues for this sector are:

- **Accident risk -** accident risks are increased through any failure in the management of waste.
- **Intractable waste -** under the Landfill Directive, the ban on landfilling of liquid wastes and other regulatory changes will require alternative disposal routes to be sought for many of these wastes.
- **Treatment of wastes prior to landfilling** - applicants will be required to demonstrate that activities in which waste is treated prior to subsequent disposal by landfilling are controlled so that all relevant landfill waste acceptance criteria are met.
- **Waste characterisation sampling and checking -** applicants will be required to demonstrate that activities to screen waste will be carried out rigorously to ensure both the effectiveness of waste treatment operations and that the correct waste storage arrangements are employed.
- **Selection of appropriate treatment techniques -** techniques should be designed and operated to avoid deliberate or inadvertent production and/or displacement of substances that may be harmful to the environment and to prevent the transfer of such substances from one environmental medium to another.
- **Immobilisation process -** applicants will be required to demonstrate the suitability of each waste stream for treatment of liquids with simple mixing processes.
- **Waste hierarchy -** appropriate measures must be taken against pollution and specifically that the production of waste is avoided.
- **Accumulations of waste -** measures will need to be taken to identify a suitable disposal route prior to acceptance of wastes onto site.
- **Emissions to sewer -** if on-site treatment based on the use of BAT can achieve a higher level of removal of a substance from the aqueous effluent than may be required by the sewer discharge consent, on site treatment should be used unless treatment at the sewage treatment works guarantees an equivalent level of environmental protection.
- **Odour associated with fugitive emissions -** the handling of any substance that is or may contain a VOC will potentially lead to odour noticeable beyond the installation boundary.
- **Site restoration (prevention of emissions to land) -** IPPC in common with Waste Management Licensing requires that, on completion of activities, there should be no pollution risk from the site

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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 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.

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 (England & Wales) (for equivalent legislation in N Ireland see **Appendix 3**). 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). 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** on page 125 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** 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 or draft 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.

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 (eg. 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**.

Innovation

The Regulators encourage the development and introduction of innovative techniques that advance indicative BAT standards criteria, ie. 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** on page 8 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 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.

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 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 Pollution Prevention and Control Regulations (England & Wales). The schedules of listed activities are slightly different in Northern Ireland so for their equivalent Regulations see **Appendix 3**

While this Sector Guidance has been compiled primarily for the waste treatment and storage sector and for other installations that undertake the 'listed activities' outlined above, it can be applicable to 'directly associated' waste management activities in other sectors e.g in-house treatment or storage.

Section 5.3 - Disposal of Waste Other Than by Incineration or Landfill

Part A(1)

(a) The disposal of hazardous waste (other than by incineration or landfill) in a facility with a capacity of more than 10 tonnes per day.

(b) The disposal of waste oils (other than by incineration or landfill) in a facility with a capacity of more than 10 tonnes per day.

(c) Disposal of non-hazardous waste in a facility with a capacity of more than 50 tonnes per day by -

(i) biological treatment, not being treatment specified in any paragraph other than paragraph D8 of Annex IIA to Council Directive 75/442/EEC, which results in final compounds or mixtures which are discarded by means of any of the operations numbered D1 to D12 in that Annex (D8); or

(ii) physico-chemical treatment, not being treatment specified in any paragraph other than paragraph D9 in Annex IIA to Council Directive 75/442/EEC, which results in final compounds or mixtures which are discarded by means of any of the operations numbered D1 to D12 in that Annex (for example, evaporation, drying, calcination, etc.) (D9).

Interpretation of Part A(1)

1. In this Part -

"disposal" in paragraph (a) means any of the operations described in Annex IIA to Council Directive 75/442/EEC on waste;

"hazardous waste" means waste as defined in Article 1(4) of Council Directive 91/689/EEC.

2. Paragraph (b) shall be interpreted in accordance with Article 1 of Council Directive 75/439/EEC.

3. Nothing in this Part applies to the treatment of waste soil by means of mobile plant.

4. The reference to a D paragraph number in brackets at the end of paragraphs (c)(i) and (ii) is to the number of the corresponding paragraph in Annex IIA to Council Directive 75/442/EEC on waste (disposal operations).

Section 5.4 - Recovery of Waste

Part A(1)

(c) Unless carried out as part of any other Part A activity, recovering hazardous waste in plant with a capacity of more than 10 tonnes per day by means of the following operations -

(i) the use principally as a fuel or other means to generate energy (R1);

(ii) solvent reclamation/regeneration (R2);

(iii) recycling/reclamation of inorganic materials other than metals and metal compounds (R5);

(iv) regeneration of acids or bases (R6);

(v) recovering components used for pollution abatement (R7);

(vi) recovery of components from catalysts (R8);

(vii) oil re-refining or other reuses of oil (R9).

Interpretation of Part A(1)

1. Nothing in paragraphs (a) and (b) of this Part applies to -

(a) distilling oil for the production or cleaning of vacuum pump oil; or

(b) an activity which is ancillary to and related to another activity, whether described in this Schedule or not, which involves the production or use of the substance which is recovered, cleaned or regenerated, except where the activity involves distilling more than 100 tonnes per day.

2. Nothing in this Part applies to the treatment of waste soil by means of mobile plant.

3. The reference to a R paragraph number in brackets at the end of paragraphs (c)(i) to (vii) is to the number of the corresponding paragraph in Annex IIB of Council Directive 75/442/EEC on waste (recovery operations).

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.

For examples of some the types of activities covered by this document, see **Section 1.7** on page 15.

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

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:

1. *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.
2. *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

1.5 Key issues

Accident risk

Accident risk is inherent when dealing with waste and in particular hazardous waste. Wastes are heterogeneous in nature and are often intrinsically aggressive to plant and equipment. Any failure in the management of the waste, from the process of characterisation and checking of wastes, to operational control for reactions and mixing of wastes, will significantly increase the risk from unwanted or runaway reactions. Combinations of inappropriate equipment and poor inspection and maintenance procedures also increase the accident risk through, for example, tank overfill situations where level indicators may not be working or have not been correctly calibrated.

Relationship to BAT

Treatment has traditionally competed with landfill for the disposal of many wastes. The requirements of PPC and the Landfill Directive will result in waste disposal activities being directed by the need for regulatory compliance and higher standards of environmental protection, and therefore require significant adjustment by the industry. An assessment of the appropriate measures including BAT will be needed to support any application.

Waste hierarchy

Both IPPC and the **Waste Framework Directive** (WFD) (75/442/EEC as amended) require that appropriate measures be taken against pollution and specifically that the production of waste is avoided. Where waste is produced, the WFD requires that waste be recovered, re-used or used as a source of energy in preference to disposal.

With regard to the waste treatment activities involving disposal this raises the question of whether these activities constitute the appropriate means of dealing with the waste. Clearly, where an opportunity to recover a waste exists, then disposal or treatment may not be the appropriate measure.

This document assumes that the treatment and disposal activities covered do have a role to play, but will not generally question whether waste treatment per se is best practicable environmental option. It will only consider whether the various techniques and their components are appropriate measures to prevent and control pollution

Waste characterisation, sampling and checking

The rigour with which these aspects are conducted is essential to waste management operations. Failure to screen waste samples adequately prior to acceptance and to confirm the composition on arrival at the installation has historically led to subsequent problems, which include inappropriate storage and mixing of incompatible substances, accumulation of wastes and unexpected treatment characteristics. Applicants will therefore be required to demonstrate that these activities will be carried out rigorously to ensure their effectiveness.

Selection of appropriate treatment techniques

In assessing the treatment options, the effectiveness of the technique in destroying hazardous substances, reducing hazard and rendering substances suitable for release to other processes must be considered.

For the waste sector in particular, because of the variable and complex composition of many waste streams, not only primary hazards but also secondary hazards must be considered.

Techniques should be designed and operated to avoid deliberate or inadvertent production and/or displacement of substances that may be harmful to the environment and to prevent the transfer of such substances from one environmental medium to another.

However, it is also recognised that, to be viable, commercial waste treatment facilities must deal with variable waste steams, and it would not always be desirable or effective to over complicate the design and operation of a waste treatment process. Any determination of BAT cannot be simply seen as a means of implementing the highest available levels of technology.

Merchant waste treatment has to deal with a wide and variable range of wastes. This requires plant and equipment that is versatile and can be used for a number of wastes. This contrasts with treatment techniques used for "in-house" treatment on producer premises, where the number of waste streams is limited and well characterised. This may lend itself to the development of dedicated single-stream treatment techniques.

Immobilisation processes

Historically, there has been a proliferation of such processes, most using in the main simple mixing processes to combine waste liquids that may be unsuitable for direct landfill with dry wastes such as pulverised fuel ash (PFA), cement dust or sawdust. There have been a smaller number of cement stabilisation plant in the UK designed to treat inorganic waste streams.

There has been little technology development of the former, however other EU states, most notably France and the Netherlands have continued to develop efficient cement stabilisation processes.

Applicants (for both new processes and Operators of existing processes) will be required to demonstrate the suitability of each waste stream for treatment by this process, to show how the effectiveness of the process has been maximised and to ensure the process can meet a standard product specification. This product specification must ensure that the subsequent treated wastes meet the requirements of the Landfill Directive, including the need to meet the relevant landfill Waste Acceptance Criteria (WAC).

Article 2 of the Landfill Directive defines treatment as: "the physical, thermal, chemical or biological processes, including sorting, that change the characteristics of the waste in order to reduce its volume or hazardous nature, facilitate its handling or enhance recovery." Article 5(4) is also crucial in relation to stabilisation, as it provides that: "the dilution or mixing of waste solely in order to meet the waste acceptance criteria is prohibited."

A role may remain for "stabilisation" and "solidification" techniques under the new regime. However, these processes will be subjected to much stricter regulation under PPC (in order to ensure that subsequent landfill Waste Acceptance Criteria are met) and their continued operation will be subject to the need to demonstrate BAT as described in the sections above.

Intractable wastes

Landfill and stabilisation processes have been relied on for the disposal of intractable wastes which are difficult to treat and historically in comparison to landfill, expensive to incinerate. These include:

- solid cyanides
- oxidising agents
- chelating agents
- high COD wastes
- wastes containing low-flashpoint solvents

Under the Landfill Directive, the ban on landfilling of liquid wastes and other regulatory changes requires alternative disposal routes to be sought for many of these wastes. The development of new and effective treatments for these wastes will be a major challenge for the industry as will the requirement upon incineration. The incineration operators view is that most of the substances listed can be safely and economically incinerated, provided there is an adequate supply of high CV wastes.

Accumulations of waste

Failure to ensure adequate throughput of wastes has led to the storage of large numbers of drums on some sites. Wastes involved are typically unchecked and drums are left to deteriorate. Such situations are often associated with large-scale site clearances and can be accompanied by competitive pressures and customer insistence to accept additional waste streams. Typically the wastes involved are difficult to handle and/or treat and may have been transferred between various Operators, with a consequent loss of information relating to original producer and composition. Under the new regime, Applicants will be required to demonstrate the efficient and effective processing of waste. A new requirement will be the need to have measures to identify a suitable disposal route prior to acceptance. Financial provision will be brought in for those sites previously benefiting from existing user rights.

Emissions to sewer

Most waste treatment installations have a sewer connection for the emission of aqueous effluents. Consents to discharge are set (in most cases) by sewerage undertakers. Although the consents limit he amount of pollutants dependent on the receiving wastewater treatment works (WwTW), this can allow the release of significant quantities of pollutants. Historically, the discharge consent has effectively set the standards for the emitting activities. However, this emphasis should change under IPPC, where emissions are determined by applying BAT to reach the most effective standard of pollution control.

Consequently, if on-site treatment can achieve a higher level of removal of a substance from the aqueous effluent than may be required by the sewer discharge consent, on-site treatment should be used. The effect of a third-party waste water treatment plant may be taken into account when determining the emission limit values to be applied to releases to sewer from the installation provided that an equivalent level of protection of the environment as a whole is guaranteed and taking such treatment into account does not lead to higher levels of pollution.

Odour associated with fugitive emissions

The handling of any substance that is or may contain a VOC (or other odorous substances, for example, mercaptans or other sulphur-containing compounds) will potentially lead to odour noticeable beyond the installation boundary, even at concentrations that may be well below benchmark emission limit values (ELV). Odours may arise from storage, transfer or bulking up of wastes containing VOC or other odorous substances. Failure to adequately inspect and maintain plant and equipment is also a contributory cause to fugitive emissions, e.g. leaks from pumps.

Site restoration (prevention of emissions to land)

IPPC in common with Waste Management Licensing requires that, on completion of activities, there should be no pollution risk from the site. Like Waste Management Licensing, prevention of both short and long-term contamination of the site requires the provision and maintenance of surfacing of operational areas, measures to prevent or quickly clear away leaks and spillages, maintenance of drainage systems and other subsurface structures. The main difference between this sector and other sectors is that the condition of the land is considered from when the original licence was issued, not from when the permit is issued.

1.6 Summary of releases

The following list of potential releases is based on pollutants listed in Schedule 5 of the PPC Regulations. It is a requirement of the PPC Regulations that reporting is mandatory for the following releases.

Table 1.1: Potential pollutant releases

Releases Source	Substances										
	Particulate	NO_x, SO_x, HCl	NH_3, Amines	H_2S	HCN	VOCs	Odours	Other organics	Metals	Suspended solids	COD
KEY	To air (A) To water (W) To land (L)										
Acceptance (sampling/ vehicle waiting)	A W L	A	A			A	A				
Transfer (pipework/ pumps/valves)		A	A	A	A	A	A	W L	W L	W	W
Raw material storage (e.g. lime)	A W L										
Drum storage, bulk liquid storage and treatment vessels		A	A			A	A	A	W	W	W
Precipitation/settlement and dewatering	W						A	W	W	W	W
Acid neutralisation		A	A[1]	A		A[2]	A[2]	A[2] W	W		W
Alkali neutralisation			A				A	W	W		W
Chromic acid neutralisation									W		
Cyanide treatment					A		A				
Biological							A		W	W	W
Stabilisation	A W L		A			A	A			W	W
Transfer and storage of wastes	A W L					A	A	A	A W L	W	W
Charging and mixing of treatment vessels	A W L					A	A	A	A W L	W	W

Table 1.1: Potential pollutant releases

Releases / Source	Substances										
	Particulate	NO_x, SO_x, HCl	NH_3, Amines	H_2S	HCN	VOCs	Odours	Other organics	Metals	Suspended solids	COD
Removal of solid residue from vessel	A W L					A	A	A	A W L	W	W
Oil reprocessing						A	A	A			W

Notes

(1) Specific problem with treatment of sulphuric acid that has been used to scrub an amine release.

(2) Conventional treatment of acidic wastes contaminated with solvents.

1.7 Technical overview

'Listed activities' in this sector can be nominally divided into storage or treatment operations. Treatment operations can be sub-divided into processes based on similar principles, summarised as; Physical/Mechanical treatment processes, Chemical treatment processes, Physical/Chemical treatment processes, Immobilisation techniques and Biological treatment processes. Examples are outlined in table 1.2 below;

Table 1.2: Examples of activities in this sector

Activity	Example wastes	Process includes
Biological	Biodegradable aqueous liquids / sludges, e.g. food wastes, leachate, methanol and other water-miscible solvents. Sorted or separately collected municipal wastes.	Bulk liquid wastes tankered into treatment facility. Aerobic and/or anaerobic treatment depending on configuration of facility and waste types. Composting / digestion pre-treatments to reduce biodegradability prior to landfill.
Acid neutralisation	Hydrochloric, sulphuric, nitric, hydrofluoric, phosphoric acids and acidic salts, for example, aluminium chloride etc.	Mixing of acids with either waste alkalis or raw materials, for example, lime, to achieve pH range 6-9. Nitric and hydrofluoric acids usually dealt with separately.
Alkali treatment	Sodium and potassium hydroxide, lime, ammonia solution, ammonium salts and amine compounds	Caustic, alkalis and lime neutralised with acids. Air stripping can treat aqueous ammonia solutions. Ammonium salts and amines should be maintained at pH < 9 to prevent gaseous release.
Chromic acid treatment	Chromium oxide (CrO_3) is acidic, toxic, water-soluble and an oxidising agent	Conversion of Cr^{6+} to less hazardous Cr^{3+} by addition of reducing agent, for example, sodium metabisulphite, followed by precipitation.
Cyanide treatment	Cyanide salts, e.g. sodium cyanide from metal surface treatments	Conversion of cyanide to less hazardous cyanate maintaining pH >10 using oxidising agent
Precipitation	Metals, for example, Zn, Ni, Cr, Pb, Cu	Precipitation using acids and alkalis to adjust pH to achieve minimum solubilities
Settlement	Effluent containing neutralised acids/alkalis, precipitated metals and other solid particulate	Particles allowed to settle out of the effluent. Particle size and efficiency of settlement can be assisted by addition of a flocculent Dissolved air flotation (DAF) to produce a floating flocculated solid is used at some installations (mainly for organic sludges)
Dewatering	Sludge created by sedimentation	Production of solid filter cake by filtration through fabric filter cloths/centrifuges
Filtration	Effluent from dewatering, also used for aqueous wastes contaminated with oil	Micro- and ultrafiltration to remove particulate. Nanofiltration and reverse osmosis can be used to remove dissolved molecules, but are not currently utilised for physical-chemical treatment
Stabilisation/ solidification	Liquid, semi-solid inorganic sludges or solids eg. contaminated soil	Mixing of wastes with binders, e.g. cement, lime, to reduce the environmental impact
Oil-water separation	Aqueous wastes contaminated with oil	Tilting plate or coalescing separator utilising differences in specific gravity
Oil processing	Oil contaminated with water	Coarse filtering, heating (80 - 90^{o}C), hot filtering and/or centrifugation and blending to produce secondary fuel oil
Pulverisation	Municipal or commercial and industrial wastes	Physical processing of wastes e.g. with hammermills to reduce volume prior to landfill

A limited number of issues relating to oil reprocessing to produce base oil are considered. For further details, reference should be made to IPC Guidance Note S2 5.04, Recovery of Organic Solvents and Oil by Distillation.

1.8 Economics

Waste treatment

In real terms, treatment charges have fallen over the last 10 years. In 2001 the average price charged for liquid-phase treatment, e.g. dilute acid neutralisation, dewatering of sludges, has been held between £15 and £35 per tonne. This represents a low financial return, and emphasis has been on optimising turnover through volume. This has been associated with determined competition within the sector, which has contributed to prices being held down. This has also been exacerbated by overcapacity. Another significant factor affecting the economic performance of the treatment sector is that it competes with landfill for a number of waste streams, particularly liquids and drummed wastes. Wastes of this type can still be landfilled for as little as £12/t, despite restraints on capacity and the Landfill Tax. The Landfill Directive will exclude these waste types, removing the low-cost option.

A major operational cost to physico-chemical treatment is the disposal of solid wastes, e.g. filter cakes, and liquid effluents. These require disposal either by landfill or by trade effluent discharge to sewer. Transport and landfilling charges may run to around £30/t for filter cake. Trade effluent charges are also significant and are expected to increase due to the implementation of the Urban Waste Water Treatment Directive.

The industry has generally maximised the constructive use of waste types used to treat other wastes. This is expected to continue, particularly as use of raw materials is a consideration for IPPC. Attention is also being given to utilising techniques such as anaerobic biological treatment to recover and use the methane generated, which is well established by the water companies for sewage sludge.

In general terms investment levels for the treatment sector can be placed in two categories: sites built prior to 1990 and those either developed or refurbished since 1990. Taken as a general observation, investment levels on sites developed prior to 1990 have been low, a situation determined by a reliance on turnover on small margins. For a typical physico-chemical treatment site developed in the 1980s, the level of investment needed to update such a plant to PPC standards is probably in the range of £250k to £750k.

Since 1990 there has been multi-million-pound investment in new sites and investment of up to around £1 million on process upgrade. These investments have typically been made as additions to a waste business portfolio and not as stand-alone operations.

With very few exceptions, investment in the treatment sector has historically been very low because of the low prices and the competition with landfill. It is expected that high levels of investment will be required to meet the standards set by the new regime.

Restrictions on landfill, which will be introduced by the Landfill Regulations, will require more treatment of waste, either to meet landfill pre-treatment requirements, waste acceptance criteria or instead of landfill. This may lead to the continuing development of sites utilising stabilisation and fixation techniques. However, these techniques have been rudimentary and subject to a number of serious problems. The typical level of charge for these processes is around £22/t in 2001.

Current proposals within the DEFRA consultation on the proposed Hazardous Waste Regulations may also be seen as a significant driver to recover hazardous wastes.

Waste treatment is typically a high-volume low-return process. A fixed or lowered base price, for either incoming waste or recycled product, has placed the commercial emphasis on maximising throughput and reducing cost overhead.

Consequently prices in general are determined by Operators at the “low” end of the market. With exceptions and also particularly for older plant, investment levels have been low, due to low returns.

The regulatory conditions are now being put in place to break the cycle of high volume, low return and low investment. There must now be greater investment and a move towards developing techniques to treat wastes that were previously being landfilled directly, or being treated by ineffective processes. These require the development of dedicated plant and equipment for specific wastes, e.g. aqueous ammonia solutions.

Not only will the waste industry need to adapt, but their customer base will no longer be able to rely on a more general non-specific treatment which may amount to little more than dilution. As a consequence, costs are anticipated to rise for waste producers.

Much has already been achieved by waste minimisation initiatives by producers. The regulatory changes are likely to lead to a further impetus to reduce waste and consider options for in-house treatment.

Oil processing

Oil processing is performed by approximately 75% of commercial used oil installations and the main output is 400,000 tpa recovered fuel oil (RFO). This is widely used as an alternative fuel in the power generating and quarry stone industries. The industry seeks to maintain a high throughput to optimise a low return of the order of a few pence per gallon on the sale of reprocessed oil.

Competition centres between regional reprocessors and national companies. Waste oil is usually collected for a small payment of the order of pence per gallon dependent on the volume of the used oil. National collectors work on large volumes as an economy of scale, while local operators are advantaged by lower cost overheads.

There is also a significant volume of oil-contaminated waters collected for recovery. These wastes have a net negative value and are processed in a manner so as to maximise the recovery of the hydrocarbon for use as a fuel.

The return on reprocessed oil is primarily determined by the price of fuel oil and gas oil, against which reprocessed oil competes. This is balanced against the costs of reprocessing and the requirement to provide an incentive for the collection of waste oil through payment on collection.

Other than transportation, the main operating overhead relates to the generation of steam for heating waste oil. Most sites have on-site boilers for steam production.

The majority of oil reprocessing sites are over 15 years old, and investment in infrastructure and pollution prevention and control measures has been patchy. A contributing factor to this variation has been inconsistent implementation of improvement programmes, either those required by the Regulator or on the initiation of an Operator’s investment programme.

An example of this relating to oil reprocessing is the checking procedures on waste oil feedstock. Typically this involves a basic assessment of the water and solids content for quality and payment purposes.

Improvements have been made, with investment in the order to £50k per site being made in analytical equipment. This has been driven in part by the quality requirements of the users of the reprocessed oil but this is not always a uniform requirement.

The market for RFO may undergo fluctuation as changes occur in its marketing under the classification as a waste. This may be accompanied by changes in the duty derogation on RFO.

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 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** on page 2 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** on page 20), preventing releases of water altogether (see **Section 2.2.2** on page 62), 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 by describing 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.

