Crematoria Guidance Review (PG 5/2 (12))

Call for initial positions

The purpose of this document is to seek the initial views of members of Crematoria Guidance Review Technical Working Group (TWG) on the scope of the review.

1. Scope of the Review

In the period immediately prior to the Covid-19 pandemic, total deaths in the UK averaged at a little over 600,000 each year. Of these around 78% of deaths are cremated, approximately 470,000 each year, there are a little over 300 crematoria.

1.1 Application to the whole of the UK

This project is to review and update the statutory guidance on Crematoria.

In England and Wales, Crematoria are regulated as a Part B activity under the Environmental Permitting Regulations 2016. In Scotland under the Pollution Prevention and Control (Scotland) Regulations 2012 and in Northern Ireland as a Part C activity under the Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013.

In England, Wales and Northern Ireland, Crematoria are regulated by local authorities, and in Scotland by the Scottish Environment Protection Agency (SEPA).

Although controlled under different regulations and by different regulators. Crematoria are essentially subject to the same regulatory controls in all parts of the UK. All subsequent reference to Part B regulation in this document should be interpreted as including Part C in the context of Northern Ireland.

Therefore the intent is that the updated guidance should apply to the whole of the UK.

Question 1 – Are you in agreement that the guidance should be applicable to the whole of the UK?

1.2 Types of Cremator

The current guidance on crematoria covers:

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

Small cremators are defined as those with a door opening of no more than 300mm x 300mm and a primary chamber of no more than 1,000mm in length.

Stand by cremators are defined as those which do not operate for more than 100 hours in any 12-month period.

Although the current guidance states it is applicable to electric cremators, little information and data specific to electric cremators is included. This may be because,

at that time, there were insufficient of these in operation in the UK to be able to define BAT.

The guidance also covers the operation of cremulators, that is equipment for reducing the size of cremated remains.

Question 2 – Are you in agreement that the definitions of small and standby cremators should be carried forward in the guidance review?

Question 3 – Are you in agreements that the guidance should cover all the equipment types described above?

Question 4 – Do you know of any other types of cremation equipment, not listed above that should be included in the review?

1.3 The Cremation Process

Cremation is described in the current guidance as a batch process consisting (excluding pre-heating and shut-down) of the steps set out in table 1 below. The guidance states that the total cremation time varies considerably, ranging from as little as 50 minutes up to in excess of 2 hours, depending upon body size and cause of death.

Table 1 – Process steps in cremation

Process Step	Typical Time
The brief "flash" caused by volatilisation of the veneer on the outside of the coffin	1 minute
Burning of the coffin	20 minutes
After the coffin breaks open, burning of the coffin and cremation of the body	40 minutes
Calcination of the remains	30 minutes
Ashing	2 minutes although times may vary

Whilst pre-heating (start-up) and shutdown are in scope of the review, they are considered to be ‘other than normal operating conditions’ (OTNOC). Similarly the period between the end of one cremation and the start of the subsequent cremation should be in scope of the review as an ‘other than normal operating condition’.

Preparation of the deceased for cremation will be outside the scope of this guidance, except in so far as the materials used in coffin construction, shrouds and gowns, etc. could have an adverse impact on emissions to air.

Since the last guidance review, the advance of digital and communications technology means that the cremation process can now be monitored (and partially controlled) remotely from the crematoria. The permitting implications of these developments needs to be considered in the review, specifically who has operational control of the cremation process and therefore is the operator of the equipment and thus the permit holder.

Question 5 – Does section 1.3 above, adequately describe the cremation process and therefore the extent of the guidance review? Please make any proposals to improve this description.

Question 6 – Please add any further comments on scope here.

2. Structure of the Guidance Document

There have been numerous changes to the way guidance documents have been published since the guidance was last reviewed. This has been driven by the growth in the use of the internet, with more and more government business moving on line. Simultaneously, government policy has evolved for more of its guidance to be set out in plain English.

This drive to simplify guidance and make it more accessible means that an update of the current text in the current format is not feasible. This means, that at this point in the process, it is difficult to be precise on what the structure and format of the new guidance will be. However it will need to include the following:

1. Legal status of the guidance
2. Scope of Guidance including relevant information about the cremation sector, e.g. process descriptions
3. Identification of the key environmental issues
4. Best Available Techniques (BAT) for preventing and controlling emissions from Crematoria
5. Emission limits values and equivalent technical measures, monitoring and reporting requirements, plus any other provisions required.

