Process Guidance Note 5/2(10)

Statutory Guidance for Crematoria

Statutory Guidance for Local Air Pollution Prevention and Control (LAPPC)

Revision of the Guidance

The electronic version of this publication is updated from time to time with new or amended guidance. The table below is an index to the latest changes (minor amendments are generally not listed).

Date of amendment	Chapter/paragraph where amendment can be found	Nature of amendment - what paragraphs have been inserted, deleted or amended - what subject matter is covered by amendment

Contents

1. Introduction

Legal basis

1.1 This note applies to the whole of the UK. It is issued by the Secretary of State, the Welsh Assembly Government, the Scottish Government and the Department of the Environment in Northern Ireland, (DoE NI), to give guidance on the conditions appropriate for the control of emissions into the air from the cremation of human remains. It is published only in electronic form and can be found on the Defra, DoENI, SEPA and WAG websites. It supersedes PG5/2 (04) and NIPG 5/2 (September 2005) Version 2.

1.2 This guidance document is compliant with the Code of Practice on Guidance on Regulation page 6 of which contain the "golden rules of good guidance". If you feel this guidance breaches the code or you notice any inaccuracies within the guidance, please contact us.

1.3 This is one of a series of statutory notes[1] giving guidance on the Best Available Techniques (BAT)[2]. The notes are all aimed at providing a strong framework for consistent and transparent regulation of installations regulated under the statutory Local Air Pollution Prevention and Control (LAPPC) regime in England and Wales, Scotland and Northern Ireland. The note will be treated as one of the material considerations when determining any appeals against a decision made under this legislation.

1.4 In general terms, what is BAT for one installation in a sector is likely to be BAT for a comparable installation. Consistency is important where circumstances are the same. However, in each case it is, in practice, for regulators (subject to appeal) to decide what is BAT for each individual installation, taking into account variable factors such as the configuration, size and other individual characteristics of the installation, as well as the locality (e.g. proximity to particularly sensitive receptors).

1.5 The note also, where appropriate, gives details of any mandatory requirements affecting air emissions which are in force at the time of publication, such as those contained in Regulations or in Directions from the Government. In the case of this note, at the time of publication this includes the following:

- Environmental Protection (England) (Crematoria Mercury Emissions Burden Sharing Certificate) 2010 which came into force on 18 March 2010;
- Environmental Protection (Crematoria Mercury Emissions) (Wales) Direction 2010 which came into force on 19 April 2010.

[1] this and other notes in the series are issued as statutory guidance in England and Wales under regulation 64(2) of the Environmental Permitting Regulations. The notes are also issued as guidance in Scotland and statutory guidance in Northern Ireland

[2] further guidance on the meaning of BAT can be found for England and Wales, Scotland, and Northern Ireland.

1.6 In **Section 4** and **Section 5**, arrows are used to indicate the matters which should be considered for inclusion as permit conditions. It is important to note, however, that this should not be taken as a short cut for regulators to a proper determination of BAT or to disregard the explanatory material which accompanies the arrows. In individual cases it may be justified to:

- include additional conditions
- include different conditions
- not include conditions relating to some of the matters indicated.

In addition, conditions will need to be derived from other parts of the note, in particular to specify emission limits, compliance deadlines and mandatory requirements arising from directions or other legislation.

Who is the guidance for?

1.7 This guidance is for:

Regulators

- local authorities in England and Wales, who must have regard to the guidance when determining applications for permits and reviewing extant permits;
- the Scottish Environment Protection Agency (SEPA) in Scotland, and district councils or the Northern Ireland Environment Agency, (NIEA), in Northern Ireland.

Operators who are best advised also to have regard to it when making applications and in the subsequent operation of their installation.

Members of the public who may be interested to know what the Government considers, in accordance with the legislation, amounts to appropriate conditions for controlling air emissions for the generality of installations in this particular industry sector.

Updating the guidance

1.8 The guidance is based on the state of knowledge and understanding, at the time of writing, of what constitutes BAT for this sector. The note may be amended from time to time to keep up with developments in BAT, including improvements in techniques, changes to the economic parameters, and new understanding of environmental impacts and risks. The updated version will replace the previous version on the Defra website and will include an index to the amendments.

1.9 Reasonable steps will be taken to keep the guidance up-to-date to ensure that those who need to know about changes to the guidance are informed of any published revisions. However, because there can be rapid changes to matters referred to in the guidance – for example to legislation – it should not be assumed that the most recent version of this note reflects the very latest legal requirements; these requirements apply.

Consultation

1.10 This note has been produced in consultation with relevant trade bodies, representatives of regulators including members of the Industrial Pollution Liaison Committee, and other potentially-interested organisations.

Policy and procedures

1.11 General guidance explaining LAPPC and setting out the policy and procedures is contained in separate documents for England and Wales, Scotland and Northern Ireland.

2. Timetable for compliance and reviews

Existing processes or activities

2.1 This note contains all the provisions from previous editions which have not been amended or removed. For installations in operation at the date this note is published, the regulator should have already issued or varied the permit having regard to the previous editions. If they have not done so, this should now be done.

2.2 Fitting mercury arrestment by end of 2012 is required at 50% of UK cremations and burden sharing is required for unabated cremations. (Details at paragraphs 4.4 – 4.10).

2.3 The new provisions of this note and the dates by which compliance with these provisions is expected are listed in the table below, together with the paragraph number where the provision is to be found. Compliance with the new provisions should normally be achieved by the dates shown. Permits should be varied as necessary, having regard to the changes and the timetable.

Table 1 - Compliance timetable

Guidance	Relevant Paragraph/Row in this Note	Compliance Date
Fit gas meter on each cremator	4.11	New and replacement cremators– from date of publication Others - within 12 months of date of publication
All other provisions		Within 12 months of the publication of this note

2.4 Replacement plant should normally be designed to meet the appropriate standards specified for new installations/activities.

2.5 Where provisions in the preceding guidance note have been deleted or relaxed, permits should be varied as necessary as soon as reasonably practicable. **Section 6** provides a summary of all changes.

2.6 For new activities, the permit should have regard to the full standards of this guidance from the first day of operation.

2.7 For substantially changed activities, the permit should normally have regard to the full standards of this guidance with respect to the parts of the activity that have been substantially changed and any part of the activity affected by the change, from the first day of operation.

Permit Reviews

2.8 Under LAPPC the legislation requires permits to be reviewed periodically but does not specify a frequency. It is considered for this sector that a frequency of once every eight years ought normally to be sufficient for the purposes of appropriate Regulations[3]. Further guidance on permit reviews is contained in the appropriate Guidance Manual for England and Wales, Scotland and Northern Ireland. Regulators should use any opportunities to determine the variations to permits necessitated by paragraph 2.2 above in conjunction with these reviews.

2.9 Conditions should also be reviewed where complaint is attributable to the operation of the process and is, in the opinion of the regulator, justified.

[3] For details see England and Wales, GGM chapter 26, Scotland, Practical guide section 10, Northern Ireland Part B Guidance page 9, Northern Ireland Part C Guidance chapter 17.

3. Activity description

Regulations

3.1 This note applies to LAPPC installations for cremation of human remains in:

- gas fired and electric fired cremators in new and existing crematoria, with or without mercury abatement
- standby cremators
- small-scale cremators

The activities are listed for regulation as follows.

Table 2 - Regulations listing activities

LAPPC	Activity	England and Wales	Scotland	Northern Ireland
		EPR Schedule 1 reference	PPC Schedule 1 reference	PPC Schedule 1 reference
Part A	n/a	n/a	n/a	n/a
Part B	Cremation of human remains	Section 5.1 Part B	Section 5.1 Part B	n/a
Part C	Cremation of human remains	n/a	n/a	Section 5.1 Part C
The links are to the original version of the Regulations. A consolidated version is **not** available on www.legislation.co.uk.				

3.2 Cremation is a batch process consisting (excluding pre-heating and shut-down) of:

a. the brief "flash" caused by volatization of the veneer on the outside of the coffin;
b. burning of the coffin;
c. after the coffin breaks open, burning of the coffin and cremation of the body;
d. calcination of the remains; and
e. ashing.

3.3 The timescales involved for these processes are typically

a. 1 minute
b. 20 minutes
c. 40 minutes
d. 30 minutes
e. 2 minutes although times may vary.

Abatement Plant

3.4 Fitting mercury arrestment by end of 2012 is required at 50% of UK cremations.

3.5 Potential pollutants from unabated cremations consist of particulate matter (PM), hydrogen chloride, nitrogen oxides, carbon monoxide, volatile organic compounds (from methane to polyaromatic hydrocarbons (PAH), mercury compounds and polychlorinated dibenzo-p-dioxins and furans (PCDD/F) often simply referred to as dioxins.

3.6 Flue gases from abated cremations may also include particulate matter from:

- alkali compounds added to the flue gases to control acid gas (e.g. hydrogen chloride) emissions;
- activated carbon powder used to control dioxin and mercury emissions;
- incompletely combusted char and soot particles.

