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Medworth Energy from Waste Combined Heat and Power Facility Permit Application

Supplementary Technical Information Report for Medworth CHP Ltd

05 August 2022

Document Control

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Project Number 12417A

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1 Introduction

1.1 Purpose of this document

This document supports the application by Medworth CHP Ltd (the Operator) for an Environmental Permit to operate a Part A(1) installation for an Energy from Waste (EfW) Combined Heat and Power (CHP) Facility (the EfW CHP Facility) under the Environmental Permitting (England and Wales) Regulations 2016, as amended (EPR). The activities taking place at the installation will need to comply with the requirements of the EPR, including the obligation to demonstrate the application of Best Available Techniques (BAT). This report has been produced to satisfy those requirements.

This document should be read in conjunction with Environment Agency application forms Part A, B2, B3 and F1, which are provided as Appendix A1 to this supporting technical information report.

The permit application is being made at a preliminary design stage to allow the application to be 'twin-tracked' with the Development Consent Order (DCO) application EN010110, submitted to the Planning Inspectorate on 7 July 2022. Consequently, as the final detailed design of the EfW CHP Facility has not been completed, the process description and associated parameter values provided in this document are based on an initial specification. The specification and process parameters may deviate slightly from that considered in this application as a result of refinements during the detailed design process following appointment of an Engineering, Procurement and Construction Contractor (EPC Contractor). However, the Environment Agency will be informed of the final detailed design specification prior to commissioning and, if required, the assessments updated to reflect any significant changes. The EfW CHP Facility will be designed to at least achieve and, where possible, exceed, the performance levels required by the Industrial Emissions Directive (IED) and the implementing BAT Conclusions for Waste Incineration.

1.2 Application structure

The application process, as prescribed by the Environment Agency, requires the completion of a number of forms. These require information on the Operator, technical information about the installation, issues for the application and the financial implications for the Operator.

The nature of the information required for several sections of these forms means that a more comprehensive response, in terms of detailed descriptions and assessments, is needed than can be entered onto the forms. Therefore, in order to submit coherent and logical descriptions of the proposed application to the Environment Agency, this report contains appropriate supporting information which provides responses to the application form sections.

Table 1-1 outlines the remaining structure of this report, with Table 1-2 through Table 1-4 identifying where the relevant information required by application forms A, B2 and B3 can be located in this report.

Table 1-1 Supplementary technical information report structure

Section reference	Title	Description of content
2	About the application	Provides a description of the Operator, the site, the activities taking place at the installation and guidance reviewed when developing the application.
3	Managing the activities	This section provides a description of the environmental management system arrangements for the installation and information on the use of raw materials and water, waste management, energy efficiency, accidents and environmental risks, permit surrender and closure, and security measures.
4	Operations	Provides detailed descriptions of the operations taking place at the installation.
5	Emissions and monitoring	Provides information on the point source and fugitive emissions to air, water and land, odour and noise, and the monitoring procedures in place.
6	Impact assessment	Assesses the environmental impacts of emissions from the installation.
7	Improvement programme	Provides proposed pre-operational and improvement conditions for inclusion in the permit.
Appendix A1	Application forms	Completed copies of Application Forms A, B2, B3 and F.
Appendix A2	Pre-application consultation	Copies of the pre-application correspondence with the Environment Agency.
Appendix A3	Site plans and drawings	Provides plans and drawings including the installation boundary, drainage plans, emission location plans etc.
Appendix A4	BAT assessment	Provides an options appraisal of combustion techniques, air pollution control systems for NO_x and acid gases, reagent selection and cooling systems, and provides a comparison of the design and operation of the installation against the sectoral BAT Conclusions.
Appendix A5	Site Condition Report	The report that establishes the baseline soil and groundwater conditions within the installation boundary in accordance with Article 22(2) of IED.
Appendix A6	Environmental risk assessment	Copy of the H1 software tool providing an environmental risk assessment for the installation.
Appendix A7	Air quality technical report	An assessment of the impact of emissions to air from the installation.
Appendix A8	Operational noise impact assessment	An assessment of the impact of noise emissions from the installation.

Section reference	Title	Description of content
Appendix A9	Climate change risk assessment	Provides the climate change risk assessment for the installation.
Appendix A10	Outline Fire Prevention Plan	Provides the required Fire Prevention Plan for any operation involving the storage of combustible waste.
Appendix A11	Combined heat and power assessment	An assessment of the CHP readiness, cost-benefit analysis under Article 14 of the Energy Efficiency Directive, and the R1 calculation for the EfW CHP Facility.
Appendix A12	Environmental Statement	Copy of the Environmental Statement that supports the Development Consent Order (DCO) application for the EfW CHP Facility.
Appendix A13	Management system certificates	Copies of the management system certificates for MVV.
Appendix A14	Outline odour management plan	Copy of the plan for managing odours.
Appendix A15	Outline operational noise management plan	Copy of the plan for managing noise and vibration.
Appendix A16	MSDS	Material safety data sheets for the main raw materials.

Table 1-2 Location of information required for environmental permit application form A

Application form section	Where addressed in this report
1 About you	Included in form A in Appendix A1
2 Applications from an individual	N/A
3 Applications from an organisation of individuals or charity	N/A
4 Applications from public bodies	N/A
5 Applications from companies or corporate bodies	
5a Name of the company	Included in form A in Appendix A1
5b Company registration number	Included in form A in Appendix A1
5c Details of directors	See Directors.pdf in Appendix A1
6 Your address	
6a Your main registered address	Included in form A in Appendix A1
6b Main UK business address	Included in form A in Appendix A1

7 Contact details	
7a Who can we contact about your application?	Included in form A in Appendix A1
7b Who can we contact about your operation?	Included in form A in Appendix A1
7c Who can we contact about your billing or invoice?	Included in form A in Appendix A1

Table 1-3 Location of information required for environmental permit application form B2

Application form section	Where addressed in this report
1 About the permit	
1a Discussions before your application	Appendix A2
1b Is the permit for a site or mobile plant?	Included in form B2 in Appendix A1
1c	N/A
1d	N/A
1 About the site	
2a What is the site name, address, postcode and national grid reference?	Section 2.2
2b What type of regulated facility are you applying for?	Included in form B2 in Appendix A1
2c	N/A
2d Low impact installations (installations only)	Included in form B2 in Appendix A1
2e Treating batteries	Included in form B2 in Appendix A1
2f Ship recycling	Included in form B2 in Appendix A1
2g Multi-operator installation	N/A
3 Your ability as an operator	
3a Relevant offences	Included in form B2 in Appendix A1
3b Technical ability	N/A
3c Finances	Included in form B2 in Appendix A1
3d Management systems	Section 3.1 and Appendix A13
4 Consultation	
4a A sewer managed by a sewerage undertaker	Included in form B2 in Appendix A1

Application form section	Where addressed in this report
4b A harbour managed by a harbour authority	Included in form B2 in Appendix A1
4c Direct into relevant territorial waters or coastal waters within the sea fisheries district of a local fisheries committee	Included in form B2 in Appendix A1
4d Is the installation on a site for which: **4d1 a nuclear site licence is needed under section 1 of the Nuclear Installations Act 1965?** **4d2 a policy document for preventing major accidents is needed under regulation 5 of the Control of Major Accident Hazards Regulations 2015, or a safety report is needed under regulation 7 of those Regulations?**	Included in form B2 in Appendix A1
5 Supporting information	
5a Provide a plan or plans for the site	Appendix A3
5b Provide the relevant sections of a site condition/baseline report if this applies	Appendix A5
5c Provide a non-technical summary of your application	See Non-technical Summary_12417A-10-R01-01-F1.pdf accompanying the application
5d Are you applying for an activity that includes the storage of combustible wastes?	Included in form B2 in Appendix A1 and Appendix A10
6 Environmental risk assessment	Section 6 and Appendix A6
6b Climate change risk screening	Included in Appendix A9 and form B2 in Appendix A1

Table 1-4 Location of information required for environmental permit application form B3

Application form section	Where addressed in this report
1 What activities are you applying for?	
1a Types of activities	Section 2.3
1b Types of waste accepted	Section 4.2
2 Point source emissions to air, water and land	Section 5
3 Operating techniques	
3a Technical standards	Section 2.5
3b General requirements	Included in form B3 in Appendix A1

Application form section	Where addressed in this report
3c Types and amounts of raw materials	Section 3.4
3d Information for specific sectors	Included in form B3 in Appendix A1
4 Monitoring	
4a Describe the measures you use for monitoring emissions	Section 5.8
4b Point source emissions to air only	Section 5.8
5 Environmental impact assessment	
5a Have your proposals been the subject of an environmental impact assessment under Council Directive 85/337/EEC of 27 June 1985 [Environmental Impact Assessment] (EIA)?	Included in form B3 in Appendix A1 and Appendix A12
6 Resource efficiency and climate change	
6a Describe the basic measures for improving how energy efficient your activities are	Section 3.3
6b Provide a breakdown of any changes to the energy your activities use up and create	Section 3.3
6c Have you entered into, or will you enter into, a climate change levy agreement?	Included in form B3 in Appendix A1
6d Explain and justify the raw and other materials, other substances and water that you will use	Section 3.4
6e Describe how you avoid producing waste in line with Council Directive 2008/98/EC on waste	Section 3.5
7 Installations that include a combustion plant (excluding waste incinerators)	N/A
Appendix 3 Specific questions for the waste incineration sector	
1a Do you run incineration plants as defined by Chapter IV of the Industrial Emissions Directive (IED)?	Included in form B3 in Appendix A1
1b Are you subject to IED as an incinerator or co-incinerator?	Included in form B3 in Appendix A1
2 Do any of the installations contain more than one incineration line?	Included in form B3 in Appendix A1

Application form section	Where addressed in this report
3 How many incineration lines are there within each installation?	Included in form B3 in Appendix A1
4 Describe how the plant is designed, equipped and will be run to make sure it meets the requirements of IED, taking into account the categories of waste which will be incinerated	Sections 3, 4 and Appendix A4
5 Describe how the heat created during the incineration and co-incineration process is recovered as far as possible (for example, through combined heat and power, creating process steam or district heating)	Sections 3.3 and 4, and Appendix A11
6 Describe how you will limit the amount and harmful effects of residues and describe how they will be recycled where this is appropriate	Section 3.5
7 Do you want to take advantage of the Article 45 (1)(f) allowance (see below) if the particulates, CO or TOC continuous emission monitors (CEM) fail?	Included in form B3 in Appendix A1
8 Do you want to replace continuous HF emission monitoring with periodic hydrogen fluoride (HF) emission monitoring by relying on continuous hydrogen chloride (HCl) monitoring as allowed by IED Annex VI, Part 6 (2.3)?	Included in form B3 in Appendix A1
9 Do you want to replace continuous water vapour monitoring with pre-analysis drying of exhaust gas samples, as allowed by IED Annex VI, Part 6 (2.4)?	Included in form B3 in Appendix A1
10 Do you want to replace continuous hydrogen chloride (HCl) emission monitoring with periodic HCl emission monitoring, as allowed by IED Annex VI, Part 6 (2.5), first paragraph?	Included in form B3 in Appendix A1
11 Do you want to replace continuous HF emission monitoring with periodic HF emission monitoring, as allowed by IED Annex VI, Part 6 (2.5), first paragraph?	Included in form B3 in Appendix A1
12 Do you want to replace continuous SO_2 emission monitoring with periodic sulphur dioxide (SO_2) emission monitoring, as allowed by IED Annex VI, Part 6 (2.5), first paragraph?	Included in form B3 in Appendix A1
13 If your plant uses fluidised bed technology, do you want to apply for a derogation of the CO WID ELV to a maximum of 100 mg/m3 as an hourly average, as allowed by IED Annex VI, Part 3?	N/A

Application form section	Where addressed in this report
14 Have you carried out a cost–benefit assessment (CBA) of opportunities for cogeneration (combined heat and power) or district heating under Article 14 of the Energy Efficiency Directive?	Included in form B3 in Appendix A1 and Appendix A11
15 Does your installation need to be combined heat and power-ready (CHP-ready)?	Included in form B3 in Appendix A1 and Appendix A11

2 About the application

2.1 The Operator

The Operator of the installation will be Medworth CHP Limited, a wholly owned subsidiary of MVV Environment Limited ('MVV'). MVV is part of the MVV Energie group of companies, providing sustainable and efficient solutions for waste-fired energy generation to publicly and privately-owned waste disposal companies as well as to Local Authorities. In the UK, MVV currently consists of six separate companies (Table 2-1).

MVV's largest project in the UK is the Devonport EfW CHP Facility in Plymouth. Since 2015, this facility has been treating approximately 265,000 tonnes of household, commercial and industrial residual waste per year to generate electricity and heat, notably for Her Majesty's Naval Base Devonport in Plymouth, as well as exporting electricity to the Grid.

In Dundee, MVV has taken over the existing Baldovie EfW Facility and has developed a new, modern facility alongside the existing facility. From 2021, the two facilities will use up to 220,000 tonnes of municipal, commercial and industrial waste as fuel each year for the generation of usable energy.

Biomass is another key focus of MVV's activities in the UK. The biomass power plant at Ridham Dock, Kent, uses up to 195,000 tonnes of waste and non-recyclable wood each year to generate electricity and has capabilities for exporting heat.

Table 2-1 MVV Environment UK Group of Companies

Company	Details
Medworth CHP Limited	The wholly owned subsidiary of MVV Environment Limited who will operate the installation.
MVV Environment Limited	The company funding and developing the project.
MVV Environment Baldovie Limited	EfW facilities diverting up to 220,000 tonnes per annum of residual waste from landfill for Dundee and Angus Councils, and for private waste disposal companies
MVV Environment Devonport Limited	EfW facility diverting 265,000 tonnes per annum of residual waste from landfill for the South West Devon Waste Partnership, and for private waste disposal companies.
MVV Environment Ridham Limited	Merchant biomass facility generating energy from up to 195,000 tonnes per annum of waste wood.
MVV Environment Services Limited	The UK electricity trading subsidiary of MVV.

2.2 The Site

Name: Medworth Energy from Waste Combined Heat and Power Facility

Address: Algores Way

Wisbech

Cambridgeshire

PE13 2TQ

Grid reference: TF 45564 07955

The EfW CHP Facility Site forms part of a wider industrial estate centred on Algores Way. The location of the EfW CHP Facility is predominantly located on an area of land currently operated by Mick George Ltd as a waste and aggregates recycling facility and waste transfer station (WTS). The south-east section of the site is unoccupied scrubland owned by Fenland District Council. It is separated from the current WTS by an earth bund and trees.

Land to the north and east comprises industrial units and land to the south comprises vacant land. The EfW CHP Facility Site is bounded directly to the north by land occupied by BJ Books and Floorspan Contracts. To the east of the site's existing entrance, occupiers of the industrial units include James Mackle (UK) Ltd, Hair World UK Ltd and Lineage Logistics, which includes a cold store.

The southern end of the EfW CHP Facility Site is bounded by New Bridge Lane. This connects with Cromwell Road to the west which provides direct access to the A47 via a four-arm roundabout.

To the west, the EfW CHP Facility Site is boarded by scrubland and a mature strip of vegetation, comprising self-set trees and undergrowth. This land includes the disused March to Wisbech Railway, known locally as the 'Bramley Line'. West of the railway, the industrial estate extends for a further 300m until it reaches Cromwell Road, after which there is a retail park comprising a cinema, Tesco Extra superstore and restaurants. The retail park is bordered to the west by the River Nene, which is a Local Wildlife Site (LWS).

Approximately 200m and 500m, respectively, to the north-east of the site, and within Algores Way industrial estate, Cambian Wisbech School occupies a unit along Anglia Way, and TBAP Unity Academy occupies a unit on Algores Way. Other notable schools within the wider area, but outside of Algores Way industrial estate, include the Thomas Clarkson Academy, approximately 750m to the north-east off Weasenham Lane.

The closest residential properties to the site consist of isolated properties along New Bridge Lane. 9 and 10 New Bridge Lane are located approximately 30m to the west and south, respectively, of the installation boundary. 10 New Bridge Lane includes land currently used as a smallholding. One residential property known as 'Potty Plants', with associated farmland, is located approximately 300m to the south-east of the site along New Bridge Lane. 2 New Bridge Lane is located approximately 300m west along New Bridge Lane. Further afield, Oakdale Place Travellers Site and Caravan Site are located south-east of the intersection of New Bridge Lane and the A47, at 400m and 500m distance respectively. The main residential areas and town centre of Wisbech lie beyond the industrial estate more than 1km to the north and the east.

The Nene Washes Special Area of Conservation (SAC), Special Protection Area (SPA) and Ramsar site is situated approximately 6.3km to the south-west of the EfW CHP Facility Site, whilst the Ouse Washes SAC/SPA/Ramsar site is located approximately 12.3km to the south-east.

The EfW CHP Facility Site location and installation boundary figures are provided in Appendix A3.

2.3 Activities

The EfW CHP Facility will consist of a Schedule 1 installation activity, as defined in the EPR, and several directly associated activities. These include:

- Two line waste incineration plant thermally treating incoming non-hazardous residual household, industrial and commercial waste;
- Generation of power with electricity exported to the National Grid, with the potential export of heat to nearby heat consumers;
- Production of incinerator bottom ash (IBA) that will be temporarily stored on-site before being transferred to a suitably licensed waste treatment facility for recovery/disposal;
- Generation of air pollution control residues (APCr) that will be temporarily stored on-site before being transferred to a suitably licensed hazardous waste facility for recovery/disposal; and
- Provision for the generation of standby power using a diesel engine in the event of interruption in the off-site electricity supply to the installation.

Table 2-2 provides descriptions of the Schedule 1 and directly associated activities.

Table 2-2 Installation activities

Activity Reference	Activity listed in Schedule 1 of the EPR	Description of specified activity	Proposed limits of specified activity
AR1	Section 5.1 Part A(1)(b)	The incineration of non-hazardous waste in a waste incineration plant or waste co-incineration plant with a capacity exceeding 3 tonnes per hour (Line 1).	The incineration of non-hazardous waste including the operation of boilers and auxiliary burners; facilities for the treatment of exhaust gases; on-site facilities for treatment of water; storage and disposal of residues, surface water and waste water; systems for controlling and monitoring incineration operations; and receipt, storage and handling of wastes and raw materials (including fuels).

Activity Reference	Activity listed in Schedule 1 of the EPR	Description of specified activity	Proposed limits of specified activity
AR2	Section 5.1 Part A(1)(b)	The incineration of non-hazardous waste in a waste incineration plant or waste co-incineration plant with a capacity exceeding 3 tonnes per hour (Line 2).	The incineration of non-hazardous waste including the operation of boilers and auxiliary burners; facilities for the treatment of exhaust gases; on-site facilities for treatment of water; storage and disposal of residues, surface water and waste water; systems for controlling and monitoring incineration operations; and receipt, storage and handling of wastes and raw materials (including fuels).
Directly Associated Activities			
AR3	Electricity generation	The generation of electricity using a steam turbine.	Generation of electricity for use on-site and export to the Grid.
AR4	Steam/hot water supply	Export of low pressure steam/hot water.	Provision for steam/hot water to be utilised by other energy users local to the EfW CHP Facility Site.
AR5	Standby combustion plant	Standby electrical generation in diesel generators to provide electrical power to the EfW CHP Facility in the event of an interruption in the off-site electricity supply.	From fuel storage to generation of electricity and subsequent use on-site.

The EfW CHP Facility includes a two-line waste incineration process; waste tipping hall and storage area; main thermal treatment process; boiler; turbine hall; on-site facilities for the treatment and/or storage of raw materials, residues and water; flue gas treatment; stacks, air cooled condensers (ACC); and devices and systems for controlling the operation of the waste incineration plant and recording and monitoring conditions.

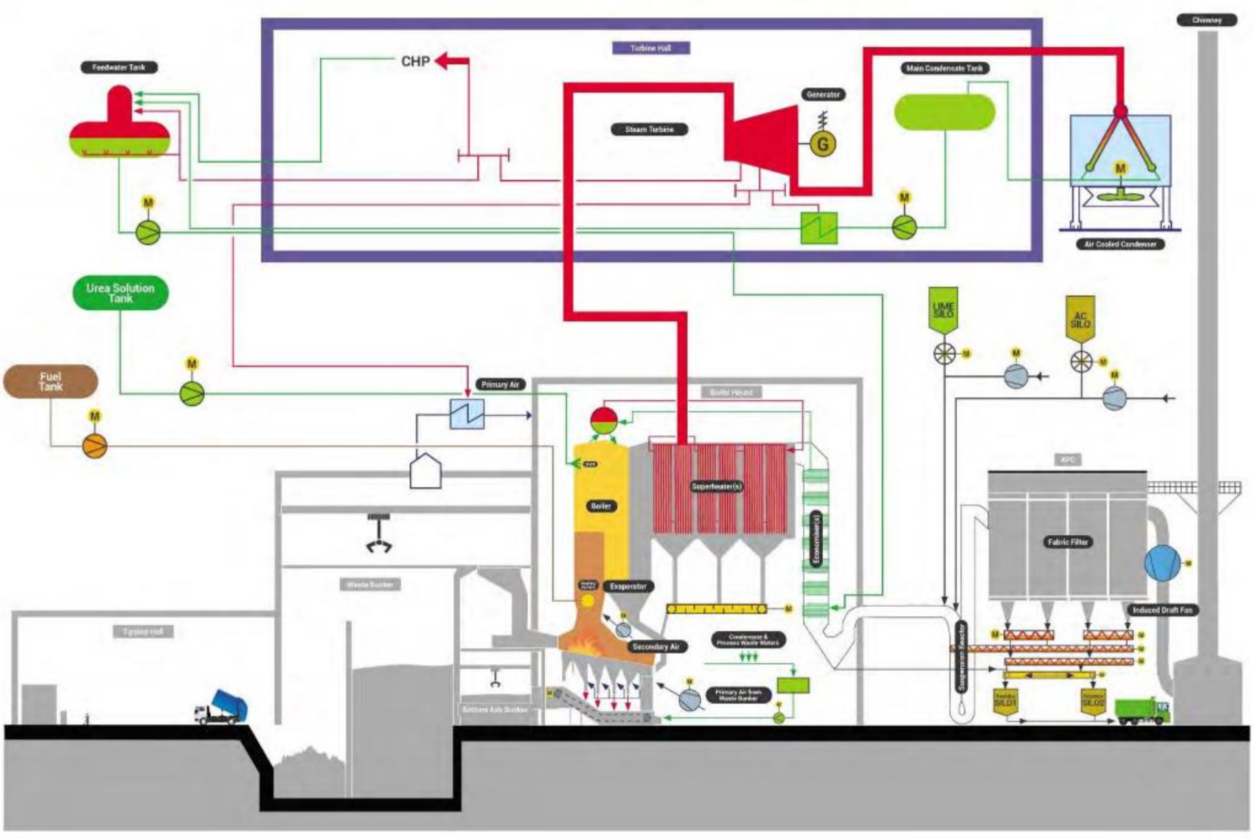
In addition to these main components, the EfW CHP Facility will also include weighbridges; supply systems for water, gas oil and air; emergency diesel generator; site fencing and security barriers; external hardstanding areas; transformers, grid connection and switching compound; internal access roads for circulation and parking; drainage systems with oil interceptors and attenuation tanks; offices; workshop; stores and welfare facilities.

The nominal design capacity of the EfW CHP Facility is 523,500 tonnes of residual waste per annum at an average net calorific value (CV) of 10.9 MJ/kg, with an annual availability of 8,000 hours. This is equivalent to a nominal 33 tonnes per hour per line. However, under low CV and high availability conditions, the waste throughput could be up to 625,600 tonnes per annum (with a maximum continuous rating (MCR) of 41 tonnes per hour per line). The impact assessments in Section 6 are based on this low CV, high availability scenario, as the worst credible case.