The possibility of publishing a downloadable pdf version of the guidance should be retained. It may be possible for the pdf document to go into more technical detail and provide links to supporting information, e.g. a non-statutory technical appendix.

Question 7 – Please make your comments on structure of the guidance and publication issues here.

3. Potential Key Environmental Issues

3.1 Emissions to Air (Pollutants of Interest)

Emissions to air are one of, if not the key environmental issues for the sector. Below is a list of pollutants that may be of interest or concern.

a) Hydrogen Chloride (HCl)

This parameter is included in the current guidance, there is an emission limit value of 200 mg/Nm^3 for unabated cremators and 30 mg/Nm^3 for abated cremators. Thus data on HCl emissions is readily available.

Chlorine in the form of salt will be present in the body of the deceased. Chlorine may also be present in coffin materials or clothing.

Techniques to minimise emissions of HCl include:

- Restricting materials used in coffins and clothing.
- Avoiding excessive temperatures in the primary chamber
- Use of an alkaline scrubbing agent, e.g. $CaCO_3$ or $NaHCO_3$ in the abatement plant

There are no statutory air quality standards for HCl, however the Environment Agency uses an Environmental Assessment Level to assess for significant pollution. This is currently set at 750 µg/m^3 as a daily mean.

It is recommended that emissions to air of hydrogen chloride should be considered a key environmental issue.

Question 8 – Do you agree that emissions to air of HCl should be a key environmental issue?

b) Total Particulate Matter

This parameter is included in the current guidance, there is an emission limit value of 80 mg/Nm^3 (95% compliance) or 160 mg/Nm^3 (100% compliance) for unabated cremators and 20 mg/Nm^3 for abated cremators. Thus data on total particulate matter emissions is readily available.

Techniques to minimise emissions of particulate matter include:

- Good combustion control, including secondary combustion zone.
- Gas flows that do not carry particles out of the cremator
- Use of dry filters, e.g. ceramic filters or bag filters.
- Filters are incorporated into the design of mercury abatement equipment

There is also an emission limit value of 50 mg/nm^3 for cremulators. The technique used to minimise emissions from cremulators is the use of dry filters, e.g. ceramic filters or bag filters.

Statutory air quality standards are in place for particulate emissions, standards are set for PM_{10} and $PM_{2.5}$ for the protection of human health, see table 2. Air quality standards are stricter in Scotland than in the rest of the UK.

Whilst data are available for total particulates emissions. There is no available data on the size distribution of particulate emissions from crematoria, if any TWG members have access to such data, it would be useful if they could share this with the group. In the absence of particle size data, current practice when assessing air impacts for significant pollution is to assume all the particulate emissions are of the particle size fraction of that assessment.

It is recommended that emissions to air of particulate matter should be considered a key environmental issue.

Question 9 – Do you agree that emissions to air of particulate matter should be a key environmental issue?

c) Carbon Monoxide

This parameter is included in the current guidance, there is an emission limit value of 100 mg/Nm^3 (95% compliance) or 200 mg/Nm^3 (100% compliance) for unabated cremators and 100 mg/Nm^3 for abated cremators. Thus data on carbon monoxide emissions is readily available.

High levels of carbon monoxide is the prime indicator of incomplete combustion. Emissions of carbon monoxide are minimised through good combustion control.

As good combustion control is a key control over the cremation process, monitoring of carbon monoxide emissions is very important for the operational control of the plant. As a pollutant, carbon monoxide emissions are not a major concern in themselves, but high CO levels could be an indicator that emissions of other pollutants are not well controlled, e.g. organic compounds.

There is a statutory air quality standard for carbon monoxide, but it is set at a level that significant pollution from carbon monoxide should not normally arise.

It is therefore recommended that emissions to air of carbon monoxide matter should not be considered a key environmental issue, however its importance as a key control parameter for the cremation process is recognised.

Question 10 – Do you agree that control of emissions to air of carbon monoxide need to be well controlled for effective operation of the crematoria?

Question 11 – Other than in the context of question 10, do you agree that emissions to air of carbon monoxide matter should not be a key environmental issue?

d) Volatile Organic Compounds

This parameter is included in the current guidance, there is an emission limit value of 20 mg/Nm^3 for both unabated and abated cremators. Thus data on volatile organic compounds emissions is readily available.