3.7 The arrestment provisions in this note are based on an abatement system of cool, capture, collect. The hot exhaust gases are cooled using, for example water tube coolers. Injecting dry lime or sodium bicarbonate and activated carbon into the gas stream captures pollutants. A dry filter captures the particulate matter and a reduction of between 90 to 98% in mercury concentrations is expected. Alternatives with equal or better performance may be accepted. However, conditions in a permit stating a percentage reduction are not recommended.

Emergency Release of Pollutants

Unabated crematoria

3.8 In existing, unabated crematoria, the chimney will have been designed at a sufficient height to achieve adequate dispersal of pollutants during normal operation. In the event of a breakdown where it is necessary to release gases immediately, then a much shorter dumpstack may be used. See also paragraph 5.11.

Existing, abated crematoria

3.9 For **existing** crematoria that choose to fit abatement, in the majority of cases the existing chimney (originally designed for dispersion of unabated emissions) will be used as the emissions release point during normal operation. It is also likely that the original, short dumpstack will be available for emergency releases that have not been abated. See also paragraphs 5.12 – 5.13.

3.10 In the event of a failure of the abatement equipment, unabated gases can follow three routes for release to atmosphere depending on the design of the plant:

1. Unabated gases can “bypass” the abatement plant and be ducted to the original, main chimney, therefore being dispersed at the optimum height.
2. Unabated gases can “bypass” to an alternative Emergency Release Vent (ERV) designed at the optimum height for the dispersal of unabated emissions.
3. Unabated gases can be directly vented to the original short dumpstack or a new, alternative, shorter ERV.

New Processes

3.11 For **new** crematoria (required to fit abatement) the chimney height may be calculated at a height for the release of abated gases during normal operation and may be **shorter** than the optimum height for unabated gases.

3.12 Emergency release vents will be included in the design that will allow unabated gases to be released in the event of a breakdown of the abatement equipment. It is not considered BAT to require that either the main chimney or the ERV be built at a height calculated to be sufficient for the release of unabated gases See also paragraphs 5.12 – 5.13.

4. Emission limits, monitoring and other provisions

4.1 Emissions of the substances listed Table 3 below should be controlled.

4.2 The emission limit values and provisions described in this section are achievable using the best available techniques described in Section 5. Monitoring of emissions should be carried out according to the method specified in this section or by an equivalent method agreed by the regulator. Where reference is made to a British, European, or International standard (BS, CEN or ISO) in this section, the standards referred to are correct at the date of publication. (Users of this note should bear in mind that the standards are periodically amended, updated or replaced. The latest information regarding the monitoring standards applicable can be found at the Source Testing Association website. Further information on monitoring can be found in Environment Agency publications (M1) and (M2)).

4.3 All activities should comply with the emission limits and provisions with regard to releases in **Table 3.**

The reference conditions for limits in **Section 4** are: 273.1K, 101.3kPa, 11% oxygen v/v, dry gas unless otherwise stated.

Table 3: Unabated cremators - emission limits, monitoring and other provisions

Row	Substance	Mass emission limits per cremator	Type of monitoring	Monitoring frequency (subject to paragraphs 4.30 – 4.32)
1	Hydrogen chloride (excluding particulate matter)	300g an hour	Extractive test	Annual
2	Total particulate matter from cremator	120g an hour for 95% of cremations and 240g an hour for all cremations	Provide visual alarms and record levels and alarms Manual extractive test (capable of collecting 75% of particulate matter with a diameter of 0.1micron or less)	Continuous indicative **plus** Annual
3	Carbon monoxide	150g in the first hour of cremation for 95% of cremations and 300g in the first hour of cremation for all cremations	Record data at less than 10 second intervals, No more than 3 cremators per analyser, Provide visual alarms and record alarm events	Continuous indicative **plus** Annual test
4	Organic compounds (excl particulate matter) expressed as carbon	30g an hour.		Annual test
Concentration limits from cremated remains reduction plant that vents externally are given in Row 5				
5	Particulate matter	50mg/m^3 with no correction for oxygen concentration or water vapour	See also paragraph 5.23	After a substantial change

Row	Parameter	Combustion Provision	Type of monitoring	Monitoring frequency (subject to paragraphs 4.30 – 4.32)
6	Temperature	Minimum of 1123K (850ºC) in the secondary combustion chamber	Measure at the entrance and after the exit from the secondary combustion zone Automatically record temperatures Visual alarm when temperature falls below 1123K Interlock to prevent cremator loading	Continuous Continuous Record alarm activations
7	Residence time	2 seconds residence time (minimum) in the secondary combustion chamber without correction for temperature, oxygen or water vapour	Measurement and calculation of the volume rate of the flue gases throughout the cremation cycle at the cremator exit.	After a substantial change
8	Oxygen	At the end of the secondary combustion chamber, measured wet or dry, minimum average 6% and minimum 3%	Monitor and record of concentration at outlet of secondary combustion zone Visual alarm and record alarm activations During discontinuous tests, continuous reference oxygen measurements should be at the same sampling location as the parameters tested	Continuous Activate alarm when oxygen falls below provision

If combustion provisions are not met, then the dioxin emission limit and monitoring provision in Row 9 should be applied				
Row	**Substance**	**Mass limits per cremator**	**Type of Monitoring**	**Monitoring frequency (subject to paragraphs 4.30 – 4.32)**
9	PCDD/F On unabated processes for cremators that don't meet the combustion provisions above	4.5 micrograms as ITEQ per 3 cremations	Extractive - Temperature, oxygen and any flow parameters that apply during the dioxin tests, should be required by the permit Interlock to prevent cremator loading unless those parameters are met	After a substantial change Continuous

When calculating mass emissions, the cremator should multiply the flow rate at that moment by the concentration at that moment.

Carbon monoxide continuous monitors may be replaced by direct continuous monitors for total gaseous combustibles. They should be calibrated by, and read as, carbon monoxide.

For all continuous measurements, the mass of emissions per hour is calculated from the measured values from 2 minutes after the close of coffin loading door until the removal of calcined remains.

Continuous emission monitors (CEMs)

There are several grades of continuous emission monitors and continuous emission monitoring, depending on the instrument and how it is calibrated. The grades recognised in this table are: Continuous quantitative measurement, continuous qualitative measurement, filter leak monitoring, indirect monitoring, and gross filter failure detection. See Appendix 4 for more detail.

Table 4: Abated cremators - emission limits, monitoring and other provisions

Row	Substance	Concentration emission limit	Type of monitoring	Monitoring frequency (subject to paragraphs 4.30 – 4.32)
1	Mercury	50 micrograms/m^3	Extractive	Annual
2	Hydrogen chloride (excluding particulate matter)	30 mg/m^3 averaged over an hour	Extractive test	Annual
3	Total particulate matter from cremator	20 mg/m^3 averaged over an hour for 95% of cremations and 40 mg/m^3 averaged over an hour for all cremations.	Provide visual alarms and record levels and alarms Manual extractive test (capable of collecting 75% of particulate matter with a diameter of 0.1micron or less)	Continuous indicative Annual
4	Carbon monoxide	100 mg/m^3 averaged over the first hour for 95% of cremations and 200 mg/m^3 averaged over the first hour for all cre mations.	Record data at less than 10 second intervals, No more than 3 cremators per analyser, Provide visual alarms and record alarm events	Continuous filter leak monitor or continuous filter failure detector Annual test
5	Organic compounds (excl particulate matter) expressed as carbon	20 mg/m^3 averaged over an hour of cremation.		Annual test
6	Particulate matter from cremated remains reduction plant that vents externally	50 mg/m^3 with no correction for oxygen concentration or water vapour		On commissioning and after a substantial change
Concentration limits from cremated remains reduction plant that vents externally are given in Row 7.				
7	Particulate matter	50mg/m^3 with no correction for oxygen concentration or water vapour	See also paragraph 5.23	After a substantial change

Row	Parameter	Combustion Provision	Type of monitoring	Monitoring frequency (subject to paragraphs 4.30 – 4.32)
8	Temperature	minimum of 800ºC in the secondary combustion chamber	Measure at the entrance and after the exit from the secondary combustion zone Automatically record temperatures Visual alarm when temperature falls below 1123K Interlock to prevent cremator loading below 800ºC	Continuous Continuous Record alarm activations
9	Residence time	2 seconds residence time (minimum) in the secondary combustion chamber without correction for temperature, oxygen or water vapour	Measurement and calculation of the volume rate of the flue gases throughout the cremation cycle at the cremator exit.	On commissioning and after a substantial change
10	Oxygen	At the end of the secondary combustion chamber, measured wet or dry, minimum average 6% and minimum 3%	record of concentration at outlet of secondary combustion zone Visual alarm and record alarm activations During discontinuous tests, continuous reference oxygen measurements should be at the same sampling location as the parameters tested	Continuous Activate alarm when oxygen falls below provision

If combustion provisions are not met, then the dioxin emission limit and monitoring provision in Row 11 should be applied				
Row	**Substance**	**Concentration emission limit/ provisions**	**Type of monitoring**	**Monitoring frequency (subject to paragraphs 4.30 – 4.32)**
11	PCDD/F On abated processes, for cremators that don't meet the combustion provisions below	0.1 nanograms/m3 as ITEQ	Extractive Temperature, oxygen and any other parameters that apply during the dioxin tests, should be required by the permit	On commissioning and after a substantial change Continuous
Continuous emission monitors (CEMs) There are several grades of continuous emission monitors and continuous emission monitoring, depending on the instrument and how it is calibrated. The grades recognised in this table are: Continuous quantitative measurement, continuous qualitative measurement, filter leak monitoring, indirect monitoring, and gross filter failure detection. See Appendix 4 for more detail.				