For the rated thermal capacity, the EfW CHP Facility aims to generate up to $55MW_e$ of electricity (net) and up to $50MW_{th}$ of usable heat in the form of hot water or steam. At the time of compiling this application, negotiations with potential off-site users of heat are ongoing and no formal agreements are currently in place for the export of heat from the EfW CHP Facility. As such, the power exported may fluctuate if heat is exported to local heat users, and/or in response to fluctuations in the composition of the waste.

An indicative process diagram is provided in Figure 2-1, with a higher resolution version provided in Appendix A3.

Figure 2-1 Process diagram



2.4 Pre-application consultation

Enhanced pre-application discussions were held with the Environment Agency on 26/02/2020 and 02/03/2022. The notes from these discussions are provided in Appendix A2.

2.5 Applicable guidance

Table 2-3 summarises the applicable legislation, guidance and technical standards that has been reviewed when developing this application.

Table 2-3 Applicable legislation, guidance and technical standards

Publisher/Document Type	Title	Version/ Date Published
European Legislation and Guidance	Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)	November 2010
	Best Available Techniques Reference Document for Waste Incineration	December 2019
	Commission Implementing Decision (EU) 2019/2010 of 12 November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration	December 2019
	Reference Document on Best Available Techniques for Energy Efficiency	February 2009
	JRC Reference Report on Monitoring of Emissions to Air and Water from IED Installations	July 2018
	Reference Document on the application of Best Available Techniques to Industrial Cooling Systems	December 2001
Defra Legislation and Guidance	Environmental Permitting (England and Wales) Regulations 2016 (SI 2016 No. 1154)	December 2016
	Environmental Permitting (England and Wales) (Amendment) Regulations 2018 (SI 2018 No. 110)	January 2018
	Environmental Permitting Guidance, Core Guidance for the Environmental Permitting (England and Wales) Regulations 2016	March 2020
Environment Agency Guidance	Additional guidance for the incineration of waste (EPR 5.01)	February 2009
	Guidance: A1 installations: environmental permits https://www.gov.uk/guidance/a1-installations-environmental-permits	February 2022
	Guidance: Legal operator and competence requirements: environmental permits https://www.gov.uk/guidance/legal-operator-and-competence-requirements-environmental-permits	June 2019
	Guidance: RGN2: Understanding the meaning of regulated facility https://www.gov.uk/government/publications/rgn-2-understanding-the-meaning-of-regulated-facility	May 2019
	Guidance: Best available techniques: environmental permits https://www.gov.uk/guidance/best-available-techniques-environmental-permits	February 2016

Publisher/Document Type	Title	Version/ Date Published
	Guidance: Risk assessments for your environmental permit https://www.gov.uk/guidance/risk-assessments-for-your-environmental-permit	April 2022
	Guidance: Air emissions risk assessment for your environmental permit https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit	July 2022
	Guidance: Assess the impact of air emissions on global warming https://www.gov.uk/guidance/assess-the-impact-of-air-emissions-on-global-warming	February 2016
	Guidance: Environmental permitting charges guidance https://www.gov.uk/government/publications/environmental-permitting-charges-guidance/environmental-permitting-charges-guidance	July 2022
	Guidance: Noise and vibration management: environmental permits https://www.gov.uk/government/publications/noise-and-vibration-management-environmental-permits/noise-and-vibration-management-environmental-permits	January 2022
	Guidance: Environmental permitting: air dispersion modelling reports https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports	January 2021
	Guidance: Control and monitor emissions for your environmental permit https://www.gov.uk/guidance/control-and-monitor-emissions-for-your-environmental-permit	May 2021
	Guidance: Environmental permitting: H4 odour management https://www.gov.uk/government/publications/environmental-permitting-h4-odour-management	April 2011
	Guidance: Monitoring stack emissions: techniques and standards for periodic monitoring https://www.gov.uk/government/publications/monitoring-stack-emissions-techniques-and-standards-for-periodic-monitoring	September 2021
	Guidance: Monitoring stack emissions: techniques and standards for CEMS and automated batch samplers https://www.gov.uk/government/publications/monitoring-stack-emissions-techniques-and-standards-for-cems-and-automated-batch-samplers	December 2019
	Guidance: Monitoring stack emissions: measurement locations https://www.gov.uk/government/publications/monitoring-stack-emissions-measurement-locations/monitoring-stack-emissions-measurement-locations	June 2022

Publisher/Document Type	Title	Version/ Date Published
	Guidance for applicants H5: Site condition report – guidance and templates	April 2013
	Guidance: Develop a management system: environmental permits https://www.gov.uk/guidance/develop-a-management-system-environmental-permits	August 2021
	Guidance: Fire prevention plans: environmental permits https://www.gov.uk/government/publications/fire-prevention-plans-environmental-permits	January 2021
	Guidance: Waste incinerator plant: apply for R1 status https://www.gov.uk/guidance/waste-incinerator-plant-apply-for-ri-status	August 2021
	UK Interpretation Document for the 2019 Waste Incineration BAT Conclusions	September 2021
Environment Agency Application Forms	Form A	August 2020
	Form B2	July 2021
	Form B2.5	December 2018
	Form B3	September 2021
	Form B6	September 2021
	Form F1	August 2020

3 Managing the activities

3.1 Management systems

3.1.1 General

MVV operates an Integrated Management System (IMS) certified to ISO 9001:2015 (quality management), ISO 14001:2015 (environmental management), ISO 45001:2018 (occupational health and safety management) and ISO 50001:2018 (energy management). The management system covers operations at its headquarters in Mannheim and its existing operational EfW and biomass plants in Germany and the UK. The scope of certification covers:

"*Services for companies in the energy supply, waste disposal and renewable energy sectors as well as the development and realisation of waste incineration plants and biomass power plants*

Operation and maintenance of waste incineration plants, biomass power plants, waste wood processing plants and photovoltaic plants; the operation of a steam network and the supply of steam as well as the generation and supply of electrical energy and heat

Material flow management: acquisition of waste of all kinds and biomass as well as marketing of residual materials and all related services."

Copies of the management system certificates are provided in Appendix A13. The objectives of the environmental aspects of the management system include the following:

- Identifying potential environmental impacts;
- Development of standard procedures to control and/or mitigate these impacts and adhere with Legal Requirements;
- Ensuring adequate responsibility, authority and resources necessary to support the IMS;
- Establishing key performance indicators to measure the effectiveness of the IMS procedures;
- Monitoring, measuring and analysing the procedures for effectiveness; and
- Implementing actions as required based on the outcomes of routine audits to ensure ongoing improvement across all processes.

The scope of MVV's current IMS certification will be extended to cover the EfW CHP Facility, including the receipt, handling and combustion of waste, and transfer of waste residues off-site. Where applicable, documented procedures will detail specifically how each of these activities will be managed and controlled for at the EfW CHP Facility Site. As the certification of the extended scope cannot take place until the EfW CHP Facility is operational, the Operator will aim to achieve this certification within 18 months following the completion of the commissioning.

The extended IMS will contain procedures for managing the operations for this specific EfW CHP Facility that comply with sector specific requirements as defined by EPR 5.01 and the Waste Incineration BAT Conclusions.

3.1.2 Operations and maintenance

Operations at the EfW CHP Facility will be delivered by a dedicated Operations department. This will include a highly skilled team of 18 shift operators, working in three shifts, to provide adequate resourcing to operate the power generation aspect of the installation 24 hours a day. These teams will be overseen by an Operations Manager who reports directly to the Facility Manager. Also reporting to the Facility Manager will be a QHSE Manager, an electrical engineer and two mechanical engineers.

In addition, six Waste Acceptance Operatives and a Waste Acceptance Supervisor, reporting to the Waste/Contract Manager, will oversee the acceptance of waste at the EfW CHP Facility. Figure 3-1 provides an organogram which provides the proposed organisational structure.

The IMS and its associated procedures will describe how to operate the EfW CHP Facility in order to comply with permit conditions and avoid, or minimise, the environmental risks during both normal and abnormal operation of the EfW CHP Facility. This includes start-up and shut-down of the plant. The procedures will also include contingency plans to ensure minimal impact on the environment in the case of breakdown or enforced shutdown.

In particular, these procedures will include:

- OP.WR Waste Receipt processes covering waste reception and handling, including waste acceptance and pre-acceptance procedures;
- OP.TT Thermal Treatment processes and associated procedures for controlling the combustion process to ensure optimal combustion is achieved and compliance with the minimum requirements of Chapter IV of IED and the associated BAT Conclusions;
- OP.TT Thermal Treatment processes including operation of the air pollution control and monitoring systems; and
- OP.MR Management of Residues processes covering the storage, handling and removal of wastes and residues from the site.

In addition to these operational procedures, the IMS will also include procedures relating to the inspection of environmentally critical equipment and operational logs which support compliance with permit conditions and minimise environmental impact.

Planned maintenance procedures will be established in accordance with the IMS process OS.MN Maintenance Philosophy, Policy and Strategy to ensure all key plant components that have the potential to affect the environmental performance of the EfW CHP Facility, or compliance with the environmental permit, remain in good working order. These maintenance procedures will apply to all individual items of main operating plant and equipment, environmentally critical equipment such as the air pollution control plant, and also minor items and components such as flexible hoses, nozzles, lubricants and greases, filters, seals on access points, electric motors etc. The maintenance procedures and instructions will define the frequency and nature of testing, servicing, inspections, checks, cleaning needs, calibration and adjustment etc.

All maintenance activities will require the appropriate permits to work from the Senior Authorised Person issued in accordance with procedure OP.SR MVV UK Safety Rules E&M. These range from work permits for general maintenance, to specific permits covering, for example, hot work, electrical isolation, working at heights etc.

Maintenance of the EfW CHP Facility is expected to be undertaken by internal resources or specialist external contractors dependent on the specific activity, the skills and experience required, and availability. Where maintenance is required to be performed by external contractors, it will be undertaken in accordance with process OS.MC Management of Contractors.

Prior to any work being undertaken by external contractors, the contractor will be required to submit for approval a method statement, risk assessment, liability insurance, company health, safety and environmental policies and how compliance with the site operating procedures will be met, they competence will be assessed in accordance with procedure OS.MC.01 Assessment and Control of Contractors. The contractor will be required to sign a form to confirm that they understand and will comply with the permit to work system described above.

Although the maintenance programme has not yet been developed in detail, the Operator is cognisant of the requirement to minimise the frequency of planned maintenance activities that would require both lines to be shutdown simultaneously. Procedures for planned shutdowns will be preferentially developed such that only a single line is shutdown at any moment in time. Where this is unavoidable, the design of the EfW CHP Facility includes sufficient waste storage capacity (equivalent to 11.5 days of storage) to cover the planned maintenance periods where both lines may be shutdown. Procedures will also be in place to divert some of the incoming waste to other facilities for longer outages. These aspects are described in greater detail in Section 4.2.

3.1.3 Competence and training

The competency of resources to operate the process in compliance with permit conditions requires a number of steps linked to operational procedures. These include:

- Defining roles and responsibilities;
- Defining competency requirements;
- Competency assessment;
- Training needs analysis;
- Training provision;
- Training records and register; and
- Periodic competency and operational review and assessment.

Procedures will be in place to identify the minimum competencies required for each role at the EfW CHP Facility. These will then be applied to recruitment and training processes for both internal resources and external contractors. Job specifications will be defined which, amongst others, will provide details on relevant qualifications and experience required. The required staffing levels will be determined by MVV based on its experience of operating similar facilities in the UK and Germany.

Initial training of personnel will be delivered by the plant supplier during the commissioning phase, prior to the EfW CHP Facility entering full operation. This training will address both normal plant operation, but also actions to be taken in the event of abnormal operation or emergency scenarios.

From this point, Managers will identify and monitor staff training needs and competency levels as part of an ongoing appraisal system. Training will be delivered using a combination of on-the-job training, mentoring, internal training courses and external training courses/events as required. These training programmes will also make employees aware of:

- The IMS and the importance of operating in line with the policies and procedures contained therein;
- Their individual role and responsibilities in achieving compliance with the IMS and the environmental permit;
- The environmental aspects associated with their role and site operations; and
- The consequences of departing from the procedures in the IMS.

Staff induction programmes will be specific to each role but will cover, as a minimum:

- MVV's environmental policy;
- The requirements of the environmental permit; and
- IMS awareness raising.

Training records will be stored and maintained on the HR system. These records will include, as a minimum, the date, type of training, training provider and any associated assessment scores. The IMS will specify a procedure for archiving records to ensure all training is recorded and training outcomes retained.

BS.FN.06.01 Procurement Instructions will be implemented to ensure that contractors are suitably qualified and experienced for the task they will be performing. This requirement will be enforced by the terms of contract with the contractor.

All relevant internal resources and contractors involved in the construction, commissioning or operation of the EfW CHP Facility will be briefed on the requirements of the permit. This will include, amongst others, the importance and responsibilities for timely discharge of any pre-operational conditions prior to commissioning, and will address conditions which are associated with limits or notification requirements.

Hard copies of the permit will be available within the plant control room, and available in electronic format on the internal intranet site.

3.1.4 Accidents, incidences and non-conformances

As part of its Integrated Management System, MVV has an Occupational Health and Safety Management System certified to ISO 45001:2018. This addresses a range of issues including emergency response and managing the consequences of accidents.

The Operator will develop a formal Accident Management Plan for the EfW CHP Facility as part of the extension of MVV's existing IMS to cover operations at the EfW CHP Facility Site. The Accident Management Plan will be developed prior to the commissioning of the EfW CHP Facility. The plan will consider accidents with the potential to impact the environment and result in non-compliance with permit conditions. An initial assessment of the potential accident risks associated with the operation of the EfW CHP Facility is presented in Section 3.2.

BS.IMS.03 Non-conformity and Corrective Action provides a process which addresses the detection, response and investigation of the causes of abnormal operating conditions that may give rise to incidents, or any non-conformances with the procedures in the IMS. This will define the short-term actions to return the EfW CHP Facility to normal operation, and long-term actions to prevent the same incident or non-conformance occurring again.

In respect of managing complaints concerning the environmental impact of the installation activities, BS.CL.01 Management of Communications and Complaints determines the process to be followed. Any complaints will be referred to the appropriate Manager (as defined by the IMS), or a nominated responsible individual in their absence who will initiate an investigation of the complaint as soon as possible. The complaint will be recorded on a complain log form or the incident management reporting software dependent on the nature of the complaint and the time/date it was received, the outcome of the investigation, and any remedial steps taken to address the complaint.

The complainant will be contacted by the appropriate Manager to confirm the details of the complaint, the outcome of the subsequent investigation and any remedial steps taken. This feedback and communication will be recorded on the incident management reporting system. Contact will also be made with the Environment Agency concerning any justifiable complaints that can be attributed to site operations.

3.1.5 Organisation and environmental responsibilities

The EfW CHP Facility will be operated 24 hours a day, seven days a week, with the exception of maintenance periods. However, with the exception of emergencies or, for example, to accommodate a waste vehicle that has been unavoidably delayed, the normal operational hours for the acceptance of waste, other raw materials, and export of residues, will be 07:00 to 20:00 during the 365 days of site operation.

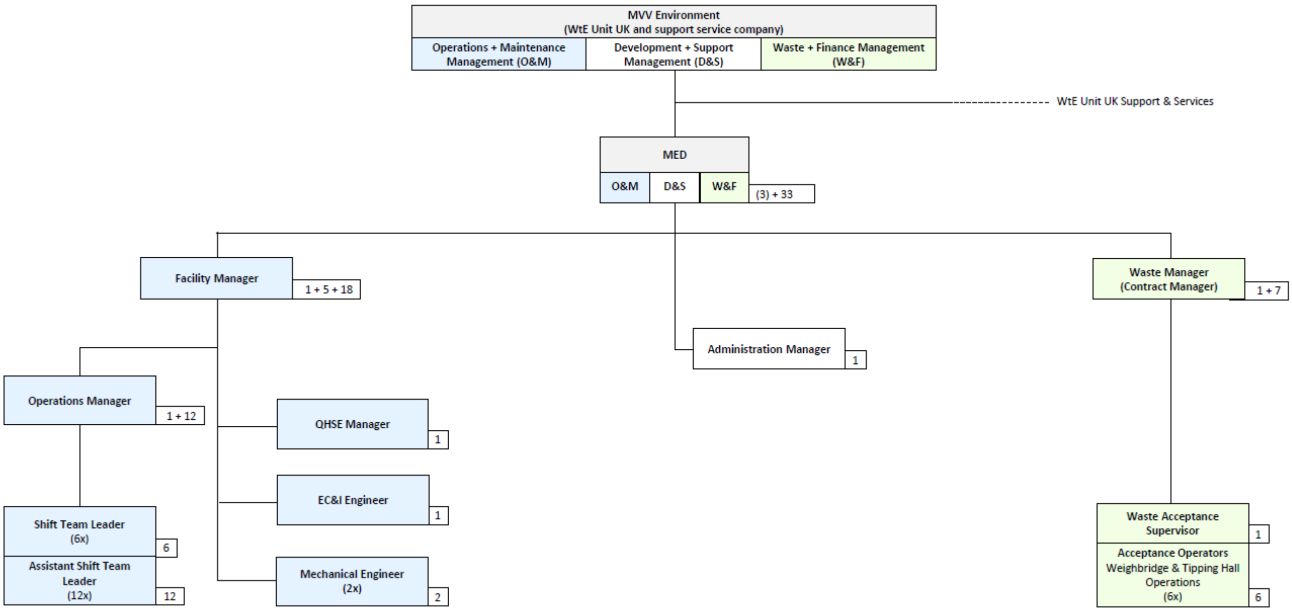
Figure 3-1 provides an organogram that displays the proposed organisational structure in respect of key management and operational roles that have responsibility for discharging the requirements of the permit and managing environmental impacts. The key organisational and environmental management roles and responsibilities are described below:

- The Facility Manager will have overall responsibility for the management of the EfW CHP Facility and compliance with the permit. This will be an individual with significant experience and track record of managing the operation of similar facilities;
- The Operations Manager will have day-to-day responsibility for the operation of the plant, ensuring that the plant is operated and maintained to the standard operating procedures and requirements of the IMS and environmental permit;
- The QHSE Manager will be responsible for tracking compliance with the permit and IMS, development of key performance indicators (KPIs) and their assessment, and producing the periodic and annual reports required by the Environment Agency under the terms of the permit; and

- The Waste/Contract Manager will be responsible for managing the team of waste acceptance operatives and implementation of the waste pre-acceptance and acceptance procedures.

The above individuals will be supported by a Business Support function, including an Administration/HR Manager, Finance Manager and Assistant, Account Manager, IT Support Technician, Community Liaison Manager and a Commercial Support Manager.

Figure 3-1 Organisational organogram



An important role of the Senior Management team described above is the continual review and assessment of the IMS. As a minimum this review will take place annually but will be supplemented by regular internal and external audits to assess the effectiveness of the management system.

The annual review will address issues such as:

- Compliance and future regulatory requirements;
- Performance levels with respect to KPIs;
- Root cause analysis with respect to any accidents, incidences or non-conformances;
- Abnormal operating scenarios and response planning;
- Staff succession; and
- Competency, development and training provisions.

The Environment Agency's guidance and indicative standards for EMS[1] is summarised below, along with a comparison of how the installation will be managed by the Operator against this guidance.

[1] https://www.gov.uk/guidance/develop-a-management-system-environmental-permits

Table 3-1 Environment Agency Standards for Environmental Management Systems

No	Indicative Standard	Controls expected to be adopted by the Operator
1	The EMS and associated management arrangements must have the means available to provide the required standards of environmental protection.	MVV has an existing EMS in placed certified to ISO 14001:2015 as part of an integrated management system (IMS). The scope of the IMS includes MVV's operations at other EfW facilities and waste wood biomass plants in the UK and Germany. The scope of the IMS will be extended to cover operations at the EfW CHP Facility and the Operator proposes to achieve certification of the extended IMS within the first 18 months of its operation. The extended IMS will reflect the specific requirements for environmental management systems in the Environment Agency's guidance. This will ensure that compliance with the permit and the required standards of environmental protection are achieved.
2	Equipment must be designed and installed to a suitable standard.	The design and operation of the EfW CHP Facility will take in to account all relevant requirements concerning BAT.
3	All equipment whose failure may lead to pollution must be operated and maintained so that it continues to operate effectively.	Planned maintenance procedures will be established to ensure all key plant components that have the potential to affect the environmental performance of the EfW CHP Facility, or compliance with the environmental permit, remain in good working order.
4	Potential accidents must be identified, any necessary measures to minimise the chances of them happening put in place and plans to minimise the effects if the worst occurs put in place.	An initial appraisal of the potential accident scenarios, associated environmental risks, and relevant mitigation measures appropriate for the design and operation of the EfW CHP Facility is provided in Section 3.2. The Operator will develop a formal Accident Management Plan as part of the extension to scope of its existing IMS to cover operations at the EfW CHP Facility.
5	Sufficient staff must be provided, they must be adequately trained in those aspects which could lead to pollution and they must know how to deal with accidents and understand the responsibilities of the permit.	Staffing levels for the EfW CHP Facility will be defined by MVV based on its extensive experience operating related facilities in the UK and Germany. Formal training will take place, both during induction, but also as part of ongoing refresher training, that will explain the importance of operating the EfW CHP Facility in accordance with the requirements of the environmental permit and the operational procedures in the IMS, including responding to any accident, incident or operational non-conformance that may have an associated environmental impact. Ongoing training needs will be identified as part of ongoing employee appraisals.

No	Indicative Standard	Controls expected to be adopted by the Operator
6	All of the necessary written operating instructions must be in place to ensure that staff know how to operate any equipment or plant under normal and abnormal situations. To demonstrate this and ensure auditability, written records must be kept.	The operating instructions and procedures for the installation will be documented in the IMS and this will be available to all employees on the internal intranet site. The procedures will address both normal and abnormal operating scenarios.

3.2 Accidents

The Operator will develop a formal Accident Management Plan as part of the extension to scope of its existing IMS to cover operations at this site. However, an initial outline of the potential accident scenarios and an assessment of their potential risk to the environment is provided in the following sections.

3.2.1 Risk assessment methodology

The methodology used for the identification and assessment of accidents and associated environmental risks follows the requirements of Environment Agency Guidance[2]. The potential environmental risks as a result of credible accident scenarios were evaluated using the following approach:

1. Hazard - what accident event has the potential to cause an environmental impact (harm)?
2. Receptor - what environmental receptor is at risk and needs protecting?
3. Pathway - what is the environmental pathway by which the hazard can reach the receptor?
4. Risk management - what measures are proposed to be implemented to reduce the risk of the hazard reaching the receptor? If the hazard reaches the receptor, who is responsible for responding to mitigate the hazard?
5. Probability of exposure – how likely is the hazard to reach the receptor such that the contact (receptor) is exposed?
6. Consequence – what is the harm that can be caused to the receptor if exposure occurs?
7. What is the overall risk – after the implementation of the risk management measures, what is the risk that still remains? This takes into account the balance between probability and consequence.

The probability of exposure is an assessment of the probability of the selected source and receptor being linked by the identified pathway. The consequence provides an indication of the sensitivity of a given receptor to a particular source or contaminant of concern under consideration. It is a worst-case classification and is based on full exposure via the particular linkage being examined.

The overall risk column is an overall assessment of the actual risk, which considers the likely effect on a given receptor, taking account of the controls present on the EfW CHP Facility Site. The criteria are set out in Table 3-2.