The presence of carbon monoxide and organic compounds at high concentrations is an indication of incomplete combustion.

- Good combustion and a secondary combustion zone
- Minimum temperature and residence time in secondary combustion zone
- Some volatile organic compounds may be adsorbed onto carbon adsorbent or carbon filters used in mercury abatement

Assessing emissions of volatile organic compounds is not straightforward as it will contain a mixture of molecules of different toxicity. In terms of measurement, the concentration of is expressed as mg of carbon. In terms of assessing significant pollution, a common method is to assume the emissions are all present as benzene because this has one of the stricter air quality standards.

It is recommended that emissions to air of volatile organic compounds should be considered a key environmental issue.

Question 12 – Do you agree that emissions to air of volatile organic compounds should be a key environmental issue?

e) Polychlorinated dibenzo-p-dioxins and furans (PCDD/F)

This parameter is included in the current guidance, there is an emission limit value of 1 ng(ITEQ)/Nm^3 for unabated cremators and 0.1 ng(ITEQ)/Nm^3 for abated cremators. However, the testing requirements are limited to commissioning unless the temperature and residence time conditions are not achieved. Thus some data on PCDD/F emissions will be available, but not to the same extent as for some of the other pollutants.

It is considered that PCDD/F will be destroyed at a high temperature (minimum 850 ˚C) in the presence of oxygen over a minimum residence time of 2 seconds. The guidance currently permits a lower temperature of 800 ˚C for those cremators with mercury abatement. Electric cremators operate at a temperature of 750 ˚C or more in the secondary combustion chamber, which is not compliant with the guidance, but it is claimed they can achieve the ELV in the guidance. Evidence to substantiate this claim needs to be provided during the review. If any TWG member has evidence or data to support this position of a lower temperature for electric cremators, please share it with the group.

Other techniques to minimise emissions of PCDD/F include:

- Minimising halogenated materials used in coffins and clothing
- Good combustion control, i.e. effective process control to ensure process stability, Variables such as temperature, residence time and oxygen levels should be continuously monitored to establish optimum operating conditions
- Rapid cooling of the flue gas through the de-novo synthesis temperature range (450 ˚C to 200 ˚C)
- Minimise emissions of particulate matter
- Adsorption on carbon adsorbents and carbon filters in mercury abatement

Dioxins and furans adhere to the surface of particulate matter, thus minimising particulate emissions will help minimise dioxin emissions.

Measurement of dioxin levels in emissions is difficult because of its low concentration and the length of sampling time needed for it to be detectable, 6 to 8 hours. This would mean sampling would need to take place over multiple cremations. In the current guidance, measurement is only carried out as part of commissioning.

There is no concentration based air quality standard as such for dioxins and furans. The main environmental risk from dioxin and furan emissions is from deposition onto land, with them then entering the food chain resulting in bio-accumulation. Guidelines and complex modelling techniques exist to estimate this risk based on emission levels.

The current emission limit value of 0.1 ng(ITEQ)/Nm^3 for abated plant is typically that of waste incineration processes. The emission limit value of 1 ng(ITEQ)/Nm^3 for unabated plant is outdated and probably indefensible in 2021.

It is therefore recommended that emissions to air of dioxins and furans should be considered a key environmental issue, particularly for unabated plant.

Question 13 – Do you agree that emissions to air of dioxins and furans should be a key environmental issue?

f) Mercury

Mercury is a naturally occurring element. Although it is naturally occurring, overexposure to it is not good for humans as it can cause damage to the brains, lungs and kidneys. Mercury enters the cremation cycle and consequently crematory emissions through silver amalgam dental fillings present in the deceased. These silver amalgam fillings contain mercury alloys which during cremation results in the volatilization of mercury and its emissions into the atmosphere.

This parameter is included in the current guidance, but only for abated cremators, there is an emission limit value of 50 µg/Nm^3 for abated cremators, there is no emission limit value for unabated cremators. Thus data on mercury compounds emissions is readily available for abated cremators. For unabated cremators, estimates might be made based on the predicted removal efficiency of the abatement equipment. Around 70% of UK cremations are carried out with mercury abatement.