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

- As a first principle, there should be evidence in the application that full consideration has been given to the possibility of **PREVENTING** the release of harmful substances, for example, by:
  – comprehensive characterisation of the wastes (see **Section 2.1.1** on page 20 and **Section 2.1.2**

on page 25)
– safe storage (see **Section 2.1.3** on page 32)
– selection of the appropriate treatment technique

2.1 In-process controls

This section covers the key issues of pre-acceptance and acceptance procedures for waste, waste storage, and specific activities for waste treatment.

2.1.1 Pre-acceptance procedures to assess waste

In order to prevent the acceptance of unsuitable wastes which may lead to adverse reactions or uncontrolled emissions, systems and procedures must be in place to ensure that wastes are subject to appropriate technical appraisal. This ensures their suitability for the proposed treatment route. These checks must be carried out before any decision is made to accept a waste.

This requires a system that has, as an initial stage, a screening step or pre-acceptance procedure, involving the provision of information and representative samples of the waste. This will allow Operators to determine the suitability of the waste for the activity before arrangements are in place to accept the waste. The second stage, acceptance procedures when the waste arrives at the site, should serve to confirm the characteristics of the waste, without the time pressure and potential hazard of checking a waste at the gate.

The Operator must obtain the following information:

- the nature of the process producing the waste, including the variability of this process
- the composition of the waste (chemicals present and individual concentrations)

and ensure that:

- a representative sample(s) of the waste should be taken from the production process and analysed
- for each new waste enquiry, a comprehensive characterisation of the waste and identification of a suitable treatment method is undertaken

The information must be recorded and referenced to the waste stream so that it is available at all times. The information must be regularly reviewed and kept up to date with any changes to the waste stream. Waste characterisation must be completed by the Operator unless all necessary information is already available from the producer or current holder of the waste.

The waste producer has obligations under the Duty of Care requirements to provide information on the:

- composition of the waste
- its handling requirements
- its hazards
- EWC code

This information is required on transfer of the waste from the producer to another party such as a waste disposal contractor. Experience of this system has shown that reliance cannot be placed solely upon it to provide sufficient information. The producer and operator of the receiving site must ensure that reliable and comprehensive information has been provided to determine the suitability of the waste for the treatment (or recovery) process in question. This also applies if wastes are only to be stored or bulked at the installation so that the information can be provided to the next holder of the waste and the ultimate disposal route identified. The requirement to characterise the waste, including sampling and analysis, equally applies to transfer as well as treatment facilities.

Enquiries from waste producers are commonly routed through a business section of a company, and not directly from the management of the plant producing the waste. Verification of the written information provided by the producer may be required, and this may require a visit to the producer, as additional factors may become apparent when dealing with staff directly involved in the waste production.

It is not unusual for the waste producer and the Operator to be separated by at least one and in some cases three or four different parties. These may be haulage contractors, brokers and waste transfer operators. Where there is a lengthy chain, information may be lost or inaccurately reproduced.

It is an advantage that, as with the provision of information, the number of links in a chain down which a waste sample may be passed is kept to a minimum. This will avoid information loss or misrepresentation.

If not dealing directly with the waste producer, the Operator should carefully verify the information received at the pre-acceptance stage, which, in addition to the minimum Duty of Care information, should include the contact details for the waste producer and a full description of the waste.

There is often reluctance amongst third parties to divulge the identity of the waste producer as this may be of commercial benefit. This however cannot override the fundamental requirement of the Operator, which is to check the information provided on a waste with the waste producer (not just the current holder), who is in the best position to verify the information.

At the pre-acceptance stage, in addition to written information regarding the waste, the Operator must obtain representative sample(s) of the waste from the production process. Any deviations from this must be fully justified.

Adequate sampling and analysis must be carried out to characterise the wastes. In all cases the number of samples taken must be based on an assessment of the risks of potential problems. Sampling regimes at the pre-acceptance stage do not necessarily have to include sampling of every drum, for example, $\sqrt{n+1}$ (where n is the total number of drums) may be acceptable provided acceptance screening includes sampling every container. In some instances physical sampling may not be necessary, for example in the case of gas cylinders or scrap batteries. In other cases such as drummed wastes, large numbers of samples will be necessary as characterisation will require the sampling of all containers. The sampling of process wastes must take account of the variability of the process, and several samples may be required to characterise the waste sufficiently.

As the circumstances of waste production may vary, sound professional judgement is required in ensuring the relevant questions are asked. Operators should ensure that technical appraisal is carried out by suitably qualified and experienced staff who understand the capabilities of the site, independent of sales staff responsible for obtaining the customer’s business. The Environment Agency considers that a minimum qualification of a degree in chemistry (or equivalent) will be required in order to equip staff to carry this assessment out correctly.

This information is necessary to:

- screen out unsuitable wastes
- confirm the details relating to composition, and identify verification parameters that can be used to test waste arriving at the site
- identify any substances within the waste (for example, by-products) that may affect the treatment process
- identify any substances within the waste that may react with other reagents
- accurately define the range of hazards exhibited by the waste
- identify any substances within the waste that may be unaffected by the treatment process and transfer in an unaltered state as a residue in the effluent
- determine the cost of the disposal option identified

- ensure regulatory compliance, for example, meet COMAH requirements

Using the information on the waste arising, and the sample provided, the Operator should verify the information provided regarding composition and hazard of the waste. Once it has been established that the waste is as described, a treatment method or option for the waste should be determined.

Wastes should not be accepted at the installation without a clear method or defined treatment and disposal route with a full costing. Experience has shown that wastes have been accepted at a site without pre-acceptance checks, on the basis that checks would take place at another treatment facility. On examination, the wastes have not only been found to be unsuitable for the site in question, but also due to the composition and hazard have been unsuitable for anything other than incineration. This extra cost has led to wastes being held in an attempt to find alternative disposal routes, which in turn has resulted in some long standing accumulations of wastes, with consequent problems with storage, e.g. leaking drums. These precautions (defined route/treatment method and costings) will need to be in place prior to final acceptance of the waste on-site, not necessarily at the tendering stage, before a contract for disposal has been obtained from the producer.

Pre-acceptance for oil reprocessing:

As a general requirement, this is not as critical as for other merchant waste treatment facilities. Typically the waste arisings are from a large number of small-volume sources, e.g. garages. Pre-acceptance procedures relating to information collection should be applied for one-off industrial arisings of waste oil and arisings from sources where other chemicals and potential contaminants may be handled, for example, chemical manufacturing.

Contamination by substances such as solvents does occur and, although relatively low levels of contamination can be accommodated by the Operator, insofar as it may not affect the sale of the recovered oil, contamination should be identified. Low-flashpoint solvents will give rise to handling difficulties as the installations are not set up for dealing with flammable materials. Petrol contamination often occurs and this significantly reduces the flashpoint of the material. This will significantly increase the risk of accident. Care should be taken in choosing and interpreting the most appropriate flashpoint determination. Further guidance is available from the HSE (see **Ref 4**). Solvents will also be driven off in the heating process, therefore increasing the VOC emissions. Contamination with polychlorinated biphenyls (PCBs) will transfer to either the recovered oil, which may give rise to dioxin formation during subsequent combustion, or the tank bottoms, oil sludges or effluent.

Pre-acceptance packing procedures for “laboratory smalls”:

Laboratory smalls consist of substances in containers of less than 5 litre capacity. They generally contain pure chemical elements and compounds from laboratories or when laboratory stores are cleared. The majority of the Operators offer a packing and collection service for laboratory smalls. A qualified chemist attends the producer’s site, classifying the substances accordingly, and packaging the containers into drums. The individual packages are prevented from mechanical damage in the drum by the use of vermiculite. This classification should be sufficient to enable the operator to identify each chemical contained within the waste, assess its hazards and identify any particular issues (e.g. water reactivity, flammability) so that wastes which have the potential to react if there is a loss of containment within a drum are packed in different drums, and are not mixed within the same drum.A list of the contents of the drum is created and stored within the drum below the lid. Each packed drum is then labelled with respect to the hazard for carriage. Some Operators only deal with laboratory smalls if the customers use their packing service. The level of supervision or management of this type of situation is dependent on a number of factors, for example, whether the Operator has confidence in the level of understanding required by the customer. In either case a full list of the drum contents should be produced. Operators should have written procedures regarding the segregation and packing of laboratory smalls. For those Operators who accept wastes packaged by their customers, this Guidance should be provided to the customer.

Records

A waste tracking system should begin at the pre-acceptance stage. With every enquiry a record should be raised (given a unique reference number) which, if the waste disposal enquiry results in waste arriving at site, should "follow" the waste during its acceptance, checking, storage, treatment or removal off-site. If the waste is a regular arising, then the document should be unique to that waste stream. Further details of the requirements of the tracking system are given in **Section 2.1.2** on page 25 and **Section 2.1.3** on page 32.

All records relating to pre-acceptance should be maintained at the installation for cross-reference and verification at the waste acceptance stage. The length of time records should be held will be determined by whether the waste is actually delivered to the site or likely to be delivered.

Indicative BAT requirements for pre-acceptance (Sheet 1 of 3)	
1	From the waste disposal enquiry the Operator should obtain information in writing relating to: • the type of process producing the waste • the specific process from which the waste derives • the quantity of waste; • chemical analysis of the waste (individual constituents and as a minimum their percentage compositions) • the form the waste takes (solid, liquid, sludge etc) • hazards associated with the waste • sample storage and preservation techniques
2	Unless a sample and analysis has already been completed by a third party and the Operator has sufficient written information from them, then the Operator should in every case obtain representative sample(s) of the waste from the production process/current holder and compare it against the written description to ensure that it is consistent.
3	Other than for pure product chemicals or laboratory smalls, the chemical analysis should relate to an actual analysis and not simply be based on product data sheets or an extrapolation of information on product data sheets. For example, taking the concentrations as specified and applying a dilution factor is not acceptable.
4	Wastes should not be accepted at the installation without a clear method or defined treatment and disposal route being determined in advance and costed before the waste is accepted at the installation.
5	The Operator should ensure that the sample is representative of the waste and has been obtained by a person who is technically competent to undertake the sampling process.
6	The type of information that would demonstrate the reliability of the sample includes: • location of sampling point, for example, effluent tank • capacity of vessel sampled (for samples from drums an additional parameter would be the total number of drums) • method of sampling, e.g. sampling tap (mid flow), "top" sample • number of samples and degree of consolidation • operating conditions at time, e.g. normal operation, shut-down, maintenance and/or cleaning • preservation techniques
7	Samples should be clearly labelled and any hazard identified.
8	Sample tracking systems within the installation should be established and be auditable.

Indicative BAT requirements for pre-acceptance (Sheet 2 of 3)

9 Analysis should be carried out by a laboratory with robust quality assurance and quality control methods and record keeping.

10 Analysis required will vary depending upon the nature of the waste, the process to be used and what is known about the waste already. Results of analysis should be kept within the tracking system. These details should include:

- check on constituents declared by waste producer/holder to ensure Permit compliance, treatment plant specification and final disposal
- all hazardous characteristics
- physical appearance
- colour
- pH
- presence, strength and description of odour assessment (note COSHH implications)

11 Further analysis may include other parameters relevant to the treatment method or waste stream e.g.:

- presence of oxidants
- acidity and alkalinity
- COD
- ammonia
- flashpoint
- presence of sulphide
- presence of cyanide
- List I and List II substances
- other substances of environmental significance

12 Also, for example in the case of oil recovery:

- chlorine
- sulphur
- metals
- PCBs

13 Installations accepting waste oil should have the facility to hold and test loads for PCBs or a surrogate test for chlorine at a level of detection to assess compliance with the requirements of the Waste Oils Directive.

14 Following characterisation of the waste, a technical assessment should be made of its suitability for treatment or storage to ensure Permit conditions are being met.

15 There must be a clear distinction between sales and technical staff roles and responsibilities. If non-technical sales staff are involved in waste disposal enquiries, then a final technical assessment prior to approval should be made. It is this final technical checking that should be used to avoid build-up of accumulations of wastes.

16 All records relating to pre-acceptance should be maintained at the installation for cross-reference and verification at the waste acceptance stage. These records should be kept for a minimum of 3 years

Indicative BAT requirements for pre-acceptance (Sheet 3 of 3)	
17	For laboratory smalls, whether or not the installation Operator packs them on behalf of the producer, a full list of laboratory smalls should be created and transported with the waste. Operators should have written procedures regarding the segregation, packaging and labelling of laboratory smalls. For those Operators who accept wastes packaged by their customers, this Guidance should be provided to the customer so as to prevent problems when the material is delivered to the installation. This guidance should include the following: • What information is required in order to meet the operators pre-acceptance checks • What chemicals are prohibited by the operators permit (e.g. radioactive chemicals, Clinical wastes, explosives,) • How to identify the waste laboratory chemical • How to establish and record the hazards posed by the chemical • Supporting documentation required (e.g. manufacturers data, material safety data sheets) • Segregation policy for waste laboratory chemicals to avoid mixing of incompatible wastes in the same drum • How to pack the chemicals • What information is to accompany the waste

2.1.2 Acceptance procedures when waste arrives at the installation

For waste treatment or transfer, the bulk of the characterisation work should have taken place at the pre-acceptance stage. This means that acceptance procedures when the waste arrives at the site should serve to confirm the characteristics of the waste. This should minimise the time the vehicle delivering the waste is kept waiting.

Measures to deal with acceptable wastes arriving on-site, such as a pre-booking system, must be in place to ensure that capacity is available.

Where waste oil is earmarked for reprocessing, there should be greater emphasis on acceptance procedures than at the pre-acceptance stage.

The issues to be addressed by the Operator in relation to waste acceptance procedures for the installation include the following:

- vehicle waiting, load inspection / checking, sampling and offloading areas
- traffic control
- procedures for checking paperwork arriving with the load
- procedures for unloading to allow inspection and sampling
- location of designated sampling point(s) (as indicated on site plan)
- visual load inspection
- drum and package labelling procedures
- infrastructure such as bunds and the like (see **Section 2.8** on page 89)
- sampling procedures for all incoming wastes including bulk (liquid and solid) wastes, wastes in drums and containers and laboratory smalls
- details of sampling of wastes in drums within designated storage, that is, timescale after receipt
- verification and compliance testing to confirm identity of the waste, description of the waste
- assess consistency with pre-acceptance information and proposed treatment method

- rejection criteria
- sample retention systems, that is, period of retention
- record keeping in relation to producer details, analysis results and treatment methods
- procedures for periodic review of pre-acceptance information
- identification of operators staff who have taken any decisions re acceptance or rejection of waste streams and decided upon treatment or disposal options chosen by suitable entry on written records

Written information

The Duty of Care obligations require that the waste should be accompanied by information describing the physical and chemical composition, hazard characteristics, incompatible substances and handling precautions. Special waste should also be accompanied by consignment notes. Information specifying the original waste producer should also be included.

Notwithstanding the legal requirements of the Special Waste Regulations and the Duty of Care (as amended), wastes should not be accepted without detailed written information identifying the source, composition and hazard of the waste.

Records

An internal tracking system and stock control procedure should be in place for all wastes, cross-referenced to the unique reference number raised at the pre-acceptance stage. This will enable the Operator to:

- take advantage of any synergies between wastes
- prevent unwanted or unexpected reactions
- ensure that the emissions are either prevented or reduced
- manage the throughput of wastes

The tracking system (which may be documentary or a computer database/series of databases, which are regularly backed up), should “follow” the waste during its acceptance, storage, treatment or removal off-site. The system should also account for the treatment or disposal route / method to which the waste is to be subjected. It should consequently be possible at any time for the Operator to identify where a specific waste is on the installation, the length of time it has been there and the proposed or actual treatment route. This is an important component of the management of the installation.

Once a waste has entered bulk storage or a treatment process, the tracking of individual wastes will not be feasible. However, records should be maintained to ensure sufficient knowledge is available as to what wastes have entered a particular vessel/tank. For example, it is necessary to keep track of residues that will be building up within a vessel between de-sludging events in order to avoid any incompatibility with incoming wastes.

For bulk liquid wastes, stock control would involve maintaining a record of the route through the process, whereas drummed waste control should utilise the individual labelling of each drum to record the location and duration of storage.

This tracking system should hold all the information generated during pre-acceptance, acceptance, storage, treatment and/or removal off-site. Records should be made and kept up to date on an ongoing basis to reflect deliveries, on-site treatment and despatches.

Labelling and segregation

Waste arriving at the installation will be labelled for transport according to the Carriage of Dangerous Goods (Classification, Packaging and Labelling) and Use of Transportable Pressure Receptacles Regulations 1996 (CDG-CPL 1996), as amended, soon to be replaced by the Carriage of Dangerous Good by Road and Rail Regulations 2004.

For COMAH installations, calculation of the hazard inventory requires hazard identification using the Chemicals (Hazard Information and Packaging for Supply) Regulations 1994, as amended (CHIP), whereas non-COMAH installations are likely to classify wastes according to the Special Waste Regulations 1996, which are due to be amended.

There are examples of substances having one hazard class under the Regulations relating to transport and quite another under the CHIP Regulations.

Segregated storage is necessary to prevent incidents from incompatible substances and as a means of preventing escalation should an incident occur. Best practice on segregation of waste is provided within HSE Guidance Note HSG71. This Guidance is also based on CDG-CPL 1996 classifications. The individual storage requirement on a particular installation will be dependent on a full assessment of risk (see **Section 2.8** on page 89). Further Guidance on storage and segregation is available from HSE in particular, HSG51, HSG71, HSG 176 and CS21 (see **Ref 4**).

A common standard is required for all installations under PPC. Operators should ensure that appropriate changes to labelling are made from those required for transport and those required for storage according to CDG-CPL 1996, and that segregation of wastes is driven by risk assessment in line with HSG71.

Emergency Acceptance

Where facilities provide a service to the emergency services such as the removal of spillages or flytipped hazardous wastes, there may be situations where it is inappropriate to require the pre-acceptance procedures in section 2.1.1 to be adhered to. As a consequence, some of the acceptance requirements outlined above would also be inappropriate. In such instances the operator should communicate the occurrence to the regulator without delay.

Indicative BAT requirements for acceptance procedures when waste arrives at the installation (Sheet 1 of 6)

Load arrival

1 On arrival loads should:

- be weighed, unless alternative reliable volumetric systems linked to specific gravity data are available
- not be accepted into site unless sufficient storage capacity exists and site is adequately manned to receive waste
- have all documents checked and approved, and any discrepancies resolved before the waste is accepted
- have any labelling that does not relate to the contents of the drum removed before acceptance on site.

2 Hazardous wastes should only be received under the supervision of a suitably qualified person (HNC qualified chemist or higher)

Load inspection

3 Visual inspection. Where possible, confirmatory checks should be undertaken before offloading where safety is not compromised. Inspection must in any event be carried out immediately upon offloading at the installation.

4 Check every container to confirm quantities against accompanying paperwork. All containers should be clearly labelled and should be equipped with well-fitting lids, caps and valves secure and in place. Any damaged, corroded or unlabelled drums should be put into a quarantine area and dealt with appropriately. Following inspection, the waste should then be unloaded into a dedicated sampling/reception area.

Indicative BAT requirements for acceptance procedures when waste arrives at the installation (Sheet 2 of 6)

5 At this stage the waste tracking system unique reference number should be applied to each container. Each container should also be labelled with the date of arrival on-site and primary hazard code.

6 Where containers are bulked, the earliest date of arrival of the bulked wastes should be transposed from the original container onto the bulk container.

7 The inspection, unloading and sampling areas should be marked on a plan and have suitably sealed drainage systems (see **Section 2.8** on page 89).

Sampling - checking - testing of wastes - storage

8 Other than pure product chemicals and laboratory smalls, no wastes should be accepted at the installation without sampling, checking and testing being carried out. Reliance solely on the written information supplied is not acceptable, and physical verification and analytical confirmation are required. All wastes, whether for on-site treatment or simply storage, must be sampled and undergo verification and compliance testing.

9 The Operator should ensure that waste delivered to the installation is accompanied by a written description of the waste describing:

- the physical and chemical composition
- hazard characteristics and handling precautions
- compatability issues
- information specifying the original waste producer and process

10 On-site verification and compliance testing should take place to confirm:

- the identity of the waste
- the description of the waste
- consistency with pre-acceptance information and proposed treatment method
- compliance with permit

11 The Operator should have clear and unambiguous criteria for the rejection of wastes, together with a written procedure for tracking and reporting such non-conformance. This should include notification to the customer/waste producer and the Regulator. Written/computerised records should form part of the waste tracking system information.

12 Documentation provided by the driver, written results of acceptance analysis, details of offloading point or off-site transfer location should be added to the tracking system documentation.

13 A record of the sampling regime for each load and justification for the selection of this option should be maintained at the installation.

14 Wastes must not be deposited within a reception area without adequate space.

15 Wastes in containers should be unloaded into a dedicated reception area pending acceptance sampling. Such storage should be for a maximum period of 5 days. During this period there should be no bulking up or mixing of drums or decanting the contents into bulk storage. Wastes should be stored within this reception area according to compatibility in line with HSE Guidance Note HSG71. Appropriate storage must be achieved immediately upon offloading.

Indicative BAT requirements for acceptance procedures when waste arrives at the installation (Sheet 3 of 6)

16 Should the inspection or analysis indicate that the wastes fail to meet the acceptance criteria (including damaged or unlabelled drums), then such loads should be stored in a dedicated quarantine area and dealt with appropriately. Such storage should be for a maximum of five working days. Written procedures should be in place for dealing with wastes held in quarantine, together with a maximum storage volume.

17 If the cause of failure to meet acceptance criteria is due to incompatibility, then the wastes should be segregated immediately to remove the hazard.

18 Tankered wastes should be sampled prior to acceptance. There should be no storage pending sampling.

19 The driver of the vehicle carrying the waste may arrive at the installation with a sample that has been taken at some stage beforehand. This should be the exception and only be relied on if:

- there are health and safety and environmental control considerations, for example, water reactive substances which would make sampling difficult, and
- the following written information has been supplied - the physical and chemical composition, hazard characteristics, incompatible substances and handling precautions, information specifying the original waste producer and process, and
- the waste has been taken directly from the production site to the waste treatment installation

20 The installation should have a designated sampling point or reception area. These should be in close but safe proximity to the laboratory/checking facility and the sampling point should be visible (or covered by CCTV), if sampling is not directly supervised by, for example, laboratory staff.

21 The offloading, sampling point/reception and quarantine areas should have an impervious surface with self-contained drainage, to prevent any spillage entering the storage systems or escaping off-site. Most spills and leaks during sampling are on a small scale, resulting from releases from the back valve of a tanker if the sample is being obtained in this way. Attention should be given to ensuring that incompatible substances do not come into contact resulting from spills from sampling, for example, within a sump serving the sampling point. Absorbents should be made available.

Sampling of bulk liquid wastes

22 Deliveries in bulk road tanker should be accompanied by a “wash-out” certificate or a declaration of the previous load so that contamination by this route can be checked.

23 Samples are usually taken by the tanker driver from one of three points on the tanker:

- top hatch
- back valve
- sight glass

24 The key requirement is to obtain a sample that is representative of the load, that is, the sample takes account of the full variation and any partitioning within a bulk load such that “worst-case” scenarios are accounted for. Taking a sample through a top hatch of the surface of the liquid may not be representative, but may be useful in establishing whether there may be a layer of, for example, solvent or some other immiscible substance, which may be unsuitable for treatment. Top samples should be obtained from the cross-section of the load, that is, a core sample.

25 A gantry should be used to avoid the need to take samples from the back valve of tankers, which is likely to result in a small spillage.