[2] https://www.gov.uk/guidance/develop-a-management-system-environmental-permits#accident-prevention-and-management-plan

Table 3-2 Risk assessment criteria

Factor and definition	Description
Probability of exposure	
High likelihood	An event that could result in exposure of the contact/receptor is very likely to occur in the short-term and is almost inevitable over the long-term.
Likely	It is probable that an event that could result in exposure of the contact/receptor will occur. It is not inevitable, but possible in the short-term and likely over the long-term.
Low likelihood	Circumstances are possible under which an event that could result in exposure of the contact/receptor could occur. It is by no means certain that even over a longer period such an event would take place, and less likely in the short-term.
Unlikely	It is improbable that an event that could result in exposure of the contact/receptor would occur even in the very long-term.
Consequences	
Severe	Acute harm to human health. Immediate pollution impact of sensitive water resource (e.g., major spillage into controlled waters). Impact on controlled waters e.g., large-scale pollution or very high levels of contamination. Catastrophic damage to buildings or property (e.g., explosion causing building collapse). Ecological system effects – irreversible adverse changes to a protected location. Immediate risks.
Medium	Chronic harm to human health. Pollution of sensitive water resources (e.g., leaching of contaminants into controlled waters). Ecological system effects – substantial adverse changes to a protected location. Significant damage to buildings, structures and services (e.g., damage rendering a building unsafe to occupy, such as foundation damage).
Mild	Non-permanent health effects to human health. Pollution of non-sensitive water resources (e.g., pollution of non-classified groundwater). Damage to buildings, structures and services (e.g., damage rendering a building unsafe to occupy, such as foundation damage). Substantial damage to non-sensitive environments (unprotected ecosystems e.g., crops).
Minor/negligible	Non-permanent health effects to human health (easily prevented by appropriate use of PPE) or loss of amenity rather than health effects. Minor pollution to non-sensitive water resources. Minor damage to non-sensitive environments (unprotected ecosystems e.g., crops). Easily repairable effects of damage to buildings, structures, services or the environment (e.g., discoloration of concrete, loss of plants in a landscaping scheme).
Overall risk	
Very high risk	Severe harm to a receptor may already be occurring OR a high likelihood that severe harm will arise to a receptor, unless immediate remedial works/mitigation measures are undertaken.
High risk	Harm is likely to arise to a receptor, and is likely to be severe, unless appropriate remedial actions/mitigation measures are undertaken. Remedial works may be required in the short-term, but likely to be required over the long-term.

Factor and definition	Description
Moderate risk	Possible that harm could arise to a receptor, but lower likelihood that such harm would be severe. Harm is likely to be medium. Some remedial works may be required in the longer term.
Low risk	Possible that harm could arise to a receptor. Such harm would at worse normally be mild and temporary.
Very low risk	Low likelihood that harm could arise to a receptor. Such harm unlikely to be any worse than mild.

The potential overall risk for each accident is calculated from the following matrix included as Table 3-3. A classification of 'Moderate' overall risk and above is considered not acceptable and requires possible further remedial measures/control mechanisms to mitigate the overall risk to an acceptable level.

Table 3-3 Overall risk definition

Potential consequence	**Probability of exposure**			
	Unlikely	Low likelihood	Likely	High likelihood
Minor/negligible	Very Low	Very Low	Low	Moderate/Low
Mild	Very Low	Low	Moderate/Low	Moderate
Medium	Low	Moderate/Low	Moderate	High
Severe	Moderate/Low	Moderate	High	Very High

Notes: Unacceptable risk level shaded in red.

3.2.2 Risk assessment

Table 3-4 provides an assessment of the accidents associated with the operation of the EfW CHP Facility that may cause harm to the environment. For all identified potential accident scenarios, there will be a number of risk management measures in place to avoid such events and/or mitigate their impacts should they occur. The final column (Overall Risk) comments on the acceptability of the risk and whether further control measures are required.

Table 3-4 Risk assessment of accidents and associated environmental consequences

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
Waste and raw material delivery						
Major vehicular accident – leading to significant loss of containment of raw materials such as fuel oil, air emission abatement reagents and water treatment chemicals	Ground/Groundwater – protection of ground and groundwater quality	Failure in joints and hardstanding	Robust road vehicles. Site speed restrictions. Approved carriers. Driver training. Inspection and maintenance of hardstanding and storage tanks/silos. Spillage containment and management procedures.	**Low likelihood**	Contamination of groundwater - breach of permit/regulations, potential restrictions on local abstraction. - **Medium**	**Moderate/low**
	Surface Water – protection of local surface water/ watercourse quality and ecology	Surface water drainage system	The surface water drainage system includes attenuation tanks and interceptors. In the event of a spillage, the attenuation tanks can be isolated allowing their content to be tested before discharge or, alternatively, pumped to a tanker for off-site disposal. If such an accident occurred, trained operators would respond in accordance with the site emergency response plan.	**Low likelihood**	Surface water – breach of permit/regulations, potential impact on local abstractions, damage to aquatic ecology - **Medium**	**Moderate/low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
Major waste delivery vehicle accident – leading to significant loss of containment of waste.	Local population – protection from loss of amenity (odours)	Air dispersion	Robust road vehicles with loads covered/enclosed. Site speed restrictions. Approved carriers. Driver training. Inspection and maintenance of hardstanding. Spillage containment and management procedures.	**Low likelihood**	Local population – odour impact, nuisance, loss of amenity – **Minor/negligible**	**Very Low**
	Ground/Groundwater – protection of ground and groundwater quality	Failure in joints and hardstanding		**Low likelihood**	Contamination of groundwater - breach of permit/regulations, potential restrictions on local abstraction. **- Medium**	**Moderate/low**
	Surface Water – protection of local surface water/ watercourse quality and ecology	Surface water drainage system	The surface water drainage system includes attenuation tanks and interceptors. In the event of a spillage, the attenuation tanks can be isolated allowing their content to be tested before discharge or, alternatively, pumped to a tanker for off-site disposal. If such an accident occurred, trained operators would respond in accordance with the site emergency response plan.	**Low likelihood**	Surface water – breach of permit/regulations, potential impact on local abstractions, damage to aquatic ecology - **Medium**	**Moderate/low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
Delivery of non-conforming waste having properties which present a greater environmental risk than permitted wastes	Local Population Odour, emissions to air, contamination of ground or surface water	Air Water Land	Weighbridge and pre-acceptance documentation checks. Management procedures and training. Approved carriers. Waste quarantine area with non-conforming wastes removed from site in shortest possible timeframe where possible. All waste stored internally with building air used as combustion air. Supervision and visual inspection by operators and CCTV. If inappropriate waste is received, responsibility would be with site management/operators under operational and, if necessary, emergency plans.	**Likely**	Local population – odour impact, nuisance, loss of amenity – **Minor/negligible** Contamination of groundwater - breach of permit/regulations, potential restrictions on local abstraction - **Minor/negligible** Surface water – breach of permit/regulations, potential impact on local abstractions, damage to aquatic ecology – **Minor/negligible**	**Low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
Waste handling and storage						
Inappropriate storage of incoming waste - resulting in loss of containment	Local population – protection from loss of amenity (odours)	Air dispersion	Waste acceptance procedures and training. Waste stored in bunker will be contained in enclosed tipping hall with air extraction to combustion process with other odour control measures in place when both lines are undergoing maintenance.	**Low likelihood**	Local population – odour impact, nuisance, loss of amenity – **Minor/negligible**	**Very Low**
	Ground/Groundwater – protection of ground and groundwater quality	Failure of bunker and other hardstanding areas to contain waste	Bunker specifically designed for waste containment and constructed in accordance with the principles of DAfStb Guideline *Concrete Construction when handling water-endangering substances*. It will be designed to achieve a minimum tightness class 2 in accordance with the requirements of BS EN 1992-3. Bunker will be subject to regular inspection and maintenance programme. If loss of containment occurred, trained operators would respond in accordance with the site emergency response plan.	**Unlikely**	Contamination of groundwater - breach of permit/regulations, potential restrictions on local abstraction - **Medium**	**Low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
Fire in waste bunker	Local population – protection from combustion products and odour	Air dispersion	Appropriate design and operation of bunker to prevent long-term storage of waste and accumulation of heat. Extraction of bunker air through combustion process. Close management of waste in the bunker by operators using CCTV. Fire detection and suppression systems to include measures described in ACE Technical Risks Engineering Information Bulletin Guidance Document and designed generally in accordance with NFPA 850 *Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations*. Bunker will be subject to regular inspection and maintenance programme. The design and construction allows for containment of firewater. Firewater retention provision designed according to Chubb Guidance document - Energy from Waste (EfW) – Fire Systems.	**Low likelihood**	Local population – odour and combustion product exposure – **Mild**	**Low**
	Ground/Groundwater – protection of ground and groundwater quality	Failure of bunker to contain firefighting water		**Low likelihood**	Contamination of groundwater - breach of permit/regulations, potential restrictions on local abstraction - **Medium**	**Moderate/low**
	Surface Water – protection of local surface	As above and overtopping of bunker resulting in firefighting		**Low likelihood**	Surface water – breach of permit/regulations, potential impact	**Low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
	water/watercourse quality and ecology	water entering surface water drains	Operational procedure to sample water in bunker prior to disposal to sewer or removal by tanker. The surface water drainage system includes attenuation tanks and interceptors. The attenuation tanks can be isolated allowing their contents to be tested before discharge or, alternatively, pumped to a tanker for off-site disposal. If fire occurs, responsibility would be with site management/operators under the site emergency response plan involving emergency services as appropriate.		on local abstractions, damage to aquatic ecology - **Mild**	
Raw materials handling and storage						
Loss of containment of materials stored in silos (e.g., activated carbon, hydrated lime)	Local population – protection from chemical dust/particulates	Air dispersion	Appropriate design and operation of silos to prevent loss of stored materials, including regular inspection and maintenance procedures. Silos equipped with bag filters to avoid losses on filling.	**Likely**	Local population – dust exposure - **Minor/negligible**	**Low**
	Ground/Groundwater – protection of ground and groundwater quality	Materials/chemicals not contained by hardstanding	Silos and filling points located on areas of hardstanding/bunding.	**Low likelihood**	Contamination of groundwater - breach of permit/regulations,	**Moderate/Low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
			Silos and hardstanding are subject to regular inspection and maintenance.		potential restrictions on local abstraction – **Medium**	
	Surface Water – protection of local surface water/watercourse quality and ecology	Materials/chemicals washed in to surface water drains by rainwater	Sealed surface water drainage system includes attenuation tanks and interceptors. The attenuation tanks can be isolated allowing their contents to be tested before discharge or, alternatively, pumped to a tanker for off-site disposal. If loss of containment did occur, responsibility would be with the site management/operators under operational spill response procedures or, if relevant, emergency response procedures.	**Low likelihood**	Surface water – breach of permit/regulations, potential impact on local abstractions, damage to aquatic ecology - **Medium**	**Moderate/Low**
Loss of containment from liquid storage tanks e.g., urea, fuel oil	Ground/Groundwater – protection of ground and groundwater quality	Spillages not contained by hardstanding/bunding.	Appropriate design and operation of storage tanks in accordance with CIRIA C736 to prevent loss of containment. Tanks equipped with high level alarms to prevent overfilling. Tanks located within appropriately sized bund constructed of material that is	**Low likelihood**	Contamination of groundwater - breach of permit/regulations, potential restrictions on local abstraction – **Medium**	**Moderate/low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
	Surface Water – protection of local surface water/watercourse quality and ecology	Liquids not being contained by bunding or spill response measures entering surface water drains by rainwater or 'clean up' operations	impervious to the chemical contained within the tank. All tanks, equipment and hardstanding are subject to regular inspection and maintenance programme. Sealed surface water drainage system includes attenuation tanks and interceptors. The attenuation tanks can be isolated allowing their contents to be tested before discharge or, alternatively, pumped to a tanker for off-site disposal. If loss of containment did occur, responsibility would be with the site management/operators under operational spill response procedures or, if relevant, emergency response procedures.	**Low likelihood**	Surface water – breach of permit/regulations, potential impact on local abstractions, damage to aquatic ecology – Medium	**Moderate/low**
Fire in bulk raw materials storage silos and tanks, e.g., carbon, fuel oil	Local population – protection from combustion products and odour	Air dispersion	Appropriate design of tanks silos in accordance with relevant standards, including earthing to prevent electrostatic charge as ignition source. Fire detection and suppression systems to include measures described in ACE Technical Risks Engineering Information Bulletin Guidance Document and designed generally	**Low likelihood**	Local population – odour and combustion product exposure – **Mild**	**Low**
	Ground/Groundwater – protection of	Failure of hardstanding/bunding		**Low likelihood**	Contamination of groundwater - breach of	**Moderate/Low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
	ground and groundwater quality	to contain firefighting water	in accordance with NFPA 850 *Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations*. The design and construction allows for containment of firewater. Regular inspection and maintenance of hardstanding		permit/regulations, potential restrictions on local abstraction - **Medium**	
	Surface Water – protection of local surface water/watercourse quality and ecology	As above, resulting in firefighting water entering surface water drains	Sealed surface water drainage system includes attenuation tanks and interceptors. The attenuation tanks can be isolated allowing their contents to be tested before discharge or, alternatively, pumped to a tanker for off-site disposal. If fire occurs, responsibility would be with site management/operators under the site emergency response plan involving emergency services as appropriate.	**Low likelihood**	Surface water – breach of permit/regulations, potential impact on local abstractions, damage to aquatic ecology - **Medium**	**Moderate/Low**
Combustion process						
Pressure surge/explosion in combustion system e.g., from LPG cylinder	Local population – protection from combustion products, release of unburnt waste material and noise	Air dispersion	Appropriate design, construction and operation of combustion plant and associated systems. Plant is designed to safely operate should pressurised gas cylinders be inadvertently introduced.	**Likely**	Local population – combustion product and unburnt waste exposure, noise	**Moderate/Low**

Hazard What has the potential to cause harm?	Receptor What is at risk? What needs protection?	Pathway How can the hazard get to the receptor?	Risk management What measures are in place to reduce risk? If it occurs, who is responsible?	Probability of exposure How likely is this contact?	Consequence What is the harm that can be caused?	Overall Risk What is the risk that still remains? The balance of probability and consequence
			Control of waste types accepted through pre-acceptance and visual inspection of loads and waste in the bunker as part of acceptance procedures and ongoing monitoring.		from explosion – **Mild**	
	Ground/Groundwater – protection of ground and groundwater quality	Failure of hardstanding/bunding to contain firefighting water	Continuous monitoring of key operating parameters, including furnace pressure. Appropriate fire detection and suppression systems as previously described. Plant located on hardstanding with regular inspection and maintenance.	**Low likelihood**	Contamination of groundwater - breach of permit/regulations, potential restrictions on local abstraction – **Medium**	**Moderate/Low**
	Surface Water – protection of local surface water/watercourse quality and ecology	As above, resulting in firefighting water entering surface water drains	Sealed surface water drainage system includes an attenuation tank and interceptors. The attenuation tank can be isolated allowing its contents to be tested and treated before discharge or, alternatively, pumped to a tanker for off-site disposal. Identifying, correcting and responding to any process failure would be the responsibility of site management/operators under operational response plan and if necessary, the emergency response plan.	**Low likelihood**	Surface water – breach of permit/regulations, potential impact on local abstractions, damage to aquatic ecology – **Medium**	**Moderate/Low**

Hazard What has the potential to cause harm?	Receptor What is at risk? What needs protection?	Pathway How can the hazard get to the receptor?	Risk management What measures are in place to reduce risk? If it occurs, who is responsible?	Probability of exposure How likely is this contact?	Consequence What is the harm that can be caused?	Overall Risk What is the risk that still remains? The balance of probability and consequence
Combustion chamber temperature falls below 850°C	Local population – protection from elevated levels of pollutants and flue gas emissions above permit limits.	Air dispersion	Appropriate design and operation of the combustion unit and associated systems. All plant subject to regular inspection and maintenance. Temperature is a key process operating parameter that is continuously monitored. Auxiliary fuel oil burners will automatically operate when the temperature reduces below a set point. This set point will be greater than 850°C and will be determined during commissioning. Should the temperature drop below 850°C, the automated control system interlocks to prevent further charging of waste and an alarm will sound. Identifying, correcting and responding to any deviation from standard operating parameters would be the responsibility of site management/operators under operational procedures and if necessary, the emergency response plan.	**Likely**	Local population – exposure to elevated concentrations of air pollutants – **Minor/negligible**	**Low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
Failure of primary or secondary combustion air fan due to e.g., power supply failure, component failure etc.	Local population – protection from elevated levels of pollutants and flue gas emissions above permit limits.	Air dispersion	Appropriate design and operation of the combustion unit and associated systems. All plant subject to regular inspection and maintenance. Automated control system interlocks to prevent further charging of waste and an alarm will sound. Effective use of process monitoring to control combustion conditions. Standby power system provided to allow safe shut-down of the plant. System will remain under negative pressure due to 'suction' created by the induced draught fan. Continuous Emissions Monitoring System (CEMS) continuously monitors emissions and the automated control system will alter dosing rates of reagents if emissions approach or exceed limits. Identifying, correcting and responding to any process failure would be the responsibility of site management/operators under operational response plan and, if necessary, the emergency response plan.	**Low likelihood**	Local population – exposure to elevated concentrations of air pollutants – **Mild**	**Low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
Air emissions abatement						
Failure of air pollution control plant such as SNCR system, dry scrubbing system due to e.g., power failure, inadequate supply of reagents, blockage etc.	Local population – protection from elevated levels of pollutants and flue gas emissions above permit limits.	Air dispersion	Appropriate design and operation of the air pollution control plant and associated systems. All plant subject to regular inspection and maintenance. Automated control system interlocks to prevent further charging of waste and an alarm will sound. Monitoring of key process operating parameters e.g., pressure drop. Standby power system provided to allow safe shut-down of the plant. Continuous Emissions Monitoring System (CEMS) continuously monitors emissions and the automated control system will alter dosing rates of reagents if emissions approach or exceed limits. Reagent storage tanks fitted with low level alarms. Identifying, correcting and responding to any process failure would be the responsibility of site management/operators under	**Low likelihood**	Local population – exposure to elevated concentrations of air pollutants – **Mild**	**Low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
			operational response plan and, if necessary, the emergency response plan.			
Leak of combustion gases to air before abatement plant, e.g., due to overpressure, plant material defect, corrosion or erosion.	Local population – protection from elevated levels of pollutants	Air dispersion	Appropriate design and operation of the flue gas treatment plant and associated systems. All plant subject to regular inspection and maintenance. Automated control system interlocks to prevent further charging of waste and an alarm will sound. Monitoring of key process operating parameters e.g., pressure. System will remain under negative pressure due to 'suction' created by the induced draught fan. Identifying, correcting and responding to any process failure would be the responsibility of site management/operators under operational response plan and, if necessary, the emergency response plan.	**Low likelihood**	Local population – combustion product exposure – **Medium**	**Moderate/low**

Hazard What has the potential to cause harm?	Receptor What is at risk? What needs protection?	Pathway How can the hazard get to the receptor?	Risk management What measures are in place to reduce risk? If it occurs, who is responsible?	Probability of exposure How likely is this contact?	Consequence What is the harm that can be caused?	Overall Risk What is the risk that still remains? The balance of probability and consequence
Failure of main induced draught fan due to e.g., power supply failure, component failure etc	Local population – protection from elevated levels of pollutants	Air dispersion	Appropriate design and operation of the flue gas treatment plant and associated systems. All plant subject to regular inspection and maintenance. Automated control system interlocks to prevent further charging of waste and an alarm will sound. Monitoring of key process operating parameters e.g., pressure drop. Standby power system provided to allow safe shut-down of the plant. Continuous Emissions Monitoring System (CEMS) continuously monitors emissions. Identifying, correcting and responding to any process failure would be the responsibility of site management/operators under operational response plan and, if necessary, the emergency response plan.	**Low likelihood**	Local population – exposure to elevated concentrations of air pollutants – **Mild**	**Low**
Power generation						
Operation of steam safety valve	Local population – protection from loss	Air propagation	Appropriate design, construction and operation of generation plant and associated systems.	**Likely**	Local population – exposure to noise – **minor/negligible**	**Low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
	of amenity due to high noise levels.		All plant will be subject to regular inspection and maintenance programme. Steam pressure will be a key operating parameter monitored. Identifying, correcting and responding to any process failure would be the responsibility of site management/operators under operational response plan and if necessary, the emergency plan.			
Major vibration due to rotating machinery being out of balance	Local population – protection from loss of amenity due to vibration.	Vibration through ground	Appropriate design, construction and operation of generation plant and associated systems. The majority of rotating machinery will be within the process buildings. Use of anti-vibration mountings. All plant will be subject to regular inspection and maintenance programme. Identifying, correcting and responding to event outwith standard operating parameters would be the responsibility of site management/operators under operational response plan and if necessary, the emergency plan.	**Unlikely**	Population – nuisance due to effects of vibration - **Mild**	**Very low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
Leak of lubricating oil for generator/ turbine	Ground/Groundwater – protection of ground and groundwater quality	Failure of bunding/hardstanding to contain leakage of oil	Appropriate design, construction and operation of generation plant and associated systems. The alternator, generator and turbine will all be within the main turbine hall. All plant will be subject to regular inspection and maintenance programme. Limited volume of oil used in system.	**Unlikely**	Contamination of groundwater - breach of permit/regulations, potential restrictions on local abstraction - **Mild**	**Very low**
	Surface Water – protection of local surface water/watercourse quality and ecology	Oil leak enters surface water drains on site	Equipment within building on contained hardstanding. will be subject to regular inspection and maintenance programme. Spill kits available locally to generator/turbine Sealed surface water drainage system includes attenuation tanks and interceptors. The attenuation tank cans be isolated allowing their contents to be tested before discharge or, alternatively, pumped to a tanker for off-site disposal. Identifying, correcting and responding to any process failure would be the responsibility of site management/operators under operational response plan and, if necessary, the emergency response plan.	**Unlikely**	Surface water – breach of permit/regulations, potential impact on local abstractions, damage to aquatic ecology - **Mild**	**Very low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
Ash handling						
Spillage/release of bottom or fly ash during handling/disposal.	Local population – protection from hazardous dust.	Air dispersion	Appropriate design, construction and operation of ash and abatement plant and associated systems. All plant will be subject to regular inspection and maintenance programme. Plant and equipment located in buildings on hardstanding. Bottom ash will be damp after passing through the quench and, therefore, unlikely to be particularly mobile. Sealed surface water drainage system includes attenuation tanks and interceptors. The attenuation tanks can be isolated allowing their contents to be tested before discharge or, alternatively, pumped to a tanker for off-site disposal. If loss of containment did occur, responsibility would be with the site management/operators under operational spill response procedures or, if relevant, emergency response procedures.	**Low likelihood**	Local population – exposure to dust/particulates – **Mild**	**Low**
	Surface Water – protection of local surface water/watercourse quality and ecology	Clean up of spillage may result in 'wash water' entering surface water drains if not managed correctly.		**Low likelihood**	Surface water – breach of permit/regulations, potential impact on local abstractions, damage to aquatic ecology - **Mild**	**Low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
General site issues						
Ineffective containment of firefighting water	Surface Water – protection of local surface water/watercourse quality and ecology.	Firefighting water enters surface water drains	Firefighting water retention storage system will be part of the final design for the plant. Firewater retention provision designed according to Chubb Guidance document - Energy from Waste (EfW) – Fire Systems. Penstock valves in drainage system on final outfall to surface water would be closed in event of a fire emergency on site. Sealed surface water drainage system includes attenuation tanks and interceptors. The attenuation tanks can be isolated allowing their contents to be tested before discharge or, alternatively, pumped to a tanker for off-site disposal. If fire occurs, responsibility would be with site management/operators under operational and if necessary, emergency response plan, involving emergency services as appropriate.	**Low likelihood**	Surface water – breach of permit/regulations, potential impact on local abstractions, damage to aquatic ecology – **Medium**	**Moderate/low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
Operator error through human/control system interface failure, illness, etc., resulting in incorrect operation of equipment and plant and unwanted release to environment	Local population – protection from air quality and noise impacts.	Air dispersion and propagation	Appropriate design of control systems to minimise potential for interface error. Automated process control minimises potential and consequences of operator error. Provision of sufficient adequately trained operators, in accordance with requirements of the IMS. Identifying, correcting and responding to any operator failure would be the responsibility of site management/senior operators under training and operational response plan and if necessary, the emergency plan.	**Low likelihood**	Local population – air quality and noise impacts. – **Mild**	**Low**
	Surface Water – protection of local surface water/watercourse quality and ecology.	Discharge of contaminated water to surface water.		**Low likelihood**	Surface water – breach of permit/regulations, potential impact on local abstractions, damage to aquatic ecology - **Mild**	**Low**
Site flooding, resulting in contaminated waste and other materials entering surface water drains	Surface Water – protection of local surface water/watercourse quality and ecology.	Direct discharge of contaminated water to surface water.	As identified in the Flood Risk Assessment supporting the DCO application, the proposed design and elevations of the site mean that the EfW CHP Facility is considered safe for its lifetime and would remain dry during the design flood event (0.5% AEP plus climate change overtopping event) and the	**Low likelihood**	Surface water – breach of permit/regulations, potential impact on local abstractions,	**Moderate/low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
			0.1% AEP plus climate change overtopping event. The residual risk from tidal breaches will be managed by ensuring that elements of the EfW CHP Facility classified as essential infrastructure would have a finished floor level no less than the peak floodplain water level at the site for the 0.1% AEP plus climate change tidal breach event. There will be a minimum stand-off distance from the edge of drains to ensure ongoing access for maintenance. Sealed surface water drainage system includes attenuation tanks and interceptors. The attenuation tanks can be isolated allowing their contents to be tested before discharge or, alternatively, pumped to a tanker for off-site disposal. Identifying and responding to any flood situation would be the responsibility of site management/operators under the emergency flood response plan.		damage to aquatic ecology – **Medium**	

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
Site security breach resulting in vandalism, damage to plant/equipment, (e.g., storage tanks, etc) causing accidental releases.	Ground/Groundwater – protection of ground and groundwater quality	Deliberate or accidental spillage of hazardous liquid materials to ground, which is not contained by hardstanding.	Site perimeter secured by fence and lockable access gates. Site manned full time, by operators and/or security staff. Process buildings will have controlled access to authorised staff only. Comprehensive CCTV monitoring to a central control room. Inspection of equipment on a regular/shift basis.	**Unlikely**	Contamination of groundwater - breach of permit/regulations, potential restrictions on local abstraction – **Medium**	**Low**
	Surface Water – protection of local surface water/watercourse quality and ecology	Deliberate or accidental spillage of hazardous liquid materials to surface water drains.		**Unlikely**	Surface water – breach of permit/regulations, potential impact on local abstractions, damage to aquatic ecology - **Medium**	**Low**

3.3 Energy efficiency

3.3.1 Overview

The EfW CHP Facility will be developed with integrated furnaces and steam raising boilers and will be a net producer and exporter of heat, in the form of 251t/h of high pressure (~45barg), high temperature (380°C) steam to a steam turbine generator (STG). The system will be designed to maximise the generation of electricity from the steam by using an efficient multi-stage extraction condensing turbine with the final stage operating below atmospheric pressure. Once all useful work has been extracted from the steam, it will be passed to an air cooled condenser (ACC) to be condensed and returned to the boiler feed water system.