Abate mercury emissions and / or burden share

4.4 Crematoria should fit mercury abatement or join a burden sharing arrangement. The following paragraphs set out the details.

New crematoria fit mercury abatement

4.5 All new crematoria (as defined in next paragraph) should be fitted with mercury abatement. However, in recognition that new crematoria commonly begin operation at substantially below full capacity, abatement should not be required to be in operation until the sooner of the following two dates:

- the date when it is likely that, within the subsequent 12 months, more than 750 cremations will take place at the crematorium,
- 31 December 2012.

4.6 For paragraph 4.5, a new crematoria is a crematoria which was not an existing installation on 1 October 2006.

Existing crematoria fit mercury abatement or burden share

4.7 By 1 June 2006 existing crematoria notified their regulator whether they opt:

- for fitting abatement, or
- for sharing the cost of abatement fitted by other crematoria (whether or not owned by the same operator), or
- to choose a combination of these two approaches.

4.8 By 31 Dec 2012 existing crematoria should be fitted with mercury abatement to the extent necessary to ensure that 50% of all cremations carried out are subject to abatement .

4.9 '50%' is based on the Federation of British Cremation Authorities' 2003 cremation statistics, but excluded are those involving stillbirths, perinatal deaths, and deaths of infants under 5 years.The total number of cremations in 2003 according to these statistics was 430,006. The total number of cremations involving stillbirths, perinatal deaths, and deaths of infants under 5 years in 2003 was 12,532. Therefore, the national 50% figure is 208,737.

Certificate of number of cremations: total, abated, burden shared,

4.10 Regulators in England and Wales are directed, and regulators in Scotland instructed, that every crematorium permit must have the following condition inserted

- The operator shall send the regulator, by no later than 1 June 2010 and 1 April in each year thereafter, a certificate from the Crematoria Abatement of Mercury Emissions Organisation (CAMEO) organisation or appropriate evidence from a comparable audited burden sharing arrangement or scheme which specifies:-

a. the total number of cremations in the past 12 months;
b. the number of cremations undertaken in cremators fitted with operational mercury abatement equipment in the previous 12 months; or
c. the number of cremations undertaken in the previous 12 months and the proportion of those subject to burden sharing arrangements under which money is paid for the benefit of abated crematoria; or
d. in cases where mercury abatement is fitted but fewer than 50% of cremations at the installation were undertaken in cremators fitted with it in the previous 12 months, the relevant information in both b) and c).

Gas meter

4.11 Each cremator should be fitted with a gas supply meter;.

- for existing cremators, by 12 months from the date of publication of this note
- for new cremators, from the date of publication of this note

This paragraph does not apply to stand-by or small scale cremators.

Monitoring, investigating and reporting

4.12 The operator should monitor emissions, make tests and inspections of the activity. The need for and scope of testing, (including the frequency and time of sampling), will depend on local circumstances.

- The operator should keep records of inspections, tests and monitoring, including all non-continuous monitoring, inspections and visual assessments. The records should be:
  - kept on site
  - kept by the operator for at least two years; and
  - made available for the regulator to examine
- If any records are kept off-site they should be made available for inspection within one working week of any request by the regulator.

Information required by the regulator

4.13 The regulator needs to be informed of monitoring to be carried out and the results. The results should include process conditions at the time of monitoring.

- The operator should notify the regulator at least 7 days before any periodic monitoring exercise to determine compliance with emission limit values. The operator should state the provisional time and date of monitoring, pollutants to be tested and the methods to be used.

- The results of non-continuous emission testing should be forwarded to the regulator within 8 weeks of completion of the sampling.
- Adverse results from **any** monitoring activity (both continuous and non-continuous) should be investigated by the operator as soon as the monitoring data has been obtained. The operator should:
  - identify the cause and take corrective action
  - clearly record as much detail as possible regarding the cause and extent of the problem, and the remedial action taken.
  - re-test to demonstrate compliance as soon as possible; and inform the regulator of the steps taken and the re-test results.

4.14 The reports required differ for abated and unabated cremators. For unabated cremators use the list below. For abated cremators use the list below, but omit particulate matter.

4.15 The operator should decide whether to report for periods of 4 weeks or 1 month.

- For each cremator, for carbon monoxide and for particulate matter, the operator should report the following continuous monitoring values to the regulator every 6 months;
  - Monthly or four weekly average from the first hour of each cremation;
  - values that exceed the 95% limit for each substance in Table 3 or 4, as appropriate in that period for each cremation;
  - 60-minute mean emission values that exceed the 100% limit for each substance in Table 3 or 4, as appropriate in that period for each cremation;
  - a list of the highest 60-minute mean emission value for each period;
  - the 95-percentile value for each period. (The Example Report in **Appendix 1** shows one way to select the 95-percentile value.)
- For temperature, and oxygen, the operator should report the following continuous monitoring values to the regulator every 6 months:
  - secondary chamber entrance temperature, 4-weekly / monthly maximum and minimum;
  - secondary chamber exit temperature, 4-weekly / monthly maximum and minimum;
  - oxygen concentration, 4-weekly / monthly minimum;

4.16 Where the combustion provisions in Table 3 or 4, as appropriate are not met continuously, then more detailed reporting may be needed.

4.17 The results should be presented in a format that enables the regulator to check compliance for oxygen, temperature, carbon monoxide and particulate matter with Tables 3 or 4, as appropriate.

4.18 In **Appendix 1** an Example Report is included, though cremator manufacturers may vary in the format they provide. The example assumes that the cremator complies with the combustion provisions although not all cremators do.

Visible and Odorous Emissions

4.19 The aim should be to prevent any visible airborne and odorous emissions from any part of the process. This aim includes all sites regardless of location.

4.20 Emissions from cremations should in normal operation be free from visible smoke and in any case should not exceed the equivalent of Ringelmann Shade 1 as described in British Standard BS 2742: 2009

- There should be no offensive odour beyond the process boundary, as perceived by the regulator
- All other releases to air, other than condensed water vapour, should be free from persistent visible emissions.
- All emissions to air should be free from droplets.

Where there are problems that, in the opinion of the regulator, may be attributable to the installation, such as local complaints of visual emissions or where dust from the installation is being transported off the site, the operator should inspect in order to find out which operation(s) is the cause.

If this inspection does not lead to correction of the problem then the operator should inform the regulator in order to determine whether ambient air monitoring is necessary. Ambient monitoring may either be by a British Standard method or by a method agreed with the regulator.

Whilst problems are ongoing, visual and olfactory checks should also be made once per day when an installation is being operated. The time, location and result of these checks, along with weather conditions such as indicative wind direction and strength, should be recorded. Once the source of the emission is known, corrective action should be taken without delay.

Abnormal Events

4.21 The operator should respond to problems which may have an adverse effect on emissions to air.

- In the case of abnormal emissions, malfunction or breakdown leading to abnormal emissions the operator should:
  - investigate and undertake remedial action **immediately**
  - adjust the process or activity to minimise those emissions; **and**
  - promptly record the events and actions taken

- The regulator should be informed without delay, whether or not there is related monitoring showing an adverse result:
  - if there is an emission that is likely to have an effect on the local community; or
  - in the event of the failure of key arrestment plant, for example, bag filtration plant or scrubber units

- The operator should provide a list of key arrestment plant and should have a written procedure for dealing with its failure, in order to minimise any adverse effects

Continuous Monitoring

4.22 Continuous monitoring can be either “quantitative” or “indicative”. With quantitative monitoring the discharge of the pollutant(s) of concern is measured and recorded numerically. For pollution control this measurement is normally expressed in milligrams per cubic meter of air, (mg/m3). Where discharge of the pollutant concerned is controlled by measuring an alternative parameter, (the “surrogate” measurement), this surrogate is also expressed numerically.

Continuous indicative monitoring is where a permanent device is fitted, for example, to detect leaks in a bag filter, but the output, whether expressed numerical or not, does not show the true value of the discharge. When connected to a continuous recorder it will show that emissions are gradually (or rapidly) increasing, and therefore maintenance is required. Alternatively it can trigger an alarm when there is a sudden increase in emissions, such as when arrestment plant has failed.

4.23 Where continuous indicative monitoring has been specified the information provided should be used as a management tool. Where used the monitor should be set up to provide a baseline output when the plant is known to be operating under the best possible conditions and emissions are complying with the requirements of the permit. Where used to trigger alarms the instrument manufacturer should be able to set an output level which corresponds to around 75% of the emission limit. Thus the alarms are activated in response to this significant increase in pollutant loading above the baseline, so that warning of the changed state is given before an unacceptable emission occurs. The regulator may wish to agree the alarm trigger level.