Indicative BAT requirements for acceptance procedures when waste arrives at the installation (Sheet 4 of 6)

Sampling drummed waste

26 The contents can only be identified with certainty if every container is sampled. Acceptance should involve sampling every container. However, analysis of composite samples is acceptable with such a sampling regime. A representative sample must be obtained by taking a core sample to the base of the container. Operators should ensure that lids, bungs and valves are replaced immediately after sampling.

Drum Labelling

27 For drummed waste, controls should ensure each drum is given a unique label to facilitate a record of:

- the location of each drum
- the duration of storage
- the chemical identity of the drums contents
- the hazard classification for each drum

28 Drums should be handled and stored so that the label is readily visible

Acceptance of laboratory smalls

29 The procedure for accepting laboratory smalls on-site should be essentially identical to that for drummed waste. They differ from the “normal” waste inputs to site in that they are in a pure concentrated form.

30 In situations where the Operator has undertaken the identification and packaging on behalf of the customer, then the on-site verification can be restricted to opening the drums to check that the containers remain undamaged. In such cases the load must be accompanied by documentation confirming the checking and packing. In situations where the drum has been packed by the customer, then full checking and verification should be undertaken. Checking packaging and segregation adequately should include emptying of the drum as soon as possible and in any event at facilities that are operated 24 hours a day, within 24 hours. At sites not operated around the clock, checking must be undertaken before the end of the working day. Repackaging the waste must be undertaken as soon as the necessary checks have been undertaken.

Waste Rejection procedures

31 Lab smalls must not be accepted at a facility where there is insufficient suitably qualified personnel to process these wastes within the above timesclaes

32 If on opening a drum it is found that it contains incompatible substances, or that the substances have not been packaged adequately, then the drum should be sorted and repacked immediately and the non-conformance procedure followed.

33 Sorting and repackaging of laboratory smalls should take place in a dedicated area/store. Once the wastes have been sorted according to hazard classification, with due consideration for any potential incompatibility problems, and repacked, then these drums should not be stored within the dedicated laboratory smalls area but should be removed to the appropriate storage area.

34 The operator should have clear and unambiguous criteria for the rejection of wastes, together with a written procedure for tracking and reporting such non-conformance. This should include notification to the customer/waste producer and the Environment Agency. Written/computerised records should form part of the waste tracking system information. The operator should also have a clear and unambiguous policy for the subsequent storage and disposal of such rejected wastes. This policy should achieve the following:

Indicative BAT requirements for acceptance procedures when waste arrives at the installation (Sheet 5 of 6)

- identifies the hazards posed by the rejected wastes
- labels rejected wastes with all information necessary to allow proper storage and segregation arrangements to be put in place
- segregates and stores rejected wastes safely pending removal

Records

35 The waste tracking system should hold all the information generated during pre-acceptance, acceptance, storage, treatment and/or removal off-site. Records should be made and kept up to date on an ongoing basis to reflect deliveries, on-site treatment and despatches. The tracking system should operate as a waste inventory/stock control system and include as a minimum:

- date of arrival on-site
- producers details
- all previous holders
- a unique reference number
- pre acceptance and acceptance analysis results
- package type and size
- intended treatment/disposal route
- record accurately the nature and quantity of wastes held on site, including all hazards and identification of primary hazards
- where the waste is physically located in relation to a site plan
- where the waste is in the designated disposal route
- identification of operators staff who have taken any decisions re acceptance or rejection of waste streams and decided upon recovery / disposal options

36 All records relating to pre-acceptance should be maintained and kept readily available at the installation for cross-reference and verification at the waste acceptance stage. Records should be held for a minimum of two years after the waste has been treated or removed off-site. Records should be held in an area well removed from hazardous activities to ensure their accessibility during any emergency.

37 The system adopted should be capable of reporting on all of the following:

- total quantity of waste present on-site at any one time, in appropriate units, for example, 205 litre drum equivalents
- breakdown of waste quantities being stored pending on-site treatment, classified by treatment route
- breakdown of waste quantities on-site for storage only, that is, awaiting onward transfer
- breakdown of waste quantities by hazard classification
- indication of where the waste is located on site relative to a site plan
- comparison of the quantity on site against total permitted
- comparison of time the waste has been on-site against permitted limit

These records should be held in an designated area, as agreed with the Agency, well removed from hazardous activities to ensure their accessibility during any emergency

38 Back-up copies of computer records should be maintained off-site.

Indicative BAT requirements for acceptance procedures when waste arrives at the installation (Sheet 6 of 6)	
	General
39	Wastes should not be accepted at the installation without a clear defined method of recovery or disposal being determined and costed and ensuring there is sufficient capacity being available. These checks should be performed before the waste acceptance stage is reached.
40	The Operator should ensure that the installation personnel who may be involved in the sampling, checking and analysis procedures are suitably qualified (HNC qualified chemist or higher) and adequately trained, and that the training is updated on a regular basis.
41	Analysis should be carried out by a laboratory with suitably accredited test methods.
42	Samples should be retained on-site for a minimum of two days after the waste has been treated or removed off-site including all residues from its treatment.
43	Once analysis has confirmed that the waste is acceptable, the Operator should only then create a batch for treatment or a load for off-site removal. Once a batch has been assembled for treatment, the operator should create a composite sample for analysis prior to treatment. Scope of analysis depends upon intended treatment but should be specified.
44	There must be a clear distinction between sales and technical staff roles and responsibilities. If non-technical sales staff are involved in waste enquiries then a final technical assessment prior to approval should be made. It is this final technical checking that should be used to avoid build-up of accumulations of wastes and to ensure that sufficient capacity exists.

2.1.3 Waste storage

The key issues for the Operator to address in relation to measures for waste storage on the installation will include the following:

- location of storage areas
- storage area infrastructure
- condition of tanks, drums, vessels and other containers
- stock control
- segregated storage
- site security
- fire risk

Once it has been determined that the waste is suitable for the installation, the Operator should have in place systems and procedures to ensure that wastes are transferred to appropriate storage safely.

Segregated storage is necessary to prevent incidents from incompatible substances and as a means of preventing escalation should an incident occur. The individual storage requirement on a particular installation will be dependent on a full assessment of risk (see **Section 2.8** on page 89). Further Guidance on storage and segregation is available from HSE, in particular, HSG51, HSG71 and HSG716 (see **Ref 4**).

Waste Tracking (Audit) Systems

The waste tracking system begins at the pre-acceptance stage, linked with acceptance should continue throughout the duration of time that the waste is kept at the site. The system adopted should meet the objectives and standards given in **Section 2.1.2** on page 25.

Once a waste has entered bulk storage or a treatment process, the tracking of individual wastes will not be feasible. However, records should be maintained to ensure sufficient knowledge is available as to what wastes have entered a particular vessel/tank. For example, it is necessary to keep track of residues that will be building up within a vessel between desludging events in order to avoid any incompatibility with incoming wastes.

For bulk liquid wastes, stock control would involve maintaining a record of the route through the process. For drummed waste, stock control should utilise the individual labelling of each drum to record the location and duration of storage together with the chemical identity and composition of the drums contents and the hazards posed by these contents.

Waste Storage

Segregated storage and the use of appropriate separation distances and or suitable engineering measures between incompatible wastes is necessary to prevent incidents from incompatible substances and as a means of preventing escalation should an incident occur. Health and safety guidance on storage and segregation is available from HSE, in particular HSG51& HSG71 (see **Ref 4**) and the measures set out in these documents do afford some degree of environmental protection. However, wastessometimes pose additional environmental hazards over and above those addressed in HSG51 & HSG71 and other activities (e.g. storage of pesticides, storage of aerosols and clinical wastes) are not addressed in these documents. These wastes should always be separated from flammable materials. For materials which are toxic, the table in HSG 71 gives ‘keep apart’ however the Agency and the HSE would advocate the precautionary approach and require ‘segregate’.

The individual storage requirements on a particular facility will therefore be dependent on a full, site-specific assessment of risk. If operating an existing facility this risk assessment will help operators decide the quantities or types of materials which can be stored so as not to impose a significant risk on the neighbouring population or ecosystems. Sites in sensitive locations (e.g. close to housing, controlled waters etc) may be required to restrict the waste held on site (either in terms of quantity, type or both) so as to control risks to an acceptable level

The control over fire risks, both by control over sources of ignition, and control of build up of any readily combustible material like packaging in the chemical storage area, should be prioritised as it is clear that many of the biggest incidents are the result of fire, which is the most likely means of causing multiple container failures in a short time.

Emergency Storage

In addition to the normal operational requirements, consideration should be given to the provision of emergency storage capacity. This would be relevant to a situation where it would be necessary to transfer a waste from a vehicle, due to a defect or potential failure of the vehicle containment. These events are infrequent, and available capacity within the installation may be a limiting factor. Similarly the Operator should specify procedures for circumstances where vehicles carrying waste are to be parked on-site overnight or on Bank Holidays, when the site may be unsupervised over these periods.

Aerosol Storage

Most aerosols contain materials which are a low hazard to the environment, indeed most are intended to release their contents just about anywhere. The risks if any, come mainly from fire which spreads to involve other materials. Aerosol cans are thin and will rust through quickly in the open air. If a fire starts in a stack of boxes it can be expected to spread quickly, with aerosols ejected as they overheat. Some distribution sites place them in cages to prevent ‘missiles’. Indoor storage should be employed, to restrict the rate of rusting, and missile risk. An assessment should be undertaken to ensure that land around the store contains nothing that would be expected to be ignited by the contents of an ejected burning can, and to prevent fire spread by radiant heat on an adjacent stack if containment is compromised.

Fire Walls

HSG 51 discusses the use of fire walls, mainly as a way of limiting the effect of a fire on nearby stocks of flammable liquids. Fire walls in many cases will also provide some useful protection to drums of non flammable waste, from a pool fire involving a stack of drums of flammable liquids. A most important benefit will come if the fire wall can prevent the flow of released liquid into stacks of other types of waste, but it will also provide useful shielding from radiant heat.

No general advice can be given about the use of firewalls to achieve segregation outside, because the properties of the materials, and the effect of fire on different types of containers is too varied. However, in some circumstances fire walls can be beneficial.

Indicative BAT requirements for waste storage (Sheet 1 of 7)

Offloading/discharge of waste

1 The Operator should have in place a system to ensure that the correct discharge point or storage area is used. The options for this include:
- ticket systems
- supervision by site staff and if relevant CCTV
- keys
- colour-coded points/hoses or fittings of a specific size

2 Offloading and quarantine points should have an impervious surface with self-contained drainage, to prevent any spillage entering the storage systems or escaping off-site (see **Section 2.8** on page 89).

3 Damaged hoses and connections must not be used.

4 Only couplings of the correct size for the connection should be used and the coupling should be able to withstand the maximum shut valve pressure of the transfer pump.

Record keeping

5 The Operator should have an internal tracking system which should satisfy the objectives and minimum standards given at **Section 2.1.2** on page 25 for all wastes.

General storage requirements

6 Storage areas are often the most visible aspects of the installation. Storage areas should be located away from watercourses and sensitive perimeters, for example, those which may be adjacent to public rights of way, housing or schools, and within the security-protected area of the installation to prevent vandalism.

7 Storage areas should be located to eliminate or minimise the double handling of wastes within the installation.

8 Storage areas should be clearly marked and signed with regard to the quantity and hazardous characteristics of the wastes stored therein.

9 The total maximum storage capacity of the site should be clearly and unambiguously stated in writing, accompanied with details of the method used to calculate the volumes held against this maximum and set out in the site plan. The stated maximum capacity of storage areas should not be exceeded and the site plan updated to reflect any changes before they are implimented.

Indicative BAT requirements for waste storage (Sheet 2 of 7)

10 All containers should be clearly labelled with the date of arrival, relevant hazard code(s), chemical identity and composition of the waste and a unique reference number or code enabling identification through stock control and cross-reference to pre-acceptance and acceptance records. All labelling should be resilient enough to stay attached and legible throughout the whole time of storage at the installation.

11 Storage area drainage infrastructure should ensure that all contaminated run-off is contained, that drainage from incompatible wastes cannot come into contact with each other and that fire cannot spread between storage / treatment areas via the drainage system.

12 Procedures must be in place for the regular inspection and maintenance of storage areas, including drums, vessels, pavements and bunds. Inspections should pay particular attention to signs of damage, deterioration and leakage. Records should be kept detailing action taken. Faults must be repaired as soon as practicable. If containment capacity or capability of bund, sump or pavement is compromised, (unless effecting a repair is more expedient and working with wastes in close proximity does not compromise safety), then waste must be immediately removed until the repair is completed.

13 There should be daily inspection of the condition of containers and pallets and written records should be kept of these inspections. If a container is found to be damaged, leaking or in a state of deterioration, it should immediately be over-drummed or the contents transferred to another container or processed.

14 Over-drumming should be seen as an emergency measure and take place, if appropriate, in a designated location equipped with Local Exhaust Ventilation (LEV) as necessary. All appropriate information should be transferred onto the label of the new container. Large quantities of wastes in over-drums should be avoided by re-drumming once the incident leading to over-drumming has been dealt with. Pallets damaged to the extent that the stability of the containers is or may become compromised should be replaced. “Plastic shrink wrap” should only be used to provide secondary stability to drum/container storage in addition to the use of sound pallets.

15 There should be vehicular, for example, forklift, and pedestrian access at all times to the whole of the storage area such that the transfer of containers is not reliant on the removal of others that may be blocking access, other than drums in the same row. Drums should not be stored on other drums more than two high and allow access for inspection on all sides. That is, four x 205 litre drums on a pallet, stacked no more than two x 205 litre drums high in rows.

16 All spillages of hazardous wastes should be logged, where spillages >200 litre then additionally the Regulator should be informed.

17 Activities that create a clear fire risk should not be carried out within the storage area, even if it is not formally classified as hazardous. Examples include grinding, welding or brazing of metalwork, smoking, parking of normal road vehicles except while unloading, charging of the batteries of fork lift trucks.

Turnover

18 Storage within the reception area should be for a maximum of five working days. Following receipt, wastes should be treated or removed off-site as soon as possible. The total storage time will depend upon the characteristics of a particular site and the waste types being stored. For example, on a site in a sensitive location handling hazardous wastes, it may be appropriate to limit storage times to one month. Other non-hazardous wastes, however, may be held on-site for longer periods. However, all waste should be treated or removed off site within a maximum of six months from the date of receipt.

Indicative BAT requirements for waste storage (Sheet 3 of 7)

Storage of drummed waste and other containerised wastes such as IBCs

19 Storage under cover for drummed waste has the advantage of reducing the amount of potentially contaminated water that may be produced in the event of any spillage and extending the useful life of the container. It is preferable that wastes are stored under cover. This should also apply to any container that is held in storage pending sampling and emptied containers. Covered areas must have adequate provision for ventilation by means of wall or roof vents or construction of the area, for example, open barn. Any such warehousing should meet the requirements of HSG71 (see **Ref 4**).

20 Containers should be stored in such a manner that leaks and spillages could not escape over bunds/edge of the sealed drainage area.

21 Containers should be stored with well-fitting lids, caps and valves, secured and in place.

22 Storage areas for containers holding substances that are known to be sensitive to heat and light or reactive with water or moisture should be under cover and protected from water, heat and direct sunlight.

23 Storage areas for containers holding flammable or highly flammable wastes should meet the requirements of HSG 51, HSG71 and HSG76 (see **Ref 4**).

Aged stock

24 It is important to avoid accumulations of waste, which may in turn lead to a deterioration in the container resulting in spillage or, in extreme cases, the deformation of the container to such an extent that it cannot be moved.

Segregation

25 In addition to the requirements of this document, the segregation of wastes should meet the requirements of HSG71 and be justified by risk assessment.

26 HSG 71 provides no guidance on the use of fire walls to achieve separation or segregation of different types of waste in outdoor storage. Fire walls which are impervious to liquid, at least 2m high, and capable of withstanding an intense fire on one side without collapse, can be used to reduce the 3m separation required for some combinations of materials marked as ‘keep apart’. No more than two sides of a storage area should be provided with fire walls, because it would prevent good ventilation.

Storage of aerosols

27 Storage of aerosols should take place under cover in closed containers or cages. Aerosols should not be stored in open containers.

Storage of laboratory smalls

28 Written procedures for the segregation and packing of laboratory smalls should be produced identifying;

- How the hazards associated with each package are identified.
- How the risks of adverse reactions occurring between individual packages are assessed, and by whom.
- The level of competence, qualification and training required by those undertaking this assessment.
- How incompatible substances (i.e. those that could react to generate heat, fire or hazardous reaction products) are prevented from being stored within the same drum.
- How the wastes are to be packed and stored.
- How the wastes are to be recovered or disposed.

Indicative BAT requirements for waste storage (Sheet 4 of 7)

29 Incompatible substances should not be stored within the same drum.

30 Sorting and repackaging of laboratory smalls should take place in a dedicated area/store. Once the wastes have been sorted according to hazard classification, with due consideration for any potential incompatibility problems, and repacked, then these drums should not be stored within the dedicated laboratory smalls area but should be removed to the appropriate storage area.

Compatibility testing

31 In order to prevent any adverse or unexpected reactions and releases before transfer involving the following activities, testing should take place prior to the transfer:

- tanker discharge to bulk storage
- tank-to-tank transfer
- transfer from container to bulk tank
- bulking into drums/IBCs
- bulking of solid waste into drums or skips

32 Any evolved gases and cause of odour should be identified. If any adverse reaction is observed, an alternative discharge or disposal route should be found.

Transfer from tanker, drums and other containers in bulk storage

33 Due consideration should be taken of the implications of scale-up from laboratory compatibility testing to bulk transfer and the Guidance is given in HSG143 (see **Ref 4**).

34 Wastes in containers should be transferred into storage vessels by dip pipe to minimise splash, fume and odour.

35 Transfer/discharge should only take place after compatibility testing has been completed and then only with the sanction of an appropriate manager. Approval should specify which batch/load of material is to be transferred, the receiving storage vessel, equipment required, including spillage control and recovery equipment, and any special provisions relevant to that batch/load

36 During bulking to tankers, vapour balance lines connected to appropriate abatement equipment should be used.

37 Tankers must not be used as reaction vessels. Blending by bulking into tankers should only take place following a risk assessment and once suitable verification and compatibility testing has been carried out.

38 If flammable chemicals are being transferred, particular caution has to be taken to avoid the generation of static electricity, with the subsequent risk of ignition. Guidance on the safe use and handling of flammable liquids is provided by the Health and Safety Executive and is contained within HSG140, including Guidance on the issue of static electricity build-up. There may be other regulatory requirements to consider such as the Dangerous Substances and Explosive Atmospheres Regulations

Indicative BAT requirements for waste storage (Sheet 5 of 7)

39 A representative sample of the receiving tank/vessel/container should be mixed in a proportional ratio with a sample of incoming waste stream that it is proposed to add to the tank/ vessel/container. The two samples should take account of the "worst-case" scenario of likely constituents. The particular test parameters will be driven by the wastes being bulked. As a minimum, records of testing should be kept including any reaction giving rise to:

- increase in temperature
- viscosity change
- separation or precipitation of solids
- evolution of gases
- evolution of odours

Bulking up into drums (includes drum, tank, tanker or small container transfers into drums)

40 Bulking/mixing should only take place under instruction from and under direct supervision of a suitable manager/chemist and should be under Local Exhaust Ventilation (LEV) in appropriate cases. Odorous materials should not be bulked up. If bulking different batches, then a composite sample must be compatibility tested prior to bulking.Containers should be kept lidded/sealed as much as possible.

41 HSG 140 advises that gravity dispensing is avoided, unless physical protective devices are provided to prevent loss of the whole tanker contents.

42 Where tankers are discharged to drums, it must be possible to close the valve at the tanker end quickly and safely in case of spillage. The valve at the dispensing end must close automatically if it is released. A minimum of two people will be needed for this operation or the operation of the tanker valve if access to the tanker valve is difficult.

Bulking of solid waste

43 Bulking of different batches must not take place without compatibility testing. In appropriate cases, LEV should be used to control odour and dust. Drums should be manipulated using mechanical means, for example, forklift with rotating drum handling fitting. Liquid waste must not be added to solid wastes other than in 'purpose-designed and built' reaction vessel, that is, decanting of liquids into a skip containing bulked solids must not take place.

Bulk storage vessels

44 Bulk storage vessels should be located on an impervious surface that is resistant to material being stored, with sealed construction joints within a bunded area with a capacity at least 110% of the largest vessel or 25% of the total tankage volume, whichever is the greater.

45 Vessels supporting structures, pipes, hoses and connections should be resistant to the substances (and mix of substances) being stored. There should be a routine programmed inspection of tanks, mixing and reaction vessels including periodic thickness testing. In the event of damage or significant deterioration being detected, the contents should be transferred to appropriate storage. These inspections should preferably be carried out by independent expert staff, and written records should be maintained of the inspection and any remedial action taken.

46 Vessels should not be used beyond the specified design life or used in a manner or for substances that they were not designed, Vessels should be inspected at regular intervals, with written records kept to prove that they remain fit for purpose. See HSE Guidance Note PM75.

47 **As a general rule, no open-topped tanks, vessels or pits should be used** for storage or treatment of hazardous or liquid wastes. Exceptions would require justification in the permit application.

Indicative BAT requirements for waste storage (Sheet 6 of 7)

48 No uncontrolled venting to atmosphere should be allowed, and all vents should be linked to suitable scrubbing and abatement systems. Vapour balance lines should be connected to suitable abatement systems.

49 Tank and vessel optimum design should be considered in each case, taking into account waste type, storage time, overall tank design and mixing system to prevent sludge accumulation and to ease desludging. Storage and treatment vessels should be regularly desludged.

50 Tanks and vessels should be equipped with suitable abatement systems and level meters with both audible and visual high-level alarms. These systems should be sufficiently robust and regularly maintained to prevent foaming and sludge build-up affecting the reliability of the gauges.

51 Storage vessels holding flammable or highly flammable wastes should meet the requirements of HSG51, HSG140, HSG716 and HSG176 (see **Ref 4**).

52 All connections between vessels must be capable of being closed via suitable valves. Overflow pipes should be directed to a contained drainage system, which may be the relevant bunded area, or to another vessel provided suitable control measures are in place.

53 Underground or partially underground vessels without secondary containment should be scheduled for replacement with above-ground structures, for example, double-skinned vessels with leakage detection.

54 Plant and equipment taken out of use should be decontaminated and removed.

55 Pipework should preferably be routed above ground; if below ground it should be contained within suitable inspection channels.

56 Silos should be equipped with dust abatement systems, level monitors and high-level alarms.

57 Storage bunkers should have extraction systems for particulate abatement or spray damping.

Tank & process pipework labelling

58 All vessels should be clearly signed as to their contents and capacity and should have a unique identifier. Tanks should be appropriately labelled.

59 Labelling should differentiate between wastewater and raw process water, combustible liquid and combustible vapour and direction of flow.

60 Written records of all tanks should be kept detailing:
- unique identifier
- capacity
- construction including materials
- maintenance schedules and inspection results
- fittings (including joints and gaskets etc.)
- waste types that may be stored/treated in the vessel including flashpoint limit

61 A suitable pipework coding system should be used, for example, RAL European standard colour coding.

62 All valves should be tagged with a unique identifier shown on the process and instrumentation diagram. All connections should be correctly sized and maintained in an undamaged state.