Small quantities of electrical power will be imported from the grid for plant start-up when neither line is operating, whilst low sulphur gas oil (or similar equivalent) will be used in the auxiliary burners for temperature safeguarding during operation and to achieve the minimum temperature requirements prior to the charging of waste at start-up. During normal operation, the parasitic load requirement will be met by the electrical generation from the STG and supplied via the internal power distribution system and transformers at the required auxiliary voltage levels. The EfW CHP Facility is also able to operate in island mode such that the STG provides the parasitic load requirement only without exporting power.

The EfW CHP Facility is designed to be CHP-ready (CHP-R) from the outset with the ability to export heat to local heat consumers where there are opportunities to do so and where suitable contractual arrangements can be established. The EfW CHP Facility is designed to be able to export up to $50MW_{th}$ of heat in the form of medium pressure 20barg steam to a district heating network. Gross power generation will range from $60MW_e$ with no heat export to $44MW_e$ with maximum heat export.

The EfW CHP Facility has a design R1 value of 0.81 (0.90 with application of climate change correction factor based on regional heating degree day analysis) at design load conditions (DLC) without the export of heat, ensuring that the installation can be classed as an energy recovery operation irrespective of the level of heat export. Appendix A11 provides a CHP-R assessment and details of the R1 calculation. Operational data will be collected during commissioning and each subsequent year, with a re-assessment of the R1 calculation made to ensure the EfW CHP Facility does/can continue to achieve R1 status.

3.3.2 Energy balance

Table 3-5 provides an estimated breakdown of delivered and primary energy consumption by the EfW CHP Facility.

As part of its Integrated Management System, the Operator will periodically conduct an energy survey/audit on major equipment within the EfW CHP Facility during its operation. This will allow identification of opportunities to reduce the parasitic load to maximise net generation and export of electricity, and to ensure that the performance of the EfW CHP Facility does not deteriorate from the initial design.

The design parasitic load for the EfW CHP Facility is an installed load of $2.8MW_e$ per line with an expected consumption of $2.5MW_e$ per line. This will be confirmed following the EPC Contractor procurement process and prior to commissioning of the EfW CHP Facility. The actual parasitic load will be monitored during commissioning trials.

An indicative energy balance to demonstrate the significant energy recovery, utilisation and losses from each stage of the process is provided in Table 3-6. Figure 3-2 presents a visualisation of the energy flows in the form of a Sankey diagram for the DLC conditions with no heat export scenario.

Table 3-5 Expected breakdown of delivered and primary energy consumption

Energy source	Energy consumption – delivered (MWh) [A]	Energy consumption – primary (MWh) [B]	% of total	Specific energy consumption (MWh/t) [C]	CO_2 emissions (tCO_2/y) [D]
Electricity from Grid (for start-up)	353	847	1.4	0.001	141
Electricity from EfW CHP Facility (parasitic load)	40,000	40,000	66.3	0.063	6,640
Gas oil (for start-up or supplementary heating to achieve minimum temperature requirement) [E]	19,507	19,507	32.3	0.03	4,877
TOTAL	59,860	60,354	100	0.094	11,658

[A] Based on annual availability of 8,000 h/y per line.

[B] Factor of 2.4 applied to derive primary energy consumption of imported Grid electricity in accordance with Environment Agency Guidance: *Assess the impact of air emissions on global warming*

[C] Based on an annual waste throughput of 625,600 t/y

[D] Emissions calculated using emission factors in Environment Agency Guidance: *Assess the impact of air emissions on global warming*

[E] Based on gas oil density of 0.85 kg/l and net calorific value of 42.6 MJ/kg per Digest of UK Energy Statistics (DUKES) 2021

Table 3-6 Energy balance for EfW CHP Facility (design load conditions with no heat export)

Item	Energy (MW)
Thermal input of waste material	201
Heat in combustion air	5.7
Heat in boiler feed water	39.2
Heat in steam produced	220
Heat in bottom and fly ash	5.4

Item	Energy (MW)
Heat in flue gas	16.9
Other losses (e.g., radiation, boiler blowdown)	3.6
Electricity generated (gross/net)	(60/55)

Figure 3-2 Indicative Sankey diagram for energy flows

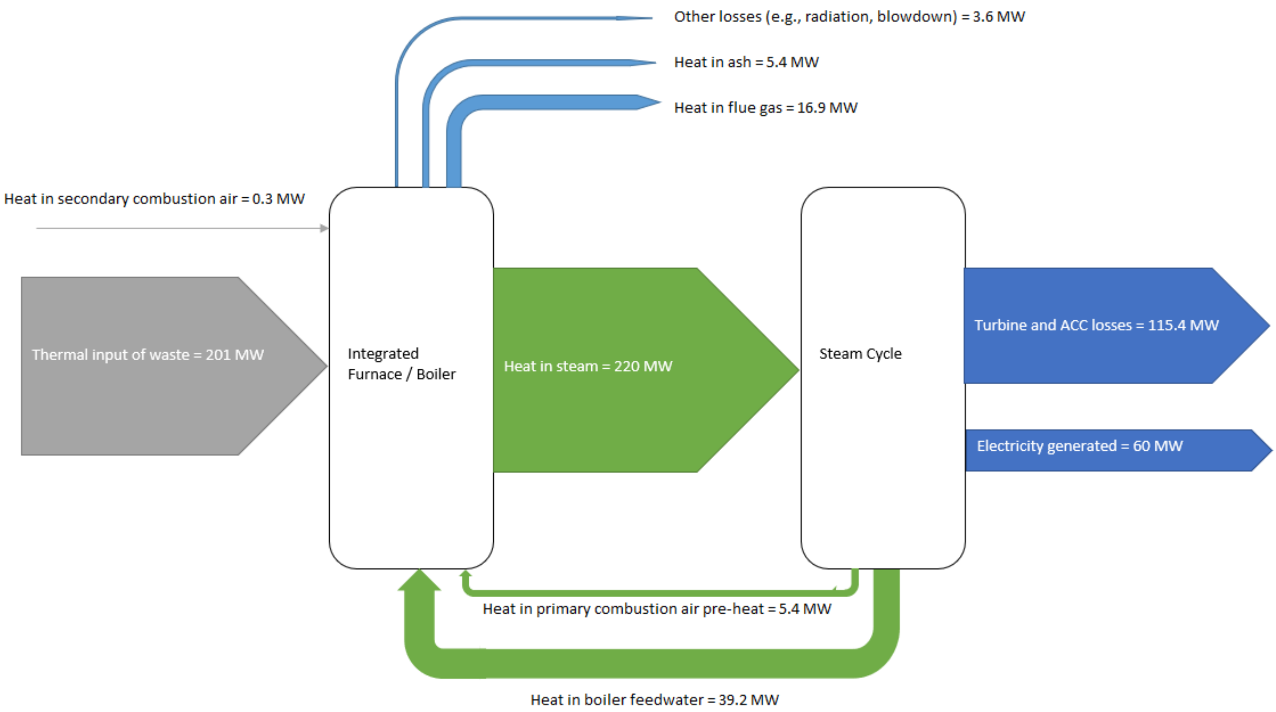


Table 3-7 compares the performance of the EfW CHP Facility against energy efficiency benchmark data from EPR 5.01 and the BAT Associated Energy Efficiency Level (BAT-AEEL) in the BAT Conclusions. The table demonstrates the EfW CHP Facility meets, or exceeds, the specified levels of efficiency.

Table 3-7 Comparison of proposed design parameters against benchmark levels for efficiency and BAT-AEEL

Parameter	Unit	EfW CHP Facility	Benchmark/BAT-AEEL
Electricity generation per 100,000 t of waste [A]	MW_e	9.6	5 – 9
Gross electrical efficiency	%	30	25 – 35

[A] Gross generation for the low CV scenario (625,000 t/y of waste) and with no heat export.

3.3.3 Basic energy requirements

The Environment Agency's energy efficiency standards for industrial plants requires that an installation be operated under basic energy efficiency measures. This requires evidence to be provided that basic, low-cost, physical energy efficiency techniques have been included in the design to avoid gross inefficiencies relating to excessive heating or cooling losses. This includes the identification and elimination of all excessive heating or cooling losses from, for example, steam systems, hot water pipes, heated vessels, ovens, chillers and other temperature-controlled zones or equipment through the implementation of basic insulation and containment methods. Examples of how such requirements will be addressed are provided below.

Energy Management System

MVV operates an Energy Management System accredited to the requirements of ISO 50001:2018 as part of its IMS and this existing accreditation will be extended to cover operations at the EfW CHP Facility. As part of the operational procedures in this system, energy use will be monitored throughout the operational lifetime of the EfW CHP Facility. Periodic audits will be undertaken to identify areas for improvement and ensure that any increased consumption above that envisaged in the original design is investigated and, where relevant, appropriate actions taken to resolve any identified issues.

The operating procedures will include preventative maintenance measures specifically aimed at maximising the energy efficiency of the EfW CHP Facility. These procedures will cover aspects such as:

- Daily/shift checks on the operation and condition monitoring of motors and drives;
- Regular walk round checks of compressed air systems to check for leaks;
- Regular walk round checks of the steam systems to check for leaks and assess the integrity of insulation;
- Development of a routine lubrication schedule for lubrication systems; and
- Operator training in energy efficiency awareness.

Insulation of steam and hot water systems

Good basic engineering design, including appropriate insulation levels, will be used throughout the EfW CHP Facility. The main combustion chambers in the furnace will be insulated to retain energy. The boiler generated high pressure steam will be transported within well insulated steam mains to the STG. All condensate pipes will be insulated to minimise heat loss during the transfer of boiler feed water back to the header tank, ensuring heat losses are minimised.

Provision of hoods, lids, air-tight seals and self-closing doors to maintain temperatures

All internal doors, where space heating/air conditioning is provided, will be self-closing as will external doors in the main office, rest room and control room areas. All will be fully draft proofed with windows double glazed. The waste reception area and other main internal process areas will not be heated.

Avoidance of unnecessary discharge of heated water or air by fitting simple timers or sensors

The office area, staff rest rooms and control room will be operated under a control system that considers both internal and external temperatures to determine the heat/cooling demand, working times and occupancy of the EfW CHP Facility.

Use of high efficiency lighting

All internal and external lighting at the EfW CHP Facility will make use of high efficiency LED lighting. Lighting in internal office areas and corridors will be equipped with time switches or motion sensors. The exterior lighting will be controlled by adjustable electric switches and/or controlled via the distributed control system (DCS) on a timer with manual override where necessary.

Design of motors

Energy efficient motors will be used and sized appropriately for their duty and, where appropriate, will be variable speed drive.

3.3.4 Sector specific requirements

In addition to the basic energy efficiency requirements, EPR 5.01 and the Waste Incineration BAT Conclusions introduce additional sector specific energy efficiency requirements. Specific energy efficiency measures that will be incorporated in the design of the EfW CHP Facility include:

- The EfW CHP Facility is designed to produce both electricity and heat;
- Generation of high pressure steam balanced against corrosion and maintenance requirements;
- Optimisation of steam extraction points from the STG for auxiliary and potential heat supply.
- Internally and externally insulated furnaces/combustion chambers designed to minimise heat loss via e.g., radiative loss;
- The boilers will be equipped with superheaters and economiser(s) to maximise efficiency;
- Pre-heating of the primary combustion air and boiler feedwater by using low grade heat extracted from the STG;
- Optimisation of boiler feedwater temperature;
- Closed steam cycle, minimising losses and fresh/cold water makeup;
- Boiler heat exchange surfaces will be cleaned on a regular basis to maximise efficient heat recovery. Online cleaning of heat exchanger surfaces will be used to optimise heat recovery efficiency;
- Use of an advanced, automated combustion control system regulating waste feed rates and combustion air requirements to maximise combustion efficiency (and minimise emissions);
- Appropriate insulation levels on all high temperature circuits;
- ACC system expanding steam to low pressure from the turbine and condensing to hot water;
- Avoiding unnecessary releases of steam and hot water; and

- Effective plant maintenance procedures to ensure the energy efficiency of the EfW CHP Facility is maintained over time, and to avoid unplanned down time or prolonged shutdowns.

Table 3-8 provides a comparison of the EfW CHP Facility's proposed operation with the sector specific indicative BAT requirements for energy efficiency from EPR 5.01.

Table 3-8 Comparison of proposed design against sector specific indicative BAT requirements for energy efficiency

No	Indicative BAT requirement	Comparison with proposed design
1	The following techniques may reduce energy consumption or increase energy recovery and thereby reduce both direct (heat and emissions from on-site generation) and indirect (emissions from a remote power station) emissions. The extent of their use should be justified in your application • Use of the heat generated for electricity generation for on-site or off-site use is expected for the majority of new installations; • Use of higher efficiency electrical generation technology e.g. gas turbines or engines; • Use of steam from boilers in on-site or off-site applications; • Use of waste heat for CHP or district heating (potential to increase overall thermal efficiencies from approx. 20 % to 75 %); • Use of waste heat for preheating combustion air, boiler feed water or plume reheat; • Effective furnace insulation and construction to retain heat e.g. refractory linings; • Maintaining steady plant capacity to prevent downtime e.g. through provision of supplementary firing with primary fuel, or waste pre-treatment; • The use of flue gas re-circulation (primarily for NOx reduction) may have the additional benefit of increasing plant energy efficiency;	The EfW CHP Facility will be designed to generate electricity for on-site power requirements and for export to the grid with the potential to export heat (steam) to off-site heat consumers subject to completion of commercial agreements. High efficiency boiler and steam turbine combination has been proposed, resulting in high electrical export efficiency and low emissions. Insulation of steam and hot water systems will be used, in particular around the main high temperature circuit from the boiler systems to the condenser. The furnaces will also be refractory lined. Waste heat will be used to preheat the primary combustion air. Plant down time will be minimised with provision of low sulphur gas oil-fired auxiliary burners for supplementary firing. As far as practicable, the variability of waste inputs will be reduced by mixing within the waste bunker to help maintain steady plant operation and optimised throughput. Flue gas recirculation may be used dependent on the final design. However, the BAT assessment demonstrates this is unlikely to be considered the BAT option for controlling NO_x emissions alone, or in combination with other techniques. All plant maintenance and off-line cleaning of heat transfer surfaces, where required, will be undertaken pro-actively by trained personnel to ensure effective heat transfer and reduce the associated energy consumption. On-line cleaning of heat transfer surfaces will be carried out automatically. Regular maintenance and checks will ensure leaks are minimised. During the detailed design phase, the water quality and the need to provide a constant water supply to the boiler will be reviewed to identify the most appropriate option for incoming water treatment at the EfW CHP Facility Site.

No	Indicative BAT requirement	Comparison with proposed design
	• Effective maintenance of heat exchangers to maintain high heat transfer; • Prevention of uncontrolled air ingress by providing and maintaining seals; • Ensuring plant layout avoids pumping and heavy transfer where possible; and • Use of ion exchange instead of high pressure membrane filtration for boiler (and other water) treatment.	
2	Irrespective of whether a Climate Change Agreement or Trading Agreement is in place, where there are other BAT considerations involved, such as: • The choice of fuel impacts upon emissions other than carbon e.g. sulphur in fuel; • Where the potential minimisation of waste emissions by recovery of energy from waste conflicts with energy efficiency requirements; and • Where the nature of waste is such that the primary concern of safe waste disposal may be jeopardised by additional energy recovery (e.g. the need for rapid cooling to prevent de novo dioxin generation).	Low sulphur gas oil will be used to provide supplementary firing and for emergency standby power generation. This reduces the reliance on off-site energy networks and will allow safe shutdown of the combustion units in the event of loss of off-site power and failure of island mode operation. The primary fuel for the EfW CHP Facility comprises non-hazardous residual waste and power generated by the EfW CHP Facility will replace/augment off-site power generation from other fuels. Although the EfW CHP Facility is designed to recovery energy for electricity generation, its primary function is the appropriate treatment of waste to the requirements specified under the IED. The energy efficiency of the EfW CHP Facility has been maximised as much as possible without compromising compliance with the minimum requirements of the IED.
3	You should provide justification that the proposed or current situation presents BAT.	This relates to point 2 above.
4	Sub-sector specific issues – Municipal waste incineration: • Steam should be generated either for direct use or electricity generation • Where electricity only is generated, 5-9MW of electricity should be recoverable per 100,000 tonnes of annual waste throughput depending on waste composition • Waste heat should be recovered unless to do so can be demonstrated not to represent BAT (this will require cost justification). All opportunities for CHP and district heating should be explored • The siting of the plant near to potential or actual energy users will aid the	Steam generated by the boilers will primarily be used for electricity generation with some auxiliary use by the EfW CHP Facility. Dependent on developing acceptable commercial arrangements with local heat consumers, the EfW CHP Facility is also designed to export steam off-site. Where the EfW CHP Facility only operates with electrical generation, the amount of electricity generation for every 100,000 tonnes of annual waste throughput is 9.6MW_e, exceeding the minimum requirements of the sector guidance. The design includes the extraction of low grade heat from the STG to pre-heat the primary combustion air. The EfW CHP Facility is designed to be CHP-ready with the ability to export heat to local consumers subject to acceptable commercial agreements being developed.

No	Indicative BAT requirement	Comparison with proposed design
	maximisation of recovery potential. Consideration should be given to joint venture projects whenever possible. • If waste heat is not recovered, provision should be made for future installation e.g. the provision of tie-ins	The EfW CHP Facility is located close to existing major consumers of heat. If the viability or commercial arrangements for export of heat cannot be demonstrated when the detailed design is complete, the Operator will continually review the potential for exporting heat to emerging heat consumers.
5 - 8	Sub-sector specific issues – hazardous waste, clinical waste, sewage sludge and animal remains.	N/A – the EfW CHP Facility will not accept these waste types.
9	Refuse derived fuels	N/A – whilst RDF may be contained within the types of waste to be accepted, it will not be the sole waste type.
10	Sub-sector specific issues – pyrolysis and gasification installations	N/A – the EfW CHP Facility is not a pyrolysis or gasification process.

3.4 Efficient use of raw materials and water

3.4.1 Raw materials

The nature of the EfW CHP Facility is such that the main 'raw material' is the incoming waste. The other principal raw materials anticipated to be used include:

- Urea;
- Hydrated lime;
- Activated carbon;
- Low sulphur gas oil/fuel oil;
- Boiler treatment chemicals; and
- Other supporting materials used in small quantities for the efficient operation and maintenance of the EfW CHP Facility, including, but not limited to:
    - Various hydraulic and lubricating oils and greases;
    - Calibration gases for the CEMS;
    - Fire-fighting agents, such as carbon dioxide and foams; and
    - Oxyacetylene and other welding gases.

Table 3-9 provides an inventory of raw materials used as part of the operation of the installation and directly associated activities. This inventory will be confirmed once the detailed design is complete as part of the pre-operational commissioning report.

All storage tanks containing liquids potentially hazardous to the environment will have appropriate containment systems in place per the guidance in CIRIA C736 *Containment systems for the prevention of pollution*. As a minimum, bunds will be designed to accommodate 110% of the storage capacity and constructed of materials that are impervious to the content of material being stored. Alternatively, if more than one vessel is located within a common bund, the bund storage capacity will be a minimum of 110% of the capacity of the largest vessel, or 25% of the total vessel storage capacity, whichever is greatest

Further details on the selection of the principal raw materials, available alternatives, measures to ensure the optimal use of these raw materials, and storage information is described in the sections below.

Urea

Urea would be used to minimise NO_x emissions as part of an advanced selective non-catalytic reduction (SNCR) system. The urea will be stored in a single tank with a capacity of ~100m^3. The storage tank will be of steel or glass reinforced plastic (GRP) construction with appropriate containment systems in place per the guidance in CIRIA C736 *Containment systems for the prevention of pollution*. The storage tank will be equipped with high level and low level switches and alarms to prevent overfilling, and to notify operators that reagent volumes are running low.

Urea will be injected into the furnace using an automated dosing control system that optimises the dosing rate based on the NO_x readings from the CEMS to minimise ammonia slippage, meet the NO_x emission limits, and avoid the unnecessary use of raw materials. The dosing control system will contain flow monitoring and alarms to alert operators in the event of a blockage or malfunction of the system.

Ammonium hydroxide is a potential alternative to urea for the SNCR system. Use of urea in preference to ammonium hydroxide results in a slightly greater emission of nitrous oxide (N_2O) and a corresponding increase in the Global Warming Potential (GWP) of the EfW CHP Facility. However, there are greater health and safety risks associated with the handling and storage of ammonium hydroxide and, for this reason, urea has been selected as the preferred reagent.

Hydrated lime

Hydrated lime would be used for dry scrubbing of the waste combustion gases to control emissions of acid gases (e.g., SO_2, HCl and HF) from the EfW CHP Facility. The hydrated lime will be stored in two silos with a capacity of ~ 330m^3 per line. The silos will be equipped with fabric filters.

Hydrated lime will be injected into a reactor upstream of a fabric filter using an automated dosing control system that optimises the dosing rate based on the HCl and SO_2 readings from the CEMS to prevent unnecessary use of raw materials whilst ensuring compliance with emission limits. Portions of the resultant APCr from the fabric filter will be recirculated back into the reactor to minimise the quantity of unreacted lime. The silos will be equipped with high level and low level alarms to prevent overfilling and to notify operators that reagent volumes are running low. Dosing rates will be monitored and alarmed to indicate a blockage or other malfunction.

