EfW Process Description

1.0 Introduction

1.1 The Energy from Waste process is essentially a Waste incineration plant that recovers energy in the form of heat and electricity from residual waste (the remaining waste after kerbside recycling).

1.2 In the UK all waste incineration plants must comply with the Waste Incineration Directive (WID) This Directive sets the most stringent emissions controls for any thermal processes regulated in the EU.

2.0 The EfW Process

The process comprises of the following:

- Waste reception and handling
- Combustion process
- Energy recovery plant
- Flue Gas treatment plant
- Ash handling
- Ash processing.

The following description should be read in conjunction with the typical process flow schematic diagram below. The various items of plant and equipment in the diagram are numbered and referred to in brackets below.

2.1 **Waste reception:** Waste collection vehicles deliver to the facility and pass over the weighbridge to be weighed; from here they are directed to a tipping bay located within the Tipping Hall (1) and tip their waste load into the refuse bunker (2) at this point. A large refuse handling crane (3) located above the refuse bunker, mixes and turns the waste to create a more uniform fuel and to prevent it becoming anaerobic and thereby reduce the production of odour. It also loads the waste into the feed hopper (4), which feeds waste into the combustion process.

2.2 **Combustion process:** The Combustion process comprises of the grate (5), where the waste is burnt. The combustion of the waste requires air, which is drawn via the primary air fan (11) from above the refuse bunker located in the Tipping hall and through the grate to support the combustion process. Drawing from the tipping hall creates a flow of air from outside of the building through the tipping hall, taking with it all odours and dust from within the tipping hall and bunker, together with vehicle emissions. These are destroyed in the combustion process. The movement of air creates a slight negative

pressure in the tipping hall ensuring that odours and dust do not escape from the building.

The heat released in the combustion process is in the form of combustion gasses and these pass through the furnace (5a) located directly above the grate and the boiler (6) which comprises of banks of water tubes. As the gasses pass through the boiler they give up their heat to the water within these tubes converting it to steam. The steam is collected in a steam drum located at the top of the boiler. In the steam drum, water trapped in the steam is removed and this dryer steam is passed through the superheater (6a) where the steam is heated further to remove any traces of moisture, and creates a high pressure superheated steam in a condition suitable to pass through the steam turbine.

2.3 **Energy Recovery Plant:** The energy recovery plant comprises of a steam turbine (21) and generator (22). The superheated steam drives the turbine which in turn rotates the generator. The generator produces electricity that is used to drive motors and operates the plant; the remaining electricity is transmitted to the nearby electricity grid system. As the superheated steam passes through the steam turbine it gives up its energy and changes its state back to low pressure steam. The system is closed loop and the steam has to be converted back to water to allow it to be pumped back into the boiler. This is done via the Air cooled condenser (23), the steam is passed through the ACC which comprises of banks of tubes where large slow speed fans blow air over the tubes, this cools the steam and condenses the steam into water. The water can then be pumped back into the boiler. Before the water enters the boiler it is passed through the boiler economiser (6b), where the water is heated by the hot combustion gasses that are exiting the boiler. This increase in temperature improves the efficiency of the system.

2.4 **Flue Gas Treatment Plant:** To ensure that the combustion gasses meet the stringent requirements of the WID before they are discharged up the chimney stack (10), they have to be treated. This treatment starts in the furnace (5a) where the gasses are designed to have a residence time of 2 seconds at 850 C, this ensures that dioxins and furans are destroyed. The configuration of the furnace also reduces the production NOx. The production of NOx is further reduced by the injection of ammonia into the gas stream. After combustion, gasses are rapidly cooled in the boiler to minimise the risk of dioxin reformation before they are discharged for further treatment to ensure compliance with the WID. This Flue Gas treatment plant requires the gasses to pass through the Gas scrubber (7) where lime and active carbon is introduced to neutralise any acid gasses and to capture mercury and any dioxins that may have reformed. The final stage of the treatment process is the bag filter where particulate matter is removed. The whole process ensures that the combustion gasses are treated to a

level well below the stringent requirements of the WID. The gasses are drawn through the boiler and the gas treatment plant by the ID fan (9) and discharged up the stack. The stack is designed to ensure that the treated combustion gasses are dispersed at a height and a velocity such that they have no significant impact on the surrounding area. The treated emissions are constantly monitored by the emissions monitoring equipment (26). This provides continuous readings of the emissions to demonstrate that they do not exceed the WID limits and if there is adverse trending in the levels, then alarms are raised and corrective action taken.