Indicative BAT requirements for waste storage (Sheet 7 of 7)	
	Other storage requirements
63	Waste or raw materials in non-waterproof packaging should be kept under cover.
	Container movement
64	Drums and other mobile containers should only be moved between different locations (or loaded for removal off-site) in accordance with written procedures. The waste tracking system should then be amended to record these changes.

2.1.4 Treatment - general principles

Treatment involves a change in or modification to the characteristics of a substance to make it suitable for another means of disposal. The properties that can be manipulated during treatment include:

- solubility
- acidity, alkalinity
- toxicity
- separation of phases
- **chemical composition**

These treatment processes may involve displacement and transfer of substances between media resulting in a liquid effluent sent to sewer and a solid residue sent to landfill. Alternatively the waste may be rendered suitable for another treatment route such as combustion of recovered fuel oil.

There are also a number of important ancillary activities associated with treatment such as waste acceptance and storage either pending treatment on-site or removal off-site.

The key issues for the Operator in relation to measures for the treatment of waste on the installation will include the following:

- ensuring that the waste is suitable for the activity (pre-acceptance)
- adequately characterising the waste (acceptance procedures)
- appropriate and safe storage of wastes (storage)
- provision and maintenance of suitable infrastructure
- operational control of the treatment process
- disposal of effluents

The Applicant must first identify the waste types to be subject to each process, including all contaminants. The chemistry of the process and the fate of all the waste components and any reaction products should be identified. Where components that may be harmful to the environment are not destroyed but are displaced from one medium to another, suitable recovery or abatement must be in place to prevent pollution.

The treatment option must provide an environmentally acceptable method, and must be demonstrated to be appropriate for each waste type.

The control of a treatment process is crucial to environmental protection and accident prevention.

There are three fundamenal steps to achieve this:

- adequately characterising the waste
- ensuring that the waste is suitable for the activity

- ensuring operational control of the treatment process including inputs, reaction monitoring and having clear end-point objectives

Monitoring of the reaction is necessary because the reaction characteristics in the reactor may vary from those in the laboratory test. Monitoring should provide early indication of any deviation from the laboratory test, which should enable measures to be taken to halt or modify the reaction. There should consequently be provision for cooling and/or quenching of reactor vessels.

In order to prevent the direct transfer of pollutants between media, it would therefore follow that substances capable of pollution that may be released from the process and are neither changed nor modified should not be subject to treatment processes. Displacement is only acceptable if recovery and/or abatement systems are in place. The options are determined by choosing between the types of waste to be handled and the level of plant and equipment utilised. Displacement and/or production of polluting substances must be balanced by recovery or abatement.

Specific substances

Volatile organic compounds (VOC)

VOCs arise from a wide range of waste types, obvious examples being waste oil and solvents. While clearly a problem in relation to these specific waste types, waste producers and treatment operators should be dealing separately with, and using plant dedicated to, these waste streams.

In accordance with the Waste Framework Directive, the first option for waste solvents should be recovery. There is an active solvent recovery market, and in addition waste solvents are utilised as a secondary liquid fuel (SLF), for example, in the cement industry. Similarly, oil has a value for the recovered fuel oil market.

There are considered to be two specific problems caused by the presence of solvents, etc. in mixed waste streams (for example, the solvent which was unaffected by the wet scrubber used to abate the acidic emission is displaced into the vapour phase by acid neutralisation) or at a level where recovery is neither technically nor economically viable which are a specific problem (that is, as contaminants associated with wastes that are difficult to handle and treat by other methods). For example, a still bottoms sludge may have a significant concentration of solvent, which if the material was in liquid form may render it suitable for recovery. However, the physical nature of the waste makes it unattractive for recovery and the remaining option is disposal. Increasingly this type of waste has been subject to stabilisation treatment processes (see **Section 2.1.5** on page 45).

The first question that should arise is whether the solvent contamination can be dealt with other than by disposal. Drying techniques are in use in the UK for still bottoms from solvent recovery processes. This can reduce the total solvent concentration by approximately 10 times.

Cyanides

Cyanide wastes typically arise as solutions that were used for a variety of operations in the metals/ electroplating industries as cleaning, de-tarnishing and electroplating solutions. Typically the waste consists of solid or liquid cyanide salts, for example, sodium cyanide from surface metal treatments. They also may present themselves in printing wastes, usually as silver cyanide. Examples of cyanide-based plating solutions include copper cyanide, zinc cyanide and cadmium cyanide. Cyanide wastes also arise as fused solids within a container or in block form when molten salts have been used for heat treatment purposes.

The volume of cyanide wastes has significantly decreased over the last 10 years, due to contraction in the plating industry and the replacement of cyanide-based cleaners with or without surface-active agents, and the use of copper pyrophosphate plating solutions in place of copper cyanide.

Chemical treatment methods are most widely used for the destruction of waste streams containing cyanide. Cyanides can be destroyed in aqueous waste streams by oxidation with a basic oxidising agent such as chlorine and alkali, or a hypochlorite solution at a pH not less than 10.

Metals

Substances such as chromium, zinc, nickel, and lead are usually present, either dissolved in solution or absorbed onto particulate or colloidal matter. The objective is to precipitate the metals typically as the hydroxide, by using lime. Aqueous waste treatment processes treat a variety of compatible aqueous waste materials by precipitating soluble metals and acidic anions out of solution while increasing the particle size of suspended solids to aid phase separation between solids and liquids by clarification and filtration.

Typical wastes would include interceptor wastes, paint spray booth wastes and process effluents. For example, galvanising/pickling acid is added to a reaction vessel, lowering the pH to 5. This allows release of ferrous ions from the acid to act as a reducing agent, reducing metals from high to low oxidation states, which can be removed (as hydroxides) from solution by later increasing the pH to 9 by lime addition. One technique is to allow the resulting treated waste to clarify and then be separated by filter press. Similarly, acid neutralisation involves the addition of waste acid to alkali within a stirred reaction vessel.

The initial stage of treatment is to acidify the waste to solubilise all metals. The pH is then adjusted to the point of minimum solubility where the metals will precipitate. Chromium, zinc and cadmium are amphoteric and solubility will rise at pH above these points (see **Table 2.1**). The resulting treated waste is allowed to clarify, then separated by filter press

Indicative BAT requirements for treatment - general principles (Sheet 1 of 3)

General principles

1 Provide adequate process descriptions of the activities and the abatement and control equipment for all of the activities such that the Regulator can understand the process in sufficient detail to assess the operator's proposals and in particular to be able to assess opportunities for further improvements. This should include:
- diagrams of the main plant items where they have environmental relevance, for example, storage, tanks, treatment and abatement plant design, etc.
- details of chemical reactions and their reaction kinetics/energy balance
- equipment inventory, detailing plant type and design parameters, for example, flashpoints
- waste types to be subjected to the process
- control system philosophy and how the control system incorporates environmental monitoring information
- process flow diagrams (schematics)
- venting and emergency relief provisions
- summary of operating and maintenance procedures
- a description of how protection is provided during abnormal operating conditions such as, runaway reactions, unexpected releases, start-up, momentary stoppages and shut-down for as long as is necessary to ensure compliance with release limits in Permits
- additionally, for some applications, it may be appropriate to supply process instrumentation diagrams for systems containing potentially polluting substances

2 Provide an assessment of the **efficiency of the treatment process** in relation to Schedule 5 (of the PPC Regulations) pollutants in terms of the removal or partition of substances within the process, for example:
- the precipitation of metals from solution for removal in the filter cake
- the degree of transfer between the incoming waste and the emissions (to air, solid waste to land and liquid effluent to sewer of, for example, pesticides or solvents)

Indicative BAT requirements for treatment - general principles (Sheet 2 of 3)

3 The Operator should analyse these parameters using the following steps:

- *process mapping* - identify the pathways within the process for the specific substance or substances
- *mass balance*
- *action plan* - if the study indicates that losses from a process are contributing to:
  - the breach of an Environmental Quality Standard
  - the breach of benchmark
  - a significant environmental impact

4 then an action plan should be prepared and implemented.

5 For each treatment process, the objectives and reaction chemistry should be clearly defined. There must be a defined end-point to the process so that the reaction can be monitored and controlled. The suitable inputs to the process must be defined, and the design must take into account the likely variables expected within the waste stream.

6 For each new reaction, proposed mixes of wastes and reagents should be assessed prior to treatment in a scale laboratory test mix of the wastes and reagents to be used. This should lead to all reactions and mixing of wastes being to a predetermined batch “recipe”. It should also take into account the potential scale-up effects, for example, increased heat of reaction with increased reaction mass relative to the reactor volume, increased residence time within the reactor and modified reaction properties. See HSG143 for further Guidance.

7 The reactor vessel and plant should be specifically designed, commissioned and operated to be fit for purpose. Such designs should include consideration of chemical process hazards and a hazard assessment of the chemical reactions, prevention and protective measures together with consideration of process management i.e. working instructions, staff training, plant maintenance, checks, audits and emergency procedures.

8 In order to track and control the process of change, there should be a written procedure for proposal, consideration and approval of changes to technical developments, procedural or quality changes.

9 All treatment/reaction vessels should be enclosed and should be vented to atmosphere via an appropriate scrubbing and abatement system (subject to explosion relief).

10 Where appropriate, reactor vessels (or mixing vessels where the treatment is carried out) should be charged with pre-mixed wastes and reagents. For example, reactor vessels should be “pre-limed” or charged first with the reacting alkali to control the reaction using, for example, calcium hydroxide solution made up prior to charging the reactor vessel. The decanting of sacks or drums to the vessel should be avoided. Failure to charge the vessel can lead to:

- concentration “hot spots” at the surface of the reaction liquor
- loss of reaction control
- emission of fume from the instantaneous reaction at the interface
- the open hatch venting any fume and by-passing appropriate abatement

11 The reaction should be monitored to ensure that the reaction is under control and proceeding towards the anticipated result. For this purpose, vessels used for treatment should be equipped appropriately eg. high-level, pH and temperature monitors. These should be automatic and continuous and linked to a clear display in the control room or laboratory together with an audible alarm. Risk assessment may require process monitors to be linked to cut-off devices.

Indicative BAT requirements for treatment - general principles (Sheet 3 of 3)

Specific substances

Volatile organic compounds (VOC)

12 Chemical process waters will contain VOCs (another specific example is contaminated ground-water), resulting in a high COD which may mean that the waste is unsuitable for direct discharge to sewer. Techniques such as drying are not an option and attention should focus on displacement methods of treating.

13 For example, the waste stream could be treated by air stripping using counter-current flow across a packed column. Stripped VOC in air flow can be removed by carbon absorption or similar technique. For other techniques to control VOC emissions, see **Section 2.2.4** on page 69.

Cyanides

14 It is important that the pH of the system remains greater than 10. If the pH is too low, then cyanogen chloride and hydrogen cyanide can be formed. Hence caustic is generally added in excess to prevent the pH from falling too low. The reaction is very rapid and the resulting cyanate cannot readily be reduced back to cyanide. Any discharge of cyanate to a water course will not enable free cyanide to be generated.

15 Since the treatment of cyanide is by oxidation, the destruction can be checked by the measurement of redox potential (electropotentials). Addition of sodium hypochlorite to an effluent sump can therefore be controlled. If there is excess hypochlorite present, then chlorine gas can be released; and if there is a lack of hypochlorite, then residual cyanide is present. Discharges of aqueous effluent to watercourses should therefore be monitored continuously for cyanide content, free chlorine and pH.

Chromium (VI) compounds

16 Chromium (VI) is the highest oxidation state of the metal. An example of it is chromic acid or chromium oxide (CrO_3) which is acidic, toxic, water-soluble and an oxidising agent. Treatment by straightforward neutralisation would be ineffective and the initial step is the reduction to Chromium (III) to the trivalent state. The conversion of Cr^{6+} to less hazardous Cr^{3+} can be achieved by the addition of a reducing agent, for example, sodium metabisulphite or waste pickling acid, which is rich in ferrous ion. The trivalent metal can then be precipitated in the normal way.

Strong acids

17 For concentrated acids (>70% w/w) there is a market for blended or re concentrated acids. It has become viable to use 50% (w/w) acids, although this requires a greater energy input. It is anticipated that the growth area for this market may be in the 20-30% acids range. This may be seen as a preferred option for some acid wastes, but is dependent on the volume and contamination of the waste.

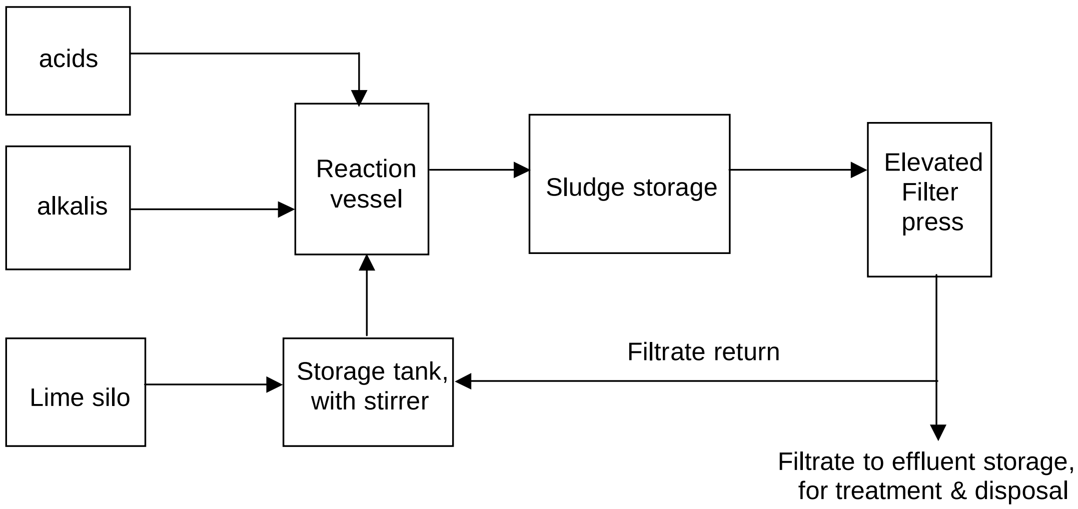
Phenolic solutions

18 A process has been developed treating aqueous wastes containing phenol (3 - 5% w/w) by catalytic oxidation, using an oxidising agent and a metal catalyst, on a 3 tonne batch basis in a stainless-steel, double-skinned vessel. The treatment procedure must take account of the exothermic nature of the reaction. Feedstock can be diluted before treatment. The process temperature, pH and redox potential are continually monitored.

Table 2.1: Minimum solubility and associated pH for metal hydroxides

Metal Ion	Minimum solubility (mg/l)	pH of minimum solubility
Cd^{2+}	0.05	11.4
Cr^{3+}	0.26	8.6
Cu^{2+}	3.2×10^{-5}	9.7
Hg^{2+}	80	>4
Ni^{2+}	5.9×10^{-4}	10.2
Pb^{2+}	83	10.9
Zn^{2+}	0.2	9.8
These figures relate to solubilities in distilled water and may differ in waste treatment applications.		

Figure 2.1: Representation of acid neutralisation processes



2.1.5 Immobilisation

The aim of these processes is to minimise the rate of contaminant migration to the environment and/or reduce the level of toxicity of contaminants in order to alter or improve the characteristics of the waste so that it can be disposed of. This relies on the properties of the reagent to produce an immobilised waste product, even where the waste product does not have a solid form. These processes retain substance(s) adsorbed onto or trapped within a solid matrix. Such processes are reversible (immobilised substances can be released) due to both poor process control and subsequent mixing with other waste types. Immobilisation may also be achieved by precipitation of metal hydroxides, cation exchange or incorporation in crystal lattices. Two types of processes have been developed, commonly referred to as stabilisation and solidification.

European Waste Catalogue definines stabilised and solidified waste with regard to their hazardous properties.

Stabilised and solidified waste appear as mirror entries in the European Waste Catalogue (subchapter 19 03), and are defined in Council of the European Communities (2002a), and the different categories clarified as:

- Totally stabilised waste - a waste that was previously hazardous and after a chemical treatment does not display any of the 14 hazardous properties of Annex III of Directive 91/689/EEC.
- Partially stabilised waste - a waste which displayed one or more of the hazardous properties, underwent a stabilisation process after which it still possesses some of the hazardous characteristics plus the property H13 - substances and preparations capable by means, after disposal, of yielding another substance, e.g. leachate which possesses any of the hazardous characteristics (and hazardous constituents which could be released into the environment in short, middle or long term).
- Solidified waste - a waste that underwent a solidification process that changed the physical state of the waste without changing its chemical properties.

Stabilisation can be categorised as the mixing of waste with a reagent (clay particles, humic organic substances such as peat and activated carbon) to reduce its environmental impact (by adsorption) and to improve the handling properties of the waste at the landfill. To achieve this, a process should provide for a physico-chemical interaction between the reagent and waste, rather than just diluting it. In addition, the potential for reversal should be assessed having regard to the conditions of final disposal (e.g. environmental factors such as pH, Eh, temperature, moisture content).

Solidification (and encapsulation or fixation) relates to the mixing of wastes with a reagent (PFA, cement or lime) to produce a solid waste form for landfill disposal. Substances are either adsorbed onto the reagent or trapped within the waste form. The product should possess a high resistance to chemical and biological degradation processes that could lead to the release of contaminants. Some processes may be designed to achieve both chemical stabilisation and solidification to further minimise the release of contaminants to the environment.

The key issues for the Operator in relation to measures for the treatment of waste by immobilisation processes will include the following:

- suitability of waste
- process control
- ‘product’ specification
- emissions to air of VOCs, dust and odour
- exclusion of wastes that may cause or contribute to adverse reactions
- the use of binders designed to mitigate the effect of adverse reaction (e.g. sulphate-resistant cement)
- the potential for reversal should be assessed having regard to the conditions of final disposal

The Operator must clearly define and describe the process, its objectives and environmental benefits. Such benefits must be justified in terms of the pre treatment requirements and waste acceptance criteria of the Landfill Directive.

Under the Landfill Directive the end-product specification will eventually need to align with the acceptance criteria for the receiving landfill, which has been set by the European Technical Adaptation Committee covering leachability, physical stability and reaction with other wastes. (2003/33/EC: Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC Official Journal L 011, 16/01/2003 P. 0027 - 0049)

In the past stabilisation has been used to dispose of aerosols, clinical wastes, explosives, laboratory small’s, shredded drums and containers, flammable and highly flammable wastes, this is not acceptable and does not constitute BAT.

Indicative BAT requirements for immobilisation (Sheet 1 of 2)

General principles

1 Simple physical dilution or absorption, without any concurrent chemical change, is not an acceptable treatment process in itself. For example, the absorption of a liquid into sawdust such that it is no longer a liquid waste is not acceptable as a pre treatment for landfill.

2 The acceptable range of characteristics of a waste that can be effectively treated by the process should be defined. This range will be determined by the ability of the process to immobilise the chemical/ion in question to ensure that the final product can meet a defined specification. These techniques are most likely to be effective upon the treatment of inorganic wastes where solubility is already quite low.

3 All immobilisation processes should take place within suitably designed reaction vessels with suitable process monitoring within enclosed and abated systems.

Pre acceptance procedures to assess waste

4 For each waste stream, laboratory scale testing should be carried out to maximise effectiveness of the mix and quantity of absorbents/binders to be added, identifying an optimum "formula" to be used in full scale treatment should the waste stream in question subsequently be found suitable. Quality control (to include leachability tests) should include screening each proposed waste to ensure that any wastes containing process inhibitors are excluded or effectively treated. Any such testing should take into account effects of different waste streams being treated in the same batch and in addition identify a minimum residence time within the reaction vessel. Records of which waste streams have been pre-tested should be kept showing whether they have been accepted or rejected as being suitable for treatment by the process.

Acceptance procedures when waste arrives at the installation

5 Quality control (to include leachability tests) should be conducted on every load prior to treatment, to confirm the levels of key indicator substances identified at the pre-acceptance stage.

Monitoring of process variables

6 The on-site laboratory forms the essential element in providing assurance that the necessary process input controls are in place and that a consistent end-product is produced.

7 Post-treatment quality control (to include leachability tests and compressive strength – solidification processes) of every batch of treated waste should be included to ensure that the process is meeting the predetermined specification of end-product before the batch is further recovered or disposed of.

8 The length of time samples need to be kept available for analysis should be specified in Quality Assurance procedures by the Operator, with reference to the length of time taken to achieve full stability of the end-product.

9 The Operator should demonstrate how batch non-conformance will be dealt with.

10 Given the wide range of existing processes and absence of any common end-product specification, operators should be able to demonstrate that as a minimum the Waste Acceptance Criteria specification in Schedule 1 (as amended) to the Landfill Regulations 2002, is being achieved.

11 Given the degree of process control that is needed to ensure the correct ratios of waste and reagent/binder enter the process and that sufficient mixing (and residence time) is achieved, these processes should take place within controlled reaction vessels. Automated loading, charging and mixing devices which can be monitored and controlled will be required.

Indicative BAT requirements for immobilisation (Sheet 2 of 2)

12 Physico-chemical treatment such as neutralisation reactions should be carried out in the liquid phase to enhance mixing and process control. Solid-phase reactions of this type should not be carried out as the completion of the reaction cannot be guaranteed.

Control of fugitive emissions to air

13 Controlled and enclosed methods of charging should be employed. Manual charging of wastes and mixing with JCBs or similar should not take place. Decanting should be replaced by enclosed conveyor systems.

14 Reagents and waste should be adequately mixed using impellers or mixing systems integral to the mixing vessel – not by JCBs or similar. Bulk transfer of dry wastes and reagents should be by suitable handling systems, for example, screw feeder, gravity or pneumatic means.

15 Decanting liquid wastes from drums and containers should be replaced by separate “make-up” tanks utilised to pre-mix liquids and pumpable sludges, and the feedstock should be delivered by pipe into the mixing vessel.

16 Operators should demonstrate that the design of extraction systems takes into account the removal of large volumes of air due to the dimensions of the mixing areas, which are effected by the need to have vehicular access for loading and unloading. The same factor will affect the abatement system, which will require a design able to handle not only the flow of air, but also the peak loading associated with charging and unloading. These factors indicate that abatement is unlikely to be able to deal with emissions from an wide range of wastes.

17 Operators must demonstrate that the designs of the extraction systems are capable of controlling all foreseeable emissions, other than in emergency situations.

18 The methods of treatment and disposal of all spent scrubber liquors, absorbents (for example, activated carbon) and trapped emissions must be detailed.