Sodium bicarbonate is an alternative to lime but has a similar level of environmental risk and associated with other operational difficulties which make it a less attractive option for acid gas control than lime. These factors are discussed further in Section 5.1.2 and the BAT assessment in Appendix A4.

Activated carbon

Powdered activated carbon (PAC) will be used to control emissions of PCDD/Fs and mercury from the EfW CHP Facility. It will be injected into the reactor along with the hydrated lime. The activated carbon will be stored in two silos with a capacity of ~ 40m^3 per line. The silos will be equipped with fabric filters.

Dosing rates of activated carbon will initially be set based on the CEMS volumetric flow rate, MVV's experience operating other facilities, and optimised as part of the commissioning trials.

The silos will be equipped with high level and low level alarms to prevent overfilling and to notify operators that reagent volumes are running low. Dosing rates will be monitored and alarmed to indicate a blockage or other malfunction.

Catalytic filter bags are an alternative to activated carbon for PCDD/F control, but this technique does not remove mercury. Consequently, activated carbon would still be required for control of mercury emissions in any case.

Gas oil (diesel)

Low sulphur (<0.1wt%) gas oil will be used to provide auxiliary firing in the furnace and as fuel for the emergency diesel generator, diesel fire pump and the operational mobile plant. The gas oil will be stored in three tanks with a combined capacity of 250m^3 in an enclosed building. The storage tanks will have appropriate containment systems in place per the guidance in CIRIA C736 *Containment systems for the prevention of pollution*. The storage tanks will be equipped with high level and low level alarms to prevent overfilling and to notify operators that fuel volumes are running low.

Alternatives to low sulphur gas oil include liquefied petroleum gas (LPG) or natural gas. LPG is gaseous at normal ambient temperatures and pressures and requires storage in specialised pressurised vessels to keep it liquefied. Storage of a flammable substance under pressure represents a significant risk of explosion in the event of a fire on-site and, due to the proximity of other users of buildings on the industrial estate, and nearby residential receptors, is considered to be too high risk for this location.

Natural gas can be used for stationary combustion and is safer to handle than LPG and is associated with lower emissions than gas oil. However, it cannot be used for the mobile plant. Furthermore, supply of natural gas to the site is reliant on an external, third party distribution grid and may not be available to allow the safe shut-down of the EfW CHP Facility.

Gas oil can be stored on-site and does not have the same risk profile of LPG. This means availability of its use as an auxiliary fuel can be guaranteed, whereas the same is not true for natural gas. Taking these factors into consideration, low sulphur gas oil has been selected as the preferred auxiliary fuel for the EfW CHP Facility.

Table 3-9 Main raw material inventory

Raw material	Nature and composition	Expected usage (t/y) [A]	Nature of storage and capacity	Fate	Environmental Effects	Alternatives
Urea	45% aqueous urea solution.	1,877	Stored in ~100m^3 tank within an enclosed building with additional containment systems in place per the guidance in CIRIA C736.	Emitted in the flue gases. The majority is reacted and reduced to nitrogen and water.	Not bioaccumulative but is hazardous to the aquatic environment.	Urea has lower ecotoxicity and lower hazards in storage and handling, but a higher GWP than ammonium hydroxide, the other alternative.
Hydrated lime	Typically >95% $Ca(OH)_2$ with some impurities including calcium carbonate.	10,635	Stored in two silos with a capacity of ~330m^3 per line. Dry materials so additional bunding etc. is not required. Any spilt material will be effectively contained by the site's concrete hard-standing. Silos have fabric filter systems in place.	Reacted with acid gases to form relatively stable salts of calcium, including sulphates and chlorides. The majority of these salts would be collected in the APCr and sent to landfill. A minor portion may be emitted from the chimneys as particulate matter.	Low toxicity to mammals. Irritant and corrosive.	Sodium bicarbonate is the main alternative but has similar environmental effects.

Raw material	Nature and composition	Expected usage (t/y) [A]	Nature of storage and capacity	Fate	Environmental Effects	Alternatives
Activated carbon	Powdered carbon.	188	Stored in two silos with a capacity of ~40m^3 per line. Dry materials so additional bunding etc. is not required. Any spilt material will be effectively contained by the site's concrete hard-standing. Silos have fabric filter systems in place.	Same as above for lime	Carbon is a stable compound with low environmental effects. Highly insoluble and immobile.	None. Carbon is recognised as BAT for dioxin and mercury removal.
Gas oil	< 0.1wt% sulphur gas oil.	1,648	Stored in three tanks with a combined capacity of 250m^3 in an enclosed building. The storage tanks will have appropriate containment systems in place per the guidance in CIRIA C736.	Combustion and released as products of combustion.	Not readily biodegradable and has the potential to bioaccumulate. Low acute toxicity to mammals but harmful to aquatic organisms.	Natural gas or LPG. However, gas oil has lower risks than LPG and on-site storage allows guaranteed supply.

Raw material	Nature and composition	Expected usage (t/y) [A]	Nature of storage and capacity	Fate	Environmental Effects	Alternatives
Water	Town mains water.	640,000m^3 [B]	Stored in various tanks, e.g., raw water, demin water, fire water tank etc.	Re-used or evaporated.	None.	None.
Calibration gases for CEMS	Liquid gas under pressure in cylinders.	< 1	Stored in gas cylinders.	Emitted to air during use.	Low impact due to limited quantities used.	None.
Various oils (e.g., lubricating oil) and grease	Various.	< 5	Stored in tins in prescribed locations in maintenance workshop.	Destruction by off-site incineration or recycled where possible.	Low impact due to limited quantities used.	None.
Boiler water treatment chemicals	Various acids and alkalis for pH control, oxygen scavenger, descaler etc.	< 1	Small containers/tanks with appropriate containment systems in place.	Discharged to the ash quench.	Low impact due to limited quantities used.	None.
Firefighting agents	Various inert foams and gases.	< 1 (emergency or training use only)	Stored in cylinders.	Emitted to air.	Low impact.	None.

[A] Based on a waste throughput of 625,600t/y

[B] Based on continuous consumption at the maximum freshwater feed rate of 80 m^3/h. However, this rate would only occur in a scenario where steam was exported and condensate was not returned from the user. The typical consumption would be 5 m^3/h without heat offtake, with an annual consumption of 40,000 m^3/y based on an annual availability of 8,000 h/y.

Table 3-10 reviews the proposed operation of the EfW CHP Facility against the indicative BAT requirements in EPR 5.01 for the efficient use of raw materials.

Table 3-10 Comparison of proposed design against sector specific indicative BAT requirements for the efficient use of raw materials

No	Indicative BAT requirement	Comparison with proposed design
1	You must identify and consider how the waste that you burn may vary, in terms of likely composition, handling and combustion characteristics. You will need to define the issues covered by Article 5 of WID unless we have granted you an exemption because you are burning your own waste at the place where that waste was generated.	As Operators of existing facilities treating similar wastes, MVV recognise the variable nature of the waste and its potential impact on plant performance. Operational procedures (described below and in Section 4) will be in place to minimise the impacts of feedstock heterogeneity on plant performance.
2	You should demonstrate that your plant has been designed and will be managed and operated so that you account for the heterogeneity of the waste. Operational plant will be able to demonstrate this by reference to actual plant data for emissions and other operational parameters. New plant may be able to make reference to the performance of other operational plant of the same design but must consider the possibility of local variations in waste character, plant modifications and management.	The EfW CHP Facility design requirements have been established by MVV based on its long track record of operating municipal EfW and biomass facilities. The firing diagram presented in Section 4 highlights the design range in terms of feedstock quality and throughput for the EfW CHP Facility. The design of the EfW CHP Facility will be such that it can cope with the variation in feed stock without operation or performance being affected. Based on the design of the EfW CHP Facility and similar plant operated by MVV, the emissions from the EfW CHP Facility are expected to be relatively consistent, and compliant with the permit requirements.
3	Improving feedstock homogeneity can minimise residues by improving operational stability throughout the installation. This will in turn lead to improved ability to optimise operational and environmental performance and reduce the amount of reagents used and wastes produced.	Bunker management procedures will be developed to ensure mixing of the different incoming waste sources to improve the homogeneity of the feed to the furnace. These management procedures will include mixing and turning of incoming wastes using trenching and stacking by the waste bunker crane to blend the incoming waste.
4	You should consider the following techniques for improving feedstock heterogeneity: • upstream waste management • procedures for removal of problem wastes • on or off site waste treatment/mixing	Waste pre-acceptance and acceptance procedures will reduce the probability for non-conforming wastes being present in the feed to the furnace. This will include visual inspection of arriving loads and/or by regular inspection by the waste bunker crane operators. As above, bunker management procedures will be in place to improve feedstock homogeneity.

No	Indicative BAT requirement	Comparison with proposed design
5	The prime purpose of incineration is to thermally treat wastes in order to minimise the amount and harmfulness of the residues arising for further disposal. Good combustion conditions with the correct temperature, residence time and sufficient turbulence are the key to securing this.	The design of the EfW CHP Facility takes specific account of these considerations. The furnace design and control systems to ensure optimum combustion conditions are described in Section 4.
6	You should consider at least the following key techniques to minimise residue production: • burnout in the furnace should achieve less than 3% TOC (e.g. by improving waste agitation on the bed / burnout time and temperature exposure). • SNCR reagent dosing should be optimised to prevent ammonia slip to ash	The EfW CHP Facility is designed to achieve a TOC content of less than 3% in the bottom ash. The SNCR dosing rates will be optimised using an automated dosing control system that optimises the dosing rate based on the NOx readings from the CEMS to minimise ammonia slippage.
7	Optimising alkaline (and other) reagent use will prevent the production of wastes (unused or contaminated) reagent.	The acid gas and other emission control systems involving the use of reagents are controlled by automatic dosing systems that control the rate of dosing based on data from the CEMS to avoid excessive consumption of raw materials and generation of wastes.
8	You should consider at least the following techniques: • alkaline reagent recycle; and • wet scrubbing. • optimisation of reagent dosing and reaction conditions	As above, reagent dosing systems are optimised with portions of the resultant APCr from the fabric filter being recycled back into the reactor to minimise the quantity of unreacted reagents.
9	Mixing of wastes produced on site can cause contamination of a large amount of waste with a smaller amount such that it cannot be recovered or easily disposed of. You must ensure that the plant is designed to keep separate waste streams apart in order to facilitate their recovery or disposal. This must include at least: • storing air pollution control residues separately from bottom ash. • considering whether to keep air pollution control residues separate from other fly ash residues collected in particulate abatement plant	The design of the EfW CHP Facility includes provision for separate storage of bottom ash and APCr.

3.4.2 Water use

The EfW CHP Facility has been designed with a principal objective of achieving minimal consumption of potable water and 'zero process effluent' production during normal operation.

Whilst some mains water will be required for topping up boiler feedwater and the ash quench system, potable uses in kitchens and washrooms, washdown operations and for fire suppression systems, fresh water consumption will be minimised through collection of process effluents for re-use, principally in the bottom ash quenching system, whilst boiler feed water used to generate steam will use recycled condensate from the ACC with condensate losses replaced using demineralised water.

The Operator will apply the following general techniques in sequence to reduce water use:

- Use water-efficient techniques at source wherever possible;
- Recycle water within the process;
- Directly measure and record fresh water consumption regularly, at every significant usage point; and
- As part of the ongoing cleaning/management include general efficiency techniques such as vacuuming, scrapping or mopping in preference to hosing down, using trigger controls on all hoses, hand lances and washing equipment, and reusing wash water where practicable.

During normal operation of the EfW CHP Facility, a peak mains water supply requirement of 80m^3/h has been estimated in the case where a CHP scheme is in place, but condensate is not returned from the steam consumers. The normal expected demand of the EfW CHP Facility will be much lower than this at 5m^3/h. The main consumers of water in the EfW CHP Facility will be as follows:

- Steam generation – demineralised water will be required to replace the boiler feedwater/condensate lost via evaporation, boiler blowdown and other steam consumers on-site. Use of demineralised water and boiler blowdown is essential to maintain the quality of boiler water and prevent the build-up of sludge and chemical impurities. Demineralised water will be fed to the process from the on-site water treatment plant. The water treatment plant is designed to continuously supply demineralised water to the process;
- Bottom ash quenching – hot IBA from the moving grate will be cooled in a water quench, with evaporated water preferentially replaced using process water generated from other areas of the EfW CHP Facility (there may be a nominal requirement for top-up using mains water in some instances);
- Washing operations – water will be required for general equipment and surface cleaning, and to washdown hardstanding surfaces or vehicles. This will be supplied from the mains water supply with trigger controls on hoses to minimise water consumption;
- Potable uses – potable water from the mains supply will be consumed in amenity areas such as kitchens, washrooms and toilets. Domestic effluents from toilets, showers and kitchen areas will be discharged to foul sewer; and
- Fire suppression systems – the requirements for fire-fighting water are intermittent but can constitute large flows when required. In the event of a fire, water would initially be supplied from the fire water tank and then from the mains water system. Fire-fighting waste waters will be retained within the waste bunker and/or surface drainage system which will be

closed in the event of an emergency using penstock valves. Procedures will be in place for sampling and testing fire-fighting runoff prior to appropriate disposal.

Rainwater collection from building roofs, roads and hardstanding areas will be discharged through an independent surface water drainage system incorporating oil interceptors and attenuation tanks. Sanitary and process effluents would be discharged to foul sewer. The steam/condensate cooling water system will also be independent to the surface drainage and foul sewer systems.

Table 3-11 provides a summary of the expected consumption within the installation and its source. Appendix A3 provides an indicative water flow drawing.

Table 3-11 Indicative water consumption within the EfW CHP Facility

Source/use	Consumption (m^3/h) [A]
Imported water to the EfW CHP Facility	
Mains water supply	5
Water consumption in the EfW CHP Facility	
Steam production	2.46 (for blowdown only)
Ash quench	1.00
Flue gas treatment systems	0 (dry scrubbing systems used)
Washing and cleaning operations	0.50
Potable and amenity uses (e.g., washrooms, kitchens)	0.21
Non-potable uses (e.g., toilets)	0.51
Fugitive emission suppression systems	0.32

[A] Expected consumption for normal operation

Water flows and volumes will be confirmed during plant commissioning and final water balances will be submitted to the Environment Agency in the post-commissioning report. Water efficiency audits will be carried out routinely as part of the IMS.

Table 3-12 reviews the proposed operation of the EfW CHP Facility against the indicative BAT requirements in EPR 5.01 for the efficient use of water.

Table 3-12 Comparison of proposed design against sector specific indicative BAT requirements for the efficient use of water

No	Indicative BAT requirement	Comparison with proposed design
1	Dry scrubbing systems do not consume significant quantities of water, with only a little required for ash quench and conditioning.	Dry scrubbing systems form the design basis for the EfW CHP Facility.
2	Semi dry gas scrubbing typically consumes 250-350 kg / tonne of waste incinerated.	N/A – the EfW CHP Facility will not use semi-dry scrubbing.
3	Municipal waste incinerators (MWIs) using wet scrubbing can consume up to 850 kg / tonne of waste incinerated, although this should be reduced by scrubber liquor re-circulation. Where this will be done, the clean water input must be made at the final (polishing) scrubber to prevent higher emissions to air. Systems with liquor treatment to remove pollutants use less water than simple bleed and top up systems.	N/A – the EfW CHP Facility will not use wet scrubbing.
4	The nature of the wastes treated in HWIs means that higher levels of water consumption (up to 1100 kg/tonne of waste) may be justified to ensure emissions to air are controlled. Multi-stage wet scrubbing systems provide lower water consumption by re-circulating the used stack end scrubber water to earlier scrubbing/quench stages. You can reduce evaporative water losses by cooling the final stage clean scrubber water, but you should ensure that stack exit temperatures are high enough to prevent a visible plume.	N/A – the EfW CHP Facility will not accept hazardous waste.
5	Most chemical waste incinerators (CWIs) employ dry scrubbing and therefore consume relatively little water.	N/A – the EfW CHP Facility will not accept chemical waste.
6	There is little data available for other incineration biomass plant types. In general the more variable the waste feed (e.g. drum incineration) the greater the justification for the use of wet scrubbing techniques that have higher levels of water consumption if they are not of the closed loop type	N/A – the EfW CHP Facility will only accept non-hazardous residual household, commercial and industrial waste.
7	In justifying any departures from these benchmarks the techniques described below should be taken into account. You should identify the constraints on reducing water use as this is usually installation-specific. With the majority of fresh water being used for gas scrubbing it will be important that you justify your choice of technique. In general the following may represent	Dry scrubbing will be used in the EfW CHP Facility and is considered to be BAT for the waste types accepted.

No	Indicative BAT requirement	Comparison with proposed design
	BAT with regard to water consumption (provided reagent use is similar and closed loop wet systems are not practicable): • MWIs –- dry or semi-dry scrubbing • HWIs –- wet scrubbing. • CWIs –- dry or semi-dry scrubbing	
8	Other incinerators will be assessed on a case by case basis and you are required to justify why lower water consumption techniques cannot be used (in order to minimise water consumption). The nature of the waste feed in terms of its composition and heterogeneity, the need to ensure emissions to air are controlled within emission limit values and the quantities of waste produced from the gas treatment are all factors that may justify the use of greater quantities of water. Closed loop effluent recycle systems may meet all of these criteria providing there is sufficient space and wet plumes are not an issue. Other prevention options such as waste pre-treatment (to improve homogeneity) or feed management (to remove or dilute high pollutant load items) should also be considered as these may reduce the need for water scrubbing systems.	N/A – the EfW CHP Facility is a municipal waste incinerator.

9	Other techniques include:
	• In wet systems, the provision of multi-stage scrubbers in series:
	  ○ with the effluents from the clean scrubbers used as feed for the dirty scrubber/ quench
	  ○ clean water feeds to final polishing/clean end scrubbers
	  ○ dirty water bleeds only or primarily from dirty end scrubbing/quench stages
	  ○ consider the possibility of scrubber liquor treatment and re-circulation
	• In semi-dry systems, the quantity of water should be measured and minimised, but without compromising the ability of the abatement plant to treat stack gases effectively and meet emission limit values. The use of BAT requires you to demonstrate that you do
		Many of these requirements are not applicable as the EfW CHP Facility will use a dry scrubbing system.
		Water consumption used for cleaning and washdown will be minimised by using trigger controls on all hoses and other washing equipment. Wash water will be directed for re-use in the bottom ash quench.
		Fresh water will primarily be used in the demineralisation plant for making up evaporative losses.
		Fresh water consumption and specific points of use will be monitored and recorded on a daily basis. Water efficiency audits will be carried out routinely as part of the IMS.
		Cooling waters in the steam/condensate system will be separated from process waters and surface drainage and recycled to the boiler feedwater/steam circuit after re-cooling.

No	Indicative BAT requirement	Comparison with proposed design

	not use too much water but you should not make reductions that could result in reagent handling (pumping) difficulties, or poor reagent reaction conditions (e.g. moisture, temperature or contact time).
	• You can minimise both water and reagent use by using fast response monitors and feedback controls to link dose rates to up-stream HCl concentrations. You may also be able to reduce water consumption through the alteration of alkaline reagent concentration (rather than volumetric pumping rate changes). This will require very small mixing tanks in order to effect a sufficiently fast concentration change. Computer software will be required to automatically manage such systems.
	• Water used in cleaning and washing down should be minimised by:
	  ○ evaluating the scope for reusing washwater; and
	  ○ trigger controls on all hoses, hand lances and washing equipment.
	• Fresh water should only be used for:
	  ○ dilution of chemicals (e.g. for gas scrubbing media);
	  ○ vacuum pump sealing (note, below, that this can be much reduced or even eliminated); and
	  ○ to make up for evaporative losses or for demineralisation plants
	• Fresh water consumption should be directly measured and recorded regularly, typically on a daily basis
	• Specific points of fresh water use, circuit overflows and recycled water quality should be monitored, particularly the discharge to the effluent treatment plant (ETP)
	• Water-sealed vacuum pumps may account for considerable water use and arrangements should be reviewed by considering improvements such as:	

No	Indicative BAT requirement	Comparison with proposed design
	○ cascading seal water through high to low pressure pumps; ○ by using modern designs with improved internal recirculation of water within the pump casing (up to 50% reduction); ○ filtering and cooling seal water with a heat exchanger prior to re-use in the pumps (90% reduction potential), or ○ filtering and cooling seal water with a cooling tower prior to re-use in the pumps (95% reduction potential), or ○ filtering and cooling seal water with injected fresh water prior to re-use in the pumps (65% reduction potential); ○ recycling the hot seal water. • Any other cooling waters should be separated from contaminated process waters and reused wherever practicable, possibly after some form of treatment, e.g. re-cooling and screening.	
10	Consideration should be given to multiple uses of water to minimise consumption. This includes the re-use of scrubber effluents as a quench media (in HWIs) and the treatment of scrubber liquors for re-use.	Due to the dry scrubbing system, no scrubber effluents will be generated within the EfW CHP Facility. Other process effluents will be used in the IBA quench.
11	Site drainage or roof water may be suitable for a wide variety of uses after even rudimentary treatment. Such uses range from on-site feed to toilet facilities, wash down water, quench or scrubber feed. You should demonstrate that such uses have been considered and justify the techniques selected and rejected.	The potential for re-using surface run-off will be investigated as part of the detailed design process.
12	In some cases effluent treatment produces good quality water which may be usable in the process directly or in a mixture with fresh water. When treated effluent quality can vary it can be recycled selectively, being used when the quality is adequate and discharged when the quality falls below that which the system can tolerate. You should confirm where you will use treated water from the ETP or justify why you do not.	Effluents that cannot be re-used in the process, for example blowdown during shutdowns or regeneration of the ion exchange unit in the water treatment plant, will be periodically sent to a neutralisation tank with testing facilities prior to being discharged to foul sewer under a Trade Effluent Consent with Anglian Water. 'Clean' water such as boiler blowdown from normal operation and backwash water from the water treatment plant will be returned to the ash quench system.

3.5 Avoidance, recovery and disposal of wastes

The primary wastes generated within the EfW CHP Facility will be bottom ash and APCr. Generation of ash will be minimised by a combination of:

- The use of an advanced moving grate which offers long ash residence times to ensure complete burn-out of bottom ash; and
- Optimum dosing of solid reagents to control flue gas emissions with the dosing rate determined by reference to the monitored concentrations of key pollutants.

Table 3-13 provides the estimated quantities of waste types generated by the EfW CHP Facility and their disposal/recovery route.

Table 3-13 Waste generation, storage and disposal/recovery routes

Waste type	Estimated quantity (t/y)	Storage location and capacity	Disposal/recovery route
Bottom ash	~165,000 (26.5% of input waste – assumes 625,600t/y waste throughput).	IBA storage bunker (2,800m^3 capacity, equivalent to minimum seven days storage). The IBA bunker will be constructed from impervious material with a collection sump so that surplus quench water can be returned to the quench bath.	Sent off-site to a suitably licenced facility for recycling where possible.
Air pollution control residues	~31,000 (equivalent to 5% of waste throughput).	Initially stored in an intermediate silo where portions will be returned to the reactor to optimise the utilisation of lime. The balance will be conveyed to one of four closed APCr silos with a combined capacity of 720m^3 (equivalent to minimum storage capacity of seven days).	Sent off-site to a suitably licenced facility for disposal or re-used for neutralisation on-site subject to further evaluation during detailed design.
Lubricating oils	Likely less than 5t/y total.	Drums.	Sent off-site to a suitably licenced facility for recycling.
General waste (e.g., paper, lighting etc.)	Likely less than 1t/y total.	Bins, boxes.	Sent off-site to a suitably licenced facility for recycling where possible or disposal.

3.5.1 Bottom ash handling

IBA, including metals accounting for ~3.5% by weight of the IBA, would be discharged from the end of the furnace grate into an ash quench bath located beneath the grate. From the bath, the ash will be moved by an inclined extraction conveyer (allowing water to drain from the ash back into the quench bath for re-use) and transferred to the IBA storage bunker.