4.24 Where continuous monitoring is required, it should be carried out as follows:

- All continuous monitoring readings should be on display to appropriately trained operating staff.
- Instruments should be fitted with audible and visual alarms, situated appropriately to warn the operator of arrestment plant failure or malfunction.
- The activation of alarms should be automatically recorded.
- All continuous monitors should be operated, maintained and calibrated (or referenced, in the case of indicative monitors) in accordance with the manufacturers' instructions, which should be made available for inspection by the regulator. The relevant maintenance and calibration (or referencing, in the case of indicative monitors) should be recorded.
- Emission concentrations may be reported as zero when the plant is off and there is no flow from the stack. If required a competent person should confirm that zero is more appropriate than the measured stack concentration if there is no flow.
- Any CEM used should provide reliable data>95% of the operating time, (i.e. availability >95%). A manual or automatic procedure should be in place to detect instrument malfunction and to monitor instrument availability

Calibration and compliance monitoring

4.25 Compliance monitoring can be carried out either by use of a continuous monitor (CEM), or by a specific extractive test carried out at a frequency agreed with the regulator.

4.26 Where a CEM is used for compliance purposes it must be periodically checked, (calibrated), to ensure the readings being reported are correct. This calibration is normally done by carrying out a parallel stand-alone extractive test and comparing the results with those provided by the CEM.

4.27 For extractive testing the sampling should meet the following requirements:

- For batch processes, where the production operation is complete within, say, 2 hours, then the extractive sampling should take place over a complete cycle of the activity; **and**
- For all activities the sampling period should be sufficient such that at least 3 results are obtained.

4.28 Should the activity either be continuous, or have a batch cycle that is not compatible with the time available for sampling, then the data required should be obtained over a minimum period of 2 hours in total.

- For demonstration of compliance where a CEM is used no daily mean of all 15-minute mean emission concentrations should exceed the specified emission concentration limits during normal operation (excluding start-up and shut-down); **and**
- no 15-minute mean emission concentration should exceed twice the specified emission concentration limits during normal operation (excluding start-up and shut-down).
- For extractive testing, no result of monitoring should exceed the emission limit concentrations specified.

4.29 Exhaust flow rates should be consistent with efficient capture of emissions, good operating practice and meeting the requirements of the legislation relating to the workplace environment.

- The introduction of dilution air to achieve emission concentration limits should not be permitted.

Dilution air may be added for waste gas cooling or improved dispersion where this is shown to be necessary because of the operational requirements of the plant, but this additional air should be discounted when determining the mass concentration of the pollutant in the waste gases.

Varying of monitoring frequency

4.30 Where non-continuous quantitative monitoring is required, the frequency may be varied. Where there is consistent compliance with emission limits, regulators may consider reducing the frequency. However, any significant process changes that might have affected the monitored emission should be taken into account in making the decision.

4.31 The following should be considered when deciding whether compliance is consistent:

a. the variability of monitoring results, for example, results which range from 15 - 45 mg/m^3, against an emission limit of 50 mg/m^3 might not qualify for a reduction in monitoring.
b. the margin between the results and the emission limit, for example, results which range from 45 - 50 mg/m^3 when the limit is 50 mg/m^3 might not qualify for a reduction in monitoring.

Consistent compliance should be demonstrated using the results from at least;

- three or more monitoring exercises within two years; or
- two or more monitoring exercises in one year supported by continuous monitoring.

Where a new or substantially changed process is being commissioned, or where emission levels are near to or approach the emission concentration limits, regulators should consider increasing the frequency of testing.

4.32 Where continuous indicative monitoring is required it is not appropriate that reduced monitoring be applied as the monitoring is required to demonstrate either compliance with emission limits on an ongoing basis or to demonstrate correct functioning of arrestment equipment.

Sampling provisions

4.33 [The mercury load in human remains varies significantly, and so testing during a cremation with no mercury load would not demonstrate compliance adequately. Dosing, [say 2 fillings worth] by placing on the coffin a wooden block with mercury amalgam inserted in it, gives confidence that the test is valid].

4.34 The operator should ensure that adequate facilities for sampling are provided on vents or ducts. Sampling points on new plant should be designed to comply with the British or equivalent standards.

Where monitoring is not in accordance with the main procedural requirements of the relevant standard, deviations should be reported as well as an estimation of any error invoked.

4.35 Whether sampling on a continuous or non-continuous basis care is needed in the design and location of sampling systems in order to obtain representative samples for all release points.

- Sampling points on new plant should be designed to comply with the British or equivalent standards, (see paragraph 4.2).
- The operator should ensure that relevant stacks or ducts are fitted with facilities for sampling which allow compliance with the sampling standards.

Unabated crematoria - preferred sampling location

4.36 In most unabated crematoria in the UK, the cremators were designed to fit into an existing building. Thus, even those built to be compliant with the Environmental Protection Act and since, tend to have very few locations where a sampling point can actually physically be placed. Fewer still have sampling points which are the correct number of flue diameters away from bends and other obstructions.

4.37 Given the choice, sampling points located in the "hot-leg" of the flue - that is, prior to the introduction of dilution air - are to be preferred. The oxygen concentration at such points will be lower and thus the correction to 11% oxygen will be better defined given a constant error on an oxygen determination.

When sampling for polychlorinated dibenzo dioxins and furans, the sampling point should if possible be located such that the temperature of the flue gases is below 200℃ – that is, outside the temperature range where reformation or de novo synthesis takes place - and remains so until discharge to atmosphere.

4.38 Where this is not possible, the operator should notify the authority of the minimum temperature at which the measurement can practically be made, and the reason why this cannot be below the maximum temperature, before sampling takes place.

Sampling points

4.39 For each pollutant to be measured, calculation of the location and number of sampling points should be carried out as specified in the relevant standard. The general requirements for sample point location is given in BS EN13284-1 and BS ISO 9096:2003. The new standards relate the sampling time to the limit of detection of the analysis method. Increasing the number of sampling points on the sample plane does not increase the sample time.

Modifications due to the batch nature of a process

4.40 Cremation is a batch process as described in Section 3. In order to take into account the batch nature of the process, at least one complete traverse across the flue should be made during each of processes (ii) to (iv).

Process (i) has too short a duration for a complete traverse and so sampling should not commence until at least **two minutes** after the coffin is charged. Similarly, sampling should stop before ashing; again, it is not practical to traverse during ashing, and the turbulence caused by the open ash door may bias the results.

Sampling time

4.41 Sampling should last for one complete cremation, commencing as soon as stable conditions are achieved inside the machine - at least two minutes after the coffin is charged - and ceasing just before the operator rakes down the machine. One must decide the total sampling time before commencing sampling, in accordance with the requirement of the relevant standard that is to be used, refer Environment Agency Technical Guidance note M2.

4.42 Unfortunately, it is not possible to know beforehand how long a charge will take to cremate, as this depends on the construction of the coffin, the weight of the body and what the deceased died of. A cancerous body will take longer to cremate, for example.

4.43 In order that the result from different cremations may be meaningfully compared, the following procedure is suggested:

i. Learn either from observation of the cremator in operation, or from the operators, the duration of an average of light, average and heavy charges, and take this as the definition of "cremation".
ii. Sample for this amount of time. If a significant amount of remains are left at the end of this period, then continue to sample if possible, or void the test.
iii. If the cremation finishes significantly before the completion of testing, then stop if possible, or again void the test.

4.44 In any case, sampling should not be for less than 1 hour. Sampling for dioxins and furans should cover the time needed to meet the limit of detection specified by the analytical laboratory (refer to BS EN1948). The requisite number of whole cremations to achieve this sampling time should be sampled and could well be from 2 to 4 cremations.

Minimum volume of gas sampled

4.45 The volume of gas sampled will depend on the size of the charge, the standard used for the testing, the type of machine (i.e., electric cremators will have a smaller volumetric flow rate) and whether sampling is performed before or after the introduction of dilution air. European standards, e.g BS EN 13284 -1 and BS EN1948, state that the sample time is calculated by the limit of detection of the analysis method employed. .

Concurrent oxygen readings

4.46 Oxygen readings will be required, which are concurrent with the monitoring of the other pollutants, in order to make the correction to standard conditions.

4.47 These readings should be made in the same sampling plane in which the other samples are being taken; if not, extra dilution air could be introduced into the flue, changing the oxygen concentration at a point downstream. Care must be taken, however, that any probe used to extract the sample of gas for oxygen analysis should not cause interference to other sampling equipment in the flue, and vice-versa.

Minimum number of samples

4.48 For a valid statistical treatment of the results to give a 95% confidence result a minimum of three samples is required, and should generally be available in one working day from all but the least used crematoria. The size of the 95% confidence interval should not exceed the following percentage of the emssion limit values:

- Carbon monoxide: 10 %
- Particulate matter: 30 %
- Total organic carbon: 30 %
- Hydrogen chloride: 40 %

5. Control techniques

Summary of best available techniques

5.1 The following table provides a summary of the best available techniques that can be used to control the process in order to meet the emission limits and provisions in **Section 4**. Provided that it is demonstrated to the satisfaction of the regulator that an equivalent level of control will be achieved, then other techniques may be used.

