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| 20/03/2024 | BR0923-OLV-01 | A.Piearcey | 5 | A.Piearcey | 20/03/2024 | |

| Status | **Conceptual** | Preliminary | Pre-HAZOP | Post-HAZOP | As-Fitted |
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# Fornax HTI Extract and Abatement Requirements Assessment




# 1. Introduction

This report is pursuant to the submission for the EA regarding the Fornax HTI facility and its original building design. It has due consideration to the continuous nature of the incineration process and hence the ***continuous*** combustion air demand. It also considers that the building, originally designed for purely natural ventilation, houses a process that has been designed for de-minimis fugitive emissions and is unlikely, under normal operating conditions, to generate odorous emissions, even without a forced extraction system.

## 1.1 Document Objectives

This document has the following objectives key objectives

- Describe the process
- State the calculated design air extract and its basis
- Clarify the use of the combustion air as a complimentary mechanical extract

## 1.2 Process Overview

The Fornax HTI facility will be located just off Heighington Lane in Newton Aycliffe, County Durham:


The facility accepts, stores and incinerates hazardous waste, including clinical waste, to produce electricity.

The waste that is received arrives bagged and sealed in plastic eurobins. This is then quality checked and then stored in racks within the waste storage area of the facility.

Bins are moved for processing via **electric vehicles**. The bins are loaded onto a hydraulic lift and the contents tipped into a chute that feeds the compactor. The compactor pushes the waste into the incinerator and also acts as a seal against escaping fumes from the incinerator.

There is no shredding or splitting of the bagged waste and it remains sealed through to incineration.

The empty bins are then moved to the cleaning area where they are either manually or automatically washed.

The cleaned bins are stored in a dedicated area on the west side of the facility building.

The incinerator and associated equipment are in a sealed off area of the main building.

The incinerator requires up to **14,000 $Nm^3/hr$** of combustion air to drive the burners. At present this is understood to be extracted external to the facility.

The ash handling, Steam generator, Fire Water storage and Air Handling Unit are all to be installed in front of the incineration section of the building on the south side of the building.

The use of electric vehicles means there is no requirement for low-level sweep extraction.

# 2. Extract Design

This section consolidates the information provided by Olive Compliance and formulates an appropriate design basis for any extraction and abatement.

The building was designed for natural ventilation through control of louvres and also ventilation of the radiant and convective heat from the incinerator room volume. The enhanced extraction can supersede this design and louvres provided to suit the new extract regime.

The additional mechanical extract has 2 key purposes

- Provide proven calculable air flow equal to or greater than the CIBSE air infiltration (leak rate) of the building. The design criteria being **2.5 $m^3/hr$** per square meter of exposed surface area.
- A forced and controlled flow of air to prevent the build-up of any trace odour emissions or spillages (from unlikely, ***abnormal*** operational events)

## 2.1 Air Extraction Volume

The exposed surface calculations give **6378 $m^2$** of relevant exposed area (See Appendix 1).

The building is designed at **2.5 $m^3/hr$** for each square meter of area hence the unmitigated 50 Pa flow is **15,945 $m^3/hr$**

The divisor is a ***factor of 10*** for the design standards of the building and so a flow of approximately **1600 $m^3$/hr** is expected to leak from the storage area under UK ambient conditions.

The calculation basis for this figure in the previous report is from the CIBSE guide A " Environmental Design" Section 4.7. This provides a means of estimating the "infiltration" rate for a building, compliant with a particular design code and in relation to its footprint.

Clearly the combustion air demand is well above the require air flow to class the storage area as primary containment.

As the proposed extract rate is greater than the predicted infiltration rate then the building will require louvres to "artificially leak" air into the building, under a gentle negative pressure.

The original building design concept was to utilise motorised louvres to generate a natural ventilation air flow through the building. This document describes an alternative to this concept by utilising fixed louvres strategically placed for optimisation of air distribution.

## 2.2 Using the Combustion Air Capacity to Optimise Extraction

There is a clear and simple route to enhancing the odour integrity of the building based on the air extraction volume calculation.

This is to take the combustion air from the waste storage area. The demand is reported to be continuous in nature and is more than enough to provide primary containment. Louvres can be opened and closed to provide the additional air into the facility as required.