The IBA storage bunker will have a minimum storage capacity of seven days (~2,800m^3) and will have a drainage system such that surplus quench water will run into a collection sump and can be returned to the quench bath. The storage bunker will be constructed from impervious material to the principles within DAfStb *Guideline Concrete Construction when handling water-endangering substances* and designed to achieve a minimum tightness class 2 in accordance with the requirements of BS EN 1992-3 *Eurocode 2: Design of concrete structures – Part 3*.

Within an enclosed building, the IBA would be loaded by means of a semi-automatic travelling overhead grab crane into an enclosed or sheeted heavy goods vehicle. The building will be vented with warm air ducted from the boiler house roof to minimise fogging, with extracted air from the building fed into the combustion chamber as secondary combustion air.

Boiler ash is generated from particulate matter in the flue gases depositing onto the surface of the boiler which are removed during online cleaning. The particulates are lighter components of the bottom ash carried over from the furnace. Boiler ash removed during online cleaning of the second and third boiler paths will be routed to the IBA quench bath using a mechanical screw conveying system and enclosed ash shuts and collected with the IBA. Boiler ash from the economiser path will be collected separately and routed to the APCr storage silos using enclosed mechanical conveyers.

The IBA would be transported off-site to a suitably licenced facility for recycling where possible, where metals contained within the IBA will be extracted and the remainder reclaimed for use as secondary aggregate.

3.5.2 Air pollution control residues handling

Residues from the fabric filters containing fly ash, reaction products from the dry scrubbing acid gas neutralisation, and organic compounds adsorbed to the activated carbon, will be removed from the filter hoppers to an intermediate storage silo using enclosed conveyers. Portions of the residues will be returned to the dry scrubbing reactor to improve the utilisation of hydrated lime, with the balance conveyed to one of four closed APCr storage silos. The combined capacity of the storage silos will be approximately 720m^3, equivalent to a seven day storage capacity.

The storage silos will be insulated with the lower cone electrically heated to prevent agglomeration of the residue and a free flow during loading. Residues from the silos will be loaded pneumatically onto a sealed bulk powder carrier for disposal in a suitably licenced off-site facility.

APCr is handled in a fully enclosed system with fabric filters on the silos and residues discharging via sealed connections into fully enclosed disposal vehicles to prevent the release of dust from handling and transfer of the residues.

The silos will contain level measurement with high and low level alarms notifying operators when a silo is reaching its storage capacity. Measuring systems will also be in place for loading of residues onto the bulk powder carriers.

Due to the high pH of the residues, APCr is typically classed as hazardous which restricts opportunities for re-use. However, MVV will continually review new opportunities for re-use/recovery of the APCr (and all other wastes generated by the EfW CHP Facility) and will give further consideration for potential re-use on-site for neutralisation as part of the detailed design process.

Table 3-14 reviews the proposed operation of the EfW CHP Facility against the indicative BAT requirements in EPR 5.01 for the avoidance, recovery and disposal of wastes.

Table 3-14 Comparison of proposed design against sector specific indicative BAT requirements for the avoidance, recovery and disposal of wastes

No	Indicative BAT requirement	Comparison with proposed design
Bottom ash handling		
1	Where ash is handled dry, you must ensure that dust does not become airborne. This may be done by the quality of the containment and/or by dust suppression sprays. Dust suppression sprays should be limited to ensure they moisten and agglomerate the surface of the ash without leading to run-off or a leachate problem, and they should use recovered water where available.	N/A – bottom ash will be handled wet.
2	Where handled wet, the ash should be held at an intermediate point to ensure that it is fully drained before it is transferred to skips or otherwise leaves the site, so that water will not drain off the ash either during transport or at final disposal. All water drained should be returned to the quench tank. Where installations have an ash hopper, the water should be pumped back. (This is less important where the ash is harmless enough to allow disposal on to the surface of land).	Bottom ash will be discharged from the grate to an ash quench tank. Once cooled, the ash will be transferred via an inclined conveyor system allowing water to drain from the ash back into the quench bath for re-use. The bottom ash will be stored in the IBA bunker prior to loading for off-site recycling. The IBA bunker will have a drainage system such that surplus quench water will run into a collection sump and can be returned to the quench bath.
3	All ash transport containers should be covered.	All conveyers and vehicles transporting ash off-site will be covered.
4	Adequate cleaning equipment, such as a vacuum cleaner, should be provided and maintained, to clean up promptly any spilled ash. With clinical waste ash in particular any such vacuum cleaner should be fitted with an absolute filter. The dry sweeping of spillages is not acceptable.	Cleaning equipment will be provided and specific procedures in the IMS will ensure any spilled ash will be promptly cleaned up.

No	Indicative BAT requirement	Comparison with proposed design
Fly ash and APC residue		
5	These two wastes are commonly combined within the process and produced as a single stream. Segregation of these streams may allow the individual streams to be reused or recycled. Both present potential hazards that may be minimised through careful storage, handling and transportation, whether alone or in combination.	Only fly ash from the economiser will be combined with APCr. Boiler ash collected from the second and third boiler ash will be collected and combined with the bottom ash for off-site recycling.
6	Fly ash should be stored and transported in a manner that prevents fugitive dust releases. During silo and container filling, displaced air should be ducted to suitable dust arrestment equipment. Apart from the minor use of dust suppression sprays (using recovered water where available), dry materials should be kept dry to avoid the formation of leachates. Dry residues for disposal should be handled in sealed containers such as tankers for large quantities, or IBCs or “big-bags” (1 m^3) for smaller installations.	Fly ash and APCr is handled in a fully enclosed system with fabric filters on the silos and residues discharging via sealed connections into fully enclosed disposal vehicles to prevent the release of dust from handling and transfer of the dry residues.
7	Ash recovered from the boiler (“boiler ash”) will, depending on the design, have properties similar to either the bottom ash or fly ash. In most installations, a BAT judgement (taking into account ash properties and the layout of the installation) will be made as to whether the boiler ash should be combined with the bottom ash or fly ash.	Influenced by the layout of the installation, boiler ash from the second and third boiler pass will be mixed with the bottom ash, whilst ash from the economiser will be mixed with the residues from the fabric filters.
Rejected feedstock		
8	You should minimise the delivery of waste that cannot be processed at the facility (unless you have an appropriate license to permit the transfer of the waste). This will include up-stream waste management, provision of information regarding the types of waste acceptable and in some cases audit of waste suppliers’ procedures.	Waste pre-acceptance acceptance measures described in Section 4 will minimise the risk of unsuitable wastes being accepted at the EfW CHP Facility.

No	Indicative BAT requirement	Comparison with proposed design
9	Despite these efforts some unsuitable wastes will still be included and delivered to the installation. Techniques should therefore be adopted for the inspection of the waste. These techniques should reflect • the nature of the waste (including any potential additional hazards that might arise from waste inspection that may limit or prevent inspection) • the history of the particular installation in respect of loads and sources of loads which may require special attention • the ability of the installation to treat the waste and its operational design envelope (including any pre-treatment/waste mixing carried out)	It will not be possible to visually inspect every waste consignment entering the Tipping Hall. However, waste will be observed as it is tipped and additionally the crane/control room operator as it is mixed in the bunker. Non-conforming wastes will be removed from the bunker and isolated in a quarantine area for further inspection, prior to transfer off-site to a suitably licenced facility.
10	Provision should be made for the safe storage of rejected loads in a designated area with contained drainage, preferably under cover. Procedures should be in place for dealing with such loads to ensure that they are safely stored and despatched for onward disposal. Storage times should be minimised.	Provision will be made for enclosed/covered storage for rejected materials, which will be transferred off-site to a suitably licenced treatment facility. Procedures for the management of rejected wastes will be developed in the IMS.
11	Examples of loads which have caused difficulties at some plants have included: • large quantities of PVC window frames (high HCl loading) • large quantities of plaster board (high sulphur loading) • large quantities of excessively wet waste (high moisture, low CV) • large quantities of iodine or mercury (particularly at HWIs) • some wastes containing wire which may jam loading systems or grates e.g. whole tyres, sprung mattresses or sofas. • large wastes that are not suited to incineration engine blocks	The EfW CHP Facility will only process residual household, commercial and industrial waste as agreed in pre-acceptance contract documentation. Some limited variation in feedstock is expected, but the bunker management procedures involving shredding and mixing of the waste, combined with the furnace design and emissions control system, is designed to be capable of treating the expected variation in waste composition without complication.
Recovered waste fractions		
12	Provision should be made for the storage of all recovered fractions. The storage provided should take account of the general guidance given in this section.	Provision has been made in the design for storage of all recovered fractions taking into account relevant guidance.

No	Indicative BAT requirement	Comparison with proposed design
13	Because ash will often be the major waste produced, you should consider potential uses e.g. • opportunities for bottom ash recycling e.g. bottom ash use as aggregate • opportunities for fly ash re-use e.g. as a neutralising agent (great care must be taken to avoid remobilisation of pollutants)	Where possible, and subject to non-hazardous classification, bottom ash will be transferred off-site where metals will be extracted from the ash for recycling and the remainder used as a secondary aggregate. Opportunities to re-use some of the APCr as a neutralising agent will be considered during detailed design.
14	You must regularly audit your waste disposal/recovery routes to ensure your waste is being properly dealt with.	Regular waste audits will be undertaken under procedures established in the IMS.
15	Where disposal occurs, you should justify why recovery is technically or economically not feasible.	The only waste which is expected to be disposed of in volume is the APCr which, due to its hazardous nature (high pH) restricts opportunities for recovery.
16	Where waste must be disposed of, you should provide a detailed assessment identifying the best environmental options for waste disposal - unless we agree that this is unnecessary. For existing disposal activities, this assessment may be carried out as an improvement condition to a timescale to be approved by us.	Only APCr and small quantities of general waste not suitable for recycling will be disposed of. MVV will continually review new opportunities for re-use/recovery of these waste streams when they become available.

3.6 Permit surrender and closure

This section describes the measures that will be taken by the Operator to ensure that the site is eventually closed in an environmentally satisfactory manner and to safeguard against the deterioration of the environment during the operations undertaken whilst permitted.

The proposed EfW CHP Facility has an operational lifetime of approximately 40 years. Whilst the unavoidable presence of raw materials and residues does present some risk, however slight, of an impact to the soil or groundwater beneath the site, the design and operational intent is to avoid such impacts occurring. The environmental risks presented by the operational activities are covered in detail in Section 3.2.2.

Guidance requires that the following areas are addressed:

- Steps to be taken at the design and build stage;
- Operations during the permit lifetime; and
- Development of a site closure plan.

3.6.1 Design and build

To assist with site closure, the design and planning activities for the EfW CHP Facility will consider the following requirements:

- Avoiding underground tanks, pipe-work and below ground process activities where possible. If these cannot be avoided, they will be constructed in such a way to minimise the risk of containment failure and integrity inspections will be included as part of the operational procedures in the IMS;
- By necessity due to spatial constraints, the building design may incorporate a number of below ground areas such as the waste bunker. This will be constructed from heavily reinforced concrete materials to appropriate design standards;
- During commissioning, all structures will be tested to ensure they are impervious to water ingress. Any solid or liquid loss from any process systems will be contained within primary bunding/containment;
- The process will use a number of vessels, tanks, bunkers, silos, etc. for either storage or process operations. Where appropriate, these will be designed for easy cleaning and dismantling, with ready and safe containment of both the process residues and the vessel components. Routine cleaning of some of these vessels will take place whilst, for others, this would be planned as a one-off operation at site closure, or where components need replacing through premature failure. If any liquid requires disposal prior to maintenance or inspection, such as boiler water, the liquid will either be discharged to the foul drainage system and to sewer, or retained on site until it can be disposed of via a suitable waste contractor;
- Tanks or other vessels storing liquid substances that are potentially hazardous to the environment will be located on impermeable hardstanding and with appropriate containment designed in accordance with the requirements of CIRIA C736 *Containment systems for the prevention of pollution*;
- Wherever possible, process systems will be insulated in a manner that will allow easy repair and replacement of the insulation, a process that, in itself, is environmentally beneficial as this maintains low energy losses. The design will also use materials that can be cleanly separated from the system at decommissioning to encourage recycling of the materials and metal substrates; and
- Although the design and construction of the plant is primarily driven by factors such as safety, legal design codes, and commercial costs, many of the plant systems and buildings are likely to contain construction materials that are inherently recyclable. Established markets exist for steel piping, valves and other fittings, certainly where they can be put to use in less demanding future uses, low pressure regimes, etc. Structural steel which has been well maintained and not subject to corrosion can be readily re-cycled, as can wall and roof sheeting, through merchants specialising in the recovery and resale of these items. The design of EfW CHP Facility will aim to be as sustainable as possible, and potential for recycling material at the end of the facilities design life will be included during the design process.

3.6.2 Operations during the permit lifetime

The baseline condition of the site is detailed in the Site Condition Report (SCR) provided in Appendix A5 of this report. This provides data on the baseline soil and groundwater conditions prior to development of the EfW CHP Facility. Further deterioration throughout the operational life of the EfW CHP Facility is considered unlikely due to the mitigation measures included in the design specification and management procedures that will be in place as identified in Section 3.2.2.

Nonetheless, should any accident, incident or pollution event take place, this will be recorded in the Operational SCR and monitoring of soil and groundwater will be performed to understand the extent of any contamination. Where relevant, remedial action may take place. These data will be supported by regular periodic monitoring of groundwater and soils as required by the environmental permit.

3.6.3 Site Closure Plan

The Operator recognise that there is a need to ensure that the design, operation and maintenance procedures support the decommissioning of the installation at the end of its operational life in a safe manner without risk of pollution, contamination or excessive disturbance. The Operator will develop a Site Closure Plan that will be subject to continuous update as and when material changes occur to the installation. The Site Closure Plan will include, but will not be limited to, the following basic elements:

- Procedures and plans for the flushing of the process and safe removal of all fluids, chemicals and other hazardous materials from the site;
- A site plan of drains that will be left in place and any underground infrastructure to be avoided;
- Methods of dismantling machinery, insulation, materials handling equipment, fabric filters etc., without significant leakage, spillage or release of dust or other hazardous materials;
- Methods for the demolition or re-use of buildings (if applicable; and
- Identification of the recyclable materials/components which can be recovered or recycled (e.g., metals).

In the course of the demolition activities, materials, plant, equipment, etc., would be recovered for recycling as far as is practicable, bearing in mind their service life and ability to be refurbished/reused, design standards, etc. The demolition will use practices applicable and accepted at the time and will be consistent with safety requirements for demolition.

3.7 Security

The site will operate 24 hours per day seven days a week.

The site will be enclosed by a security fence and the control room will be manned at all times. Access to the main plant control rooms will be restricted to authorised staff only. Appropriate security systems will be installed including CCTV and lighting.

A high definition (1080p) CCTV monitoring system would be provided to cover and record key areas including the weighbridge, queuing area, access routes, pedestrian routes, un-loading and loading areas. The system would also cover unauthorised access to the site and be operational 24 hours a day. Adequate capacity would be provided for storing the recorded material and information for 90 days.

4 Operations

4.1 Overview and process description

The proposed EfW CHP Facility will recover the energy contained within the residual waste fuel to generate electricity for export to the local distribution network and nearby industrial consumers, and to provide steam to nearby heat consumers, subject to completion of final design and contractual negotiations. It is expected that the proposed EfW CHP Facility will comprise the following main infrastructure:

- Waste tipping hall and a waste bunker building serving two waste process lines;
- Two process lines, each having a capacity of 312,800t/y of waste, incorporating furnace feed hoppers, advanced moving grate furnace, integrated boiler including economiser and superheater, air pollution control (APC) including storage of residues (IBA and APCr), continuous emissions monitoring systems (CEMS) and chimneys;
- A common steam turbine and generator set supplied with steam from the boilers on the individual process lines;
- Incinerator bottom ash quench bath and storage enclosure.
- “Heat off-take” equipment which will allow the possibility to supply heat to off-site end users;
- Air cooled condenser; and
- Plant electrical and control systems, control room, workshops, etc.

Each processing line will recover the energy content of the waste in a dedicated high pressure boiler producing steam that will be utilised in a single combined steam turbine generator. The electricity generated, which is not used on site to meet the parasitic load, will be exported to the local distribution network and via private wire to nearby industrial consumers.

Waste will be delivered to the EfW CHP Facility in enclosed RCVs or covered walking floor articulated lorries from pre-approved suppliers. On entering the EfW CHP Facility Site, documentation will be checked, the vehicles will be weighed and their gross weight and registration plate number stored on a database. After depositing the waste in the tipping hall, and before leaving the site, the vehicles will be reweighed and the net weight of the waste delivered calculated as the difference between the gross weight of the incoming vehicle and the empty weight of the same vehicle exiting the EfW CHP Facility site.

Vehicles entering the tipping hall will reverse up to one of several tipping bays to deposit their contents in the tipping bunker. From here, waste will be transferred to the main waste bunker by a crane. Air from within the tipping hall will be extracted via the waste bunker for use as primary combustion air within the furnace. This system will keep the inside of the building slightly below atmospheric pressure and will limit fugitive emissions of odorous air and dust generated by waste handling.

When neither line is operating, dependent on the final detailed design, air will either be extracted from the waste bunker and treated in a combined dust/carbon filter to remove dust and odour prior to being discharged to air from roof mounted ducts and/or an odour neutralisation system will be used.

Waste delivered into the tipping hall will be available for visual inspection so that, when required, unsuitable or unauthorised items can be removed. Any wastes removed would be stored in a skip within a dedicated quarantine area within the building. However, it is not practical to inspect each and every load. Waste pre-acceptance and receipt and acceptance procedures will minimise the likelihood of non-conforming waste being accepted.

Below the waste chute platform in the waste bunker, a slow rotating waste shredder will reduce the size of any bulky waste delivered to the EfW CHP Facility, if necessary. The purpose of the shredder is solely to reduce the size fraction of bulky waste making it easier to handle and reducing the likelihood of a blockage within the processing lines. Other than size, the shredding process will not alter any of the other properties of the waste e.g., it will not affect the CV. The shredder will be equipped with a conveyor and chute to discharge the shredded bulky waste back into the waste bunker.

Once the waste is transferred into the waste bunker, one of two overhead cranes fitted with a hydraulic grab will homogenise the waste prior to feeding it into the furnace by means of a pre-programmed mixing routine. The cranes will be able to operate in fully automatic, semi-automatic and manual modes.

In automatic mode, the cranes will be fully automated and, under pre-programmed routines, will be responsible for clearing of tipping bays, distribution of waste in the bunker for best use of bunker capacity, mixing of waste and feeding of waste to the feed hoppers of the furnace.

In manual mode the operator has the ability to inspect the waste to identify any unsuitable or non-conforming items that should not have been disposed of at the EfW CHP Facility and which, under normal circumstances, should not be fed into the furnace. This may include, for example, gas canisters. However, the EfW CHP Facility is designed to safely operate should such items be inadvertently fed into the furnace.

Two cranes will be provided in order to allow continuous operation even in the case of down time (for fault or maintenance) to one of the cranes. Each crane will be fitted with calibrated load cells to record the weight of waste transferred to the furnace.

The mixed waste will be fed into each of the feed hoppers. From here, the waste will be transferred by a hydraulic ram onto the advanced inclined reciprocating grate; the thickness and length of the waste on the grate will be such that an adequate feed will be provided to the thermal process. Air distribution and grate speed will be adjusted across the grate to ensure ideal combustion conditions and complete combustion of the waste.

The grate would have a drying and ignition zone, a combustion zone and a burn-out zone. Primary combustion air, drawn from the waste bunker and tipping hall, will be supplied from under the grate through small holes in the grate bars. Furnace temperatures will range from 850°C to 1,250°C. The walls of the furnace will be water cooled, refractory lined and Inconel clad.

During its movement along the grate, the waste will be combusted and, once the material reaches the end of the grate, it will be non-combustible ash. The ash (IBA) will fall from the grate into a water bath equipped with a mechanical ash discharge conveyor. This would quench the hot ash and act as an air seal to prevent uncontrolled ingress of air into the primary combustion zone. The bottom ash will then be conveyed to an IBA storage bunker before being transferred off-site for recycling in a suitably licenced facility.

Gases resulting from combustion of waste on the grate will pass into a high temperature secondary combustion zone lined with a combination of refractory materials and Inconel cladding. The secondary chamber will be equipped with secondary air injection distribution nozzles, configured to achieve good mixing of the secondary combustion air with combustion products from the primary combustion zone.

The high temperature secondary combustion zone is sized so that the products of combustion, after the last injection of secondary air, and under the most unfavourable conditions, are held at a temperature of at least 850°C for a minimum of two seconds. This is to ensure efficient destruction of organic compounds, including dioxins and furans and carbon monoxide. In the unlikely event that the temperature arising from the combustion of waste on its own is insufficient to meet this requirement (e.g., when burning very low CV waste), auxiliary burners fired on 0.1wt% sulphur gas oil (or similar alternative) will be used to maintain the minimum temperature and residence time requirements.

Urea will be injected into the secondary combustion zone to reduce oxides of nitrogen to molecular nitrogen and water vapour using selective non-catalytic reduction (SNCR). This reaction is optimised at temperatures between 850°C and 1,100°C. Consequently, as the reaction is sensitive to temperature, the urea injection nozzles will be installed at several levels within the secondary chamber to enable the injection of urea to be optimised and precisely adjusted to the temperature conditions within each zone.

The waste feed rate, supply of primary and secondary combustion air, grate speed and injection rate of urea will be controlled by an advanced combustion control system which continuously monitors parameters such as steam flow rate, flue gas oxygen and NO_x content, combustion temperature and waste depth on the grate, to optimise the combustion process and keep the rate of steam generation constant. This ensures that:

- The boiler and steam generator operate at their optimum efficiency; and
- Over firing of the boiler with the consequent increase in thermal stress and corrosion, as well as the risk of increased emissions, is avoided.

The amount of heat released during combustion of the waste will vary according to its CV. The automatic control system will respond to variations in CV by modifying the waste feed rate and grate speed to maintain a constant heat release and, hence, constant steam flow rate. In addition to conventional combustion control monitoring systems, infrared cameras will be provided to record and control the fire location and burnout on the grate.

On leaving the secondary combustion zone, the hot flue gases will pass into the integrated steam boiler. The geometry of the furnace and boiler is designed to minimise areas where excessive corrosion could occur. In certain areas of the combustion chamber and second boiler pass that cannot be protected by refractory lining, the metalwork would be protected by layers of Inconel applied under carefully controlled conditions to ensure full bonding between the parent metal and the alloy.

The boiler will, subject to final detailed design, be a combined water wall and water tube boiler with an economiser to control the outlet flue gas temperature and recover energy from the flue gas. The boiler will be equipped with a feed-water tank, feed-water pumps, systems for cleaning the heat transfer surfaces during operation and superheaters for generation of superheated high pressure steam at up to 46barg (design load condition is 45barg) and 380°C.

Steam will be generated by evaporation of water which circulates by natural buoyancy through the evaporator sections and the water tube walls of the combustion chamber. Steam from the evaporators is saturated, i.e., it is in equilibrium with the water, and will condense immediately if heat is removed. To minimise condensation of the steam within the steam turbine and maximise its efficiency, the saturated steam will be further heated in superheaters.

The combustion gases will cool rapidly as they pass over the superheaters. This maintains heat transfer efficiency, minimises erosion and minimises ash deposits on the tubes. An economiser will further reduce the flue gas temperature to the optimum temperature required by the air pollution control system and pre-heats the boiler feedwater to increase thermal efficiency. The rapid cooling of the flue gases in the boiler, coupled with minimal ash deposits, helps to minimise the reformation of dioxins and furans.

Superheated steam from both lines will be transferred by appropriately insulated pipework to a common steam turbine generator. The expansion of steam will deliver work (energy) in the form of shaft power which, in turn, would be used to drive an electrical generator (alternator).

The EfW CHP Facility will use a high efficiency single shaft condensing steam turbine, driving a water-cooled synchronous generator via a reduction gearbox. The turbine would be provided with oil systems for lubricating the turbine, reduction gearbox, generator main and subsidiary bearings, and a high pressure hydraulic system for the operation and servo control of the governing and emergency shut off valves. The oil systems would have main, secondary and emergency pumps, and filtration and cooling systems as required.