Table 5: Summary of control techniques

Release source	Substance	Control techniques
Flue gas	Nitrogen oxides	No control
	Odour	Good combustion and a secondary com bustion zone
	Carbon monoxide	Good combustion and a secondary com bustion zone
	Volatile organic com pounds	Good combustion and a secondary com bustion zone
	PAH	Good combustion and a secondary com bustion zone
	Mercury and its com pounds	Abatement , or contribute via burden sharing scheme
	Particulate matter	Good combustion, slow gas velocities and a secondary combustion zone. Abatement further minimises emissions
	Hydrogen chloride	Minimise halogens combusted, avoid excessive temperature in primary chamber. Abatement further minimises emissions
	PCDD/F	Minimise chlorine combusted and particulate matter emitted, good combustion and a secondary combustion zone, Abatement further minimises emissions
	Carbon dioxide	Measure gas consumption, good cremator design
Cremated remains size reduction machine	Particulate matter	Filter on machine or external dispersion and filter if needed.
Spent gas-cleaning materials	Particulate matter, mercury	Keep containers tightly lidded

Techniques to control emissions from contained sources

Particulate matter (PM)

5.2 Particulate matter in unabated cremators is controlled by good combustion and by gas flows that do not carry particles out of the cremator. Mercury abatement further lessons emissions of particulate matter.

Hydrogen chloride

5.3 Hydrogen chloride mostly arises from the salt content of bodies. Chlorine is avoided in coffins, shrouds, clothing and other materials burnt. Condensation is prevented by dilution and preheating stacks.

Mercury abatement further lessens emissions of hydrogen chloride.

Mercury

5.4 Mercury is highly volatile and therefore almost exclusively passes into the flue-gas stream. Mercury is only partially removed with particulate matter. The rest remains in the flue gases as volatile organic compounds.

- Where activated carbon is used as part of the abatement technique, operators should be aware of potential health and safety risks arising from spontaneous combustion.

Volatile organic compounds

5.5 Volatile organic compounds are controlled by good combustion.

Dioxins

5.6 Good combustion and low particulate matter emissions minimise the emission of PCDD/F (polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans often referred to as 'dioxins and furans' or even just 'dioxins'). Mercury abatement further lessens emissions of dioxins.

Nitrogen oxides

5.7 Nitrogen oxides arising from coffins might be lessened by switching from coffins made using board made from wood and nitrogen-containing resins. However plain wood is considered too expensive to be required as BAT. Cardboard caskets also contain nitrogen in the wet strength additives. Nitrogen is always be present in the body. Thermal NOx is minimal due to the secondary chamber temperature and because combustion is staged over primary and secondary chambers.

Carbon monoxide

5.8 Carbon monoxide is a pollutant but is also the prime indicator of incomplete combustion that would emit un-burnt hydrocarbons, PAH and PCDD/F, which are much more difficult to monitor. Abatement of carbon monoxide is not BATNEEC/BAT but good combustion minimises emissions. Carbon monoxide emissions after the first 60 minutes ought to be minimal.

Carbon dioxide

5.9 Carbon dioxide emissions are minimised by cremator design and operation. Gas meters allow measurement of gas consumption, and comparison with other sites. Advances in combustion control, allied with short period carbon monoxide monitoring to monitor good combustion, may allow significant reduction in carbon dioxide emissions for next generation cremator designs.

Odour

5.10 Odour is prevented by good combustion

Emergency Release of Pollutants

Unabated crematoria

5.11 Dumpstacks should **not** normally be used when cremation is underway. Occasions when the dumpstack is used during a cremation should be notified to the regulator. Use of the dumpstack during cremation more than once a year should be investigated and remedial action taken.

- In the event of the use of a dumpstack during cremation:
  - the failure, its cause and cure should be entered in the log; **and**
  - the regulator should be notified immediately (preferably by fax or e-mail).

Existing, abated crematoria and new processes

5.12 Where there is more than one gas cleaning system and that system fails, that system should not be used until it is repaired. Where there is only one gas cleaning system then cremations should continue, the regulator should be notified immediately (preferably by fax or email) and repairs are expected within 24 – 48 hours.

5.13 Dumpstacks/ERVs should **not** normally be used when cremation is underway. Occasions when the dumpstack/ERV is used during a cremation should be notified to the regulator. Use of the dumpstack/ERV during cremation more than once a year should be investigated and remedial action taken.

- In the event of the use of a dumpstack/ERV during cremation:
  - the failure, its cause and cure should be entered in the log; **and**
  - the regulator should be notified immediately (preferably by fax or e-mail).
- Dumpstacks/ERVs should only be used:
  - when the heat removal plant has failed and the abatement plant would be damaged; **or**
  - during warm-up and shutdown, provided that compliance is demonstrated with the carbon monoxide limit.

- Dusty materials, dusty wastes and wastes containing mercury should be kept tightly contained

Waste materials collected from inside the abatement plant will need to be disposed of in the same way as waste sorbent.

Coffin materials and cremator design

5.14 The emission limits and provisions specified in section 4 above may be achieved by careful use of materials in coffin construction and furnishing and by cremator design and operation (including abatement at new processes). The range of materials used for coffin or casket construction now includes cardboard, wickerwork (made from willow) as well as wood composite board and solid wood. Shrouds are also available and may use natural fibres such as cotton, linen or wool. A body in a shroud may be supported on a stiff baseboard. Materials to be avoided in coffin or casket construction, furnishings and body preparation/embalming include halogenates, metals (except steel screws and staples), wax and more than a thin layer of water based lacquer on wood.

- PVC and melamine should not be used in coffin construction or furnishings;
- Cardboard coffins should not contain chlorine in the wet-strength agent. (e.g. not using polyamidoamine-epichlorhydrin based resin (PAA-E));
- Packaging for stillbirth, neonatal and foetal remains should not include any chlorinated plastics:
- Coffins containing lead or zinc should not be cremated;
- The cremator should be designed and operated in order to prevent the discharge of smoke, fumes, or other substances during charging;
- The charging system should be interlocked to prevent the introduction of a coffin to the primary combustion zone unless the secondary combustion zone temperature exceeds that specified for good combustion in the permit;
- The cremator and all ductwork should be made and maintained gas tight if under positive pressure to prevent the escape of gases from the ductwork or cremator to the air.

Good combustion

5.15 As one of the means of achieving good combustion, all new cremators should be designed so that there is adequate secondary air in the primary combustion zone to ensure good turbulence.

5.16 The secondary combustion zone starts after the last injection of combustion air. Air injected at support burners in the secondary combustion chamber is ignored, as long as there is no more than about 6% excess oxygen for the fuel burnt.

- All cremators should be designed to ensure complete combustion and should be fitted with a secondary combustion zone;

- The manufacturer should state the volume of the secondary combustion zone;
- When re-bricking a cremator, the convolutions of the secondary combustion chamber should be maintained and the volume of the chamber recalculated and restated.

5.17 Residence time in the secondary combustion zone should be demonstrated at commissioning or by calculation.

Cremated remains

5.18 For all cremators, the remains in the cremator should only be moved when calcination is completed.

- The removal of ash and non-combustible residues from the cremator should be undertaken carefully so as to prevent dust emissions via the flue;
- Cremated remains should be moved and stored in a covered container;

5.19 Many cremated remains treatment plants have an internal filter and discharge inside the building and for them an emission limit and testing are unlikely to be needed.

- Cremated remains treatment plant venting externally should be:
  - abated to meet the particulate matter limit in Table 3 or 4, as appropriate; **and**
  - testing should be needed at commissioning only;
  - subsequent performance can be demonstrated indicatively, for example by the use of a pressure drop indicator on the bag filter.

Standby cremators

5.20 Some crematoria may wish to retain a stand-by cremator for use in the event of breakdown of the main cremator or other occasional need for additional cremator capacity.

5.21 Such plant should be permitted if it meets all the following criteria:

5.22 capable of operating without causing a nuisance (as in the Environmental Protection Act 1990 Part III); **and**

- during any period of eight hours the aggregate of the periods of emission of dark smoke should not exceed five minutes; **and**
- no single emission of dark smoke should exceed two minutes; **and**
- no black smoke should be emitted.

5.23 The following conditions and also the management paragraphs 5.42 - 5.44 should also be complied with:

- The standby cremator should be clearly identified.
- Standby plant should operate for no more than 100 hours in any 12-month period.
- All periods of operation and the reason for standby plant operation should be recorded in the log.
- The local enforcing authority should be notified by telephone, in advance if possible, of the operation of standby plant.
- Visual and olfactory assessments of emissions should be made at the start and at least once during each cremation cycle in standby plant, the location and result of the assessment should be recorded in the log. (The frequency of assessments can be reduced if a continuous particulate matter monitor is operating.)
- Remedial action should be taken immediately in the case of abnormal emissions.
- PVC and melamine should not be used in coffin construction and furnishings
- Cardboard coffins should not contain chlorine in the wet-strength agent (i.e. not using polyamidoamine-epichlorhydrin based resin (PAA-E)).
- Packaging for stillbirth, neonatal and foetal remains should not include any chlorinated plastics.
- Coffins containing lead or zinc should not be cremated.
- The remains in the cremator should only be moved when calcination is completed.