A useful adsorbent such as activated carbon can be used to control mercury emissions, and this has the added advantage of also controlling dioxin emissions. Activated carbon can be injected into the flue gas in the form of a powder which is then removed downstream using a filter. Alternatively the activated carbon can be in the form of a fixed bed or cartridge that the flue gas passes through. Mercury abatement is stated to be between 90 and 98% effective in removing mercury from the flue gas.

Mercury emissions are one of the pollutants covered by the OSPAR Convention to which the UK is a member. Emissions from crematoria with no abatement measures in place form a significant contribution to the atmosphere, the Environment Agency estimates that crematoria accounts for around 16% of atmospheric mercury emissions in the UK (ref 6).

There are no statutory air quality standards for mercury, however the Environment Agency uses an Environmental Assessment Level to assess for significant pollution. This is currently set at 0.25 µg/m^3 as an annual mean and 7.5 µg/m^3 as a daily mean. However, the main environmental risk from mercury emissions is from deposition onto land, with them then entering the food chain resulting in bio-accumulation (similar to dioxins and furans). Guidelines and complex modelling techniques exist to estimate this risk based on emission levels.

The disposal of residues from mercury abatement is outside the scope of the guidance. It is controlled through waste legislation, rather than through permit

conditions. Storage of reagents and residues is within the scope of the guidance, due to the potential for fugitive dust emissions.

It is therefore recommended that emissions to air of mercury should be considered a key environmental issue, particularly for unabated plant.

Question 14 – Do you agree that emissions to air of mercury should be a key environmental issue?

g) Nitrogen Oxides (NO and NO_2)

This parameter is currently not included in the guidance. There is no requirement to monitor or control emissions of NO_X. Thus data on NO_X emissions are not readily available for abated cremators.

Nitrogen oxides are produced by all combustion processes. The two mains sources are thermal NO_X and chemical or fuel NO_X from the combustion of nitrogen containing materials.

There are numerous techniques available for minimising thermal NO_X emissions, these are generally classed as primary measures, e.g. low NO_X burners, flue gas recirculation or secondary measures, e.g. Selective Non Catalytic Reduction (SNCR) and Selective Catalytic Reduction (SCR). Application of these techniques may not be straight forward in cremators because of the batch nature of their operation. Measures to minimise chemical (or fuel) NO_X are to restrict the materials used in coffin materials and clothing, e.g. nitrogen containing polymers. SNCR and SCR will also abate chemical NO_X emissions.

Work by Ben Copeland (ref 5) indicates that electric cremators have around one third less NO_X emissions in comparison with gas cremators. However this is based on a very small amount of data. If TWG members have access to NO_X emissions data, it would be useful if they could share this with the group. It is possible data may be available from the Netherlands where electric cremators are more widespread.

Nitrogen oxides are a key pollutant of concern, especially in urban environments. Statutory air quality standards are in place for NO_X emissions, standards are set for the protection of human health, see table 2.

It is therefore recommended that emissions to air of nitrogen oxides should be considered a key environmental issue.

Question 15 – Do you agree that emissions to air of nitrogen oxides should be a key issue?

h) Other Pollutants

TWG members are invited to consider whether there are other pollutants of concern that should be monitored or for which emission limit values should be considered.

i) Carbon dioxide

Emissions of carbon dioxide are important due to their effect on global warming. They are an inevitable consequence of any combustion process.

Emissions of carbon dioxide are minimised through energy efficiency, fuel choice and minimising the weight of coffin materials. Carbon dioxide emissions do not ordinarily result in localised air quality issues and control of emissions through emission limit values is not feasible.

Given the climate emergency, it is undeniable that emissions of carbon dioxide are a key environmental issue. Work by Ben Copeland (ref 5) indicates that electric cremators have around half the CO_2 emissions in comparison with gas cremators. As the carbon intensity of electricity reduces, this will further reduce the carbon intensity of electrical cremators in comparison with gas. There is also a risk that at some point prior to 2050, natural gas may cease to be a public utility. Fuel choice is therefore likely to be a key issue for new cremators, which can ordinarily be expected to have an operating life of 15 to 25 years.

ii) Ammonia

This parameter is currently not included in the guidance. Where NO_X abatement is installed using the SNCR or SCR technique, there will be emissions of excess unreacted ammonia, known as ammonia slip. High levels of ammonia emissions can be both a risk to human health and the environment. Ammonia slip can also result in emissions of nitrous oxide (N_2O) which is a potent greenhouse gas.