Control of fugitive emissions to controlled water, sewer and groundwater

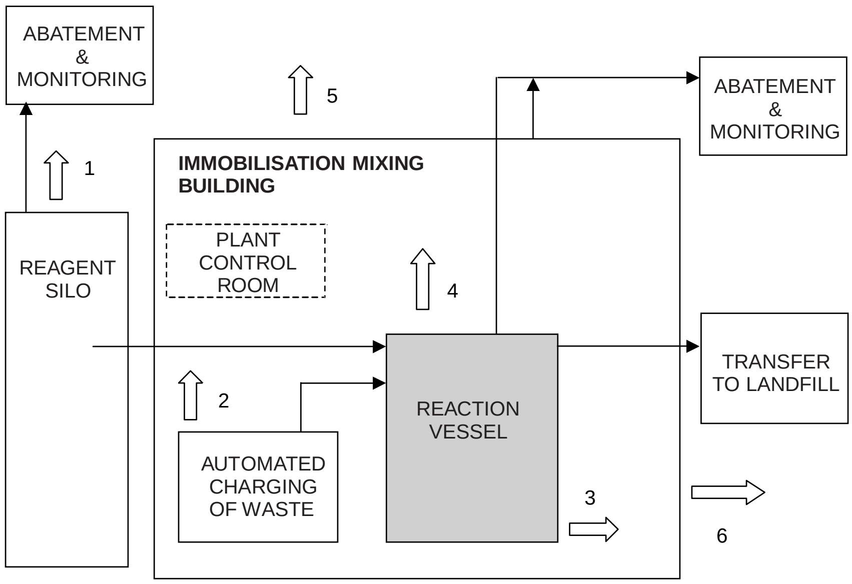
19 All plant should be subject to a regular inspection and maintenance programme. Underground or partially underground vessels without secondary containment should be scheduled for replacement with above-ground structures, for example, double-skinned vessels with leakage detection

20 Further BAT issues are identified in **Table 2.6**.

Table 2.2: Emission Summary for immobilisation Processes

Emission Pathway (**Figure 2.2**)	Emission to:	Through
1	Air	Dust from the overfilling of reagent silos. Fugitive dust emissions from silo connections. Dust from reagent stockpiles stored loose
2	Air	VOCs, dust odour from transfer of wastes and reagent
3	Land Water	Leakage through badly maintained or damaged equipment
4	Air	Reaction of incompatible substances. Uncontrollable reaction due to incorrect dosing of reactants or formation of hot spots through poor mixing
5	Air	Emissions via roof vents Transfer from mixing pit to removal off-site
6	Air	Emissions via access doors from spillages/leaks during charging of reaction vessel

Figure 2.2: Emission summary for immobilisation processes



2.1.6 Secondary liquid fuel

Blending of solvents for recovery is not a Schedule 1 ‘listed activity’, however it may be undertaken at an installation as a ‘directly associated activity’

The aim of this process is to blend wastes from various sources to create a waste fuel in, for example, cement kilns. Wastes utilised include solvents, oil sludges, distillation residues and tank bottom sludges. The quality assurance of these processes is driven by the need to meet the specification set by the receiving facility. The blend in particular is set to meet calorific values and limits on contaminants, for example, chlorine and heavy metals. For further information reference should be made to the Environment Agency’s Substitute Fuels Protocol.

The process includes offloading from drums or bulk tanker via a macerator into primary blending tanks. This is followed by secondary blending, specification checking and storage pending despatch.

Within the UK there are a wide range of waste streams entering into secondary liquid fuel (SLF) production, as control has so far focused on the contractual blend specification agreed between the producer and waste management company. The Regulator will ensure due consideration has been given to whether SLF and recovery within a cement kiln represents BPEO for the waste types identified in the cement kiln application.

Prior to receipt at the kiln the waste might have passed through various treatment or blending facilities before final certification of the blend is made. As with other waste streams, a crucial control measure is to ensure adequate transfer of knowledge between holders of the waste. This should ensure that the constituents of all wastes bulked together to form a blend are known and recorded.

This document addresses the preparation of secondary liquid fuel. Incineration and co-incineration is dealt with under Guidance for the associated sector, for example, incineration or cement and lime.

Indicative BAT requirements for secondary liquid fuel	
1	Pre-acceptance criteria (see **Section 2.1.1** on page 20), waste characterisation (see **Section 2.1.2** on page 25), waste storage (see **Section 2.1.3** on page 32 and process control (see **Section 2.1.4** on page 40).
2	Emissions to air (see **Section 2.2.1** on page 59).
3	Emissions to water (see **Section 2.2.2** on page 62).
4	Fugitive emissions to air (see **Section 2.2.4** on page 69).
5	Accidents (see **Section 2.8** on page 89).

2.1.7 Oil processing

There are a number of oil treatment activities that fall under this general heading, some examples are;

regeneration of Used Transformer Oil (UTO)

re-refining of used engine oil

production of Recovered Fuel Oil (RFO)

Oil reprocessing to produce RFO is a straightforward process. The processes involved can be described as follows:

- storage of feedstock with demulsification, if necessary
- heating of the feedstock to drive off the water content
- removal of solids

The oil feedstock is characterised by water content and solids content, both of which need to be removed. The activity can be described as a process to remove water and solids from waste oil to produce a secondary fuel oil. Solids are removed by settlement during storage and filtration. Both stages produce a vapour phase that produces VOCs emission to air. The process also produces an aqueous phase contaminated with oil, which requires separation prior to emission to sewer. Solid residues from the storage, process and filtering stages are removed to landfill.

Another option for the re-use of waste oil is to produce base lube oils by re-refining waste oil. This represents a potential higher economic return, but in the medium term it is expected that oil reprocessing to produce RFO will continue to be the primary method of oil recovery. One possible effect of any expansion of re-refining to produce base lube oils is that this may divert the “cleaner” end of waste oils spectrum into re-refining.

This section deals with the pollution control issues specific to oil reprocessing to produce RFO. These relate to emissions to air, connected to the displacement of VOCs during the reprocessing and associated odour issues. There is also an issue of removing oil from effluent discharged to sewer.

Other issues to do with characterisation of the waste feedstock, prevention of emissions to land and water and prevention of accidents are common to all waste treatment activities under consideration in this document.

Indicative BAT requirements for oil processing	
1	Some BAT issues are identified in the emission summary (see **Table 2.3** below).

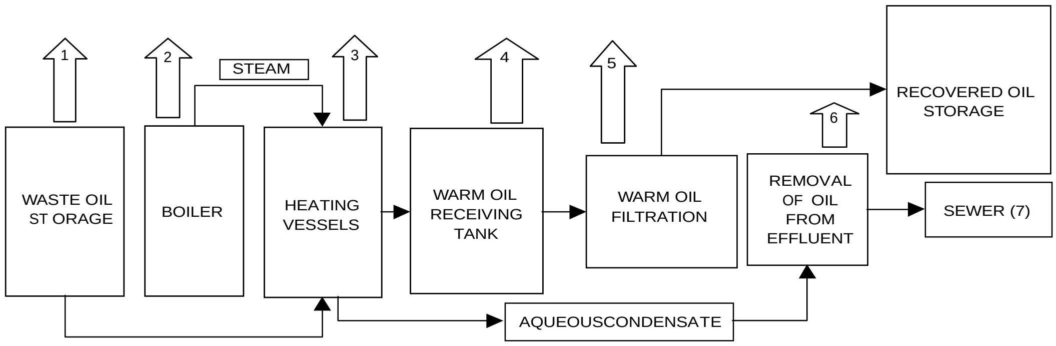
Table 2.3: Emission Summary - Oil Re-processing

Emission Pathway (**Figure 2.3**)	Media	Through	Pollution Control Measure
1	Air	Displacement of vapour during loading. “Breathing” via vents	Refer to **Section 2.2.1** on page 59
2	Air	Combustion gases via stack. Most oil reprocessing facilities generate steam from in-house boilers.	Refer to IPC Guidance Note S2 1.04, Combustion Processes: waste and recovered oil burners 3MW and over
3	Air	Heating vessels are typically insulated mild steel tanks. Heat is delivered to the oil by a heat exchange system typically based on internal or “blind” steam coils. This arrangement can be difficult to clean and maintain. This may lead to inefficient energy use related to raising steam. Heat exchange units external to the vessel are used and provide an alternative. Water vapour is driven off and the oil feedstock may be heated to 90°C, which serves to separate the majority of suspended (as opposed to dissolved) water. This occurs as a result of the reduction in viscosity of the oil phase (brought about by the increased temperature) leaving gravity to achieve the desired result as the water sinks to the tank bottom. VOCs are emitted during heating of oil to drive off water vapour. Emissions may consist of displaced vapour comprising water vapour and VOCs. Carbon absorption could be used but may be affected by water vapour. Condensation should be considered to collect the organic fraction which can be used as boiler feed or incinerated	Refer to **Section 2.2.1** on page 59
4	Air	VOCs from transfer of warm oil to receiving tanks	Refer to **Section 2.2.1** on page 59
5	Air	VOCs emitted when warm oil is passed through filters to remove solids. Warm oil from the heating vessels is typically passed over open filters to remove solids. These are situated in either open yards or buildings. The filters used are typically vibrating metal mesh, more commonly used in relation to mineral aggregates. It is crucial to the sale of the recovered fuel oil that the high solids content retained in the warm oil, is removed. The action of removal of solids is aggressive and the filters need to be robust to deal not only with the solids but also the warm oil. This stage is a source of VOCs and odour. Extraction of the vapour should be possible from hoods over open filters. Abatement for VOCs and odour control may be by extraction or displacement to condensers, carbon absorption, biofilter or thermal oxidation. For high concentration VOC releases, thermal oxidation/incineration may be considered. If it is not possible to provide extraction, there is an alternative method for the removal of solids from the oil. Centrifuges are used for this purpose and have the advantage of minimal emissions	Refer to **Section 2.2.1** on page 59

Table 2.3: Emission Summary - Oil Re-processing

Emission Pathway (Figure 2.3)	Media	Through	Pollution Control Measure
6	Air	Oil is removed from liquid effluent prior to discharge to foul sewer or other waters usually by oil/water interceptors, tilting plate separator and/or filtration techniques.	Refer to Section 2.2.4 on page 69, Control of fugitive emissions to air
	Water	Every single-chamber oil interceptor should be large enough to have a minimum of six minutes retention at maximum foreseeable flow rates. In a multi-chamber oil interceptor, each chamber interceptor should have a minimum of six minutes retention at maximum foreseeable flow rates. Oil interceptors cannot accept water-miscible substances. VOCs are a significant emission when drawn off from a process tank into open channels and also when warm oil is passed over a tilting plate separator	Refer to Section 2.2.2 on page 62
7	Water	Effluent to sewer. VOC release from warm water to sewer	Refer to Section 2.2.2 on page 62
8	Air	VOC release during watering off	Refer to Section 2.2.4 on page 69
9	Air	VOC displacement	Refer to Section 2.2.4 on page 69
10	Land	Removal of sludge from storage and heating vessels and filtration units is currently landfilled. It is anticipated that further treatment of the sludge will be required to meet WAC	Refer to Section 2.6 on page 84

Figure 2.3: Representation of an oil recovery process



2.1.8 Biological process

Biological processes can be sub-divided into 2 main categories, these being;

anaerobic treatment (biological breakdown in absence of oxygen)

aerobic treatment (biological breakdown using oxygen)

Aerobic treatment processes include; Composting, Activated sludge, Trickle filter, Rotating biological contactor, Aerated lagoons and stabilisation ponds

Anaerobic treatment processes include; Anaerobic digestion

The basic principle, common to all, is that natural, micro-organism based activity breaks down certain compounds either through metabolism to provide nutrient energy or through co-metabolism. Effective processing depends on selecting a micro-organism suitable for the species requiring treatment, and on carrying out the treatment under conditions which are suitable, including careful control of the nature and composition of the waste. It is perceived that Biological processes have little effect on inorganic wastes including metals, although some absorption into a sludge phase may occur with some processes

The Landfill Regulations currently prohibits the disposal of liquid hazardous waste in landfill and will exclude the disposal of non-hazardous liquid wastes from landfill within the next few years. This may create an opportunity for existing treatment methods and the development will focus on methods to treat COD. Specific attention will be given to “hard” COD that is not readily susceptible to biodegradation. This could involve the use of dedicated biological techniques, aerobic and/or anaerobic digestion in tandem with chemical oxidation.

Aerobic biological systems are generally more robust than anaerobic systems, which are sensitive to chlorinated and sulphur compounds, pH and temperature fluctuations and may require a pre-acidification stage. Anaerobic systems are more effective at breaking down ring compounds (for example, phenols) and generate methane that can be utilised as a fuel. Aerobic systems may be unsuitable for treating VOC-containing wastes, which may be emitted to air.

Biological plants should be designed to give sufficient residence time to achieve adequate breakdown of the more complex compounds present in the wastewater. Modern aerobic plants have retention times in the order of 23 hours, although a universal figure cannot be given. Sludge age is also important and optimum operating temperatures will also aid degradation. Some aerobic plants are currently planned to operate at around 30^{o}C.

Other techniques such as fixed film reactors appear to offer certain advantages over activated sludge and trickling filter systems. These include higher hydraulic loading rates (due to higher mineralisation rates), increased biomass stability and resistance to shock loadings and temperature fluctuations.

The presence of substances that are not subject to beneficial treatment, such as toxic metals, must be considered and limits proposed. Dilution or buffering through flow is not treatment.

Indicative BAT requirements for biological processing	
1	Refer to **Section 2.1.1** on page 20 and **Section 2.1.2** on page 25.

2.1.9 Carbon absorption

This technique has been previously mentioned in connection with VOC abatement, but can also be used as a treatment method, for example, in dealing with aqueous wastes contaminated with pesticides. The spent absorbent is destroyed by incineration.

Indicative BAT requirements for carbon absorption	
1	There are no specific BAT issues for this section. For further information see **Section 3.11** on page 124

2.1.10 Wet air oxidation

Attention has been given to the development of destructive physico-chemical treatment methods for aqueous effluents with high COD, which would not be suitable for direct discharge to a WwTW, but would be too expensive to incinerate.

Attempts at using wet air oxidation for merchant waste treatment has suffered from problems connected with heterogeneous and variable waste feedstock. There are no current applications in merchant waste treatment.

A pharmaceutical manufacturer near Newcastle operates a Zimpro Wet Air Oxidation system, and a chemical manufacturer in West Yorkshire has recently installed a BOC Gases Loprox and Vitox oxidation plant. This indicates the suitability for using dedicated processes for specific waste streams on waste producer premises.

Indicative BAT requirements for wet air oxidation	
1	Refer to **Section 2.1.1** on page 20 and **Section 2.1.2** on page 25.
2	See **Section 2.10** on page 95 and **Table 2.16**.

2.1.11 Air stripping

Ammonia solutions up to 20% w/w can be treated by a dual-column air stripping system with acidic scrubber. A dual-column process has been developed, in which the initial column raises the temperature of the feedstock and maintains the pH between 10 and 11. The feedstock is transferred to the second column, where it is run counter-current across a packed column against air. The ammonia removed in the gas phase is scrubbed with sulphuric acid to produce ammonium sulphate.

Indicative BAT requirements for air stripping	
1	There are no specific BAT issues for this section.

2.1.12 Settlement

Settlement involves settling by gravity, and is used in waste treatment for the removal of particulate and colloidal solids, and flocculent suspensions arising from acid-alkali reactions to precipitate metals out of solution. The efficiency of the sedimentation process is affected by the wastewater and suspended solids characteristics, variation in flow and general operation. The solids may be discrete suspended particles that are self-settling, or they may be of a range of sizes and surface characteristics, which require the formation of flocculating suspensions to coagulate and settle the mass, through chemical conditioning. Settlement is carried out in clarifiers that should be specifically designed with an inlet, outlet, settling zone and sludge blanket (or sludge zone). Sludges liberated from a settlement stage are typically around 1% dry solids content.

Air flotation is a physical solids separation process relying upon the chemical conditioning of the suspended solids to form a flocculated structure that can be floated to the surface of a reactor by introducing fine bubbles of air. The basic mechanism of air flotation is to introduce small air bubbles into the wastewater containing the suspended solids to be floated. The fine air bubbles attach themselves to the chemically conditioned particles and hence the solids float to the surface, where they are accumulated, thickened and removed by mechanical skimming or suction withdrawal. Usually chemicals such as polymers, aluminium sulphate or ferric chloride are used to enhance the adhesion of bubbles. The method of air supply is used to define the process.

Flotation is used when gravity settlement is not appropriate, for example, when:

- the particulates have poor gravity settling characteristics
- the density difference between the suspended particles and water is too low
- there is a space constraint at the site
- oil and grease are to be removed
- recovery of material is required

Dissolved air flotation (DAF) is most widely used because of its effectiveness in removing a range of solids. The DAF system generates a supersaturated solution of wastewater and compressed air by raising the pressure of the wastewater stream to that of the compressed air, then mixing the two in a retention tank. This supersaturated mixture of air and wastewater flows to a large flotation tank where the pressure is released, thereby generating numerous small air bubbles. Through a combination of adsorption and entrapment, the flocculated particles rise to the surface of the reactor. The suspended solids float to the top of the liquid and form a foam that is then skimmed off. Some soluble colloidal substances are removed from the wastewater by adding coagulation and flocculation chemicals (e.g. iron salts, aluminium salts and polyelectrolytes) to form precipitates with the solutes.

Indicative BAT requirements for settlement	
1	Refer to **Section 2.10** on page 95 and **Table 2.16**.

2.1.13 Drum washing, crushing, shredding and cutting

This section is without prejudice to Section 2.6 on **Waste recovery or disposal**. It should be noted that most drums and IBC's are designed, manufactured and marked to enable reconditioning and refurbishment, and as such, used 205 litre drums and 800 and 1000 litre IBCs should be cleaned and reconditioned to enable re-use where technically and economically possible.

[1]Container washing and cutting operations must take account of the former contents and any residues that may be present. Containers used to store cut drums/IBCs should be covered.

[1]In the context of this document a ‘drum’ (sometimes referred to as a barrel) is a cylindrical container (usually metal or plastic) generally used for transport or storage of liquids or powder.

Drum crushers/shredders are typically used for two purposes:

- extracting wastes that cannot be removed from used containers using those practices commonly employed to remove material from the type of packaging involved, including pouring, pumping, aspirating, shaking, scraping, chipping etc, or if necessary a combination of these
- as a means of reducing the volume of a drum containing a residue that cannot be removed using the above practices

Most plant comprises a proprietary compaction unit. There are examples of modified processes, which may be as simple as a metal spike onto which drums are dropped. Regardless of the technique employed, there is usually no provision for environmental control and the emissions are dependent on the composition of the waste held within the drum.

An example of suitable plant consists of a fume-extracted enclosure mounted on a raised platform and containing a hydraulically operated remotely controlled crushing head. Waste residues expelled from the drums during crushing are passed via an enclosed chute into a drum placed underneath the elevated platform. Vapours are extracted through an oil scrubber and two activated carbon filters in series, before discharge to atmosphere. Interlocks prevent operation of the crusher when either the crusher door is open or the abatement system is not operating.

Drum crushing/shredding units should only vent direct to atmosphere if they are used to crush drums that have been washed and fully purged of their former contents. Where nominally empty drums[2] or drums containing wastes are crushed or shredded, units should not vent direct to atmosphere. The mixing of some wastes may generate toxic or flammable atmospheres and there is also the possibility of static discharges, exothermic reactions and spontaneous combustion with some types and mixes of wastes and reagents. For this reason, procedures must be in place that firstly identify the residual contents of drums to be crushed, and secondly ensure that drums containing residual contents that could cause any of the above occurring are crushed in such a way that the mixture and possible reaction of residual contents expressed from crushed drums is prevented.

[2] In the context of this document ‘nominally empty’ means as empty as practically possible, using practices commonly employed to remove material from the type of packaging involved - including pouring, pumping, aspirating, shaking, scraping, chipping etc., or if necessary a combination of these"

Indicative requirements for drum washing, crushing, shredding and cutting	
1	Empty containers that are in sound condition and are free from residual waste should be sent for reconditioning and re-use. Those drums that are not able to be re-used should be cleaned to facilitate recycling or recovery by other means (see **Section 2.6** on page 84 on waste recovery or disposal).
2	BAT for pre-acceptance criteria (see **Section 2.1.1** on page 20), waste characterisation (see **Section 2.1.2** on page 25) and process control (see **Section 2.1.4** on page 40) as outlined in earlier sections should be followed to prevent incompatible reactions from washwaters or residues.
3	Drums containing (or which have contained): • flammable and highly flammable wastes[1] • volatile substances[2] that cannot be recovered, should not be subject to crushing, unless the residues have been removed and the drum cleaned.
4	Processing of containers should only be undertaken following written instruction. These instructions should include which containers is to be processed and the type of container to hold residues.
5	Emissions to air (see **Section 2.2.1** on page 59) should be controlled by ensuring: • drum crushing and shredding plant is fitted with an extractive vent system linked to abatement, for example, an oil scrubber and activated carbon filter • the abatement system should be interlocked such that the plant cannot operate unless the abatement system is working • all cutting operations should be subject to LEV
6	BAT techniques for emissions to water are outlined in **Section 2.2.2** on page 62, and include the need to: • keep skips for the storage of crushed/cut drums covered • sealed system, e.g. chute, for containment of residues • sealed drainage (see **Section 2.8** on page 89)
7	BAT for fugitive emissions to air are outlined in **Section 2.2.4** on page 69.
8	Necessary measures for accident prevention is outlined in **Section 2.8** on page 89.

[1]As defined by the Special Waste Regulations 1996.

[2]A volatile substance can be defined as that with a vapour pressure > 1.5 mm Hg at 25 oC.

2.1.14 Road tanker washing

Most treatment plants incorporate a washing-out facility to enable the removal of residues from vehicle tanker barrels. In some cases, vapours may become trapped within the sludges. BAT for road vehicle washing includes appropriate actions to avoid any uncontrolled releases, and the identification of intrinsic hazards or potential pollution problems at the waste characterisation stages for residues of wastes that have been delivered to the installation. In this case the washings can be transferred to appropriate storage and treated in the same way as the waste from which it was derived.

Indicative BAT requirements for road tanker washing	
1	Where washwaters from multiple loads are collected and bulked up, procedures should be in place and followed to ensure compatibility of tanker residues with washout previous loads.

2.1.15 Sludge treatment and disposal

In terms of capital expenditure and operating costs, sludge treatment is a significant component, and the management and disposal of sludge will remain as one of the most fundamental issues facing the Operator.

Sludges that are taken from the bottom of settlement tanks will generally be around 0.5 -1.0% dry solids content, with slightly higher values (up to 4% dry solids) for dissolved air flotation.

Sludge dewatering increases the dry solids content of a sludge, producing a "solid" waste. It is a grey area as to where a liquid sludge becomes a solid waste; however, any sludge over 10% dry solids becomes difficult and expensive to pump. Dewatering produces a sludge "cake", which may be between 20 and 50% dry solids, which will in turn significantly reduce disposal costs.

In most cases, further dewatering will first require some form of chemical conditioning to assist in the separation of the bound and entrained water from within the sludge. There is a wide range of high molecular weight polymeric flocculents that are particularly effective, and the high price of such chemicals should be more than offset by the improvement in performance of the dewatering process. A number of sludge dewatering processes exist, and selection will depend upon the nature and frequency of solids produced, and the sludge cake required. Examples include:

- Filter (or plate) presses which are batch processes, and can be manually intensive. The "plates" are covered with a suitable filter cloth (dependent upon the application) and the sludge is fed into the plate cavity. The sludge is dewatered under pressure with the filtrate passing through the filter cloth. Once the pressure is released and the plates separated, the cake is either manually scraped off or vibration mechanisms employed to automate the process. A filter press can produce up to 40% dry solids cake.
- The belt press continuous process with a filter cloth continually running through rollers that forcefully dewater the sludge. Performance optimization requires regular and specialised maintenance. A belt press can produce up to 35% dry solids cake. Chemical costs are generally quite high.
- Centrifuges are also continuous processes that should produce a cake of up to 40% dry solids for certain sludges. Because of the "closed" nature of the centrifuge, associated odour problems are minimal.

Indicative BAT requirements for sludge treatment	
1	Where odorous wastes are treated the storage of filter cake and filter press should be under cover, subject to LEV and with sealed drainage to storage and treatment.
2	Provision should be made to prevent filter cake being carried out of the storage area on vehicle wheels and dust generation from the storage and loading areas.
3	Analysis of the sludge/filter cake should be undertaken to ensure that the treatment process objectives are being met and the process is working effectively.