Small-scale cremators

5.24 Small-scale cremators may be developed in order to cremate stillbirth, neonatal and foetal remains. Not all the standards for full-scale cremators are appropriate for such small-scale cremators because of the relatively small mass of pollutants emitted. For these purposes "small--scale cremators" should be taken to mean cremators with a maximum door opening of 300 x 300 mm and with a maximum length of primary chamber of 1,000 mm.

5.25 When stillbirth, neonatal or foetal remains are cremated in full-scale cremators, the guidance for those cremators should apply.

5.26 The following paragraphs, or parts of paragraphs, should apply to small-scale cremators:

i. Paragraphs 4.19 – 4.20 but with visual and odour assessment once during each cremation,
ii. Paragraphs 4.21, 5.3, 5.14, 5.35 – 5.46
iii. The reference to "coffins" in paragraph 5.14 includes packaging for stillbirth, neonatal and foetal remains.

Cremation standards in the event of mass fatalities

Originally published as AQ17(06).

5.27 Paragraphs 5.27 to 5.34 are issued as a precautionary measure in the event of a national emergency giving rise to mass fatalities. The Government intend to alert regulators at the time when an emergency situation exists which triggers the guidance. There will be a similar alert when the situation is at an end after which the guidance will no longer apply.

5.28 In the event of mass fatalities, such as could arise from pandemic flu, crematoria may need to operate for sustained periods. This means that there is a greater prospect of breakdown of equipment, including equipment for reducing air emissions. There could also be implications for staffing of crematoria.

Current guidance

5.29 This paragraph reminds regulators and operators that it is good practice to ensure that:

- spares and consumables are available at short notice;
- to have an audited list of essential items;
- those spares and consumables subject to continual wear should be held on site or should be available at short notice from guaranteed local suppliers so that plant breakdowns can be rectified rapidly;
- staff at all levels need the necessary training and instruction in their duties relating to the control of the process and emissions to air and refer, among other things, to the Crematorium Technicians Training Scheme and to the Training and Examination Scheme for Cremation Technicians.

5.30 Regulators and crematoria operators should bear in mind that:

a) larger quantities of spares and consumables may be needed in the event of an emergency causing mass fatalities;

b) an emergency causing mass fatalities may have implications for the number of trained staff that can be called upon.

5.31 In order to minimise the potential for breakdowns during such an emergency, it is important that all crematoria plan for such an eventuality, taking account of a) and b).

5.32 If this is done, there might nonetheless be either a breakdown of equipment affecting air emissions or a shortage of staff trained on the air pollution aspects of operating the crematorium. There might also be a heightened demand which warrants operating any standby cremator for longer than the 100 hours specified in paragraph 5.23. In such circumstances, and in the public interest, regulators should take a balanced view to enforcement action in the event of a breach of permit conditions.

5.33 If best endeavours have been taken to reduce the likelihood of a breakdown or staff shortage, it may well be appropriate to allow a crematorium to continue to operate while breaching permit conditions without any enforcement action being taken[4]. One consideration may be whether the area in question is designated a local Air Quality Management Area for any of the pollutants emitted from the crematorium. Steps should be taken to rectify the breaches where practicable and as soon as is feasible. Government would not expect these allowances to be continued beyond the duration of the emergency.

5.34 This guidance is without prejudice to any restrictions or requirements there may be under health and safety legislation.

Air Quality

Dispersion & Dilution

5.35 Pollutants that are emitted via a stack require sufficient dispersion and dilution in the atmosphere to ensure that they ground at concentrations that are deemed harmless. This is the basis upon which stack heights are calculated using HMIP Technical Guidance Note D1 **[D1].** The stack height so obtained is adjusted to take into account local meteorological data, local topography, nearby emissions and the influence of plant structure.

5.36 The calculation procedure of D1 is usually used to calculate the required stack height but alternative dispersion models may be used in agreement with the regulator. An operator may choose to meet tighter emission limits in order to reduce the required stack height.

5.37 Where an emission consists purely of air and particulate matter, (i.e. no products of combustion or any other gaseous pollutants are emitted) the above provisions relating to stack height calculation for the purpose of dispersion and dilution should not normally be applied. Revised stack height calculations should not be required as a result of publication of this revision of the PG note, unless it is considered necessary because of a breach or serious risk of breach of an EC Directive limit value or because it is clear from the detailed review and assessment work that the permitted process itself is a significant contributor to the problem.

5.38 In order to maintain maximum advantage from thermal buoyancy and momentum, emissions should take place from the minimum practicable number of chimneys. Each cremator should have its own flue in a multi-flue stack. For crematoria with abatement plant, each abatement plant can have one flue plus a dump stack. As the dump stack is used about once a year or less, the dump stack height can be the same as the abated stack height.

An operator may choose to meet tighter emission limits in order to reduce the required main stack height, but the dump stack height may not be reduced.

[4] Note: as regards maintaining cremation temperatures, the Food Standards Agency and the World Health Organisation take the view that H5N1 virus in uncooked poultry when cooked to 70ºC negates the risk.

Ambient air quality management

5.39 In areas where air quality standards or objectives are being breached or are in serious risk of breach and it is clear from the detailed review and assessment work under Local Air Quality Management that the permitted process itself is a significant contributor to the problem, it may be necessary to impose tighter emission limits. If the standard that is in danger of being exceeded is not an EC Directive requirement, then industry is not expected to go beyond BAT to meet it. Decisions should be taken in the context of a local authority's Local Air Quality Management action plan. For example, where a permitted process is only responsible to a very small extent for an air quality problem, the authority should not unduly penalise the operator of the process by requiring disproportionate emissions reductions.

Paragraph 59 of the Air Quality Strategy 2007 [Volume 1] gives the following advice:

"...In drawing up action plans, local authority environmental health/pollution teams are expected to engage local authority officers across different departments, particularly, land-use and transport planners to ensure the actions are supported by all parts of the authority. In addition, engagement with the wider panorama of relevant stakeholders, including the public, is required to ensure action plans are fit-for-purpose in addressing air quality issues. It is vital that all those organisations, groups and individuals that have an impact upon local air quality, buy-in and work towards objectives of an adopted action plan."

Stacks, vents and process exhausts

5.40 Liquid condensation on internal surfaces of stacks and exhaust ducts might lead to corrosion and ductwork failure or to droplet emission. Adequate insulation will minimise the cooling of waste gases and prevent liquid condensation by keeping the temperature of the exhaust gases above the dewpoint. A leak in a stack/vent and the associated ductwork, or a build up of material on the internal surfaces may effect dispersion:

- Flues and ductwork should be cleaned to prevent accumulation of materials, as part of the routine maintenance programme.

5.41 When dispersion of pollutants discharged from the stack (or vent) is necessary, the target exit velocity should be 15m/sec under normal operating conditions. In order to ensure dispersion is not impaired by either low exit velocity at the point of discharge, or deflection of the discharge, a cap, or other restriction, should not be used at the stack exit. However, a cone may sometimes be useful to increase the exit velocity to achieve greater dispersion.

Management

Management techniques

5.42 Important elements for effective control of emissions include:

- proper management, supervision and training for process operations;
- proper use of equipment;
- effective preventative maintenance on all plant and equipment concerned with the control of emissions to the air; and
- ensuring that spares and consumables - in particular, those subject to continual wear – are held on site, or available at short notice from guaranteed local suppliers, so that plant breakdowns can be rectified rapidly. This is important with respect to arrestment plant and other necessary environmental controls. It is useful to have an audited list of essential items.

Appropriate management systems

5.43 Effective management is central to environmental performance; It is an important component of BAT and of achieving compliance with permit conditions. It requires a commitment to establishing objectives, setting targets, measuring progress and revising the objectives according to results. This includes managing risks under normal operating conditions and in accidents and emergencies. It is therefore desirable that installations put in place some form of structured environmental management approach, whether by adopting published standards (ISO 14001 or the EU Eco Management and Audit Scheme [EMAS]) or by setting up an environmental management system (EMS) tailored to the nature and size of the particular process. Operators may also find that an EMS will help identify business savings.

5.44 Regulators should use their discretion, in consultation with individual operators, in agreeing the appropriate level of environmental management. Simple systems which ensure that LAPPC considerations are taken account of in the day-to-day running of a process may well suffice, especially for small and medium-sized enterprises. Authorities are urged to encourage wider adoption of EMS by operators, but it is outside the legal scope of an LAPPC permit to require an EMS for purposes other than LAPPC compliance. For further information/advice on EMS refer to the appropriate chapter of the appropriate Guidance Manual for England and Wales, Scotland and Northern Ireland.