In the absence of secondary NO_X abatement, ammonia emissions are unlikely to occur.

It is therefore recommended to defer consideration of ammonia as a key environmental issue, pending the TWG's consideration of nitrogen oxides.

iii) Poly Aromatic Hydrocarbons (PAHs)

This parameter is currently mentioned in the guidance, but not subject to any specific controls. Emissions of PAHs should not ordinarily arise, it is possible that these substances could arise, for example, from inappropriate materials being used in coffin construction in combination with poor combustion control. In this unlikely event, the abatement plant would offer some reduction in emissions.

It is therefore recommended that emissions of PAHs are not considered a key environmental issue.

iv) Sulphur dioxide

This parameter is currently not included in the guidance. The use of natural gas as the fuel means that the only source of SO_2 emissions would arise from sulphur present in the coffin materials, clothing or the deceased.

It is therefore recommended that emissions of sulphur dioxide are not considered a key environmental issue. This would need to be reconsidered in the event that fuels other than electricity or natural gas, e.g. liquid fuels, were used.

Question 16 – Do you agree that emissions to air of carbon dioxide should be a key environmental issue?

Question 17 – Do you agree that emissions to air of ammonia as a key environmental issue be deferred pending consideration of emissions of nitrogen oxides?

Question 18 – Do you agree that emissions to air of PAHs and SO_2 should not be a key environmental issue?

i) Odour Emissions

Control of odour emissions comes within the scope of Part B permitting. Well controlled combustion processes should not ordinarily be odorous.

It is therefore recommended that emissions of odour are not considered a key environmental issue.

Question 19 – Do you agree that emissions to air of odour should not be a key environmental issue?

Question 20 – Do you think there are emissions of other substances not considered in this paper that should be examined as a potential key environmental issue?

j) Other Combustion Control Parameters

The guidance also sets a minimum oxygen concentration at the exit of the secondary combustion chamber for both unabated and abated cremators of 3 vol% at any point in the cremation and an average of 6 vol% over the cycle.

The guidance also sets minimum temperature and residence requirements for the secondary combustion chamber to ensure the destruction of organic compounds including dioxins and furans (PCDD/PCDF). Some cremators may comprise more than one primary chamber with a common secondary combustion chamber and abatement.

It is proposed that the guidance review should examine the parameters and standards for control over the combustion process needed to ensure good combustion and that emissions are minimised.

This is considered further in the next section.

3.2 Emission Limit Values (for Emissions to Air)

The current guidance contains emission limit values in a number of alternative ways.

a) Concentration based ELVs

The reference conditions for concentration based ELVs are a temperature of 273.1K, 101.3kPa, and 11% oxygen v/v, dry gas.

b) Mass emission ELVs

For unabated cremators, ELVs are expressed both in terms of a mass emission in g/hour or as a concentration limit. For abated cremators, ELVs are expressed only as a concentration limit except for Carbon Monoxide levels.

Mass emission ELVs are set out as equivalent alternatives to concentration based ELVs, but only one limit should be used in the permit. The current guidance puts the choice of type of ELV with the operator.

It is recommended that the review consider what is the most appropriate way of expressing emission limit values, either as concentrations or mass emissions or a combination of the two.

Question 21 – Do you agree to consider the most appropriate way of expressing emission limit values, i.e. either as concentrations or mass emissions or a combination of the two?

c) Continuous or Periodic Monitoring and Monitoring Frequency

For both concentration and mass emission ELVs, the measurement period is defined as being one hour starting 2 minutes after coffin loading.

Continuous monitoring is currently specified for the following parameters:

- Total Particulate Matter (Cremators)
- Carbon monoxide
- Temperature
- Oxygen

The type of continuous monitoring specified is qualitative. There are detailed requirements on calibration associated with continuous measurement set out in the current guidance, much of which is now incorporated into BS, EN or ISO monitoring standards.

Annual periodic monitoring is currently specified for the following parameters:

- Hydrogen chloride
- Organic compounds
- Mercury

For the following parameters, measurements at equipment commissioning or replacement only are specified.

