Huntingdon Crematorium Environmental Permit Application

Part B Permit application supplementary information

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1.0 The installation

Huntingdon Town Council (the Operator) plans to open Huntingdon Crematorium in May/June 2021. This supplementary information document details the equipment proposed in the crematorium, describes the cremation process and provides how the Operator intends to apply Best Available Techniques (BAT) to prevent, or where that is not possible, to minimise emissions to air from the operation of the installation.

1.1 Description of the proposed installation

The installation is to comprise:

2 No. DFW single-ended electric cremators, each equipped with:

- Primary cremation chamber.
- Secondary combustion chamber.
- Interlocked charge door.
- Automated and integrated charging bier.
- Front door inspection window.
- Ash collection hopper.
- By-pass stack.
- Servomex Servotough FluegasExact 2700 secondary combustion chamber Oxygen analyser.
- Automatic control system.
- 450mm diameter steel emergency release vent (located directly above each cremator) equipped with air injector fan.
- 12.7m 0.25m diameter exhaust stack (after flue gas cleaning)

2 No. Flue Gas Cooling and Flue Gas Cleaning installation, comprising:

- Danstoker heat exchanger with automatic cleaning system.
- Dump cooler with cooling fans.
- DFW O 2-12 particulate abatement and dust collection hopper, with Kevlar/Nomex filtration.
- Fixed bed cartridge filter for mercury and acid gas abatement.

2 sets of emissions monitoring equipment, comprising:

- Bühler BDA 02 (or similar) dust probe.
- Fuji Electric (or similar) carbon monoxide dry gas analyser.
- Extractive emissions monitoring ports.

1 set of ash processing equipment, comprising:

- DFW Europe Ash Processor.

A full plant schematic diagram of the components of the installation is provided in Appendix 1. Please refer to these diagrams in conjunction with the numbers in brackets in the narrative in the activity description in the next section.

1.2 Activity description

The coffin will be received in the crematory lobby from the catafalque in the chapel following the completion of the memorial service. A wheeled trolley will be used to safely and considerately move the coffin to the coffin store, or to the charging bier ready for cremation.

The proposed cremators are single ended electric machines. The cremators will be entirely operated by electricity, and will not contain any auxiliary gas burners.

Figure 1: The DFW Electric Cremator.

Electric elements within the refractory linings will heat the cremator from the blockwork into the combustion chamber air space. This is different to a gas burner system, which first heats the air in the chamber, then the refractory lining as shown in Figure 2 below. The electric cremator will be highly insulated, and temperature will be maintained 24-hours a day, 7-days per week at all times other than for planned preventative maintenance.

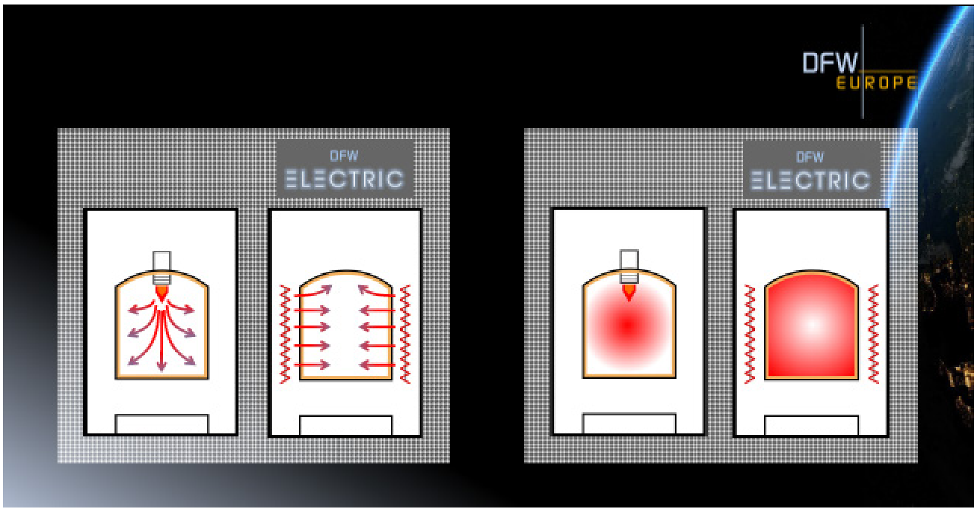

Figure 2: Gas Vs Electric heating.