The air can be easily measured, continuously to prove flow and hence provide a robust indication of odour integrity.

During winter months, where the air is very cold it may be that the building internal temperature could become too cold and so reduced air extract from the warehouse could be achieved by taking some air from the incinerator room to maintain the demand. This concept needs development by the vendor.

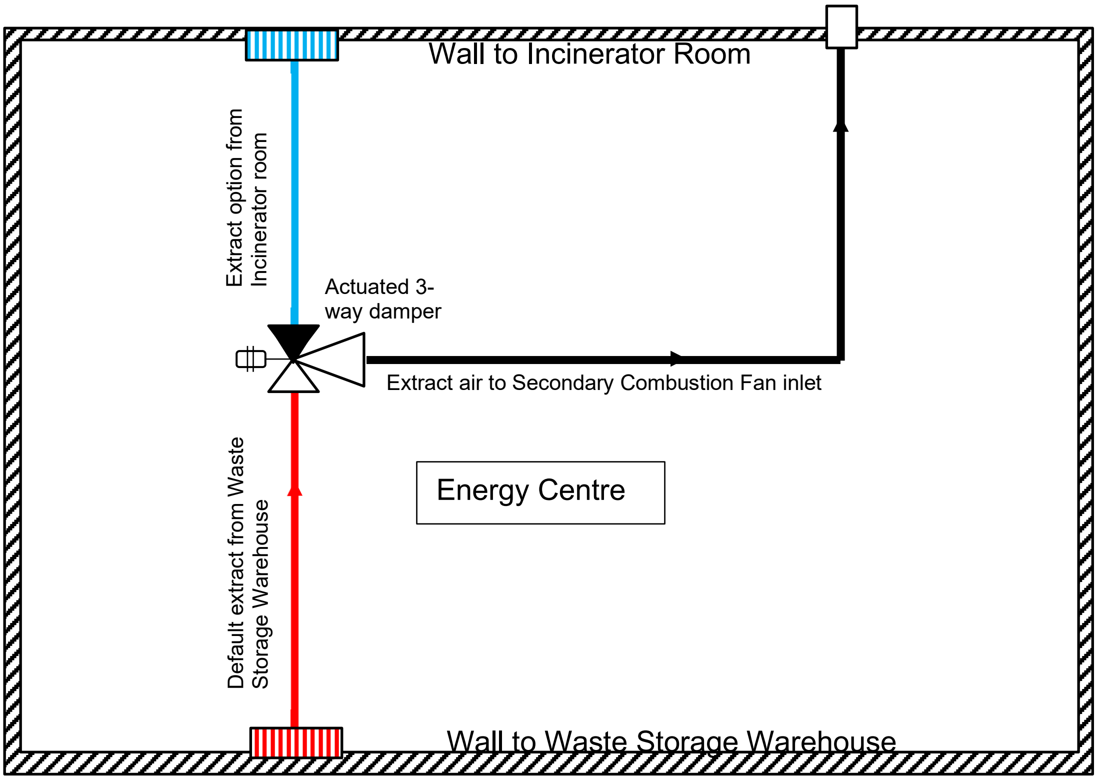
This forced draft and controlled extract flow is very simple to implement and it has 3 key advantages:

- The flow is incinerated and hence abated
- The flow is exhausted via a high level stack to maximise dispersion
- The flow and its associated environmental impact would be required in any case and so re-purposing the extract for odour control as well as its combustion function optimises carbon footprint.

The preferred method of air transfer is to have a 3-way damper (diverter damper) that is actuated to allow remote actuation from the control room.

This will route air to the secondary combustion air fan from one of 2 locations:

- A High level fire damper in the wall of the energy centre to the waste storage warehouse
- A louvre in the energy centre wall to the incinerator room.
  The default position will be taking air from the waste storage warehouse. This will be diverted to the incinerator room in the event that the outside air is too cold to pull through the waste storage warehouse.




The ducting route from the Energy Centre will be optimised and designed by the vendor.

### ***2.2.1 Louvre Design and Placement***

At 14000 $Nm^3/hr$ (15,050 $Am^3/hr$), We require a certain louver area to allow fresh air in.

The above airflow is approximately **4.2 $m^3/s$**.