Once all usable work has been extracted from the steam, it will be condensed in an ACC. In the ACC, steam will very quickly condense, creating a vacuum to extract the maximum practical mechanical energy from the expansion in the steam turbine. Condensate from the ACC will be collected in a condensate tank before being directed to the boiler feedwater tank and returned to the boiler system by feedwater pumps in a closed loop system to minimise the consumption of boiler make-up water.

The design of the steam turbine system will allow for heat export to local heat consumers, in the form of medium pressure steam, subject to suitable commercial arrangements being established. Export of heat will, however, reduce the electrical export from the EfW CHP Facility.

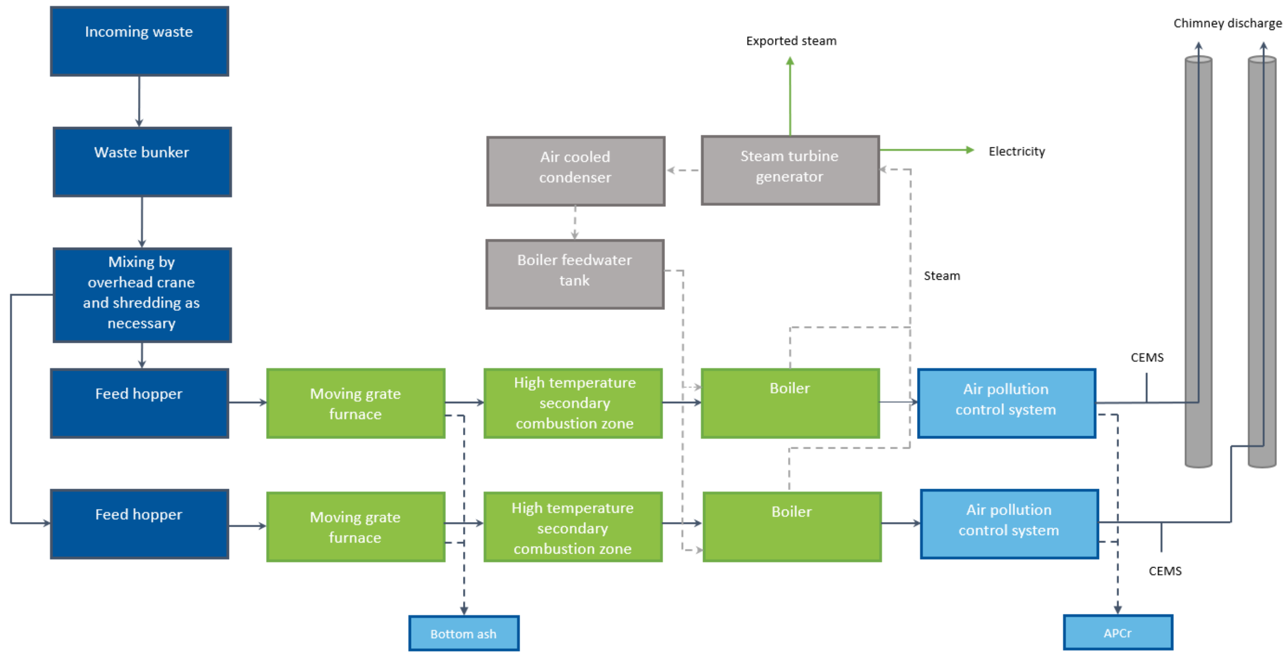
After passing through the steam boiler, the flue gas will enter an air pollution control system. This is expected to comprise of, subject to the final design, a hydrated lime and activated carbon injection system and reactor for control of acid gas, VOC, dioxin, furan and mercury emissions, and a fabric filtration plant for control of particulate matter emissions. APCr will be removed from the filter and stored in silos prior to transfer off-site to a suitably licenced waste disposal facility.

After treatment in the flue gas treatment plant, the cleaned flue gases will be discharged to atmosphere through individual chimneys, one per line.

The EfW CHP Facility will be equipped with a control and monitoring system that will provide automatic control of the process operating conditions and allow staff to monitor the different areas of the process. Of particular importance will be the monitoring and logging of process parameters, including emissions to air such as dust, CO, HCl, TOC, SO_2, NO_x, O_2, H_2O and CO_2. A comprehensive continuous emissions monitoring system (CEMS) will be installed with a data acquisition and handling system (DAHS) to allow reporting of emissions to the requirements of the permit. Each line will have dual/redundant CEMS, ensuring at least one CEMS is available at all times should one of the CEMS fail or require maintenance.

Figure 4-1 provides a simplified block flow diagram of the main processes taking place at the EfW CHP Facility.

Figure 4-1 Simplified block flow diagram



4.2 Incoming waste and raw material management

4.2.1 Waste pre-acceptance and acceptance

The EfW CHP Facility will only accept non-hazardous residual household and industrial and commercial (HIC) waste. Such waste will be loose residual material, including Refuse Derived Fuel (RDF), comprising material which is presently exported from the UK for final treatment, and those HIC waste streams that are currently managed at domestic landfill facilities and EfW facilities further away. Table 4-1 provides a complete list of the EWC codes that will be accepted by the EfW CHP Facility, with the majority (90-95%) being from the 19 and 20 codes.

Contracts will be held with the suppliers of waste to the EfW CHP Facility that will specify the type and properties of waste that can be sent to the EfW CHP Facility and other waste acceptance criteria. Documented procedures for pre-acceptance and acceptance will be established as part of the IMS prior to the commissioning of the EfW CHP Facility and provided for approval to the Environment Agency.

Pre-acceptance procedures will include regular audits of the companies that supply waste to the EfW CHP Facility to review their operations and ensure that waste being supplied to the EfW CHP Facility is in accordance with the waste description, specifications and other criteria established in the contracts.

Hazardous waste will not be combusted at the EfW CHP Facility and the pre-acceptance and acceptance measures will minimise the potential for such waste to be received.

Table 4-1 Waste types to be accepted at the EfW CHP Facility

EWC code		Description of waste (Maximum total throughput = 625,600 tonnes per year)
02		**WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION AND PROCESSING**
02 01		**Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing**
	02 01 02	Animal-tissue waste
	02 01 03	Plant-tissue waste
	02 01 04	Waste plastics (except packaging)
	02 01 06	Animal faeces, urine and manure (including spoiled straw), effluent, collected separately and treated offsite
	02 01 07	Wastes from forestry
	02 01 09	Agrochemical waste other than those mentioned in 02 01 08
02 02		**Wastes from the preparation and processing of meat, fish and other foods of animal origin**
	02 02 02	Animal-tissue waste
	02 02 03	Materials unsuitable for consumption or processing
02 03		**Waste from fruit, vegetable, cereals, edible oils, cocoa, coffee, tea and tobacco preparation and processing, conserve production, yeast and yeast extract production, molasses production and fermentation**
	02 03 04	Materials unsuitable for consumption or processing
02 05		**Waste from the dairy production industry**
	02 05 01	Materials unsuitable for consumption or processing
02 06		**Waste from the baking and confectionary industry**
	02 06 01	Materials unsuitable for consumption or processing
	02 06 02	Wastes from preserving agents
02 07		**Wastes from the production of alcoholic and non-alcoholic beverages (except coffee, tea and cocoa)**
	02 07 01	Wastes from washing, cleaning and mechanical reduction of raw materials
	02 07 02	Wastes from spirits distillation

EWC code		Description of waste (Maximum total throughput = 625,600 tonnes per year)
	02 07 04	Materials unsuitable for consumption or processing
03		**WASTES FROM WOOD PROCESSING AND THE PRODUCTION OF PANELS AND FURNITURE, PULP, PAPER AND CARDBOARD**
03 01		**Wastes from wood processing and the production of panels and furniture**
	03 01 01	Waste bark and cork
	03 01 05	Sawdust, shavings, cuttings, wood, particle board and veneer other than those mentioned in 03 01 04
03 03		**Wastes from pulp, paper and cardboard production and processing**
	03 03 01	Waste bark and wood
	03 03 07	Mechanically separated rejects from pulping of waste paper and cardboard
	03 03 08	Wastes from sorting of paper and cardboard destined for recycling
04		**WASTES FROM THE LEATHER, FUR AND TEXTILE INDUSTRIES**
04 01		**Wastes from the leather and fur industry**
	04 01 08	Waste tanned leather (blue sheetings, shavings, cuttings, buffing dust) containing chromium
	04 01 09	Wastes from dressing and finishing
04 02		**Wastes from the textile industry**
	04 02 09	Wastes from composite materials (impregnated textile, elastomer, plastomer)
	04 02 10	Organic matter from natural products (for example grease, wax)
	04 02 21	Wastes from unprocessed textile fibres
	04 02 22	Wastes from processed textile fibres
09		**WASTES FROM THE PHOTOGRAPHIC INDUSTRY**
09 01		**Wastes from the photographic industry**
	09 01 07	Photographic film and paper containing silver or silver compounds
	09 01 08	Photographic film and paper free of silver or silver compounds
15		**WASTE PACKAGING, ABSORBENTS, WIPING CLOTHS, FILER MATERIALS AND PROTECTIVE CLOTHING NOT OTHERWISE SPECIFIED**
15 01		**Packaging (including separately collected municipal packaging waste)**
	15 01 01	Paper and cardboard packaging

EWC code		Description of waste (Maximum total throughput = 625,600 tonnes per year)
	15 01 02	Plastic packaging
	15 01 03	Wooden packaging
	15 01 04	Metallic packaging
	15 01 05	Composite packaging
	15 01 06	Mixed packaging
	15 01 07	Glass packaging
	15 01 09	Textile packaging
15 02		**Absorbents, wiping cloths, filter materials and protective clothing**
	15 02 03	Absorbents, filter materials, wiping cloths and protective clothing other than those mentioned in 15 02 02
17		**CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATION SOIL FROM CONTAMINATED SITES)**
17 02		**Wood, glass and plastic**
	17 02 01	Wood
	17 02 03	Plastic
17 09		**Other construction and demolition wastes**
	17 09 04	Mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03
19		**WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTEWATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE**
19 02		**Wastes from the physicochemical treatments of waste (including dechromation, decyanidation and neutralisation)**
	19 02 03	Premixed wastes composed only of non-hazardous wastes
	19 02 10	Combustible wastes other than those mentioned in 19 02 08 and 19 02 09
19 04		**Vitrified waste and wastes from vitrification**
	19 04 01	Vitrified waste
19 05		**Wastes from aerobic treatment of solid wastes**
	19 05 01	Non-composted fraction of municipal and similar waste

EWC code		Description of waste (Maximum total throughput = 625,600 tonnes per year)
	19 05 02	Non-composted fraction of animal and vegetable waste
	19 05 03	Off-specification compost
19 06		**Wastes from anaerobic treatment of waste**
	19 06 04	Digestate from anaerobic treatment of municipal waste
	19 06 06	Digestate from anaerobic treatment of animal and vegetable waste
19 08		**Wastes from waste water treatment plants not otherwise specified**
	19 08 01	Screenings
19 10		**Wastes from shredding of metal-containing wastes**
	19 10 04	Fluff-light fraction and dust other than those mentioned in 19 10 03
19 12		**Wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified**
	19 12 01	Paper and cardboard
	19 12 02	Ferrous metal
	19 12 03	Non-ferrous metal
	19 12 04	Plastic and rubber
	19 12 07	Wood other than that mentioned in 19 12 06
	19 12 08	Textiles
	19 12 09	Minerals (for example sand, stones)
	19 12 10	Combustible waste (refuse derived fuel)
	19 12 12	Other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 19 12 11
20		**MUNICIPAL WASTE (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS**
20 01		**Separately collected fractions**
	20 01 01	Paper and cardboard
	20 01 08	Biodegradable food waste
	20 01 10	Clothes
	20 01 11	Textiles

EWC code		Description of waste (Maximum total throughput = 625,600 tonnes per year)
	20 01 25	Edible oil and fat
	20 01 38	Wood other than that mentioned in 20 01 37
	20 01 39	Plastics
	20 01 99	Other fractions not otherwise specified
20 02		**Garden and park wastes (including cemetery wastes)**
	20 02 01	Biodegradable waste
	20 02 03	Other non-biodegradable waste
20 03		**Other municipal wastes**
	20 03 01	Mixed municipal waste
	20 03 02	Waste from markets
	20 03 03	Street sweeping residues
	20 03 04	Street cleaning residues
	20 03 06	Waste from sewage cleaning
	20 03 07	Bulky waste
	20 03 99	Municipal wastes not otherwise specified

Table 4-1 includes two ‘unspecified’ waste codes, i.e., 20 01 99 and 20 03 99. These waste codes have been included in the application in the event of requests from local authorities to receive e.g., fly-tipped waste which may be more difficult to characterise. Wastes received under these codes would be subject to the same acceptance measures as other waste types, with waste rejected or transferred to an appropriately licensed waste management facility if it is found to contain material that is hazardous or otherwise not consistent with other defined waste codes in the permit. Under the waste acceptance procedure to be developed as part of the IMS, the Operator will maintain a register of all instances where these 99 codes are received.

4.2.2 Receiving, handling and storing waste

Waste will be delivered to the EfW CHP Facility from pre-approved suppliers using enclosed or covered RCVs and walking floor articulated lorries. Waste vehicles will enter the EfW CHP Facility from the southern area of the site and enter a vehicle queuing area to accommodate on-site vehicle queuing before reaching the gate house and weighbridge. Sufficient space will be provided in the vehicle queuing area to prevent vehicles queuing on the public highway.

From the queuing area, vehicles will be directed to the site entry weighbridge where the vehicle will be weighed using weighing cells. Automatic Number Plate Recognition (ANPR) cameras will be available to store these data on automated tracking system such that, when the same vehicle leaves the EfW CHP Facility via the site exit weighbridge, the difference in the weight of the vehicle can be used to automatically record the mass of waste deposited.

At the weighbridge, waste transfer paperwork will be checked to ensure that the delivered waste conforms to the contractual specifications and the waste types included in the permit. Visual checks will also be performed to ensure that the vehicle is providing adequate containment of the waste. At this point, should a delivery be suspected of containing non-conforming wastes, a visual check of the contents will be made within the enclosed tipping hall. If confirmed as non-conforming, the load will be rejected and returned to its place of origin. If it is deemed acceptable, it will be directed for unloading.

The entire tipping hall will be designed to be enclosed to minimise fugitive emissions of dust and odour, further aided by the maintenance of a slight negative pressure by means of the suction created by extracting building air for use as the combustion air requirement of the furnaces. When both furnace lines are not operational, the air above the waste bunker will be extracted via an odour control unit consisting of an appropriate treatment technology, for example activated carbon, for discharge at roof level, and/or odour neutralisation sprays will be deployed, subject to final detailed design.

Waste will initially be deposited in the tipping bunker before being transferred to the main waste bunker by one of two mechanical cranes. The waste will be stored and regularly mixed in the waste bunker by the cranes to improve the homogeneity of waste loaded into the furnace and obtain, as far as possible, a consistent CV of the waste. The main waste bunker has a capacity of ~46,000m^3 with an equivalent waste storage capacity of approximately 11.5 days.

Below the waste chute in the bunker, a slow rotating waste shredder will reduce the size of any bulky waste delivered to the EfW CHP Facility, if necessary. The purpose of the shredder is solely to reduce the size fraction of the bulky waste making it easier to handle and reduce the likelihood of blockages in the process. Other than size, the shredding process will not alter any of the other properties of the waste e.g., it will not affect the CV. The shredder will be equipped with a conveyor and chute to discharge the shredded waste back into the bunker.

It will not be practical to perform a visual check on every waste delivery vehicle prior to the unloading of waste. Consequently, the waste will be observed by an operative as it is tipped into the tipping bunker. Potential non-conforming waste can be removed from the bunker by the crane operator by changing the operating state of the cranes to manual mode to allow further inspection in a dedicated quarantine area within the enclosed building, prior to transfer off-site to an appropriately licensed waste disposal or recovery facility.

To maximise the capacity of the EfW CHP Facility for internal waste storage whilst maintaining full capacity for receiving waste, the floor and foundations of the tipping and main waste bunker will be below the finished floor level. The bunkers will be a watertight concrete construction designed to the requirements of DAfStb *Guideline Concrete Construction when handling water-endangering substances* and designed to achieve a minimum tightness class 2 in accordance with the requirements of BS EN 1992-3 *Eurocode 2: Design of concrete structures – Part 3*. The bunkers will be fitted with appropriate fire detection and suppression systems.

The two waste cranes have the potential for simultaneous operation and can operate in a fully automatic, semi-automatic or manual mode. In the automatic mode, clearing of tipping bays, distribution of waste in the bunker to optimise bunker capacity, and mixing and feeding of the waste to the furnace chutes and hoppers is performed.

The cranes are equipped with calibrated weighing equipment, allowing automated recording and registration of the charged waste. The weight data is sent via an interface to the central distributed control system and also saved independently of this system. In return, data on the waste level in the feed chute is transmitted to the crane control system.

Waste will be mixed and moved by means of a large grab mounted on the travelling cranes. Bunker management procedures will be developed to ensure mixing of the different incoming waste sources to improve the homogeneity of the feed to the furnace and prevent the development of anaerobic conditions. These management procedures will include mixing and turning of incoming wastes using trenching and stacking by the waste bunker crane to blend the incoming waste.

During a short planned or unplanned plant shutdown, waste will continue to be unloaded into the bunker. Once the bunker is at its capacity, waste will no longer be accepted by the EfW CHP Facility and an alternative recovery/disposal route will be arranged. For a planned shutdown, the waste levels will be reduced in the waste bunker prior to the shutdown to allow a longer period before the bunker is at its capacity.

When only one line is shutdown, extraction of air above the waste bunker for use as primary air in the one remaining operational furnace will be sufficient to maintain negative pressure within the building. When both lines are required to be shutdown, for example to allow maintenance on the common STG or electrical systems, air above the waste bunker will be extracted through carbon filters and/or an odour neutralisation system will be used, dependent on the final detailed design. The operational plan for the EfW CHP Facility will aim to reduce the frequency of maintenance events occurring on both lines simultaneously.

Table 4-2 reviews the proposed operation of the EfW CHP Facility against the indicative BAT requirements in EPR 5.01 for incoming waste and raw material management.

Table 4-2 Comparison of proposed design against sector specific indicative BAT requirements for incoming waste and raw material management

No	Indicative BAT requirement	Comparison with proposed design
All installations		
1	Pre-treat waste to the degree necessary to reduce variations in feed composition and to control emissions within ELVs and to prevent unnecessary waste production.	The EfW CHP Facility will be designed to treat residual household and industrial and commercial waste. Whilst such wastes exhibit a higher degree of heterogeneity then other waste types, bunker management procedures will be in place that ensure waste deposited within the waste bunker is appropriately mixed such that a homogeneous feed is charged. The EfW CHP Facility is designed to accommodate the expected range of waste composition and CVs without exceeding the Emission Limit Values (ELVs) or generating excess residues.
2	Maintain a high standard of housekeeping in all areas and provide and maintain suitable equipment to clean up spilled materials.	The EfW CHP Facility will operate with trained staff and procedures in the IMS will require a high level of housekeeping for the site. Appropriate spill kits and training will be provided to site operators so that any spillages can be cleaned up as soon as they are identified.
3	You should only load and unload vehicles in designated areas provided with proper hard standing. Such areas should have appropriate falls to an adequate drainage system.	Loading and unloading of vehicles will only take place in areas with appropriate hard standing connected to an appropriate drainage system.
4	Store uncontained or potentially odorous waste inside buildings with suitable odour control e.g. negative pressure created by feeding combustion air, automatic or restricted size doorways.	All odorous material will be stored in areas that are enclosed within buildings accessed using fast acting doors. Air from within these areas will be extracted to be used as combustion air within the furnace lines or via a dedicated odour management system and/or treated by an odour neutralisation spray system when both lines are inoperative.
5	Provide firefighting in accordance with the requirements of Local Fire Officers, especially for MWI reception bunkers, CWI storage and for chemical wastes.	Comprehensive fire detection and suppression systems, particularly around the waste bunker, will be installed using thermal/infra-red detection systems with water quench systems.
6	You should store fuels and treatment chemicals in tanks or silos, unless they are supplied in drums. If there is any risk of fugitive emission the tanks, silos should be provided with closed loop vapour systems and or scrubbers (for liquids), or fabric filters (for powders or material that may give rise to dust).	Fuels and reagents for the flue gas treatment system will be stored in tanks or silos as relevant to the phase in which the material is stored. Silos storing the activated carbon and hydrated lime will be equipped with filters to prevent/reduce emissions during loading/unloading operations.

No	Indicative BAT requirement	Comparison with proposed design
7	Provide roofing and drainage segregation to minimise contamination of rainwater. Provide storage capacity for contaminated rainwater to allow for sampling and testing prior to release (see also WID article 8(7)).	The rainwater collection system from building roofs, roads and hardstanding areas will discharge through an independent surface water drainage system incorporating oil interceptors and attenuation tanks. Sanitary and process effluents would be discharged to foul sewer. The steam/condensate cooling water system will also be independent to the surface drainage and foul sewer systems. In the event of a spillage, the attenuation tanks can be isolated allowing their contents to be tested discharge or, alternatively, pumped to a tanker for off-site disposal. In the event of a fire, penstock valves in the drainage system on final outfall to surface water would be closed, allowing contaminated firefighting water to be retained in the waste bunker or surface drainage system.
Municipal		
8	We will regard your techniques for the delivery and reception of waste as BAT if you comply with all legislative requirements. There are specific requirements in respect of checking statutory documentation and a general duty to "take all necessary precautions". Your procedures and management system must enable you to identify and manage the risks associated with the reception wastes.	The IMS will contain documented waste pre-acceptance and acceptance measures that will allow the EfW CHP Facility to comply with all legislative requirements.
9	Incoming municipal waste should be: • in covered vehicles or containers; and • unloaded into enclosed reception bunkers or sorting areas with odour control (see below).	All incoming waste will arrive in covered vehicles and will only be unloaded or inspected in the enclosed tipping hall.
10	Use design and handling procedures to avoid any dispersal of litter.	All waste handling will be carried out within the main tipping hall building that will minimise the generation and dispersal of litter.
11	Use techniques to maximise the homogeneity of waste fed into the incinerator.	Wastes within the bunker will be regularly mixed and blended with other waste in the bunker to maximise the homogeneity of the waste feed to the furnaces.

No	Indicative BAT requirement	Comparison with proposed design
12	Your inspection procedures must ensure that any wastes which would prevent the incinerator from operating in compliance with its permit are segregated and placed in a designated storage area pending removal.	At the weighbridge, waste transfer paperwork will be checked to ensure that the delivered waste conforms to the contractual specifications and the waste types included in the permit. Visual checks will also be performed to ensure that the vehicle is providing adequate containment of the waste. At this point, should a delivery be suspected of containing non-conforming wastes, a visual check of the contents will be made within the enclosed tipping hall. If confirmed as non-conforming, the load will be rejected and returned to its place of origin. If it is deemed acceptable, it will be directed for unloading. Procedures and infrastructure (e.g., CCTV) will be in place to allow visual inspection of the waste if required. However, it will not be practical to visually inspect each and every load. Any potentially non-conforming wastes can be removed by manual intervention of the crane operator and stored in a quarantine area pending removal from site.
13	Waste may then be transferred to the feed chute e.g. by a grab crane.	Waste will be fed to the feed chute via grab cranes.
14	Where the waste is not pre-treated or sorted, use smaller grab sizes on a more frequent basis to allow for greater waste inspection	Bunker management procedures developed in the IMS will maximise the homogeneity of waste fed to the furnace.
15	Operate low volume water fog sprays above the storage bunkers if you need to control dust emission. Minimise liquid run-off and wash down from the storage and handling areas and use them in the process, such as in the ash quench, wherever possible.	This will be considered as part of the final detailed design.
16	To minimise odour: • Provide self-closing doors for any potentially odorous indoor areas; • Ventilate bunkers and use the extracted air as a source of furnace combustion air; • During shutdown, particularly where there is only one furnace, doors will limit odour spread while still allowing vehicle access. Air should be extracted via a separate system; • Treat extracted air which is not incinerated if odours cause local complaints;	Measures incorporated into the design and operation of the Facility include: • Doors to the tipping hall will be equipped with a fast acting door to minimise emissions of both dust and odour. • Air above the bunkers will be used as primary combustion air. • During shutdowns where both lines are inoperative, air above the bunkers will be extracted through carbon filters, and/or an odour neutralisation spray system will be used dependent on the final design. • Bunker management procedures will be established as part of the IMS to prevent the development of anaerobic conditions.