- Total Particulate Matter (Cremulators)
- Dioxins and furans (PCDD/F)
- Residence time in secondary combustion chamber

Although in the case of particulates from cremulators a monitor to alert the operator to gross filter failure should be fitted and operating continuously.

d) Monitoring for Effective Operational Control

Monitoring for effective operational control will need to be continuous. All the parameters which are currently monitored continuously are needed for effective control. Consideration should be given to adding VOCs to this list.

Effective operational control should ensure that emissions are in compliance all the year round and not just when the compliance monitoring is being carried out.

It is recommended that the list of parameters requiring continuous monitoring and the performance parameters that need to be achieved are within the scope of the guidance review.

There is lengthy and detailed information on continuous monitoring within the current guidance. Much of this can probably be covered by reference to relevant monitoring standards, for example EN 14181 in relation to monitoring for compliance and EN 15859 along with EN 17389 when monitoring is for process control.

Question 22 – Do you agree to review the list of plant performance parameters and standards that need to be achieved along with their monitoring requirements?

e) Monitoring for Compliance

Data from continuous monitoring can also be used for compliance purposes.

It is anticipated that compliance monitoring of other parameters would be periodic and at a minimum frequency of once per year. Consideration ought to be given as to whether any parameters require more frequent monitoring, e.g. mercury where emissions could differ significantly from cremation to cremation, especially in unabated crematoria.

For dioxins and furans, due to the complex nature of the measurement, consideration might be given to more frequent monitoring than just at commissioning, e.g. once every 2 or 3 years. Instinctively, it feels like an emissions test at commissioning is not sufficient protection.

The current guidance refers to the Source Testing Association website for information on monitoring standards. It also refers to the Environment Agency's Publications M1 and M2 for further information on monitoring. The M2 guidance has been withdrawn. Although not reflected in the current Guidance, the following monitoring standards are currently relevant and may need to be reflected in the updated guidance:

Mercury – EN 13211
Hydrogen Chloride – EN 1911
Total Particulate Matter – EN 13284-1
Carbon Monoxide – EN 15058
Organic Compounds (excluding particulates) – EN 12619
Dioxins and Furans – EN 1948 Parts 1 to 3
Oxygen – EN 14789
Quality Assurance of dust filter monitor – EN17389
Oxides of Nitrogen (NO and NO_2 expressed as N02 – BS EN 14792

f) Monitoring for Information Purposes

For parameters that could be new to emissions monitoring, e.g. nitrogen oxides and ammonia. It is possible that there may be insufficient emissions data on which to set an ELV. Thus in some cases, monitoring requirements may need to be included in permits for the purpose of gathering information to inform future reviews.

Question 23 – Do you agree to review the number and frequency of emissions monitoring for compliance and information purposes?

g) Tests at Commissioning

It is proposed to retain the requirement to demonstrate that the secondary combustion chamber can achieve the minimum temperature and residence time requirements as part of commissioning. Consideration needs to be given as to the most appropriate way of making that demonstration.

Question 24 – Do you agree to review the testing and reporting requirements at the commission stage of new cremators?

h) Emissions Standards

Foe emissions monitoring to be worthwhile, it is important that all emissions monitoring must be to a recognised standard.

It is possible that modifications to recognised EN, ISO or BS standards may be needed in some cases, due to sampling difficulties for what is a short duration batch process.

Regulator and public confidence in reported emissions data is further enhanced if all monitoring methods, equipment and personnel are certified or have accreditation to a recognised standard, for example the Environment Agency's MCERTS.

It is proposed that certification and / or accreditation of methods, equipment and personnel should be part of the guidance review.

Question 25 – Do you agree to include permit requirements for appropriate accreditation of monitoring methods, equipment and personnel as part of the guidance review?

3.3 Emissions to Water and Land

Emissions to water are not controlled under Part B regulation. In any event emissions to water are not expected from crematoria. Thus they are outside the scope of this review.

The spreading of Ashes on water or land is also outside the scope of this review.

In any event this has little impact on water quality; other items should not be placed in the water with the ashes. Personal items and wreaths might contain plastic and metal parts, which can cause litter and harm wildlife. They must not be put into the water or left on the riverbank where they could be washed into the water.

3.4 Energy Efficiency

The current guidance includes a requirement for gas fired cremators to keep a record of gas consumption and to use a conversion factor to convert the gas consumption data into emissions of carbon dioxide.