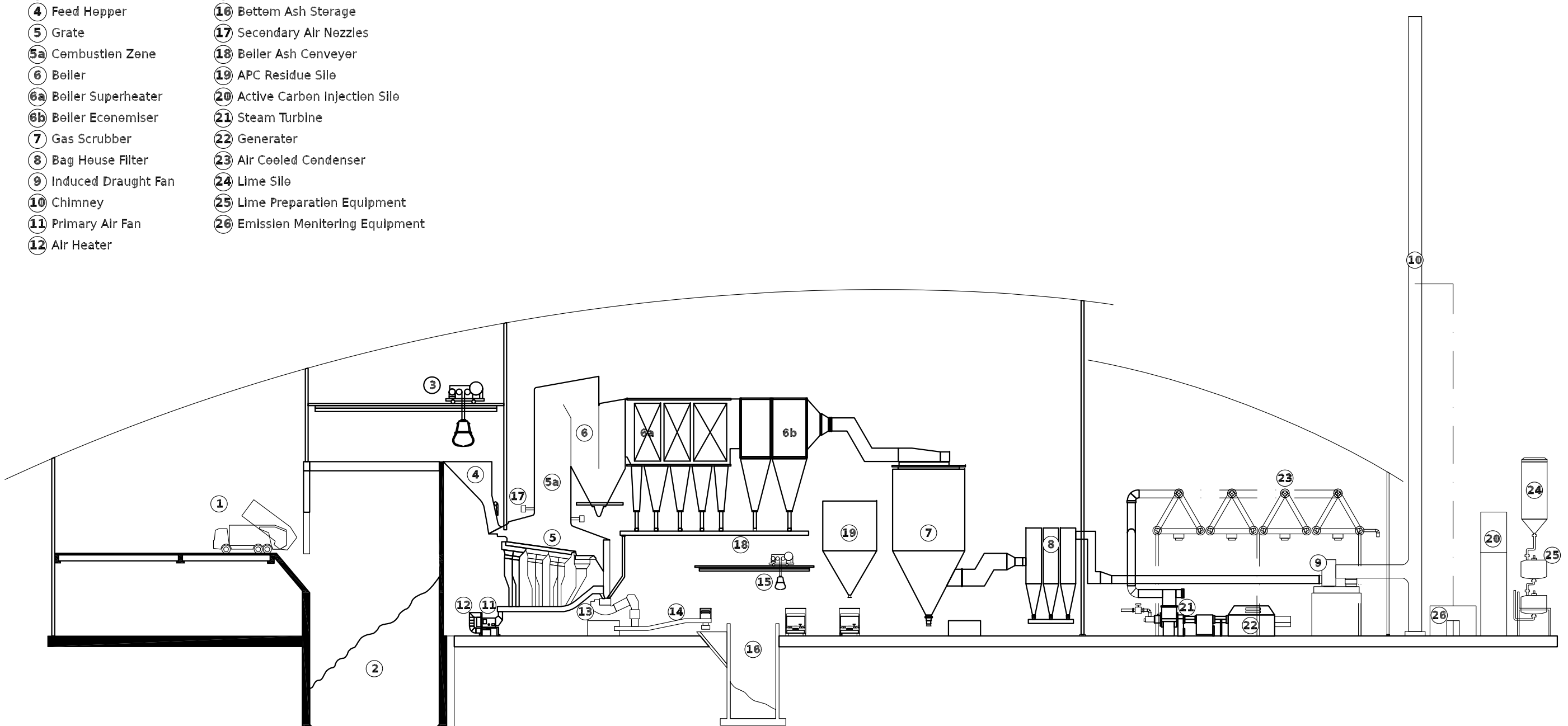
2.5 Ash Handling and processing: After combustion of the waste an ash residue remains, this is known as incinerator bottom ash (IBA). The IBA is discharged from the grate, quenched with water to cool it and to prevent dust, and then discharged into the Ash Bunker (16). All waste process water and some harvested rainwater is used to quench the ash.

The IBA is removed from the bunker by an overhead crane (15) and into a dumper truck. The IBA is transported to the on-site Ash Processing area. Here the IBA is passed through trommels and screens where it is graded into different sizes to form Incinerator Bottom Ash Aggregate (IBAA). This material is used as a secondary aggregate in the construction industry. During the treatment process ferrous and non ferrous metals are recovered for recycling.

In addition lighter fractions of ash, known as fly ash, is deposited in the boiler and collected in hoppers beneath. These ashes are collected separately and discharged to the Flue Gas treatment residue storage silo (19).

Residues are also produced in the Gas scrubber; these are discharged into the emissions treatment residues silo (19). The bag filter collects the particulate matter (dust) form the combustion gasses, this particulate material is removed from the filter using a pulse of air and is collected in the hoppers below, from here it is conveyed to the flue gas treatment residue silo (19). This material, which represents 4% of the total incoming waste, is disposed of at a specialist land fill site.

1. Tipping Hall
2. Refuse Bunker
3. Refuse Handling Crane
4. Feed Hopper
5. Grate
5a. Combustion Zone
6. Boiler
6a. Boiler Superheater
6b. Boiler Economiser
7. Gas Scrubber
8. Bag House Filter
9. Induced Draught Fan
10. Chimney
11. Primary Air Fan
12. Air Heater
13. Ash Discharger
14. Ash Conveyor
15. Ash Crane
16. Bottom Ash Storage
17. Secondary Air Nozzles
18. Boiler Ash Conveyor
19. APC Residue Silo
20. Active Carbon Injection Silo
21. Steam Turbine
22. Generator
23. Air Cooled Condenser
24. Lime Silo
25. Lime Preparation Equipment
26. Emission Monitoring Equipment



ENERGY FROM WASTE PLANT TYPICAL SYSTEM DIAGRAM

COVANTA ENERGY
for a cleaner world