2.2 Emissions control

2.2.1 Point source emissions to air

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

Point source emissions relate to those emissions that result from the collection of gas from a vessel or area and are passed either via abatement or direct to a stack or vent.

Table 2.4: Point Source Emissions to Air

Activity	Emission point	Abatement options for specified pollutants				
		VOCs	Odour	Particu-late	NH_3, H_2S, Amines	Acid gases
Acid-Alkali neutralisa-tion	Reactor vessel	Ab, Ad, To	Ab, Ad, To		Ab	Ab
Immobilisation	Mixing vessel	Ab, Ad, To	Ab, Ad, To	Ff, Cy		
OIL REPROCESSING	Heating vessels	Co, To	Co, To, Bo			
	Warm oil receiving tanks	Co, To	Co, To, Bo			
	Filtration systems	Co, To	Co, To, Bo			
BULKING UP AND TRANSFER OF WASTE		Ad	Ad			
SECONDARY LIQUID FUEL BLENDING		Ad, Ab, To	Ad, Ab			
DRUM CRUSHING AND SHREDDING		Ad, Ab	Ad, Ab			
See **Table 2.5** on page 60 for air abatement options key.						

Table 2.5: Air abatement options Key

Key	Name	Comment
Ab	Absorption	Suitable for high-flow, low-concentration (e.g. 1-200 mg/m^3 VOCs), low-temperature gas streams, where the pollutant is chemically reactive (or soluble in the case of VOC contaminants). A common use is the treatment of extracted air from reactor vessels with the scrubber liquor typically a caustic solution. Hypochlorite may be used for cyanide scrubbing and odour control. A two-stage system could be utilised, e.g. alkali and hypochlorite scrubbers in series. Water supply and effluent disposal facilities must be available. Monitoring provisions include: • pH, flow rate and level of scrubber liquors and scrubber pressure drop • pressure drop monitoring with alarm • exit concentrations should be periodically monitored under different operating conditions There should be a programme for the regular changing of absorbent in absorption units.
Ad	Adsorption	Carbon adsorption is commonly used as abatement for local extraction points e.g. bulking up and sampling points. It should be avoided where the air steam is moist because the polar nature of the common adsorbents will preferentially adsorb water vapour. For this reason carbon adsorption is not generally suitable for abatement of air emissions from oil processing heating vessels (see **Section 2.1.7** on page 50).
Co	Condensation	Condenser is a term describing a heat exchanger where a gas is cooled to effect a change to the liquid phase. Applications would include emissions from oil reprocessing heating vessel (see **Section 2.1.7** on page 50) which would incorporate recovery of oil components. It can be used as a pre-treatment for thermal oxidation, reducing the fuel requirement and the overall size of the oxidiser.
To	Thermal oxidation	Used for VOC control and will usually require the addition of supplementary fuel to support the combustion process. The Operator can offset the cost of the supplementary fuel when there is a requirement elsewhere on-site for the waste heat that is generated.
Bo	Biological oxidation	Biofilter is a generic term applied to any biological oxidation process taking place in a packed system. This includes the conventional trickling filters, bioscrubbers (microbial population supported in scrubber liquor) or biobeds (packed system using soil, peat and bark). Biobeds have been installed on waste treatment sites for the abatement of odorous emissions. Operational conditions include: • Incoming air must have a relative humidity of >90% (this may require the use of a humidifier). • Particulate must be removed. • Hot gases may need to be cooled closer to the optimal activity temperature for aerobic micro-organisms, generally 25 to 35^{o}C, and the potential temperature rise across the bed of up to 20^{o}C should be taken into account. • The major operating parameters such as the off-gas temperature and back-pressure should be checked daily. • The moisture content in the filters should be monitored regularly. • A low-temperature alarm should be fitted to warn of freezing, which may damage the filter and may affect the growth of the microbial population. • The packing medium must be supported to allow a fast, even air flow without pressure drop. • The medium should be removed when it starts to disintegrate, affecting air flow (bark is less resistant than, for example, heather). • Choice of medium and supporting system affects the power requirement to maintain air flow with power to overcome bed resistance. This is the largest operational cost. • Biofiltration and bioscrubbing have lower operating costs than many other air pollution control technologies for treating low concentrations of biodegradable organic pollutants. Bioscrubbers have the higher maintenance cost of the two. Environmental benefits include low energy requirements and the avoidance of cross-media transfer of pollutants. Consideration should be given to the effect of loss of biomass due to the introduction of toxic compounds, and a stand-by procedure should be developed for such an event.

Table 2.5: Air abatement options Key

Key	Name	Comment
Cy	Cyclones	Relatively cheap and reliable. Not effective against particle sizes < 10 µm, which may require additional measures, for example fabric filters. Operational requirements include: • monitoring of exit concentrations under different operating conditions
Ff	Fabric filters	The industrial fabric filter is generally constructed from a woven material or a felted fabric to provide the filtration medium through which the particle-laden gases are passed. Fabric filters are typically used as secondary or tertiary gas cleaning devices with a cyclone, dry scrubber located upstream. Filter efficiency may be enhanced by pre-coating the filter cloth prior to being brought on-line. Fabric filters are not generally suitable for use in moisture-laden streams or those with acidic, tarry or sticky characteristics due to the adverse effects of fabric "blinding" and adherence problems. Pressure drop should be monitored with alarm and measurement of inlet and exit concentrations is required. An opacity meter or particle impingement detector can be used to monitor performance. There should be a programme for the regular cleaning of filters.

Ref 6 gives cross-sectoral guidance on abatement techniques for point-source emissions to air.

Further detailed information about the control of VOC's can be obtained from Agency guidance Speciality Organic Chemicals Sector IPPC S4.02 'Control of emissions of volatile organic compounds (VOCs) '

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

1 In conjunction with information in this Guidance Note, information and recommendations in the BREF on Common Waste Water and Waste Gas Treatment/ Management Systems in the Chemical Sector should be formally considered as part of the assessment of BAT for point-source releases to air.

2 Abatement is used to clean what could be termed incidental emissions from a process. Emphasis should be placed on the prevention of the production and displacement of pollutants. Abatement can be readily overloaded and become ineffective. Abatement techniques should not be used as an inline process tool as part of the treatment process.

3 Operational control is required to prevent the production of gas during any mixing process. In a dilute aqueous system it should be possible to conduct neutralisation processes without either deliberately or inadvertently producing gases as described above. In such systems, processes involving potentially hazardous substances, for example, acid neutralisation can normally be performed without creating substances that require continuous abatement, for example, SO_x, etc. However, the production of such substances may occur and abatement, for example, wet scrubbing should therefore be installed.

4 Correctly operate and maintain the abatement equipment, including the handling and disposal of spent scrubber medium or spent carbon.

5 The benchmark values for point source emissions to air listed in **Section 3.2.1** on page 112 should be achieved unless alternative values are justified and agreed with the Regulator.

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

7 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** on page 125).

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

Control of visible particulate plumes

8 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

9 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.

10 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.

11 VOCs. Refer to **Section 3.11** on page 124 for general thresholds for Class A and B substances see**Table 3.13: VOCs benchmark emission values**

12 The Operator should justify whether or not abatement is required, assessing the impact of the emissions (this can be done in the response to **Section 4.1** on page 125) and the costs of abatement (see **Ref 2**).

2.2.2 Point source emissions to surface water and sewer

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 7 Releases to water references**) 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 **Ref 7 Releases to water references** see page 130.

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 substances that give rise to the COD of the effluent, the waste materials may contain persistent organic pollutants, some of which are poorly biodegradable, and which can be particularly toxic.

The effluent will be a complex mixture of substances. For emissions to controlled waters, the use of whole effluent bioassays for the assessment of the complex effluent or the control of process inputs should be considered in conjunction with the Regulator.

The use of direct toxicity assessment (DTA) for environmental assessment is included in the document **IPPC Environmental Assessments for BAT** and can be used to:

- supplement chemical-specific assessments accounting for the effects of substances that might otherwise go undetected
- provide an alternative to chemical-specific assessment when there are insufficient ecotoxicological data on the chemicals of concern

A tiered approach is advocated which might involve not using DTA or using cost-effective high-throughput methods.

A DTA approach should be used as a “trigger” for action by industry to investigate and reduce known ecotoxicity problems rather than applied as a pass/fail permit condition, although there may be occasions where this is needed to deliver environmental improvements or gain and maintain public confidence.

Nature of effluent

The majority of point sources from treatment plants are to foul sewer. Emissions to watercourses and groundwater (under consent) are rare, as they would not meet the relevant EQS. Some installations have no connection to foul sewer and consequently rely on tankering away effluent to another disposal point. The emissions can be summarised as in **Table 2.6**.

Table 2.6: Point source emissions to water

Emission to	Unit Process or Activity
Sewer	Physico-chemical treatment Final effluent from acid-alkali neutralisation and precipitation of metals
	Oil reprocessing Effluent treatment to removal oil from condensate and yard drainage
	Cleaning
Watercourse	Rainwater collection
	Car park drainage

A distinction can be made between installations conducting “dry” or solid-phase operations, e.g. transfer or stabilisation that does not produce a distinct liquid effluent, and those conducting liquid-phase treatment, e.g. acid neutralisation and oil-water separation.

“Dry” processes may produce effluent as a result of rainwater collection and spills / leakages. In general, the strength of this effluent in terms of metals and COD will be relatively low. “Wet” processes, in addition to the general effluent arising from yard drainage etc., produce an effluent from the reaction, precipitation, settlement and dewatering processes.

Although precipitation techniques for metals are reasonably effective a typical physico-chemical process (under a trade effluent consent) may discharge between 1 - 3 tonnes of metals to sewer annually. This is associated with particulate carried over in the effluent from the process arising from inefficiencies in either the precipitation stage or settling out of the precipitated metals.

Typically discharges to sewer also include levels of COD of several thousand milligrams per litre. The nature is dependent on the wastes being handled at the installation which invariably involves a wide variety of substances and so results in a complex effluent. Some organics will be removed by adherence of the pollutants to the sludge. However, it can be anticipated that a proportion of organic material will be to some extent water-soluble and will not be affected by the treatment process.

Consideration could be given to membrane processes, for example, micro-, ultra- and nano-filtration. These are being utilised by some water utilities on discharges from WwTW, primarily to control pathogens. There would appear to be scope for the application of these filtration techniques (including sand filters) to remove particulate in effluent, reducing suspended solids.

It is important to note that, whereas a trade effluent consent for a discharge to sewer allows the release of a stated level of pollution, this does not necessarily mean that this is BAT for the treatment process. BAT requires that pollution should be prevented or reduced, within the cost and benefit framework of BAT.

In addition to the BREF and the techniques below, guidance on cost-effective effluent treatment techniques can be found in **Ref 5**, **Water efficiency references:**.

The primary consideration should be to prevent releases of harmful substances to the aquatic environment, whether releases are direct or via a sewage treatment works.

Indicative BAT requirements for control of point source emissions to surface water and sewer (Sheet 1 of 4)	
1	In conjunction with information in the following sections of this Guidance Note (Sections 2.2.2.1-2.2.2.9), information and recommendations in the BREF on Common Waste Water and Waste Gas Treatment/ Management Systems in the Chemical Sector (see **Ref 7**) should be formally considered as part of the assessment of BAT for point-source releases to surface water or sewer
2	The following general principles should be applied in sequence to control emissions to water: • water use should be minimised and wastewater reused or recycled (see also **Section 2.4.3** on page 81) • contamination risk of process or surface water should be minimised (see also **Section 2.2.5** on page 71) • 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
3	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.

Indicative BAT requirements for control of point source emissions to surface water and sewer (Sheet 2 of 4)

4 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.

5 Where prevention is not possible, the emissions benchmarks given in **Section 3** on page 110, should be achieved.

6 Where effluent is treated off-site at a sewage treatment works the above factors still apply. In particular, it should be demonstrated that:

- when considering emission limit values for releases from the installation to sewer, 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.)
- 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.
- a suitable monitoring programme is in place for emissions to sewer.

7 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.

8 The primary objective of a waste water treatment operation has been to produce an effluent that can be transferred to the sewerage undertaker under the terms of a trade effluent discharge consent. It must be emphasised that, if emissions can be reduced further than the treatment provided by the undertaker, or prevented altogether, at reasonable cost, then this should be done irrespective of the requirements of a trade effluent consent. BAT therefore can go further than existing consents. Furthermore, irrespective of the receiving water, the adequacy of the plant to minimise the emission of specific persistent harmful substances must also be considered. Guidance on treatment of persistent substances can be found in References (see **Releases to water references** Ref. 7).

9 As a minimum, all emissions should be controlled to avoid a breach of water quality standards (see **Section 3.2** on page 112 and **Section 4.1** on page 125), but where another technique can deliver better results at reasonable cost it will be considered BAT and should be used (see **Section 1.1** on page 2). Unless reasonably self-evident, the EQS and BAT points should be demonstrated by calculations and/or modelling in the Application.

10 Effluent management within a waste treatment installation can be classified as shown in **Effluent management techniques Table 2.7**.

Primary treatment

11 The Operator should ensure that the levels of metals in solution are minimised by:

- adjusting pH to correct level for minimum solubility
- not exceeding the correct pH level for minimum solubility

Indicative BAT requirements for control of point source emissions to surface water and sewer (Sheet 3 of 4)

12 Harmful and persistent substances, constituting a proportion of the COD load, such as solvents, pesticides, organohalogens and other organic substances, may be adsorbed onto particulate and colloidal matter and be removed as a solid residue. The treatment process does not determine the efficiency of this and removal is highly variable. As a "rule of thumb" to facilitate biodegradation, the COD/BOD ratio of effluent to sewer should typically not exceed 10:1 (see **Monitoring Guidance Ref 11**).

13 The Operator should ensure that cyanide treatment is taken to completion by maintaining pH > 10 and prevent the carryover of NaOCl due to overdosing.

14 The Operator should ensure that the effluent is free of visible oil. This should include procedures to ensure the correct configuration, operation and maintenance of oil-water separation plant.

Secondary treatment - sludge treatment

15 For sludge treatment see **Section 2.1.15** on page 58.

Tertiary treatment

16 Tertiary treatment refers to any process that is considered a "polishing" phase after the secondary treatment techniques, which may also encompass the recovery of specific substances. The need for tertiary treatment is dictated by three potential factors:

- the requirement to meet discharge conditions based on environmental quality standards (EQS) which may be stricter than the requirements of BAT, relevant substances including ammonia, List I and List II substances and suspended solids
- recycling of water for process water or wash water
- recovery i.e. oil from water contaminated with oil by, for example, ultrafiltration

17 There are two categories of tertiary treatment processes:

- macrofiltration
- membrane techniques

18 Macrofiltration describes the tertiary removal of suspended solids, usually through the use of sand filtration or mixed media (for example, sand/anthracite blends). Filters may be either gravity filters or pressure filters.

19 More specialised types of filtration media, such as granular activated carbon (GAC), are used to remove certain chemicals, tastes and odours. GAC works by absorbing the contaminants onto and within the carbon granules. In time the carbon will need regeneration, which is usually carried out by incineration.

20 A number of constantly "self-cleaning" sand filters have also proven to be extremely effective at polishing suspended solids from the final effluent.

Indicative BAT requirements for control of point source emissions to surface water and sewer (Sheet 4 of 4)

21 Membrane techniques is a term applied to a group of processes that can be used to separate suspended, colloidal and dissolved solutes from a process wastewater. Membrane filtration processes use a pressure-driven, semi-permeable membrane to achieve selective separations. Much of the selectivity is established by designations relative to pore size. The pore size of the membrane will be relatively large if precipitates or suspended materials are to be removed (crossflow microfiltration), or very small for the removal of inorganic salts or organic molecules (ultrafiltration or reverse osmosis). During operation, the feed solution flows across the surface of the membrane, clean water permeates through the membrane, and the contaminants and a portion of the feed remain. The clean or treated water is referred to as the permeate or product water stream, while the stream containing the contaminants is called the concentrate, brine, reject, or sludge returns. The Operator should have a strategy for dealing with the concentrate.

22 The technologies employed depend on the level of "filtration" that is actually required, and generally consist of:

- microfiltration
- ultrafiltration
- nanofiltration
- reverse osmosis

Effluent management parameters

23 The Operator should conduct daily visual checks on the effluent management system and maintain a log.

24 The Operator should have in place procedures to ensure that the effluent specification is suitable for the on-site effluent treatment system or discharge criteria

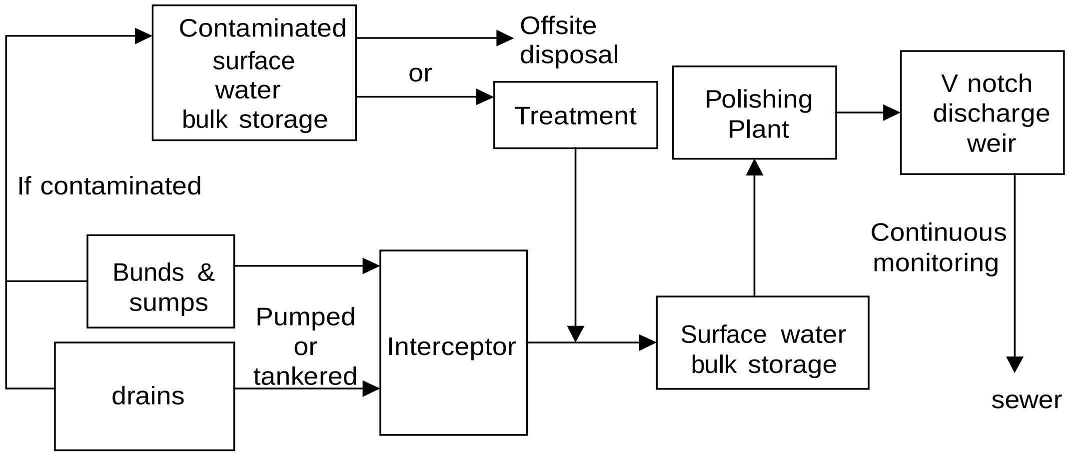
25 The Operator should have in place a system for monitoring effluent discharge and sludge quality (see **Section 2.10** on page 95).

26 Measures should be in place to isolate effluent where samples indicate a breach of specification. Incidents of this nature should be recorded in the effluent log.

Table 2.7: Effluent management techniques

Classification	Objective	Techniques
Screening	To avoid introducing harmful and persistent substances into the system which will be unaffected by treatment	Pre-acceptance and acceptance measures (see **Section 2.1.1** on page 20 and **Section 2.1.2** on page 25)
Primary treatment	Removal or reduction of target substances from wastes	Precipitation of metals pH neutralisation Oxidation of cyanide COD reduction
Secondary treatment	Sludge treatment and disposal	Settlement Thickening and dewatering
Tertiary treatment	"Polishing" of effluent Recovery of substances from effluent	Filtration Membranes

Figure 2.4: Effluent management 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. 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 4**)

Indicative BAT requirements for Application Question B2.4 Identify if there may be a discharge of any List I or List II substances and if any are identified, explain how the requirements of the Groundwater Regulations 1998 have been addressed.	
1	In general, there should be no permitted releases to groundwater of either a direct or indirect nature.
2	If there are releases to groundwater and they are to continue, the requirements of the Regulations, as summarised above, must be complied with.

2.2.4 Fugitive emissions to air

Fugitives

Examples of common sources of fugitive emissions are:

- open vessels (for example, the effluent treatment plant)
- sampling activities
- storage areas (for example, bays, stockpiles, lagoons, etc.)
- the loading and unloading of containers
- transferring/bulking up of material from one vessel to another
- conveyor systems
- pipework and ductwork systems (for example, pumps, valves, flanges, catchpots, drains, inspection hatches, etc.)
- poor building containment and extraction
- potential for by-pass of abatement equipment (to air or water)
- spillages
- accidental loss of containment from failed plant and equipment
- tanker and vessels manhole openings and other access points

- displaced vapour from receiving tanks
- cleaning or replacing of filters
- drum cutting
- wastewater storage
- drum storage
- tank cleaning
- tanker washing

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 control of fugitive emissions to air

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

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)

Indicative BAT requirements for control of fugitive emissions to air	
3	For Information on Odour, see **Section 2.2.6** on page 72.
4	A leak detection and repair (LDAR) programme should be established for installations handling solvents and similar volatile materials. In addition: • Non-intrusive tank volume measurements should be used. • When cleaning filters, filter pot lids should be replaced as soon as possible. • Filter slops should be stored in sealed drums. • Contaminated waters have potential for odours and should be stored in covered tanks. • Drum storage (see **Section 2.1.3** on page 32) should be regularly inspected. • Maintenance schedules should ensure regular cleaning/desludging of tanks to avoid large scale decontamination activities. All odorous materials being transferred directly to sealed containers • Tanker washing should be conducted under a permit to work scheme. If the load is likely to give rise to odour, then the first wash should be with water/aqueous waste and discharged direct to abated storage systems before opening the tanker manways. Open tanker barrel for the minimum amount of time. All washings to be directed to abated storage systems.

2.2.5 Fugitive emissions to surface water, sewer and groundwater

Fugitives

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 released.

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 control of fugitive emissions to Water (Sheet 1 of 2)	
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; • 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).

Indicative BAT requirements for control of fugitive emissions to Water (Sheet 2 of 2)	
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 "Releases to water references" on page 131. 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, locate 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).

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 tor 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.

The definition of pollution includes "emissions which may be harmful to human health or the quality of the environment, cause offence to human senses or impair or interfere with amenities and other legitimate uses of the environment". Odour emissions can constitute "offence to human senses" and are associated with point sources (see **Section 2.2.1** on page 59) as well as fugitive sources (see **Section 2.2.4** on page 69).

Further guidance on odour can be found at Integrated Pollution Prevention and Control (IPPC) IPPC Horizontal Guidance Note for Odour - H4: Parts 1 and 2 see **Odour references** (see **Ref 12**).

Indicative BAT requirements for Odour control (Sheet 1 of 2)	
1	The requirements for odour control will be installation-specific and depend on the sources and nature of the potential odour. In general:
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.

Indicative BAT requirements for Odour control (Sheet 2 of 2)

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.

6 The objective is to prevent emissions of odorous releases that are offensive and detectable beyond the site boundary. This may be judged by the likelihood of complaints. However, the lack of complaint should not necessarily imply the absence of an odour problem.

7 Assessment of odour impact should cover a range of reasonably foreseeable odour generation and receptor exposure scenarios, including emergency events and the effect of different mitigation options.

8 For complex installations, for example where there are a number of potential sources of odorous releases or where there is an extensive programme of improvements to bring odour under control, an odour management plan should be maintained.

9 Emphasis should be placed on pre-acceptance screening (see **Section 2.1.1** on page 20) and the rejection of specific wastes, for example, mercaptans, low molecular weight amines, acrylates or other similarly highly odorous materials, that are only suitable for acceptance under special handling requirements. These may include dedicated sealed handling areas with extraction to abatement.

10 Scrubber liquors should be monitored to ensure optimum performance, i.e. correct pH, replenishment and replacement.

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.

It is a requirement that the management of the installation site is controlled by a person who is a "fit and proper person". This includes a component whereby the management of the Specified Waste Management Activity (SWMA) that is to be carried out is in the hands of Technically Competent Management (TCM), see Agency Guidance '**TECHNICAL COMPETENCE FOR OPERATORS OF AUTHORISED WASTE FACILITIES.**'

Note that "deemed" and "pre-qualification" competence do not apply for the purposes of PPC.