Training

5.45 Staff at all levels need the necessary training and instruction in their duties relating to control of the process and emissions to air. In order to minimise risk of emissions, particular emphasis should be given to control procedures during start-up, shut down and abnormal conditions. Training may often sensibly be addressed in the EMS referred to above.

- All staff whose functions could impact on air emissions from the activity should receive appropriate training on those functions. This should include:
  - awareness of their responsibilities under the permit
  - steps that are necessary to minimise emissions during start up and shut down
  - actions to take when there are abnormal conditions, or accidents or spillages that could, if not controlled, result in emissions.
- The operator should maintain a statement of training requirements for each post with the above mentioned functions and keep a record of the training received by each person. These documents should be made available to the regulator on request.

Maintenance

5.46 Effective preventative maintenance plays a key part in achieving compliance with emission limits and other provisions. All aspects of the process including all plant, buildings and the equipment concerned with the control of emissions to air should be properly maintained. In particular:

- The operator should have the following available for inspection by the regulator:
  - A written maintenance programme for all pollution control equipment; **and**
  - A record of maintenance that has been undertaken

Cremator maintenance

5.47 A well-maintained cremator should have:

- Written maintenance and cleaning programmes available to the regulator with respect to pollution control equipment, including control instrumentation and the cremator secondary chamber, and ducts and flues, and if fitted, abatement plant;

5.48 Cleaning of cremator ducts and flueways is considered part of preventative maintenance e.g. raking out twice a year:

5.49 Maintenance of an existing crematorium will need to include at least the following: (See also Appendix 2).

- inspecting, repairing and replacing brick, flue, control software and hardware, monitoring equipment etc;
- regular maintenance and inspection by service engineer;
- operator maintenance - daily, weekly, monthly, by number of cremations;

6. Summary of changes

The main changes to this note, with the reasons for the change, are summarised below in **Table 5**. Minor changes that will not impact on the permit conditions e.g. slight alterations to the Process Description have not been recorded.

Table 5: Summary of changes

Section / Paragraph / Row	Change	Reason	Comment
1. Introduction			
	Simplification of text	Make note clearer	
	Addition of links	Change to electronic format	Removes need for extensive footnotes/references
2. Timetable for compliance and reviews			
	Simplification of text	Make note clearer	
	Addition of links	Change to electronic format	Removes need for extensive footnotes/references
3. Activity Description			
	Additional descriptive text – abatement plant and emergency releases	Make note clearer	
4. Emission limits, monitoring and other provisions			
Table 3 & Table 4	ELVs/provisions for unabated and abated crematoria	Clarify different monitoring provisions for unabated and abated processes	
Para 4.11	Requirement for cremators to be fitted with gas meters	Gather data to inform on CO_2 emissions	
Paras 4.36 – 4.48	Sampling provisions for unabated crematoria, previously in Section 9 of PG5/2(04)	Make note clearer	
5. Control techniques			
Paras 5.2 – 5.10	Revised text for control techniques of emissions from contained sources	Make note clearer	
Paras 5.11 – 5.13	Revised text and conditions relating to emergency releases of pollutants from abated and unabated crematoria	Make note clearer	
Paras 5.27 – 5.34	Guidance on cremation standards in the event of mass fatalities (previously published as AQ17(06)	Consolidate AQ notes into PG note	
Paras 5.35 – 5.39	Clarification of air quality guidance including exhaust velocity requirements	Make note clearer	
Paras 5.47 – 5.49	Additional text for cremator maintenance	Make note clearer	
Appendix 1	Revised Example Report	Allow for revised monitoring	

		provisions	
Appendix 2	Guidance on Well-maintained cremators (previously published as AQ12(05)	Consolidate AQ notes into PG note	
Appendix 3	Supplementary Guidance on burden-sharing, previously published as AQ24(05)	Consolidate AQ notes into PG note	
Appendix 4	Guidance on CEMs for monitoring particulate from Part B processes	Make note clearer	

7 Further information

Sustainable consumption and production (SCP)

Both business and the environment can benefit from adopting sustainable consumption and production practices.

Estimates of potential business savings include:

- £6.4 billion a year UK business savings from resource efficiency measures that cost little or nothing
- 2% of annual profit lost through inefficient management of energy, water and waste
- 4% of turnover is spent on waste.

When making arrangement to comply with permit conditions, operators are strongly advised to use the opportunity to look into what other steps they may be able to take. Local authority regulators may be wiling to provide assistance and ideas, although cannot be expected to act as unpaid consultants.

Health and safety

Operators of processes and installations must protect people at work as well as the environment:

- requirements of a permit or authorisation should not put at risk the health, safety or welfare of people at work
- equally, the permit or authorisation must not contain conditions whose only purpose is to secure the health of people at work. That is the job of the health and safety enforcing authorities

Where emission limits quoted in this guidance conflict with health and safety limits, the tighter limit should prevail because:

- emission limits under the relevant environmental legislation relate to the concentration of pollutant released into the air from prescribed activities
- exposure limits under health and safety legislation relate to the concentration of pollutant in the air breathed by workers
- these limits may differ since they are set according to different criteria. It will normally be quite appropriate to have different standards for the same pollutant, but in some cases they may be in conflict (for example, where air discharged from a process is breathed by workers). In such cases, the tighter limit should be applied to prevent a relaxation of control.

Further advice on responding to incidents

The UK Environment Agencies have published guidance on producing an incident response plan to deal with environmental incidents. Only those aspects relating to air emissions can be subject to regulation via a Part B (Part C in NI) permit, but regulators may nonetheless wish to informally draw the attention of all appropriate operators to the guidance.

It is not envisaged that regulators will often want to include conditions, in addition to those advised in this PG note, specifying particular incident response arrangements aimed at minimising air emissions. Regulators should decide this on a case-by-case basis. In accordance with BAT, any such conditions should be proportionate to the risk, including the potential for harm from air emissions if an incident were to occur. Account should therefore be taken of matters such as the amount and type of materials held on site which might be affected by an incident, the likelihood of an incident occurring, the sensitivity of the location of the installation, and the cost of producing any plans and taking any additional measures.

Appendix 1

EXAMPLE REPORT

[For abated plant, omit lines for particulate matter and “2 minutes from loading” and amend the criteria for temperature and CO criteria]

MONTHLY/FOUR WEEKLY REPORT for [crematorium name]

Cremator number: [ ]

Report for the month / four weeks period starting: [date]

Total number of cremations: [ ]

Number of cremations with results not reported: [ ]

(due to instrument faults or other reasons)

Emission and combustion provisions: average, minimum and maximum values

	PG5/2 Criteria	Average value for period	Minimum value	Maximum value
Secondary Chamber Start Temperature (℃)	850ºC			
Secondary Chamber End Temperature (℃)	850ºC			
Oxygen % measured wet or dry	Average 6% Minimum 3%			n/a
Residence time seconds	2			n/a
Carbon Monoxide	150 for 95% of crems: 300g max			
Particulate matter	120g for 95% of crems, 240g max			
The units for carbon monoxide and for particulate matter should be g per first hour of cremation.				
Carbon monoxide and particulate matter values are corrected to 273K, 101.3kPa, 11 % oxygen, dry gas (correction for dry gas can be by fixed correction factor based on commissioning measurements)				
Values are reportable from 2 minutes after coffin loading to the start of calcined remains removal				

Table Emission limit exceedances

	PG5/2 Criteria	Average value for period	Minimum value	Maximum value
Percentage of cremations over Emission Limit:	<5%			<5%
Number of cremations over Twice the Limit:	nil			nil

Monthly / four weekly 95 percentiles of Cremation Values: For each of carbon monoxide and particulate matter;

How to select the 95 percentile value

- For 19 cremations or less in the period, enter the highest emission values.
- For 20 to 39 cremations in the period, enter the 2nd highest emission values
- For 40 to 59 cremations, the 3rd highest emission values
- For 60 to 79 cremations, the 4th highest
- For 80 to 99 cremations, the 5th highest
- For 100 to 119 cremations, the 6th highest

For each additional hundred cremations add 5.

For example: for 130 cremations, enter the '2nd+5' highest emission values, i.e. the 7th highest values for carbon monoxide and particulate matter

95 percentile values for carbon monoxide and particulate matter

Substance	95 percentile mg/m3
Particulate matter	
Carbon monoxide	

Cremations exceeding the 100% Limits: (CO 300g or 240g/m3, particulate matter 240g or 160mg/m3

Parameter	Value	Date	Time

Cremations above the 95% Limits: (CO 150g or 100mg/m3, particulate matter 120g or 80mg/m3

Parameter	Value	Date	Time

Appendix 2

AQ12 (05) Well-maintained cremators

Much of this Appendix was originally issued as AQ12(05) and is intended to assist regulators as they inspect cremators and maintenance / cleaning programmes

The following is a checklist for local authorities when inspecting crematoria, and for crematoria operators. Not all items will necessarily require consideration at every inspection. Overall, compliance with the checklist should be evidence of a good standard of maintenance.