There is no equivalent requirement for electric powered cremators, but the recording of energy consumption and conversion of energy consumption into carbon intensity should be feasible.

The efficient use of energy is important regardless of fuel type.

Cooling of the combustion gases is needed where abatement is installed, this is because the temperature of the gases after the secondary combustion chamber are too high for the safe operation of the abatement equipment.

Abatement therefore affords an opportunity for heat recovery, the available quantity of heat means that this is most likely to occur as hot water, which could then be used for space heating.

It is recommended that data is collected and reviewed on fuel consumption and energy efficiency with a view to establishing performance standards or targets.

Question 26 – Do you agree to consider the setting of energy consumption and / or efficiency targets or standards?

3.5 Noise

Noise emissions are not controlled under Part B regulation. Noise is controlled through statutory nuisance legislation. Noise is therefore outside the scope of this review.

3.6 Consumption of water, raw materials and chemicals

The main consumable will be the reagents used in abatement plants. It is proposed to collect data on consumption and the quantity of residues for disposal. It is not proposed at this time to set performance standards.

Setting performance standards on the consumption of abatement reagents could act counter to the objectives of reducing emissions to air.

Question 27 – Do you agree to collecting data on abatement reagents consumption and residues for disposal, but not setting performance standards?

3.7 Stack Height and Efflux Velocity

Guidance on siting and planning crematoria originally issued in 1978 (ref 3) stated that:

‘The stack should generally be at least 12 metres high and should not be less than 3 metres higher than the highest part of the associated building to reduce the likelihood of flue gases being caught in down-draughts.’ In 1978, when this guidance was originally produced, all crematoria would have been unabated.

The current guidance on crematoria says that chimney heights should be calculated to be a suitable height for the release of gases, during normal operation. Stack heights should be calculated using HMIP Technical Guidance Note (Dispersion) D1, which dates back to 1996. Unabated crematoria will need a higher stack than abated crematoria because of the higher concentration of pollutants in the emissions. There is no requirement for abated crematoria to emit via an alternate higher stack in the event of operating in bypass mode.

It is important to note that stack height calculations will be based on adequately dispersing those pollutants for which an emission limit value has been set. The D1 calculation will be made for the pollutant requiring the greatest level of dispersion.

The methodology quoted for calculating stack height is now 25 years out of date. If other pollutants are considered, e.g. nitrogen dioxide, it is possible that NO_X could be a pollutant of greater concern requiring greater dispersion and a higher stack. Together this means that the stack height for some existing crematoria may be too low.

It is therefore proposed that data on stack height should be collected and the methodology used for calculating stack height should be reviewed. The Environment Agency's current method for predicting the ground level impact of emissions is listed in reference 2. This is one method that could be used to assess whether the stack height is sufficient.

Question 28 – Do you agree to a review of the methodology for determining stack height?

3.8 Mercury Abatement

For cremators which were in operation at 31 December 2012, BAT is either that these include mercury abatement, or they are part of a burden sharing scheme, such that at least 50% of UK cremations are carried out in cremators fitted with mercury abatement.

CAMEO (Crematoria Abatement of Mercury Emissions Organisation) is a burden sharing scheme operated across the industry as a whole by the Federation of Burial and Cremation Authorities. Membership is optional. Alternative schemes may be operated across smaller clusters of crematoria. Every cluster should achieve the target of at least 50% of cremations being carried out in cremators fitted with abatement.

For cremators brought into operation from 1 January 2013, BAT is to fit mercury abatement. There is no requirement to fit mercury abatement to small cremators and to standby cremators.

Replacement cremators should include mercury abatement. The guidance says that where mercury abatement needs to be replaced, there should be the option of joining a burden sharing scheme. This clause is the current guidance is not consistent with the requirement to fit mercury abatement to new cremators.

Mercury abatement plant will also reduce emissions of particulate matter, hydrogen chloride, and dioxins and furans (PDDF).

In view of the benefits that abatement brings, the question needs to be posed as to whether mercury abatement should be BAT for all crematoria with well-established criteria for allowable exemptions. The level of abatement has remained around 68 to 70% of cremations for the past 3 to 4 years.

Question 29 – Do you agree to a review of making mercury abatement a mandatory requirement for all crematoria, subject to an appropriate implementation period?