Indicative BAT requirements for management (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

Indicative BAT requirements for management (Sheet 2 of 3)

2 The maintenance system should include auditing of performance against requirements arising from the above and reporting the result of audits to top management.

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** on page 89 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.

Indicative BAT requirements for management (Sheet 3 of 3)
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.
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** on page 85, 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** on page 80)
- 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** on page 78)
- understand the fate of by-products and contaminants and their environmental impact (**Section 2.4.2** on page 80)

2.4.1 Raw materials selection

This section looks at the selection and substitution of raw materials and the following section, **Section 2.4.2** on page 80, 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 possible raw material options should be carefully examined.

An Application for a Permit should contain a list of the materials in use which have 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 in the installation (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 for the continued 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.

The proportion of raw materials (i.e. purchased reagents) used is relatively low and in the first instance wastes are used to treat wastes. However, raw materials are used and **Table 2.8** summarises their use.

Table 2.8: Examples of raw materials usage

Raw material	Application	Principal environmental characteristics
WASTE TREATMENT		
Calcium hydroxide (lime)	Usually purchased in powder form for acid treatment	Hazardous substance Powder difficult to handle Produces large sludge volumes For example, the treatment of sulphuric acid results in a large net production of calcium sulphate sludge. Treatment costs for concentrated sulphuric acid may consequently be up to £200/t
Sodium hydroxide (caustic soda) solution	Abatement reagent typically used in wet scrubbing systems to control acid gases and is also used as a scrubbing liquor in oil processing	Hazardous substance Very low levels of mercury may be found in some grades of caustic soda, which may transfer to effluent leaving the installation
Ferric chloride solution	Additive to aid precipitation of metals and conditioning agent for sludge formation (that is, helps with floc formation)	Strongly coloured in the event of a spillage or incident. No other factors
Sodium hypochlorite	Used in treatment and abatement for cyanide wastes scrubbing and odour control	Strong oxidising agent. Must be stored away from potentially incompatible substances Very low levels of mercury may be found in some grades of caustic soda, which may transfer to effluent leaving the installation
OIL REPROCESSING		
De-emulsifiers	To “crack” emulsified oil-water mixtures in oil recovery	High oxygen demand if released to water in the event of an accident

Consideration has been given to utilising spent lime from incinerator lime injection acid gas abatement systems. Purchased lime has a much higher alkalinity than the spent lime and consequently larger volumes are required of the spent lime, which places a limitation in relation to the size of reactor vessel, that is, > 50 t capacity vessels are required. This requires a similar scale-up with mixing tanks to produce the lime solution. Attention should also be given to the level of metal and organic contamination that may be present.

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.

5 The substitutions in **Table 2.9** should be employed, where applicable.

Table 2.9: Examples of Raw material substitutions

Raw material	Selection techniques
Sodium hydroxide	• Only "mercury-free" Sodium hydroxide should be used
Sodium hypochlorite	• Only "mercury-free" Sodium hypochlorite should be used
Deemulsifiers	• Only fully biodegradable products with known, safe degradation products should be used

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** on page 84. Waste avoidance/minimisation, and the use of clean technologies, is a theme which runs throughout **Section 2.1** on page 20 and **Section 2.2** on page 59. 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** (**Ref 3**) for detailed information, guides and case studies on waste minimisation techniques.

Indicative BAT requirements for waste minimisation audits Identify the raw and auxiliary materials, other substances and water you propose to use.	
1	Some waste minimisation issues are covered in **Section 2.1.4** on page 40.

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 See "Water efficiency references:" on page 130.

Indicative BAT requirements for water efficiency (Sheet 1 of 2)

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 on page 71).

Indicative BAT requirements for water efficiency (Sheet 2 of 2)	
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** on page 62 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.
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.

2.5 Waste handling

In this Sector Guidance Note, waste handling issues are inherent to the 'listed activities'. See **"Pre-acceptance procedures to assess waste" on page 20**, **See "Acceptance procedures when waste arrives at the installation" on page 25.** and **See "Waste storage" on page 32.**

2.6 Waste recovery or 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** on page 20 and related issues are addressed in the sections on abatement techniques (see **Section 2.2** on page 59). The specific requirement for a waste minimisation audit is noted in **Section 2.4.2** on page 80.

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

Indicative requirements for waste recovery or disposal
Describe how each waste stream is proposed to be recovered or disposed of. If you propose any disposal, explain why recovery is technically and economically impossible and describe the measures planned to avoid or reduce any impact on the environment.

1 Waste production should be avoided wherever possible. Any waste that is produced 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.

Filter cake

3 The filter cake arising from the treatment of acidic and alkali solutions and metal precipitation can contain percentage levels of metals such as zinc and copper. Dry solids content should not be less than 15% w/w to facilitate handling (see **Section 2.1.15** on page 58).

Stabilised sludges (see Section 2.1.15 on page 58).

4 The process feedstock should not include substances such as solvents that could be recovered at a subsequent stage by, for example, drying.

Contaminated containers

5 Most drums and and IBC's are designed, manufactured and marked to enable reconditioning / refurbishment. As such 205 litre drums, 800 and 1000 litre IBCs should be cleaned and reconditioned to enable re-use where technically and economically possible.

6 Containers that cannot be re-used where there is no reconditioning market and which have been cleaned can be released into the secondary materials market.

Recovered oil

7 Where it cannot be recycled, utilisation as secondary fuel oil may be acceptable.

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 (2.7.1) 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 (2.7.1)
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 2.10: 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.

*Operator to specify conversion factor of primary source to delivered energy.

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 (2.7.2) (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

Indicative BAT requirements for basic energy requirements (2.7.2) (Sheet 2 of 2)
Describe the proposed measures for improvement of energy efficiency.

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).

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** on page 75 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** on page 88, 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 2.11**.

Table 2.11: 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

Where there is no CCA or DPA in place, the Operator should demonstrate the degree to which the further energy-efficiency measures identified in the implementation plan, including those below, have been taken into consideration for this sector and justify where they have not.

Indicative BAT requirements for further energy efficiency (2.7.3)
Climate Change Agreement or 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**).

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 3** for equivalent legislation in 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 2.1** on page 20. 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 requirements for accidents and abnormal operation (Sheet 1 of 4) Describe your documented system that you proposed (to be used) to identify, assess and minimise the environmental risks and hazards of accidents and their consequences.	
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: • arrangements for the receipt, and checking of incoming wastes, including rejection and quarantine • arangements for the storage, segregation and separation of differing waste types • procedures for the internal transfer, including "bulking-up", of waste materials • 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 requirements for accidents and abnormal operation (Sheet 2 of 4)
Describe your documented system that you proposed (to be used) to identify, assess and minimise the environmental risks and hazards of accidents and their consequences.

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 **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.
- there should be an up-to-date site plan showing the precise location of wastes having specific hazard characteristics (eg oxidising, flammable, dangerous when wet etc) with clear identification of the perimeters of the various designated storage areas and their maximum storage capacity.
- 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.

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

- security systems to prevent unauthorised access should be provided where appropriate.
- 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; fire walls, firebreak,s 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** on page 69 and **Section 2.2.5** on page 71) 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.

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

- Spillage prevention controls must be in place during the transfer of substances (for example, transfer of bulk liquid waste from tanker to storage vessels)
  - The weakest link and subsequently the main source of spillage during transfer from the vehicle to storage arises from the transfer hoses. This is due to either:
  - "tanker drive-off" - a vehicle pulling away whilst still coupled (systems should be in place to prevent this)
  - or because the hose couplings have become damaged or are incompatible. Although the spillages tend to be relatively small, measures should be taken to ensure that the couplings are the correct fit and system. This will prevent the coupling loosening or becoming detached, and in turn will also be helped by the installation providing and maintaining its own hoses.
  - A more serious event would occur if the coupling were unable to withstand the maximum shut valve pressure of the transfer pump.
  - Although the volume lost during routine operations due to ill fitting or damaged hoses may be relatively small, persistent spillage may have a cumulative effect on the surface of the area, which in the long term may damage the surface and lead to a fugitive emission (see **Section 2.2.5** on page 71).
  - Spillages of this nature may also be a source of odour (see **Section 2.2.6** on page 72) and represent poor "housekeeping" practice, requiring constant attention and cleaning.
  - Protection of the transfer hose may not be necessary where a gravity feed system is in place. It will however still be important to maintain a sound coupling at each end of the transfer hose.
  - A more acute accident situation may arise due to the failure of plant or equipment. This may include the failure of a pump seal or the blockage of a filter pot commonly used at transfer points. The prevention of these situations should be addressed by the provision of routine maintenance.
  - A further type of acute incident is associated with the failure of the seal on the road tanker. The prevention of such an incident is outside the control of the Operator of the installation (though not necessarily beyond that of the company that operates the installation). Some provision should be made within the installation for emergency storage for leaking vehicles.
  - In addition to accidents connected with some failure in the transfer equipment, measures should be taken to ensure that the correct waste is discharged to the correct transfer point and that the waste is then transferred to the correct storage point. In order to prevent an unauthorised discharge, a lockable isolating valve should be fitted to loading connection. It should be kept locked during periods when there is no supervision of the unloading points.
  - Drainage from discharge points can be connected or transferred to relevant storage for wastes that have been sampled and checked.
- bulking up of liquid wastes from small containers into larger ones
- unloading/movement of drums and containers
  - Typically drums and containers are delivered on wooden pallets and the pallets are unloaded by forklift. The drums are usually secured together often by shrink-wrap. All pallets should be sound and undamaged and forklift drivers should be trained in the handling of palletised goods.
  - Any damaged pallets should be replaced on arrival and not transferred into storage. Transfer of damaged pallets may lead to other pallets being stored on top, resulting in further damage and possible collapse of the stack.
  - Adequate space should be provided within drum storage areas and drivers should be adequately trained to minimise forklift truck damage to the integrity of drums.
- accumulations of liquids in bunds, sumps, etc., should be dealt with promptly
- such accumulations requiring removal should be analysed to ensure the correct disposal route, for example, pH, COD, heavy metals and other known contaminants from the spillage

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 **Noise references:**)

- 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**

Indicative BAT requirements for noise and vibration (Sheet 1 of 2) 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).

Indicative BAT requirements for noise and vibration (Sheet 2 of 2) 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.	
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.

2.10.1 Emissions monitoring

Indicative BAT requirements for emissions monitoring (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 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.

2 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).

3 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.

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

5 Monitoring and reporting of emissions to water and sewer should include at least the parameters in **Table 2.12**, **Table 2.13** and **Table 2.14** below.

Monitoring and reporting of emissions to air

6 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.

7 The Operator should also have a fuller analysis carried out covering a broad spectrum of substances to establish that all relevant substances have been taken into account when setting the release limits. This should cover the substances listed in Schedule 5 of the Regulations unless it is agreed with the Regulator that they are not applicable. The need to repeat such a test will depend upon the potential variability in the process and, for example, the potential for contamination of raw materials. Where there is such potential, tests may be appropriate.

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

8 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.

9 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** on page 62.

Monitoring and reporting of waste emissions

10 For waste emissions, the following should be monitored and recorded:

- the physical and chemical composition of the waste
- its hazard characteristics
- handling precautions and substances with which it cannot be mixed

11 See **Table 2.15** below.

Table 2.12: Monitoring of process elements for emissions to water

Parameter	Monitoring frequency
Flow rate	Continuous and integrated daily flow rate
pH	Continuous
Suspended solids	Continuous
Temperature	Continuous
COD/BOD	Flow weighted sample or composite samples, weekly analysis, reported as flow weighted monthly averages
TOC	Continuous
Turbidity	Continuous
Dissolved oxygen	Continuous
Odour	Daily

Table 2.13: Monitoring of process effluents released to sewer

Parameter	Monitoring frequency
Flow rate	Continuous (using a flow proportional sampler to create a 24 hr composite sample which is analysed daily against trade effluent consent) and integrated daily flow rate
pH	Continuous
Temperature	Dependent on process. If process may generate an effluent > 25oC continuous monitoring would be appropriate
TOC	Dependent on process. See **Table 2.15**
Odour	Daily

Table 2.14: Monitoring and reporting of emissions to air

Substance/sources	Frequency
Point source emissions e.g. scrubbers from reactors, mixing vessels, storage vessels, drum crushers or vents from extraction systems, for example, total carbon and speciated VOC	Weekly – under a representative range of operating conditions
Oil reprocessing – heating vessels, warm oil receiving tanks and filtration plant	Weekly – under a representative range of operating conditions
Oil process tanks and condenser outlets	Continuous temperature
Combustion emissions	See separate Guidance (**Ref 6**)
Fugitive emissions boundary fence monitoring to detect releases from for example drum storage areas, for example, total carbon and speciated VOC	Weekly – under a representative range of operating conditions
Odour	Daily as well as dynamic dilution olfactometry at appropriate intervals

2.10.2 Environmental monitoring (beyond installation)

Indicative BAT requirements for environmental monitoring (beyond 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 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.

Monitoring of emissions to air:

- Oil reprocessing installations should have in place daily olfactory odour monitoring programmes (see **Section 2.2.6** on page 72).
- Only larger (> 50 MW) boiler plant may have sufficient impact on local air quality to require specific air quality management programmes.
- Otherwise daily visual monitoring to air for smoke, dust, litter, plumes and daily olfactory odour monitoring, with more extensive monitoring if nuisance is occurring or appears likely (see **Ref 12**).

Monitoring of emissions to land:

6 It is unlikely that sludge would be re-used for agricultural benefit or ecological improvement or where sensitive soil systems or terrestrial ecosystems are at risk from indirect emission via the air. Otherwise there should no emissions to land and consequently there are no monitoring requirements.

Monitoring of emissions to groundwater:

7 Groundwater monitoring should take place where:

- there are any subsurface structures carrying or holding waste or other harmful substances for example, fuel
- there is uncertainty about surfaces on operational areas and drainage systems, especially on older sites

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 Some process variables may affect the environment and these should be identified and monitored as appropriate. Examples might be:

2 as shown in **Table 2.16**.

Table 2.15: Monitoring of resource use

Resource variable	Comment	Monitoring frequency
Fresh water use across the installation and at individual points of use	See **Section 2.4.3** on page 81	Normally continuous and recorded
Energy consumption across the installation and at individual points of use		Normally continuous and recorded

Table 2.16: Monitoring of treatment process

Treatment Process	Comment	Monitoring frequency
Efficiency of the treatment process as a whole (see **Section 2.2** on page 59)	The precipitation of metals from solution for removal in the filter cake The degree of transfer between the incoming waste and the emissions (to air, solid waste to land and liquid effluent to sewer of for example pesticides or solvents)	Continuous
Reaction monitoring (acid-alkali neutralisation)	To ensure that the reaction is under control and proceeding towards the anticipated result	Continuous and automatic monitoring of pH and temperature
Cyanide treatment	pH to be maintained > 10 Discharges of aqueous effluent to watercourses should therefore be monitored continuously for cyanide content, free chlorine and pH	Continuous pH and continuous free chlorine
Treatment of phenolic solutions	Reaction monitoring	Process temperature, pH and redox potential - continually monitored
Oil re-processing	Maintain temperature <90 °C	Continuous and recorded
Temperature in heating vessels and condenser outlets		
Stabilisation	To ensure product meets declared specification	Each batch
Wet air oxidation	Oxygen (interlocked and alarmed at a minimum of 2% 02) Temperature Pressure	Continuous

2.10.4 Monitoring standards (Standard Reference Methods)

2.10.5 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.

Organisations undertaking manual stack emission monitoring (and any subsequent analysis of samples) must be accredited by UKAS to ISO/IEC 17025.

2.10.6 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 2.10.5.

2.10.7 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 2.10 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 2.17: 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

2.10.8 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.

2.10.9 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.

2.10.10 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

2.10.10.1 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 2.18: 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) (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 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)

Indicative BAT requirements for monitoring standards (Standard Reference Methods) (Sheet 2 of 2)

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

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)**).

Operators of new Installations are required to return the site to a 'satisfactory state' which had been previously been identified in the site report. Installations that transfer from the Waste Management Licensing regime that are SWMA's are subject to additional closure requirements as the operator is required to return the site to a 'satisfactory state' which would reflect the state of the site when the WML was originally issued.

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, where appropriate, measures relating to the design and construction of the installation).

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

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, where appropriate, measures relating to the design and construction of the installation).

- 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
- 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** on page 2 (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

It is possible that some waste management activities that are undertaken at an installation may not be 'listed activities' themselves and where they are not 'directly associated activities' they cannot be incorporated into the PPC permit. These activities will be required to be regulated under the Waste Management Licensing Regulations 1994 either under a WML or an appropriate exemption

Wastes that are stored for treatment within the installation boundary that are not subject to the PPC permit, must be clearly marked and stored in clearly designated areas

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 issues
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.

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 the emissions inventory 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.

3.2 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.

3.2.1 Emissions to air associated with the use of BAT

The emissions quoted below are daily averages based upon continuous monitoring during the period of operation. See **Section 3.2.6** on page 115 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%

3.2.2 Emissions to water associated with the use of BAT

Wastewater treatment systems can maximise the removal of metals using precipitation, sedimentation and 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 limit

Where spot samples are taken:

- no individual spot sample in a range of samples, shall exceed the limit by more than 50%

3.2.3 Standards and obligations

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 3** for equivalent legislation in 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 7** 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** on page 129).
- 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.

3.2.5 Statistical basis for benchmarks and limits in Permits

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:

- Temperature 273 K (0^oC), pressure 101.3 kPa (1 atmosphere), no correction for water vapour or oxygen.
- The reference conditions for combustion or incineration processes are as given in the appropriate Guidance Note.

These reference conditions relate to the benchmark release levels given in this Note and care should always be taken to convert benchmark and proposed releases to the same reference conditions for comparison. The Permit may employ different reference conditions if they are more suitable for the process in question.

To convert measured values to reference conditions, see the **Monitoring Guidance** for more information.

3.3 Biological oxygen demand (BOD)

The following benchmark emissions are relevant for discharge to water, including sewer.

Table 3.1: Benchmark emission values

UK Water quality objectives	BOD (ATU) (mg/l, 90%ile)	Dissolved O_2 (% saturation, 10%ile)
Class 1	2.5	80
Class 2	4.0	70
Class 3	6.0	60
Class 4	8.0	40
Class 5	15	20
Designated freshwaters SI 1997/1331		Dissolved O_2 (mg/l *)
Salmonid imperative: guideline:	- 3	50%>9 50%>9 100%>7
Cyprinid imperative: guideline:	- 6	50%>7 50%>9 100%>5

* 50% median and 100% minimum standard

Benchmark emission values

The BOD benchmarks are obviously important where a treated effluent is being discharged to a watercourse. It is also an important measure where the effluent is to be treated off-site (see **Section 2.2.2** on page 62) where the Operator has to assess the off-site treatment against what could be carried out on-site under BAT criteria.

On-site biological treatment plant can be designed to deliver a concentration of 10-20 mg/l (flow weighted monthly average), for any incoming load. The mass release will therefore be determined by the water flow. Minimisation of water usage would therefore be important. Lower values can be achieved by filtration as secondary or tertiary treatment.

For new plant discharging to controlled water, 10-20 mg/l represents BAT in the general case. Existing plant should be uprated to meet at least the larger values in the ranges for the appropriate plant in **Table 3.1**.

In specific cases it may be possible to demonstrate that BAT does not require these levels. Such a case should be based upon:

- understanding of the chemical composition of the discharge, in particular the lack of persistent, bio-accumulative, or toxic elements which could have been removed by further treatment
- a knowledge of the local environment and an assessment of the likely impact thereon
- an appropriate environmental monitoring programme to demonstrate that there is no significant impact

3.4 Chemical oxygen demand (COD)

Other applicable standards and obligations

None

Benchmark emission values

Not available

Emission limit values would normally only be set if the impact of the COD was understood and there is a clear reason for setting the limit, such as to drive a reduction to an agreed plan, as a toxicity surrogate or where there are agreed actions that can be employed to control it. Thus it is more important that there is:

- an understanding of the chemical composition of the discharge, in particular the lack of persistent, bioaccumulative, or toxic elements which could have been removed by further treatment
- a knowledge of the local environment and an assessment of the likely impact thereon
- an appropriate environmental monitoring programme to demonstrate that there is no significant impact

3.5 Halogens

Other applicable standards and obligations

(Extracts from standards are quoted for ease of reference. The relevant standards should be consulted for the definitive requirements.)

Table 3.2: Extract from standards for residual chlorine

Designated freshwaters SI 1997/1331	Total residual chlorine (as mg/l HOCl)
Salmonid imperative: guideline:	0.005 -
Cyprinid imperative: guideline:	0.005 -
Dangerous Substances List 1 (Fresh or tidal)	

Benchmark emission values

Table 3.3: Halogens benchmark emission values

Media	Substance	Activity	Benchmark value	Basis for the benchmark
To air	HCl and HF	Combustion/incineration	See appropriate Guidance	

3.6 Heavy metals

Other applicable standards and obligations

(Extracts from standards are quoted for ease of reference. The relevant standards should be consulted for the definitive requirements.)

Table 3.4: Extract from standards for heavy metals

Designated freshwaters SI 1997/1331	Zinc and Copper
UK water quality objectives	Dependant on water hardness – see Regulations and Note 1

Table 3.5: Extract from standards for heavy metals

Dangerous Substances emission limits µg (as metal)/l annual average	Mercury	Cadmium
Dangerous Substances emission limits List 1 Fresh: Coastal:	1.0 0.3	5 2.5
Dangerous Substances emission limits List 2 (Fresh or tidal)	Most metals – see Note 1	

Note 1: unless these metals are known to be used – from assessment of raw materials inventory or from a one-off analysis (see **Section 2.1.1** on page 20), further monitoring or emission limit values are not normally required.

Benchmark emission values

Where sources of mercury or cadmium cannot be eliminated or reduced to the levels in **Table 3.4** and **Table 3.5** by control at source, abatement will be required to control releases to water. In biological treatment 75 - 95% of these metals will transfer to the sludge. Levels are unlikely to cause problems for the disposal of sludge but care will need to be taken to ensure that levels in the receiving water are acceptable. The figures **Table 3.6** are achievable, if necessary, to meet water quality standards.

Table 3.6: Heavy metals benchmark emission values

Media	Substance	Activity	Achievable levels if required	Basis for the benchmark
To water	Mercury	Transferred from caustic	0.1 µg/l	Parity with other sectors
To air	Heavy metals	Combustion/incineration	See appropriate Guidance	

3.7 Nitrogen oxides

Other applicable standards and obligations

(Extracts from standards are quoted for ease of reference. The relevant standards should be consulted for the definitive requirements.)

Statutory Instrument 1989 No 317, Clean Air, The Air Quality Standards Regulations 1989 gives limit values in air for nitrogen dioxide.

Statutory Instrument 1997 No 3043, Environmental Protection, The Air Quality Regulations 1997 gives air quality objectives to be achieved by 2005 for nitrogen dioxide

The UNECE Convention on Long-Range Transboundary Air Pollution. Negotiations are now under way which could lead to a requirement further to reduce emissions of NO_x.

The Waste Incineration Directive requires a NO_x level of 200 mg/m^3.

Benchmark emission values

Table 3.7: Nitrogen oxides benchmark emission values

Media	Activity	Benchmark value		Basis for the benchmark
		Mass release	Concentration	
To air	Waste acid treatment			Sound process control should prevent the emission of NO_x
To air	From combus-tion plant		See appropriate Guidance Note	Will require the use of good combus-tion chamber design and low NO_x burners

3.8 Nutrients

Other applicable standards and obligations

(Extracts from standards are quoted for ease of reference. The relevant standards should be consulted for the definitive requirements.)