Maintaining a hot machine aims to minimise the heating and cool cycling of the refractory (maximises refractory life) and to minimise the electrical demand to heat the oven from cool. The primary and secondary chambers are both heated: the primary chamber to at least 650°C, and the secondary chamber to at least 750°C. UK test reports confirm that all UK emission limits can be met at this operating temperature.

The cremators will each be equipped with an Automatic Insertion Machine (AIM) **(1)** which will be mounted in the floor in front of each cremator, and out of sight other than when in active use.

When a coffin needs to be inserted into the cremator **(2)**, the operator pushes the button on the Touch Screen and the AIM will rise from the floor to a pre-set level. The coffin will then be transferred to the AIM. When ‘ready to cremate’, the operator pushes the button on the Touch Screen and the AIM raises to the level of the primary chamber hearth. The charge door will then automatically open, and the AIM inserts the coffin directly into the primary chamber. Any heat or smoke released during charging will be ducted to the charge door LEV **(3)**. After coffin insertion, the AIM withdraws, and the charge door closes. The AIM will then automatically park itself out of sight in the floor.

When ‘ready to cremate’, the secondary combustion chamber temperature is set to be >750°C, and the charge door will be interlocked to prevent coffin insertion below this temperature. Combustion conditions will be controlled by bespoke software, enabling the fully automatic operation of the cremator. Electrical energy will be supplied to both primary and secondary chambers to maintain secondary combustion chamber temperature. Combustion air will be managed within pre-set operational parameters by the control system, using data from primary and secondary combustion chamber thermocouples and the Servomex Oxygen analyser.

All new crematoria are required to be equipped with ‘mercury abatement’, and this will be the case for Huntingdon Crematorium and each cremator will be equipped with its own dedicated mercury abatement system. Hot gasses from the secondary combustion chamber will pass through a heat exchanger **(5)** though a refractory lined duct. The heat exchanger will be used to reduce the temperature of the flue gasses to around 120-150°C. Unwanted heat will be use in an adjacent glasshouse or dissipated via an externally located aero cooler **(11)**. Cooled combustion gasses will pass through a spark arrestor and then a dust collector **(6)** comprising of 102m^2 of filtration area provided by Kevlar/Nomex filter units, which will be periodically and automatically cleaned by compressed air. Collected dust will fall into a sealed dust collection hopper for off-site disposal as hazardous waste.

Cooled and filtered combustion gasses will then pass through a fixed bed flue gas cleaning system for the control of Mercury, Dioxins and Hydrogen Chloride **(7)**. A stainless-steel perforated cartridge will contain a mixture of activated carbon and bicarbonate granules and will be mounted inside an insulted steel housing mounted-in line with the flue gas stream. Cooled, filtered and cleaned combustion gases will be released to air via a 12.7m chimney stack **(8)**. This stack will be equipped with emissions monitoring ports and emissions monitoring equipment.

Each cremator will also be equipped with an emergency relief vent (dump stack) **(4)** to bypass the flue gas cleaning systems in the event of a problem. This serves to protect the boiler and filter system by ducting the very hot gases from the secondary combustion chamber to air.

Cooled cremated remains will be transported to the ash processing area, where they are checked for metal objects (such as artificial joints and metal pins) that would otherwise damage the processing equipment. The ash processor **(9)** will process the remains to a consistent granular powder. This will be a fully enclosed unit. Processed remains are prepared for spreading or interment on the ash table **(10)**. The ash table does have an external vent, principally for operator protection, and is fully filtered prior to release.