At 1 m/s superficial Velocity this requires a total open area of **4.2 $m^2$**.

Most louvres have a 47% open area (to be confirmed with louvre supplier) so this equates to a total louvre area of :

**8.9 $m^2$**. We suggest this is rounded to **10 $m^2$** as it is easier to block installed louvre, than to have to retrofit louvre later down the line.

This can be manifest in any arrangement; e.g. 10 off 1m x 1m louvres or 5 off 1m x 2m louvres etc.

We suggest that these are place at approximate head height and on the opposite side of the warehouse from the point of extract. To minimise "dead-spots" a larger number of small louvres should be deployed along the length of the North wall to spread out the fresh air intake through the various waste racks.

It should be noted that the fresh air distribution is not critical in this application as the process containment integrity is of a high quality and there is little opportunity for fugitive emissions.

# 3. Summary of Recommended Approach

The recommended approach is to move to a more robust and demonstrable forced extract system to ensure the odour integrity for the building. This to provide proof positive of building containment. The combustion air demand will be used to provide this augmentation.

The combustion air can be taken from anywhere in the waste storage area of the building. This should be done to minimise the required ducting and associated pressure loss.
The ducting should have actuated and manual dampers so that the combustion air can be taken from its original external source to provide control over the building environment and to provide flexibility in balancing.

The combustion air is 10 times greater than the actual calculated requirement and so the suggested louvres will provide the balance against the infiltration rate.

The flow rate of the combustion air can be easily and reliably measured on a continuous basis. A trigger point of **1600 $m^3$/hr** can be set as a low flow alarm warning of potential loss of integrity in normal operation. Suitable actions for this event would be tabled in the Odour Management Plan.

Any flow rate greater than this trigger, would, by definition, indicate building containment and sufficient average negative pressure but with a more robust measurement technique.

There is then no requirement at all for any other extract or abatement.

To facilitate this the following needs to be established:

- The shortest duct route to the combustion air fan(s) inlet manifold
- The additional pressure loss of the extract duct from the waste storage facility – suggest 10 m/s duct velocity to keep this down.
- Whether the currently specified combustion air fans have the capacity to overcome the additional loss or if a larger capacity is required.

As we have discussed the very low odour loads anticipated, we believe that the building could operate with reduce extract, indefinitely without risk of an odour release and so the extract can be balanced with due consideration to external weather and temperature if required .

ASK PIEARCEY

# Appendix 1: Building Volume and Surface Area Calculation Output.

| Dimensions | Distance m | Areas | Area m2 |
|---|---|---|---|
| Total building length | 90.6 | Estimated Roof angle (Deg) | 4.80 |
| Total building width | 59.5 | Total area of Reception side Width | 753 m2 |
| Height to Apex | 14.1 | Area of Incinerator building front | 633 m2 |
| Height to Eaves | 11.2 | Incinerator left side | 293 m2 |
| Edge to Apex distance long | 34.1 | Incinerator right side | 270 m2 |
| Edge to Apex distance short | 25.4 | Roof area (none incinerator side) | 3108 m2 |
| Length Incinerator face wall | 37.9 | Roof area left incinerator | 628 m2 |
| Height incinerator face wall | 16.7 | Roof area right incinerator | 578 m2 |
| Depth Incinerator area | 18.5 | Clean bin building side | 96 m2 |
| Roof slope distance long side | 34.3 | Clean bin building roof area | 899 m2 |
| Roof slope distance short side | 24 | Clean bin area Front face | 315 m2 |
| Height of triangle (apex) | 2.9 | **Area for infiltration Calculation** | **6378 m2** |
| Clean bin area apex height | 7.8 | **Volumes** | **Vol m3** |
| Clean bin area eaves | 5.3 | Clean bin storage volume | 5740 m3 |
| length clean bin area | 14.9 | Incinerator Building volume | 11709 m3 |
| Width clean bin area | 59.5 | Total Building Volume estimate | 73962 m3 |
| Clean bin triangle height | 2.5 | **Estimated Waste Storage volume** | **56513 m3** |
| Clean bin area roof angle | 9.5 | Building Footprint | 5391 m2 |
| Clean bin roof slope length | 15.1 | ***Minimum Effective Stack height*** | ***19.7*** |