Table 3.8: Extracts from standards for nutrients

UK water quality objectives	Ammonia total (mg/l N, 90%ile)	Non-ionised ammonia (total) (mg/l N, 95%ile)
Class 1	0.25	0.021
Class 2	0.6	0.021
Class 3	1.3	0.021
Class 4	2.5	-
Class 5	9.0	-

Table 3.9: Extracts from standards for nutrients

Designated freshwaters SI 1997/1331	Nitrite (mg/l N)	Ammonia total (mg/l N, 90%ile)	Non-ionised ammonia (total) (mg/l N, 95%ile)
Salmonid imperative: guideline:	- 0.150	0.780 0.030	0.021 0.004
Cyprinid imperative: guideline:	- 0.460	0.780 0.160	0.021 0.004

Benchmark emission values

Nitrogen and phosphorus in the effluent will arise from the treatment of nitric acid, ammonia compounds, amines, etc., and phosphoric acid. The benchmarks are obviously important where a treated effluent is being discharged to a watercourse, where account must be taken of nitrate or phosphate vulnerability of the receiving environment.

It is also an important measure where the effluent is to be treated off-site (see **Section 2.2.2** on page 62) where the Operator has to assess the off-site treatment against what could be carried out on-site under BAT criteria.

3.9 Suspended solids

The term "particulate" for releases to air includes all particle sizes from submicrometre combustion fume to coarse dust from storage yards. Suspended solids refers to releases to water.

Other applicable standards and obligations

(Extracts from standards are quoted for ease of reference. The relevant standards should be consulted for the definitive requirements.)

Water:

see **Table 3.10**.

Table 3.10: Extracts from standards for suspended solids

Designated freshwaters SI 1997/1331	Suspended solids annual average (mg/l)
Salmonid or cyprinid guideline:	25

Air:

Statutory Instrument 1989 No 317, Clean Air, The Air Quality Standards Regulations 1989 gives limit values in air for suspended particulates.

Statutory Instrument 1997 No 3043, Environmental Protection, The Air Quality Regulations 1997 gives air quality objectives to be achieved by 2005 for PM_{10}.

Benchmark emission values

Not available.

BAT requires that emissions are prevented or reduced where an assessment of the costs and benefits shows such action to be reasonable. However, the nature of the receiving water will influence the assessment of the benefits, also, particulate matter is a carrier for many other pollutants that adhere to it (to whichever medium it is released) and this must be taken into account. Reductions are more likely to be driven by the need to reduce BOD/COD.

Table 3.11: Suspended solids benchmark emission values

Activity	Benchmark value	Basis for the benchmark
Particulate to air		
Fugitive from equipment, plant buildings, storage yards and materials handling (see **Section 2.2.4** on page 69)	"No visible dust" criteria may normally be appropriate	Parity with other UK industrial sector benchmarks for fugitive or low-level, relatively benign, nuisance dusts
Point release from enclosed systems (see **Section 2.2.1** on page 59)	50 mg/m^3	
Point release from combustion plant/ incineration	See appropriate Guidance Note	See appropriate Guidance Note. Based on parity with other sectors

3.10 Sulphur dioxide

Other applicable standards and obligations

(Extracts from standards are quoted for ease of reference. The relevant standards should be consulted for the definitive requirements.)

Statutory Instrument 1989 No 317, Clean Air, The Air Quality Standards Regulations 1989 gives limit values in air for sulphur dioxide.

Statutory Instrument 1997 No 3043, Environmental Protection, The Air Quality Regulations 1997 gives air quality objectives to be achieved by 2005 for sulphur dioxide.

The UNECE Convention on Long-Range Transboundary Air Pollution. Under this Convention, a requirement further to reduce SO_2 emissions from all sources has been agreed. The Second Sulphur Protocol (Oslo, 1994) obliges the UK to reduce SO_2 emissions by 80% (based on 1980 levels) by 2010.

Benchmark emission values

Table 3.12: Sulphur dioxide benchmark emission values

Media	Activity	Benchmark value		Basis for the benchmark
		Mass release	Concentration	
To air	From combustion plant		See appropriate Guidance Note	Would include low-sulphur fuels or control of sulphur emissions

3.11 Volatile organic compounds (VOCs)

The term “volatile organic compounds” includes all organic compounds released to air in the gas phase.

Other applicable standards and obligations

(Extracts from standards are quoted for ease of reference. The relevant standards should be consulted for the definitive requirements.)

The “Solvents Directive” - The EC Directive on the limitation of emissions of VOCs due to the use of organic solvents in certain activities and installations is to be adopted shortly.

“Reducing Emissions of VOCs and Levels of Ground Level Ozone: A UK Strategy” was published by the Department of the Environment in October 1993. It sets out how the Government expects to meet its obligations under the UNECE VOCs Protocol to reduce its emissions by 30% (based on 1988 levels) by 1999, including the reductions projected for the major industrial sectors. Waste treatment is included in the “other miscellaneous industries” sector, with no specific reduction targets stated.

The UNECE Convention on Long-Range Transboundary Air Pollution. Negotiations are now under way which could lead to a requirement to further reduce emissions of VOCs.

Benchmark emission values

These values relate to point source emissions. However, as a first principle, pre-acceptance screening and testing should be used to ensure that unsuitable wastes do not enter the treatment process.

Table 3.13: VOCs benchmark emission values

Emission	Activity	Threshold	Benchmark value	Basis for the benchmark
High risk extremely hazardous to health, such as benzene, vinyl chloride and 1,2–dichloroethane	Various	0	2–5 mg/m^3	Parity with other UK industrial sector benchmarks
Class A compounds: those organic compounds that may cause significant harm to the environment, such as acetaldehyde, acrylic acid, benzyl chloride, carbon tetrachloride	Various	100 g/h	20 mg/m^3	
Class B Compounds: organic compounds of lower environmental impact than Class A compounds	Various	5 t/yr or 2 kg/hr	75 mg/m^3 as carbon	

For emissions to water see BOD/COD.

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 the impact assessment (Sheet 1 of 2) Provide an assessment of the potential significant environmental effects (including transboundary 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 the impact assessment (Sheet 2 of 2) Provide an assessment of the potential significant environmental effects (including transboundary 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 The Waste Management Licensing Regulations

Some requirements of the **Waste Framework Directive** (WFD) are implemented in England and Wales through Schedule 4 of the **Waste Management Licensing Regulations 1994** (WMLR) (for equivalent legislation in N Ireland see **Appendix 3**) or the **Waste Management Licensing Regulations (Northern Ireland) 2003**. Article 4 of the WFD is concerned with the 'relevant objectives' (see paragraph 2 below) and is implemented via paragraph 4 of Schedule 4 of the WMLR. These 'relevant objectives' are over arching provisions that apply to all installations that undertake the disposal or recovery of waste.

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 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 the assessment for BAT, in which case a cross-reference may suffice.

The PPC permit also implements the requirements imposed by Article 9 of the WFD. These provisions will apply to all installations that dispose of waste by means of operations specified in Annex IIA of the WFD. This definition of disposal covers a broad range of activities such as landfill, waste treatment and storage.

Many installations will undertake on-site treatment operations of waste generated as a result of production activities eg. effluent treatment. In the future, greater emphasis will be placed on the treatment of waste to meet permit conditions that mirror the obligations of Regulation 11(3) set out in Section 2.6, or Regulation 10 of the **Landfill (England and Wales) Regulations 2002** (for equivalent legislation in N Ireland see **Appendix 3**) or the **Landfill Regulations (Northern Ireland) 2003**.

Permits that authorise these Annex IIA disposal activities are required to address Article 9 requirements whether the disposal operation is a 'listed activity' or a 'directly associated activity'. The mechanisms and structure of a PPC application are likely to address most of these requirements. It will however, be necessary for the Operator briefly to consider each of these points individually and ensure they are addressed by their proposals.

Indicative BAT requirements for the Waste Management Licensing Regulations (Sheet 1 of 2)
Explain how the information provided in other parts of the application also demonstrates that the requirements of the relevant objectives of the Waste Management Licensing Regulations 1994 have been addressed, or provide additional information in this respect.

1 In relation to activities involving the disposal or recovery of waste, the Regulators are required to discharge their functions in accordance with the relevant objectives as set out in Schedule 4 of the Waste Management Licensing Regulations 1994. (For the equivalent Regulations in Northern Ireland, see **"Equivalent legislation in Northern Ireland and Wales" on page 137**

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 process or methods which could harm the environment and in particular without:
  - risk to water, air, soil, plants or
  - animals or
  - causing nuisance through noise or odours or
  - adversely affecting the countryside or places of special interest
- Implementing, as far as material, any plan made under the plan-making provisions

Indicative BAT requirements for the Waste Management Licensing Regulations (Sheet 2 of 2)
Explain how the information provided in other parts of the application also demonstrates that the requirements of the relevant objectives of the Waste Management Licensing Regulations 1994 have been addressed, or provide additional information in this respect.

3 Operators should identify any development plans made by the local planning authority, including any waste local plan and Waste Strategy 2000 commenting on the extent to which the proposals accord with the contents of any such plan.

4 Where a Regulator grants or modifies a permit and the activities authorised by the permit include the disposal of waste, it is required to exercise its function as set out in paragraph 6 of Schedule 4 of the Waste Management Licensing Regulations 1994, "Matters to be covered by permits". (For the equivalent Regulations in Northern Ireland, see **See "Equivalent legislation in Northern Ireland and Wales" on page 137.**). In particular, the Regulator must ensure that the permit covers;

5 (a) the types and quantities of waste,

6 (b) the technical requirements,

7 (c) the security precautions to be taken,

8 (d) the disposal site, and

9 (e) the treatment method.

10 Where other Directives may apply (for example, the Waste Incineration Directive or Waste Oils Directive), many of the requirements referred to in the paragraph above will have been specified in detail as a result of the requirements of such Directives.

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 purposes of the Conservation (Natural Habitats etc) Regulations 1994 (SI 1994/2716).
Your response should cover all relevant issues pertinent to your installation, including those below. In doing so you should justify your proposals against any indicative requirements stated.

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 Northern Ireland see **Appendix 3**). 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. The same information can also be accessed via tthe 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 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**

Ref 2 Assessment methodologies:

• *E1 BPEO Assessment Methodology for IPC*

• *IPPC Environmental Assessments for BAT* H1

Ref 3 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 4 HSE GUIDANCE References

• *HSG51, Storage of flammable liquids in containers,* ISBN 0-7176-1471-9

• *HSG71, Chemical Warehousing - the storage of packaged dangerous substances* ISBN 07176-1484-0

• *CS21, The Storage and Handling of Organic Peroxides*ISBN 0-7176-2403-X

• *HSG 176 Storage of flammable liquids in tanks,* ISBN 0-7176-1470-0

• *The Safe Use and Handling of Flammable Liquids*HSG 140

• *HSG 143 Designing and Operating safe chmical reaction processes* ISBN 0-7176-1051-9

• *Storage and Handling of Corrosive Liquids, ITN/IPC4/02,* Environment Agency

• *The Storage and Handling of Drums and Intermediate Bulk Containers* PPG 26, Environment Agency

Ref 5 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 6 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 7 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 8 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

Ref 9 Energy references

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

Ref 10 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 11 Monitoring Guidance

• *MCERTS approved equipment* link via **www.mcerts.net**

• *Technical Guidance Note M1 - Sampling requirements for monitoring stack emissions to air from industrial installations, Version 2, Environment Agency, 2002*. **www.environment-agency.gov.uk**

• *Technical Guidance Note M2 - Monitoring of stack emissions to air,* Version 2, Environment Agency, 2003. **www.environment-agency.gov.uk**

• *Technical Guidance Note M18 - Monitoring of discharges to water,* Version 1, Environment Agency,, 2004. **www.environment-agency.gov.uk**

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

Ref 12 Odour references

• *Odour Assessment and Control – Guidance for Regulators and Industry* (joint agencies guidance in preparation)

• *Integrated Pollution Prevention and Control (IPPC) IPPC Horizontal Guidance Note for Odour -* H4: Parts 1 and 2

Ref 13 Noise references:

• *H3 Horizontal Guidance for Noise Part 1* Regulation and Permitting

• *H3 Horizontal Guidance for Noise Part 2* Assessment and Control

Ref 14 Closure references

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

Ref 15 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 16 Directives

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

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

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

• *Habitiats Directive* (92/43/EC)

Appendix 1: Abbreviations

BAT	Best Available Techniques – see IPPC A Practical Guide or the Regulations for further definition
BAT Criteria	The criteria to be taken into account when assessing BAT, given in Schedule 2 of the PPC Regulations
BOD	Biochemical Oxygen Demand
BPEO	Best Practical Environmental Option
BREF	BAT Reference Document
CEM	Continuous Emissions Monitoring
CHP	Combined heat and power plant
COD	Chemical Oxygen Demand
ELV	Emission Limit Value
EMS	Environmental Management System
EQS	Environmental Quality Standard
ETP	Effluent treatment plant
ITEQ	International Toxicity Equivalents
MCERTS	Monitoring Certification Scheme
NIEHS	Northern Ireland Environment and Heritage Service
SAC	Special Areas of Conservation
SECp	Specific Energy consumption
SED	Solvent Emissions Directive
SEPA	Scottish Environment Protection Agency
SPA	Special Protection Area
TSS	Suspended solids
TOC	Total Organic Carbon
VOC	Volatile organic compounds
WML	Waste Management Licence

Appendix 2: Some common monitoring and sampling methods

The Agency's Technical Guidance Notes (Monitoring) M1, Sampling Requirements for Monitoring Stack Emissions to Air from Industrial Installations, and M2, Monitoring of Stack Emissions to Air, are available via the "Search Site" facility on the Agency's web page, http://www.environment-agency.gov.uk/, entering M1 or M2 as the keyword. These documents provide key references as regards more detailed insight into different approaches to monitoring stack emissions, sampling strategies and choice of technique, method, and equipment. Relative advantages and disadvantages of continuous versus periodic measurements are summarised in Part 2 of M2. Situations where continuous monitoring (continuous emissions monitoring systems - CEMs) may be more appropriate are discussed further in Section 5 of this note. Manual sampling and analysis methods are used to meet periodic or intermittent regulatory monitoring requirements and in some cases for validation and calibration of CEMs.

Table 4.1: Measurement methods for common substances to water

Determinand	Method	Detection limit Uncertainty	Valid for range mg/l	Standard
Suspended solids	Filtration through glass fibre filters	1 mg/l 20%	10-40	ISO 11929:1997, EN872 - Determination of suspended solids
COD	Oxidation with di-chromate	12 mg/l 20%	50-400	ISO 6060: 1989, Water Quality - Determination of chemical oxygen demand
BOD5	Seeding with micro-organisms and measurement of oxygen content	2 mg/l 20%	5-30	ISO 5815: 1989, Water Quality Determination of BOD after 5 days, dilution and seeding method EN 1899 (BOD 2 Parts)
AOX	Adsorption on activated carbon and combustion	-- 20%	0.4 - 1.0	ISO 9562: 1998, EN1485 - Determination of adsorbable organically bound halogens.
Tot P				BS 6068: Section 2.28 1997, Determination of phosphorus –ammonium molybdate spectrometric method
Tot N				BS 6068: Section 2.62 1998, Determination of nitrogen Part 1 Method using oxidative digestion with peroxydisulphate, BS EN ISO 11905
pH				SCA The measurement of electric conductivity and the determination of pH, ISBN 0117514284
Turbidity				SCA Colour and turbidity of waters 1981, ISBN 0117519553 EN 27027:1999
Flow rate	Mechanical ultra-sonic or electromagnetic gauges			SCA Estimation of Flow and Load, ISBN 011752364X
Temperature				
TOC				SCA The Instrumental Determination of Total Organic Carbon and Related Determinants 1995, ISNB 0117529796 EN 1484:1997
Fatty acids				Determination of Volatile Fatty Acids in Sewage Sludge 1979, ISBN 0117514624
Metals				BS 6068: Section 2.60 1998, Determination of 33 elements by inductively coupled plasma atomic emission spectroscopy
Chlorine				BS6068: Section 2.27 1990, Method for the determination of total chlorine: iodometric titration method

Table 4.1: Measurement methods for common substances to water

Determinand	Method	Detection limit Uncertainty	Valid for range mg/l	Standard
Chloroform Bromoform				BS 6068: Section 2.58, Determination of highly volatile halogene-taed hydrocarbons – Gas chromatographic methods
Dispersants Surfactants Anionic Cationic Non-ionic				SCA Analysis of Surfactants in Waters, Wastewaters and Sludges, ISBN 01176058 EN 903:1993 (Used for anionic surfactants)
Pentachloro-Phenol				BS5666 Part 6 1983, Wood preservative and treated timber quantitative analysis of wood preservatives containing pentachlorophenol EN 12673:1997 (used for chlorophenol and polychlorinated phenols)
Formaldehyde				SCA The determination of formaldehyde, other volatile aldehydes and alcohols in water
Phosphates and nitrates				BS 6068: Section 2.53 1997, Determination of dissolved ions by liquid chromatography
Sulphites and sulphates				BS 6068: Section 2.53 1997, Determination of dissolved ions by liquid chromatography
Ammonia				BS 6068: Section 2.11 1987, Method for the determination of ammonium: automated spectrometric method
Grease and oils	IR absorption	0.06 mg/kg		SCA The determination of hydrocarbon oils in waters by solvent extraction IR absorption and gravimetry, ISBN 011751 7283

Table 4.2: Measurement methods for air emissions

Determinand	Method	Av'ging time Detection limit Uncertainty	Compliance criterion	Standard
Formaldehyde	Impingement In 2,4 dinitro-phenyl-Hydrazine HPLC	1 hour 1 mg/m^3 30%	Average of 3 consecutive samples below specified limit	US EPA Method 316 Method specific to formaldehyde.
Ammonia	FTIR or Ion Chromatography	1 hour 0.5mg/m^3 25%		US EPA Method 320 for extractive instruments. US EPA Method 26 for wet chemistry.
VOCs	Speciated - Adsorption Thermal Desorption GCMS	1 hour 0.1 mg/m^3 30%		BS EN 1076:1997 Workplace atmospheres. Pumped sorbent tubes for the determination of gases and vapours. Requirements and test methods.
	Total Organic Carbon	1 hour 0.4 mg/m^3 calculated	Continuous or spot check	BS EN 12619:1999. Determination of the mass concentration of total gaseous organic carbon at low concentrations in flue gases – continuous flame ionisation method.3
Chloroform	Absorption on activated carbon solvent extraction. GC analysis	1 hour 1 mg/m^3 20%	Average of 3 consecutive samples below specified limit	MDHS 28 Chlorinated hydrocarbon solvent vapours in air (modified)
Oxides of Sulphur	UV fluorescence Automatic analyser	1 hour 1 ppm 10%	95% of hourly averages over a year below specified limit	BS6069 Section 4.4 :1993 (ISO 7935) Stationary source emissions-determination of mass concentrations of sulphur dioxide4.

Table 4.2: Measurement methods for air emissions

Determinand	Method	Av'ging time Detection limit Uncertainty	Compliance criterion	Standard
	Wet sampling train Ion chromatography	1 hour 1 mg/m^3 25%	Average of 3 consecutive samples below specified limit	BS6069 Section 4.1:1998 (ISO 7934) Method for the determination of the mass concentration of sulphur dioxide-hydrogen peroxide/barium perchlorate method
Hydrogen Chloride	Wet sampling 3 analytical methods	30 minute minimum 0.2 mg/m^3 calculated	One test	BS EN 1911:Parts 1-3:1998 Manual method of determination of HCl
Particulate matter	Extractive – sample train	3 minutes per point 5 mg/m^3 10%	One test	BS EN 13284-1:2002 Determination of low range mass concentration of dust — Part 1: Manual gravimetric method.
	Continuous – Automatic analyser	Continuous N/A 10%	Continuous	BS ISO 10155:1995Automated Monitoring of mass concentrations of particles – performance characteristics, test methods and specifications.
PCDD/F	Extractive – Sample train GC/MS	4 hour minimum 8 hour maximum 0.1 ng I-TEQ/m^3 calculated		BS EN 1948:1997 determination of the mass concentration of PCDD/F

Measurement uncertainty is defined as total expanded uncertainty at 95% confidence limit calculated in accordance with the Guide to the Expression of Uncertainty in Measurement, ISBN 92-67-10188-9, 1st Ed., Geneva, Switzerland, ISO 1993.

See also **Monitoring Guidance**

Appendix 3: Equivalent legislation in Northern Ireland and Wales

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

Table 4.3: Equivalent legislation

England	Wales	Northern Ireland
PPC Regulations (England and Wales) 2000, SI 2000 No.273 (as amended)	As England	PPC (NI) Regulations 2003, SR 2003 No.323
SI:1994 1056: Waste Management Licensing Regulations	As England	SR 2003 No. 493: The Waste Management and Licensing Regulations (NI) 2003
The Water Resources Act 1991	As England	The Water (NI) Order 1999
SI 1989 No.317: Clean Air, The Air Quality Standards Regulations 1989	As England	SR 1990 No.145: The Air Quality Standards Regulations (Northern Ireland) 1990
SI 1995 No. 3146: The Air Quality Standards (Amendments) Regulations 1995		SR1996 No.23: The Air Quality Standards (Amendments) Regulations (Northern Ireland) 1996
SI 2002 No. 3043 The Air Quality (England) (Amendment) Regulations 2002	SI 2002 No. 3182 (W.298) The Air Quality (Amendment) (Wales) Regulations 2002	
SI 2000 No.928: The Air Quality (England) Regulations 2000	SI 2000 No.1940 (W.138): The Air Quality (Wales) Regulations 2000	No NI equivalent
SI 2002 No. 3117 The Air Quality Limit Values (Amendment) Regulations 2002	SI 2002 No. 3183 (W.299) The Air Quality Limit Values (Wales) Regulations 2002	
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	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	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	The Quality of Bathing Water Regulations (NI) 1993
SI 1997 No.1331: The Surface Waters (Fishlife) (Classification) Regulations 1997	As England	The Surface Water (Fishlife) (Classification) Regulations (NI) 1997

Table 4.3: Equivalent legislation

England	Wales	Northern Ireland
SI 1997 No.1332: The Surface Waters (Shellfish) (Classification) Regulations 1997	As England	The Surface Water (Shellfish) (Classification) Regulations (NI) 1997
SI 1994 No.2716: The Conservation (Natural Habitats, etc) Regulations	As England	Conservation (Natural Habitats etc) Regulations (Northern Ireland) 1995
SI 1999 No.743: Control of Major Accident Hazards Regulations (COMAH) 1999	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	SR 1998 No.401. The Groundwater Regulations (Northern IrelandI) 1998
SI 2002 No.2980: The Waste Incineration (England and Wales) Regulations 2002	As England	SR 2003 No.390: The Waste Incineration Regulations (Northern IrelandI) 2003

Appendix 4: 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 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 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

Dichlorvos

Dicofol

Dieldrin

Dimethoate

Tetrachloroethylene

Triazophos

Tributyl tin oxide (TBTO)

Tributyl-phosphate

Trichlorfon

1,2,4-Trichlorobenzene

Trichloroethylene Dichlorprop

Trichlorophenol (all isomers)

Trifluralin

Triphenyl tin oxide (TPTO)

Triphenyl-phosphate

Appendix 5: List of changes

Table 4.4: List of Changes

Change	Reason	Author	Authorised By	Date