2.0 Emissions

2.1 Foreseeable emissions

The foreseeable emissions from each stage of the cremation process are as follows:

2.1.1 Foreseeable emissions during cremator start-up

The cremator will be totally heated by electricity, meaning that there are no emissions at start-up.

2.1.2 Foreseeable emissions during cremation operations

During normal cremation operations the foreseeable contained emissions from the cremator will the products of combustion of the coffin and its contents. The principal emissions will be:

- Combustion emissions (NOx, SOx, CO).
- Particulate matter.
- Hydrogen chloride.
- Mercury (dependent on its presence in the human body).
- Steam plume.

2.1.3 Abnormal operations

Abnormal cremation operations will hopefully be rare, but in addition to the emissions from cremator operations, other foreseeable contained emissions could include:

- Visible smoke.
- Possible combustion odour.

2.1.4 Foreseeable emissions during cremator shut-down

The cremator will be maintained hot 24-hours a day, 7-days a week other than for planned preventative maintenance.

When the cremator is shut down, only heat will be released because the primary cremation chamber will be empty.

2.1.5 Foreseeable emissions during fly-ash removal

Fly-ash collected from the filtration system could give rise to fugitive emissions of particulate matter.

2.1.6 Foreseeable emissions during remains removal and preparation

After cremation, the fully calcined remains are dry and brittle, and could give rise to fugitive emissions of particulate matter.

2.2 Emissions quantification

Emissions from crematoria are generally contained emissions, and these can be quantified based on existing data for similar cremation equipment.

2.2.1 Quantification of contained cremator emissions

The proposed installation is not currently operational however, the manufacturer has provided emissions information from another UK DFW electric cremator installation in Oxfordshire, and Geleen in Holland (Table 1):

Parameter	Oxfordshire[1] (750°C)	Geleen[2] (750°C)	Geleen[2] (800°C)	PG5 Emission Limit
Particulate Matter	0.90	0.5	1.1	20mg/m^3
Mercury	0.004	0.006	0.002	50μg/m^3
Dioxins	0.01	0.01	0.01	0.1ng/m^3
Carbon Monoxide	9.2	22.6	30.3	100mg/m^3
Hydrogen Chloride	0.07	5.9	2.7	30mg/m^3
Sulphur Dioxide	3.2	7.9	7.5	No PG5 emission limit
Nitrogen Oxides	212	176	279	No PG5 emission limit

All reported at 11% O_2

Table 1: Emissions Quantification
([1]Element Report Referece ERO-2936: 2nd-4th December 2020)
([2]Tauw Report Referece R003-1271511PZX-V01: October 9, 2019)

2.2.2 Quantification of fugitive emissions

It is not possible to quantify fugitive emissions, however these will be contained and controlled as far as practicable in accordance with site specific Best Available Techniques.

The off-site impact of fugitive emissions is highly unlikely.

3.0 Controlling emissions

Contained and potentially fugitive emissions from the installation will be controlled as follows:

3.1 Controlling combustion emissions

Combustion emissions will be controlled by optimising combustion conditions in the secondary combustion chamber:

The temperature and composition of the combustion gasses in the primary chamber are highly variable from charge to charge, so the secondary combustion chamber is designed to treat these gases at a consistent temperature and for a consistent period of time.

The manufacturer has designed the cremator secondary combustion chamber to achieve a two second residence time at 750°C or more. The commissioning process will confirm that the cremator meets the two second residence time over a full hour of cremation.

Electrical energy will be supplied to the elements in the secondary chamber walls to maintain secondary combustion chamber temperature. Thermocouples continuously monitor secondary combustion chamber temperature to ensure that the required temperature is maintained.

Figure 3: Servomex Oxygen Analyser.

A Servomex Servotough FluegasExact 2700 will continuously monitor secondary combustion chamber Oxygen, and the control software will manage the provision of combustion air, with the aim of maintaining a minimum average Oxygen of 6% and minimum Oxygen of 3%.