Maintenance arrangements

Contract

i. is there an external contract for maintenance and servicing? Who with: manufacturers, combustion engineers?
ii. is it structured? Does it cover preventative, and responsive work? Does it set response times?
iii. if not, what are the arrangements, who carries them out, how qualified (qualifications/experience) are they to deal with the 'usual' problems? unusual problems? how long does it take to fix problems? How does the paperwork support the arrangements?

Paperwork

iv. are there structured inspections by the service engineer? with paperwork to set expectations? and documented faults and remedies? and advice on operator maintenance standards?

Some practical suggestions to help check if a cremator is "well maintained"

Regulators may find the following points useful to raise when they inspect cremators, and where appropriate to inspect themselves. The questions should help to elicit information from the operator, and service engineer if present, about how the cremator operates when it is fully compliant. (Inspections when the engineer is present can be informative.)

Answers will give an indication of whether the cremators have problems and how the operator/ engineer adjust operations as and when problems arise.

a) Do the operatives note the CO, particulate and oxygen readings on the emissions monitoring system when the cremator is in pre-heat (i.e. just burners running)?
b) Do the operatives observe the primary burner flame (with the loading door shut) so they can spot if the flame significantly changes?

c) Where are the analyser manufacturer's instructions and what do they say about calibration and its frequency? When were the analysers calibrated last? are all the analysers working correctly?

d) How does the control system correct for any excursion in primary chamber behaviour? Eg low oxygen, high CO. Do the primary burners and primary air respond to low oxygen or high CO or both (eg do they turn off?)

e) How the control system deals with different weights of a cremation?

f) What is the largest size, weight of cremation accepted, and how are they managed - manual or automatic? Loaded into a colder primary chamber?

g) Is the sealing and paintwork in general checked regularly for "smoke" marks, which are likely to be a sign of pressurisation? These marks will give clues to cleanliness of combustion.

h) Similarly, is the area around the loading door checked regularly for scorch or smoke stains?

i) Are the ductworks checked regularly for any signs of leaks (as far as is accessible)?

j) The regulator might watch the stack at the loading of a coffin to see if there is any smoke?

k) The regulator might watch the stack at 10 to 20 minutes into cremation,

l) (coffin collapses) - is there smoke at the stack and check for smell around the grounds and in the cremator room?

Regulators should, as a matter of course, check the data logger when they visit to see whether there were any emission limit exceedances which were not reported in accordance with PG5/2.

For electrical cremators some of these points will need to be adapted

Dustiness

a) How much dust is there in the ducts and flues? How long since they were cleaned out? How are they cleaned out? The box below contains a very simple guide to describing dustiness and its variations, but is only one possible approach.

Simple dustiness guide

(Health and safety note: remember to ascertain safety before opening ducts and flues. Gas temperature, pressure, constituents of any outflows or duct contents are important, as are surface temperatures, sharp edges etc. The operator and/or manufacturer/service engineers will probably have already assessed risk for such operations.)

This is a rule of thumb guide to describing dustiness and its variations:

- colour;
- thickness of deposit might be gauged;
  - dust shows on dry fingertip [dust free latex glove? rub gently];
  - thick enough to write in with a finger [how lit: from room, by torch?];
  - finger drawn through dust makes a furrow;
  - thick enough to measure with a ruler ;
- extent of deposition in square ducts, in corners, patches on the base;
  - less than a beer mat;
  - more than a beer mat;
  - most of the surface;
- in round ducts;
  - continuous;,
  - long patches;
  - short patches.

Appendix 3

Supplementary Guidance on Burden Sharing

This Appendix was originally issued as AQ24(05) and is supplementary guidance on burden sharing, following on from AQ1(05) and AQ13(05). It advises on a deferral of the reporting deadline and contains further background on burden sharing options.

Deadline

These two notes advised that all cremator operators should have informed their regulators by 31 December 2005 whether they will be opting for installing mercury abatement equipment or sharing the cost of abatement fitted by other crematoria.

Following representations from the All Party Parliamentary Group on Funerals and Bereavement, the Minister has agreed that this deadline should be put back to 1 June 2006 to allow operators more time to develop and finalise their plans.

Burden sharing options

The Department is aware that different operators have chosen different burden sharing options to achieve the specified 50% national mercury reduction. The following points are intended to clarify for regulators and operators the considerations likely to be material in deciding whether to fit abatement equipment or contribute to the cost.

a) it is believed that a small number of local authorities have decided to fit mercury abatement in order to safeguard the local environment and not participate in burden sharing. For the reasons set out in the two consultation paper issued by Defra and WAG:
www.defra.gov.uk/corporate/consult/crematoria/index.htm

It remains Defra and WAG's view that the environmental impact from mercury emitted from crematoria is through long-range transportation before its deposition, take-up by fish, and consumption as food. Therefore, the focus should not be on local environmental protection. It is for this reason that Defra and WAG have set a national reduction figure, not limits for each individual crematorium.

b) the 50% reduction figure was determined after extensive consultation to reflect an appropriate balance between costs to crematoria operators (and any consequential increase in cremation fees passed on to the public) and environmental benefits. Neither Defra nor WAG are promoting a reduction in excess of this amount through burden sharing, or because some authorities have decided to fit abatement irrespective of burden sharing.

c) Defra/WAG made allowance for a burden sharing approach to be adopted for implementing the 50% reduction in order to enable costs to be spread throughout the sector, which the sector organisations believed could if properly managed minimise increases in cremation fees. However, by way of reminder, if, in the light of evidence obtained in June 2006, burden sharing is shown not to be viable, Defra and WAG have already stated that they will revert to the more conventional approach of securing the 50% by requiring all crematoria above a certain size to fit mercury abatement (with limited exceptions where installation of abatement is demonstrably impossible because of space constraints or heritage considerations). The NAFD and FBCA have calculated that this will result in 35% of crematoria meeting the total cost of abatement, with consequent impacts on their cremation costs.

d) Defra and WAG are aware that the following burden sharing methods have been adopted:

   i) a good many operators have concluded that the best way is to join the CAMEO scheme, which is arranging burden sharing at the national level and provides an umbrella organisation for both running the system and reporting to Defra and WAG. CAMEO will issue guidance on the criteria for deciding whether cremation authorities are to fit abatement or contribute towards the cost and will approve and register all burden sharing arrangements, with CAMEO members all being free to choose their burden sharing partners. CAMEO intend levying and administering an environmental surcharge from members from January 2007, which is considered by the scheme to be the most economical and effective way to collect and redistribute to authorities fitting abatement equipment in line with the phasing programme. For details of the CAMEO approach, contact The Secretary, The Federation of British Cremation Authorities, 41 Salisbury Road, Carshalton, Surrey SM5 3HA. Email address fbcasec@tiscali.co.uk

   ii) some operators have chosen to fit abatement to a proportion of the cremators at their crematorium/ crematoria;

   iii) some operators have made local agreements with nearby operators to share costs and abatement.

Both ii) and iii) could be undertaken within the CAMEO scheme, with CAMEO verifying the arrangements and monitoring the data.

Phasing

Attached to this AQ note, for information, is a note sent to cremation organisations in September this year on the subject of phasing. Regulators should ensure, under the burden sharing approach, that all crematoria which are fitting abatement should do so by the end of 2012, with permit conditions to that effect. Regulators will need to consider enforcement action against any operator failing to comply. The indicative phasing timetable was issued to cremation organisations because cremator and abatement equipment manufacturers are unlikely to be able to meet demand if it is concentrated in the last two or three years before the 2012 deadline.

Appendix 4

Table 6 – Options for continuous monitoring of particulate for Part B processes

Type of monitoring	Capability of instrument	Tests required on initial set up of instrument	Annual tests required	3 yearly tests required	What can be recorded from instrument	What this functionality enables the Alarm Levels to be set to detect
Quantitative measurement	Instrument capable of being calibrated for a specific application e.g. Class 1 or 2 MCERTS	Instrument functionality test 3/5 point calibration (see RM-QG-6)	Instrument functionality test 3/5 point calibration (see RM-QG-6)	Instrument functionality test 3/5 point calibration (see RM-QG-6)	mg/m^3 over time	% of ELV
Qualitative measurement	Instrument capable of being calibrated for a specific application e.g. Class 1 or 2 MCERTS	Set up and 3 point calibration	Instrument health check	Health check 3 point calibration	mg/m^3 (approx) over time	Approx % of ELV
Filter leak monitoring	Filter leak monitor with trend output e.g. Class 3 MCERTS	Set up and set reference	Instrument health check	Instrument health check Set reference	Trend of plant operation over time	Change in plant operation causing a defined factor increase in emissions
Indirect monitoring	Parameter which has a credible relationship between what is being monitored and a failure condition. See Note	Set up	Instrument health check	Health check Set up	Trend of plant operation over time	Changes in plant operation
Note: e.g. Water level in wet scrubber or pH in wet scrubber but NOT differential pressure (dp) across a bag filter (dp measures filter blinding but does not change with holes in filters)						
Gross filter failure detection	Instrument designed to detect large increases in emissions	Set up and set alarm	Instrument health check	Set up and set alarm	Incidence of Gross failure	Catastrophic failure of filter