4. Mass Fatality Guidance

Clauses 5.31 to 5.38 give supplementary guidance to operators and regulators in the event of a mass fatality incident.

These clauses were activated on a nationwide basis in response to the Covid-19 pandemic, as the course of the pandemic has been brought under some measure of control, these clauses have been stood down in some parts of the UK.

The crematoria guidance review is an opportunity to review the effectiveness of these clauses and to include updated guidance in the light of experience.

Question 30 – Do you agree to include the mass fatality clauses of the current guidance within scope of this review?

5. Data Collection

A request is made for operators and regulators to nominate well performing crematoria (with and without mercury abatement) for a data collection exercise, based on existing data-sets, on emissions and other parameters relevant to their environmental performance.

TWG members are also requested to make available any other technical information that they think would assist the review, including any targeted or more detailed emissions monitoring data from UK or international sources.

Question 31– Is there anything missing that you consider important for the review?

Simon Holbrook and Chidi Igwebuike 10th September 2021

Local Authority Unit, Environment Agency

References

1. Process Guidance Note 5/2(12), Statutory Guidance for Crematoria
2. Air emissions risk assessment for your environmental permit - GOV.UK (www.gov.uk)
3. The Siting and Planning of Crematoria (originally produce in 1978, reproduced in 2016).
4. FCBA Annual Report 2020
5. A comparison of gas and electric cremator emissions in the UK – Ben Copeland (Coventry University) April 2021
6. Impact on air-quality through cremation, due to increased mortality rates – With a focus on modelling emissions of mercury from unabated crematoria – Environment Agency Report ref: AQMAU-C2047-WD01

Appendix

Table 2: UK Air Quality Standards / Ambient Air Directive Limit Values for the Protection of Human Health

Pollutant	Limit	Conc^{n} measured as	Comments
Particulates (PM_{10})	50 µg/m^3	24 hour mean	not to be exceeded more than 35 times a year ([1])
	40 µg/m^3 ([2])	annual mean	
Particulates ($PM_{2.5}$)	25 µg/m^3 ([3])	annual mean	
Nitrogen dioxide (NO_2)	200 µg/m^3	24 hour mean	not to be exceeded more than 18 times a year
	40 µg/m^3	annual mean	
Sulphur dioxide (SO_2)	350 µg/m^3	1 hour mean	not to be exceeded more than 24 times a year
	125 µg/m^3	24 hour mean	not to be exceeded more than 3 times a year
Benzene	5 µg/m^3	annual average	England and Wales
	3.25 µg/m^3	running annual mean	Scotland and Northern Ireland
Carbon monoxide	10 mg/m^3	8 hour mean	maximum daily running 8 hour mean ([4])

([1]) Not to be exceeded more than 7 times per year in Scotland
([2]) 18 µg/m^3 in Scotland
([3]) 10 µg/m^3 in Scotland
([4]) In Scotland as running 8 hour mean

Table 3: Ambient Air Directive Target Values and UK Air Quality Strategy Objectives

Pollutant	Objective	Conc^{n} measured as	Comments
Sulphur dioxide (SO_2)	266 µg/m^3	15 minute mean	not to be exceeded more than 35 times a year
Poly Aromatic Hydrocarbons (PAHs)	0.25 ng/m^3 B[a]P	as annual average	

Table 4: Environmental Assessment Levels for protection of human heath

Pollutant	Limit	Conc^{n} measured as	Comments
Ammonia	180 µg/m^3	Annual mean	
	2,500 µg/m^3	Daily mean	
Hydrogen Chloride	750 µg/m^3	Daily mean	
Mercury	0.25 µg/m^3	Annual mean	
	7.5 µg/m^3	Daily mean	

Table 5: UK Air Quality limits and targets for protected conservation areas

Pollutant	Limit	Concⁿ measured as	Comments
Nitrogen dioxide (NO_2)	30 µg/m^3 ([1])	annual mean	
	75 µg/m^3	daily mean	
Sulphur dioxide (SO_2)	10 µg/m^3	annual mean	where lichens or bryophytes are present
	20 µg/m^3 ([1])		where lichens or bryophytes are not present
Ammonia	1 µg/m^3	annual mean	where lichens or bryophytes are present
	3 µg/m^3		where lichens or bryophytes are not present
([1]) Ambient Air Directive Limit Value			

c