3.2 Controlling particulate matter emissions

Particulate matter emissions will be controlled by a filter system, which will comprise a filter housing containing 102m^2 of Kevlar/Nomex filter cartridges (Figure 4).

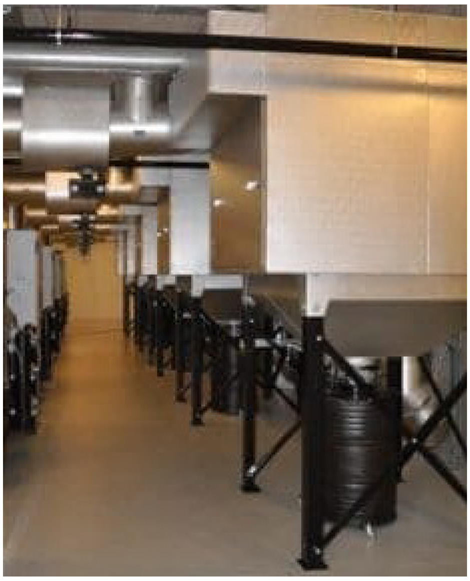

Figure 4: Dust filter unit with collection drum.

The filter cartridges will be frequently and automatically cleaned with a pulse of compressed air. This will displace the dust that has accumulated on the outside of the filter element.

3.3 Controlling emissions of mercury, dioxins and hydrogen chloride

The key control measure is the secondary combustion chamber of 750°C or more during the cremation. Noted that that this is a departure from the guidance in PG5/2 however the PG note has not yet been updated for New Generation electric cremators (Note: PG note review soon to be undertaken and electric machines may well become BAT for new installations) and as Table 1 clearly demonstrates, the dioxin and HCl emission limits can comfortably be met at this temperature. The lower temperature also means that the electrical energy input requirements are lower, and NOx emissions (although not currently regulated but an important pollutant nonetheless) are also lower.

Whilst the overall contents of the coffin cannot be controlled, funeral directors will be instructed in writing to ensure that the following are not presented for cremation due to their potential for unwanted emissions:

- PVC or melamine in coffin construction or furnishings, and cardboard coffins containing chlorine in the wet strength agent (e.g. not using polyamidoamine epichlorhydrin based resin (PAA-E)).

Emissions of mercury, dioxin and hydrogen chloride will be limited in a closed system via a cartridge pre-filled with a mixture of activated carbon and bicarbonate granules.

Cooled and de-dusted combustion air is drawn through the packed bed of granules where the abatement takes place. Service life depends on the installation and the number of cremations undertaken.

The carbon/bicarbonate cartridge can be replaced by a ‘dummy filter’ to allow the Operator to continue to cremate if necessary in the event of a problem with the carbon/bicarbonate filter. The Regulator will be notified whenever this is the case. Emissions will remain filtered for dust and will release via the main stack, but will not count for the purposes of trading abated cremations in the CEMO scheme.

3.4 Controlling particulate emissions during fly-ash removal

Dust displaced from particulate abatement drops into a sealed collection hopper at the bottom of the filter housing for disposal as hazardous waste containing Mercury. Drums will be stored sealed prior to collection.

Waste consignment notes will be obtained and retained on site as part of the Duty of Care process for waste handling.

3.5 Controlling particulate emissions during remains preparation

A DFW Cremulator is proposed for the for the preparation of remains after cremation.

Figure 5: DFW Cremulator.

A power magnet removes metallic items, and 20 stainless steel clappers reduce the cremated remains to a uniform granular powder.

4.0 Unintentional emissions

Good management controls, maintenance and operational standards will mean that unintentional emissions are rare.

The most common (but still rare) event is flue gas treatment (FGT) system bypass, which happens to protect the cremator and the flue gas treatment system or because of a power outage. The bypass butterfly valve is held shut pneumatically under normal operations, meaning that it will fail to safe (i.e. to bypass) in the event of a problem, including power outages.

In a bypass event, the emissions from the cremator will be released to air via a separate, 450mm diameter steel emergency release vent located on the crematorium roof, directly above the cremator.

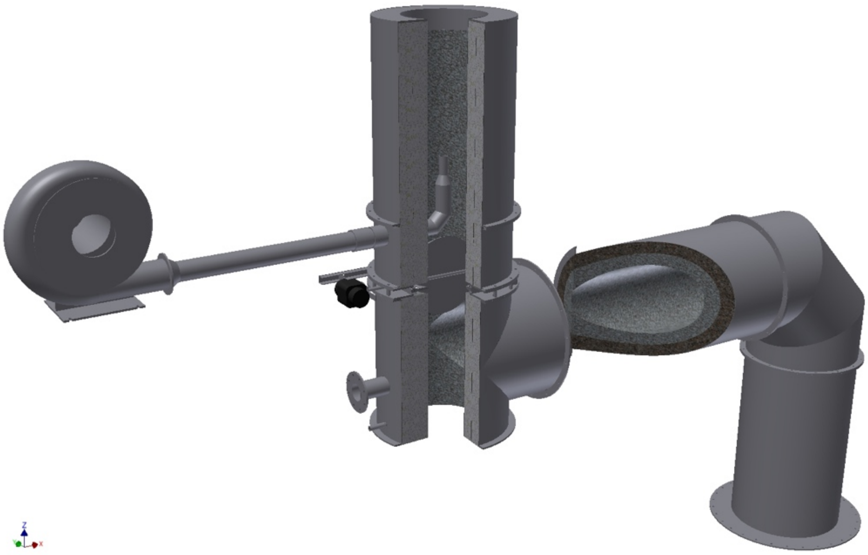

Figure 6: Emergency release vent with Injector Air Fan.

The emergency release vent will contain an injector air fan (Figure 6), supplying additional air for the dispersion and dilution of emissions.

If possible, and depending on the stage of cremation and the cause of the bypass event, the flue gas treatment system can be re-set to maintain abated emissions without undue delay. The worst case scenario is that the cremation finishes unabated.

In a bypass event, the cremator operator will keep a record of the incident, equipment information, and whether or not any visible smoke or cremation odour was experienced

Fully bypassed and therefore unabated cremations will not count towards emissions trading scheme operated by Crematoria Abatement of Mercury Emissions Organisation (CAMEO).

A cremation cannot commence with the machine in full bypass to the emergency release vent.

5.0 Monitoring emissions

A combination of continuous emissions monitoring and extractive emissions monitoring will be undertaken in order to ensure that compliance with emission limits is demonstrated:

5.1 Extractive emissions monitoring

Extractive emissions monitoring will be undertaken after commissioning the system, and then once every year thereafter. Sampling ports will be provided and will be located in the ductwork in accordance with Environment Agency Guidance M1 as far as practicable.

Extractive emissions monitoring will be undertaken in accordance with Table 2 (or equivalent standard), and results reported at reference conditions of 273K, 101.3kPa, dry gas, 11% oxygen.

Parameter	Test method	Emission limit mg/m³ (unless stated otherwise)	Notes
Total Particulate Matter	EN 13284Part 1	20	
Hydrogen Chloride	EN 1911 Parts 1-3	30	
Mercury	EN 13211	50µg/m³	
Dioxins & Furans	EN 1948	0.1 ng/m³	Commissioning only
Water Vapour	EN 14790	-	
Total VOCs (as Carbon)	EN 12619	20	
Carbon Monoxide	EN 15058	100	2 x 30-minute averages
Oxygen	EN 14789	>3%	
Velocity & Vol. Flow Rate	EN 13284		
Secondary combustion chamber residence time		2 seconds or more	Commissioning only

Table 2: Proposed emissions monitoring.

5.2 Continuous emissions monitoring

Continuous emission monitoring will be undertaken for carbon monoxide and particulate matter on each abated stack:

5.2.1 Carbon monoxide continuous emission monitoring

The Fuji Electric ZPA (Figure 7) is a Non-Dispersive Infra-Red (NDIR) carbon monoxide analyser for measuring the concentration of carbon oxides (CO & CO_2) in dry gas conditions. It is linked to the cremator display and CEM reporting software.

Figure 7: Fuji Electric ZPA carbon monoxide analyser.

It is a 19" rackmount unit, which will be housed in its own dedicated analyser cabinet. It has an in-built auto-calibration function, meaning that it can easily be calibrated on site with ambient air, without the need for certified calibration gases. The output is linked to the computer control system where results and warnings are automatically recorded.

5.2.2 Particulate matter continuous emission monitoring

The Bühler BDA 02 Particle Monitor (Figure 8) is a particulate monitor using a tribo-electric probe. The action of a dust particle impacting on the probe creates and electrical signal, which the monitor equates to an emission concentration.

Figure 8: Bühler BDA 02 Particle Monitor.

Calibration is by gravimetric measurement. The output is linked to the computer control system where results and warnings are automatically recorded.

6.0 Environmental management techniques

In addition to the technical controls described, Memoria operates in accordance with a documented Environmental Procedures Manual. The Draft manual is provided in Appendix 2 and contains examples of the information and recording systems detailed below:

6.1 Daily operations

A daily documented health check will be performed on the cremator and analytical equipment.

6.2 Emissions reporting & notifications of alarm events

The data from the monitoring and control systems on the cremator and the exhaust gas flue are collected to provide operational information on the performance of the cremator during each cremation.

6.1.1 Emissions reporting

The DFW cremator software automatically records the following information to produce what is referred to as the PG5/2 report:

- Average, minimum and maximum secondary combustion chamber inlet and outlet temperatures (5-minute averages).
- Average and minimum secondary combustion chamber oxygen (5-minute averages).
- The highest 60-minute mean emission values (particulates and CO).
- Details of any excursion events.

An example of the monthly PG5 report is provided in Appendix 3.

6.1.2 Notifications & alarm events

The DFW cremator software automatically records an alarm event (fault or emission limits exceedance) for review and action by the cremator operator. Alarm events history is retained on the computer for inspection by the Regulator as required.

A specific notification will be made to the regulator under the following circumstances:

- Flue gas treatment system by-pass.
- Double emission limit exceedances.
- 7-days prior notification of extractive emissions monitoring.
- Reporting extractive emissions monitoring within 8 weeks of testing.

6.3 Maintenance

A service agent will provide ongoing maintenance support and servicing for the cremator and flue gas treatment systems. A maintenance/service report will be retained following every visit.

The following spares and consumables are held in any event:

- Thermocouples (all sizes).

6.4 Training

All cremator Operators will be trained by the cremator manufacturer and to ICCM certification standards. ICCM Certificates will be displayed in the crematory area.

6.5 Mass fatalities

In the event of circumstances giving rise to mass fatalities (such as pandemic) the Operator has an outline procedure in place to guide site operations.

7.0 Environmental impact

Emissions from abated cremators are tightly controlled by emission limits in Secretary of States Process Guidance Note PG5/2.

7.1 Local air quality

The proposed cremation equipment performs better than the emission limits contained within the statutory guidance for the cremation sector for abated plant.

Dispersion modelling also been carried out by the manufacturer and reports that emissions will not give rise to impacts of concern to human health outside the crematorium site.

The Air Quality Assessment of Emissions to Atmosphere from the proposed Huntingdon Crematorium report is provided in Appendix 4.

7.2 Designated sites

Part B permit applications require that all designated sites within 500m of the proposed regulated activity be assessed in terms of environment impact.

There are no statutory designated withes within 500m of the prosed activity. A location plan showing the nearest designated sites is provided in Appendix 5.

Appendices

Appendix 1 - Maps Plans & Diagrams
Appendix 2 - Draft Environmental Procedures
Appendix 3 - Example monthly reports
Appendix 4 - Dispersion modelling report
Appendix 5 - Designated sites map