No	Indicative BAT requirement	Comparison with proposed design
	• Where there is a recycling facility before the incinerator, you should give careful attention to building sealing arrangements at the design stage, so that the volume of odorous air needing extraction will not exceed the furnace requirements; • Employ bunker management procedures (mixing and periodic emptying and cleaning) to avoid the development of anaerobic conditions; • Remove wastes on a first in, first out basis so as not to exceed a specified maximum storage time (e.g. 4 days or less if problems arise); • Divert waste away from the site during shut downs if odour management is not effective; • Generally, multiple stream plants are preferred to large single stream plant to provide continuity of odour control and waste movement; and • The quality of incoming waste being stored should be limited to the permitted limit, and must be confined to the designated areas.	• Only permitted wastes will be accepted at the EfW CHP Facility. Should any non-conforming waste be identified, this will be removed to a dedicated quarantine area within the tipping hall and removed from site to an appropriately licensed waste treatment facility at the earliest practicable opportunity.
Pre-treatment		
17	Remove large bulky items. The extraction of recyclable material and shredding of the remaining waste might be justified although this may be carried out prior to delivery to the installation. Such pre-treatment can help ensure a more consistent feed to the furnace aiding good process control and preventing emissions.	Any bulky items identified during acceptance, or subsequently identified in the bunker, will be removed and loaded into a slow rotating waste shredder below the waste chute level in the bunker.
18	N/A – the EfW CHP Facility does not incorporate fluidised bed combustion	

No	Indicative BAT requirement	Comparison with proposed design
19	Decisions regarding the need for and extent of waste treatment at municipal waste incinerators should take account of the wider waste strategy adopted in the locality as this will influence the composition of the waste delivered. For example, where removal of recyclable materials is being carried out within the waste catchment area (as demonstrated by recycling performance or facility provision) incineration without further front end MRF or shredding may be justifiable as BAT for the remaining waste, provided statutory emission limit values can be secured and the additional environmental gains are outweighed by the costs.	These factors have been considered in the development of the outline design of the EfW CHP Facility and will be further considered at detailed design. The EfW CHP Facility will include a shredder to reduce the size of bulky wastes, as necessary, prior to being charged in the furnace.
Chemical		
20 - 36	Not relevant as the EfW CHP Facility will not accept chemical waste.	
Animal		
37 - 44	Not relevant as the EfW CHP Facility will not accept animal waste.	
Other animal waste incineration (including MBM)		
45 - 52	Not relevant as the EfW CHP Facility will not accept animal waste.	
Sewage sludge		
53 - 58	Not relevant as the EfW CHP Facility will not accept sewage sludge.	
Drum incineration		
59 – 66	Not relevant as the EfW CHP Facility will not accept drums.	
Pyrolysis and gasification		
67 – 69	Not relevant as the EfW CHP Facility is not a pyrolysis or gasification plant.	
Refuse derived fuel incineration		
70 – 72	Not relevant as, whilst the EfW CHP Facility will accept RDF, it is not a dedicated RDF installation.	
Co-incineration		
73 – 74	Not relevant as the EfW CHP Facility is not a co-incinerator.	

4.3 Waste charging

The EfW CHP Facility will be fully automated with proprietary digital control functions, implemented on well proven and modern process control system technology. The process control system will be computer based, and via a number of process visuals on the control screens within the control room, the operators will be able to manually interact with the plant and obtain all necessary information from the process. The automated control system will only allow waste to be fed onto the grates under stable operational conditions within set parameters. At no time will waste be fed into the furnaces if the secondary combustion chamber is below 850°C or if an ELV is being exceeded.

The grate feeding system consists of three main elements:

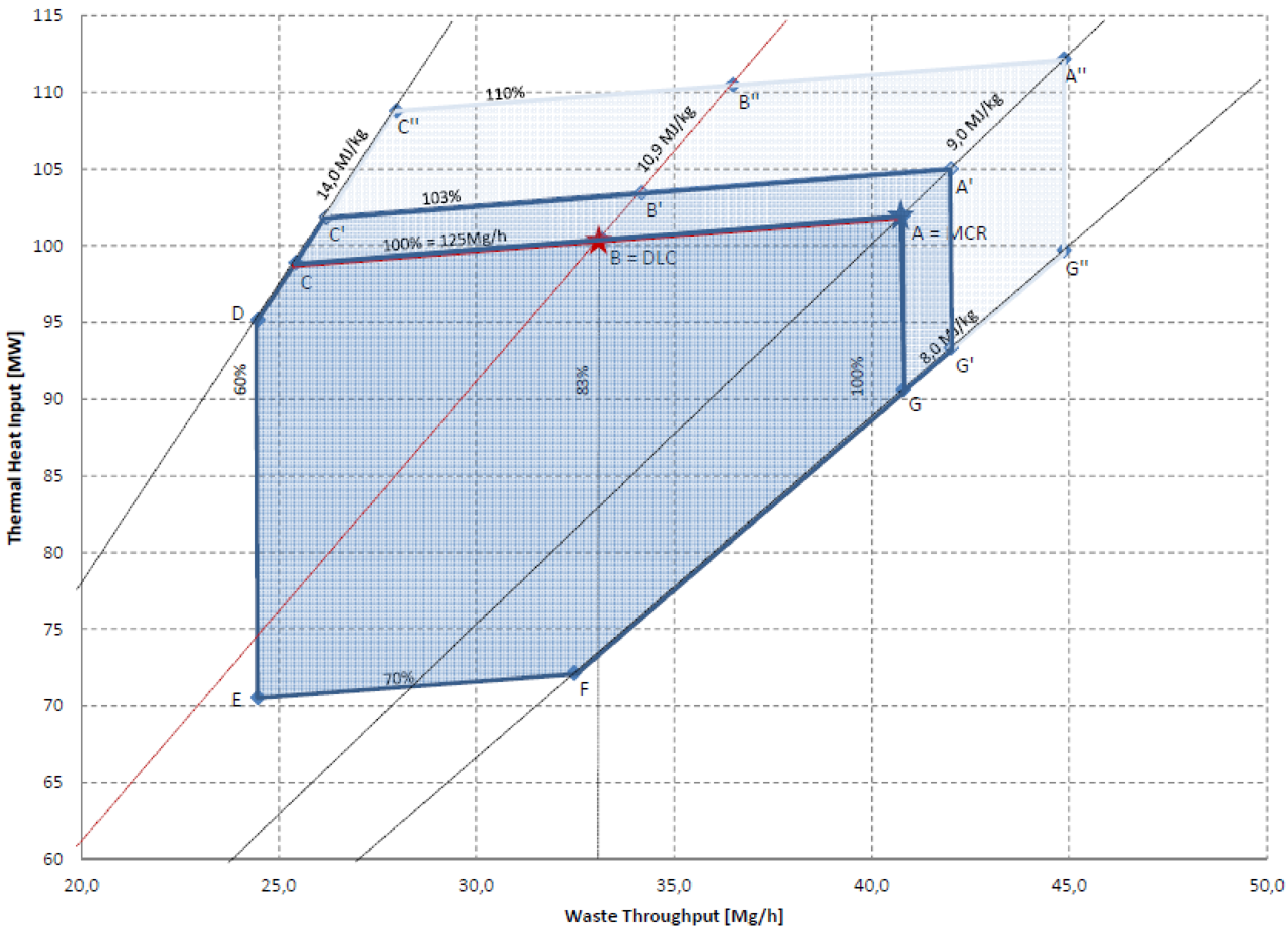
- Upper hopper component with safety waste chute flap;
- Fuel feeding hopper with level measurement; and
- Fuel feeding rams.

The overhead cranes will transfer waste from the bunker into a feed hopper. From the feed hopper, waste will be deposited onto the moving grate using a water-cooled feed chute. Level detection is provided in the feed chute and the overhead cranes will automatically transport fuel from the bunker to the fuel hopper as long as the level in the feed chute is within set-points. Low-level alarms will signal to the system that more waste material needs to be transferred from the bunker. The low-low-level with an alarm will trigger the closing of the waste chute flap.

The chute is designed such that the waste in the chute will form an air lock between the bunker and the furnace. The connection between the hopper and feed chute is designed to be as air-tight as possible to prevent backflow of combustion gases, or excess air flows into the combustion unit and boiler. Blockages in the chute will be avoided by a two-sided downwardly expanding shaft. The chute exit to the combustion chamber will be designed in such a way that hermetical sealing between the chute and combustion chamber by the waste is guaranteed.

The waste will be fed from the feed chute to the furnace by hydraulic ram feeders. The fuel feed rate will vary and will be automatically controlled by the process control system to maintain a set heat release rate on the grate to achieve stable operating conditions within the plant capacity firing diagram (Figure 4-2). The ram feeders can be controlled independently by the system, allowing fine control of the distribution of waste across the entire width of the grate.

Figure 4-2 Plant capacity firing diagram



Strong seals between the ram feeder and ram feeder enclosure will prevent fines being dragged back and backflow of combustion gases. The design of the ram feeder enclosure will prevent the formation of an explosive atmosphere under all operating conditions.

Firefighting systems will be installed above and within (depending on final design) the feed chute in case of back burning or high temperatures in the chute. The waste chute is equipped with a hydraulic closing safety flap with locking pins.

Table 4-3 reviews the proposed operation of the EfW CHP Facility against the indicative BAT requirements in EPR 5.01 for waste charging.

Table 4-3 Comparison of proposed design against sector specific indicative BAT requirements for waste charging

No	Indicative BAT requirement	Comparison with proposed design
Indicative BAT		
1	Incinerators and co-incinerators should use an automatic system to prevent waste feed: • At start-up, until the required temperature has been reached; • Whenever the required temperature is not maintained; and • Whenever the continuous monitors show that any emission limit value is exceeded due to disturbances or failures of the purification devices.	The EfW CHP Facility will use an automated control system to ensure that these conditions are met.
2	Waste charging must be interlocked with furnace conditions so that charging cannot take place when the temperature and air-flows are inadequate, when any flue gas cleaning bypasses are being exceeded for a period of time in excess of the limits set within WID	Waste charging will be interlocked with furnace conditions to ensure charging only takes place within set parameters.
3	Make the charging operation as airtight as possible and ensure that the fan control system is capable of responding to changes in furnace pressure during charging, to avoid escape of fumes or excess air flows.	The design of the overall system is to ensure that it is as airtight as practicable and under slight negative pressure.
4	In systems that use a waste filled charging chute or hopper to achieve an airtight seal, the mechanism that loads the chute should be interlocked to prevent loading under the conditions outlined by WID.	The automated waste charging system will be interlocked to ensure charging only takes place within set parameters.
Charging rates		
5	Charging rates outside the installation design capacity seriously undermine environmental performance. The capacity will vary according to the calorific value (CV) of the waste feed. The design should be declared in the application and a firing diagram included. At all installations close attention should be paid to the procedures that are in place to ensure that the designed charging rate is not exceeded. You should alter mass throughput rates in order to ensure optimum combustion conditions are achieved, whilst ensuring that waste residence	The waste feed rate, supply of primary and secondary combustion air, grate speed and injection rate of urea will be controlled by an advanced combustion control system which continuously monitors parameters such as steam flow rate, flue gas oxygen and NOx content, combustion temperature and waste depth on the grate, to optimise the combustion process and keep the rate of steam generation constant. The automatic control system will respond to variations in CV by modifying the waste feed rate and grate speed to maintain a constant heat release and, hence, constant steam flow rate, whilst ensuring sufficient waste residence time on the grate to meet

No	Indicative BAT requirement	Comparison with proposed design
	in the chamber is sufficient to secure ash burnout requirements.	the minimum burnout requirements. In addition to conventional combustion control monitoring systems, infrared cameras will be provided to record and control the fire location and burnout on the grate. The firing diagram is provided in Figure 4-2.
Chemical waste		
6 – 8	Not relevant as the EfW CHP Facility will not accept chemical waste	
Municipal and clinical waste		
9	Use sealed delivery chambers where there is a risk of either waste or products of combustion escaping from the feed mechanism. Positive pressure inert gas blanketing maybe necessary to prevent reactions in the feeder system. Feed purge gases to the incinerator.	The chute is designed such that the waste in the chute will form an air lock between the bunker and the furnace. The connection between the hopper and feed chute is designed to be as air-tight as possible to prevent backflow of combustion gases, or excess air flows into the combustion unit and boiler.
10	Normal feed mechanisms for solid wastes include ram, gravity and hopper feeds. You should engineer the waste feed to prevent back flow of combustion products through it. You should include a low-level alarm in the feed hopper.	The EfW CHP Facility will be equipped with a ram feeder. Strong seals between the ram feeder and ram feeder enclosure will prevent fines being dragged back and backflow of combustion gases. Level detection is provided in the feed chute and low-level alarms will be provided.
11	The isolation doors that prevent the fire burning back up to the chute should be double doors and/or have a cooling system, to prevent ignition of waste in contact with the outside of the door.	The waste chute will be water cooled and equipped with a hydraulic closing flap with locking pins.
12	Ensure a consistent feed to ensure steady combustion conditions. Systems in which the grate steadily draws the waste on to it are preferred. You must take particular care in the control of combustion where waste feed is intermittent.	The automated control system will ensure a steady feed rate on to the grate.
13	For moving grate systems it is particularly important that operating procedures show how overloading of the furnace will be prevented. You should provide automatic means, controlled by measured combustion parameters, to vary the waste feed rate to maintain good combustion conditions.	Overloading of the grate will be prevented by automatic adjustment of the grate speed, loading ram speed and the waste depth.

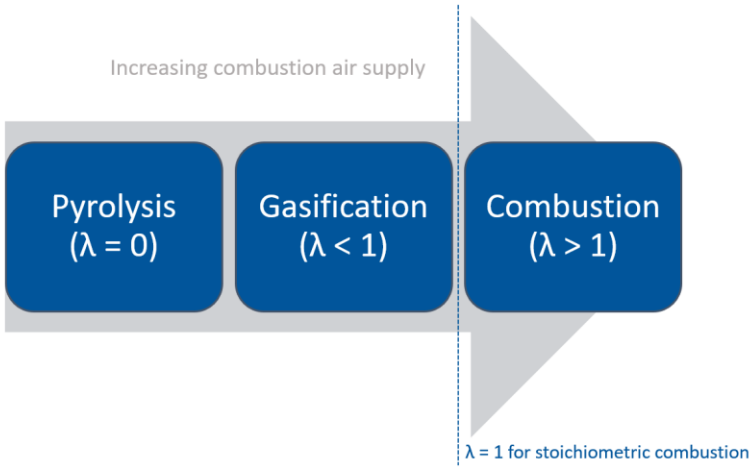
No	Indicative BAT requirement	Comparison with proposed design
14	Not relevant as the EfW CHP Facility will not accept clinical waste.	
Sewage sludge		
15	Not relevant as the EfW CHP Facility will not accept sewage sludge.	
Drum incineration		
16 – 19	Not relevant as the EfW CHP Facility will not accept drums for incineration.	
Animal carcasses		
20	Not relevant as the EfW CHP Facility will not accept animal carcasses.	
Pyrolysis and gasification		
21	Not relevant as the EfW CHP Facility is not a pyrolysis or gasification plant.	
Refuse derived fuels		
22	Not relevant as, whilst the EfW CHP Facility will accept RDF, it is not a dedicated RDF installation.	
Co-incineration		
23	Not relevant as the EfW CHP Facility is not a co-incinerator.	

4.4 Furnace types

This section of the application report relates to the description of furnace types referenced in EPR 5.01 and has been used to describe the furnace currently proposed for the EfW CHP Facility. The specific furnace will be supplied following a competitive procurement process, and the description given here is that which will form the conceptual design for the specification for that procurement.

There are three basic processes for the thermal treatment of residual municipal wastes, which can be categorised by the amount of air supplied (Figure 4-3).

Figure 4-3 Air/fuel ratios for different thermal treatment techniques



Pyrolysis involves thermal treatment of waste at high temperature in the absence of air. This produces a gas high in organic compounds, a tar of long chain organic compounds and a carbon rich char. The gas can undergo additional processing to produce a synthetic natural gas.

Gasification is the thermal treatment of waste at high temperature in sub-stoichiometric (i.e., reduced oxygen) conditions. This produces a gas rich in short chain organic components, carbon monoxide and hydrogen, and an ash with low carbon content. The gas produced can be processed to produce a synthetic natural gas or burnt in a heat recovery system.

Combustion involves the thermal treatment of waste at high temperature in super-stoichiometric conditions to ensure complete oxidation of organic compounds to carbon dioxide and water vapour. The flue gas has no/negligible calorific value as the combustion process has released the energy content of the waste in the form of heat, which is recovered by the boiler as steam.

Combustion has been selected as the thermal treatment technique for the EfW CHP Facility as it is the only technique proven in the UK at the required capacity level of the EfW CHP Facility. Whilst gasification and pyrolysis have been developed for lower capacity facilities, there have been well-documented construction and/or operational issues with many of these types of plant that have significantly affected availability and/or resulted in permits being revoked [3,4,5,6,7].

Following a review of the different combustion options for thermally treating waste in Appendix A4, moving grate technology has been selected as BAT for the EfW CHP Facility as it is the most suitable option for processing large quantities of heterogeneous waste. Other combustion techniques have been discounted on the basis of scale, or the requirement for a homogeneous fuel.

[3] https://www.endswasteandbioenergy.com/article/1712896/documents-reveals-vast-list-issues-waste-gasification-plant
[4] https://www.letsrecycle.com/news/gasification-plant-remains-closed-after-re-testing/
[5] https://waste-management-world.com/a/air-products-to-ditch-plasma-gasification-waste-to-energy-plants-in-teesside
[6] https://resource.co/article/Waste_Law/Scotgen_permit_revoked_after_series_breaches-3554
[7] https://resource.co/article/troubled-gasification-plant-stay-closed-until-2018-11585

The precise design and supplier of the moving grate furnace will be determined during detailed design once the EPC contract has been awarded. However, it is expected to have the following basic design features:

- The thermal treatment of waste will take place in two stages. The first stage will involve drying, ignition, initial combustion and burn-out of the waste, which will be carried out on an advanced moving grate system. The second stage will involve a high temperature secondary combustion zone in which complete oxidation will be achieved through multiple injection points of secondary combustion air (and potentially re-circulated flue-gas if selected as part of the final detailed design, although this is not anticipated) supported by auxiliary burners if required to ensure the minimum temperature requirement under IED is met;
- The geometry of the grate, furnace, secondary combustion zone and location and design of the nozzles for combustion air will be optimised using computational fluid dynamics modelling at the detailed design stage;
- Primary combustion air will be added to the furnace beneath the grate through small holes in the grate bars, whilst secondary combustion air will be added above the waste in the secondary combustion zone to ensure complete combustion;
- Bottom ash from the grate will be discharged from the furnace into an ash quench system;
- The geometry of the secondary combustion chamber qualifying zone, together with the boiler walls and passes, superheater, economiser and the system for the injection of air and re-circulated flue-gas (if installed) will be designed to provide optimum levels of turbulence based on computational fluid dynamics modelling; and
- There will be low emissions of CO, VOCs and NO_x from the furnace due to a combination of design and control measures, including:
    - Optimisation and control of combustion air supply;
    - Good levels of turbulence;
    - Control of the temperature profile throughout the process;
    - Control of the furnace and grate, including charging rates, grate speed and bed depth; and
    - Injection of urea at multiple levels in the secondary combustion zone.

4.5 Furnace requirements

Effective furnace design and control of the combustion process are the most important factors ensuring wastes are effectively processed in a thermal treatment plant and that the production of potentially harmful emissions are minimised. The furnace will be designed to ensure that the following minimum requirements of Chapter IV of IED are met:

- Waste gases produced during combustion will be maintained at a minimum temperature of 850°C for at least two seconds after the last injection of combustion air under the most unfavourable conditions whenever waste is being burnt;
- This design requirement will be confirmed using detailed Computational Fluid Dynamics (CFD) modelling prior to commissioning and validated during commissioning performance tests;
- The amount and harmfulness of residues will be minimised;

- Achievement of less than 5% loss on ignition (dry weight) in the bottom ash or 3% total organic carbon (TOC); and
- Ensure that emissions do not give rise to significant pollution.

The furnace design will be based on the principle of combustion. That is the conversion of the solid waste into a gas by the application of heat in a super-stoichiometric atmosphere. Complete combustion of the waste will be achieved by the end of the moving grate with the gases released starting to be oxidised above the waste bed and with final oxidation occurring in the high temperature secondary combustion zone. The solid waste is reduced in volume and is discharged via the bottom ash from the furnace at the end of the moving grate.

Combustion air flow will be automatically controlled to achieve the complete combustion of the waste and the required burnout of the gases released. The furnace and combustion ductwork will be made gas tight and, in addition, the induced draft fan will ensure a slight negative pressure is maintained above the grate and throughout the system to prevent any leakage of fugitive emissions.

Primary combustion air will be taken from above the waste bunkers and tipping hall, thereby destroying any odours released during handling and storage of waste in those areas. Air dampers and the variable speed primary and secondary air fans will be controlled to maintain combustion of the waste. The primary combustion air will be preheated to increase the energy efficiency of the EfW CHP Facility.

To complete the combustion of the gases released within the furnace, the high temperature secondary combustion zone will operate at temperatures in excess of 850°C with a residence time of at least two seconds for any point within the plant capacity firing diagram (Figure 4-2). This will ensure that all residual organic compounds (including dioxins and furans) are oxidised and carbon monoxide converted to carbon dioxide. The combustion air flow within the secondary combustion zone will act as a semi stirred rector, providing additional mixing of the combustion gases.

The following parameters will be measured and controlled in the secondary combustion zone to ensure these design requirements are met:

- Oxygen content; and
- Temperature of the gases from the primary combustion zone and at the exit of the secondary combustion zone. Subject to the completion of the detailed design once an EPC Contractor is appointed, these measurements will be supported by an infra-red camera system to provide a continuous temperature profile across the combustion bed.

The control system will continuously adjust the following operating parameters to maintain efficient combustion and ensure a constant level of steam production and maintain operation within the plant capacity firing diagram:

- Ram feeder speed and stroke;
- Primary air flow;
- Grate speed; and
- Secondary air flow.

The furnace will operate with a minimum excess oxygen content greater than 5% (design point is 6-7%). The level of excess oxygen will be monitored and automatically controlled to ensure effective burn out of the waste, whilst optimising energy efficiency. The optimum oxygen content will be determined during the commissioning stage.

Auxiliary burners, providing 60% of the boiler load and fired using low sulphur (<0.1wt%) diesel, will be installed to ensure the minimum temperature requirement is met. Subject to completion of the detailed design phase, these burners are expected to operate in the following circumstances:

- Furnace pre-heating during start-up. A temperature controller will adjust burner outputs to achieve a set point temperature in the secondary combustion zone (a minimum of 850°C) before waste is fed onto the grate;
- Maintaining the temperature in the secondary combustion zone above 850°C during operation. It is expected that the control system will start one or more burners, if required, when the temperature is reducing and approaches an operator adjustable set point above 850°C. This will ensure that the temperature remains above 850°C at all times when waste is being fed onto the grate. When the temperature rises above the set point temperature, the burner(s) will be shut-down and temperature control transferred back to the main control system; and
- During shutdown when waste is no longer being charged but waste is still present on the grate. The auxiliary burners will fire to maintain the minimum temperature requirement within the secondary combustion zone until the grate is clear of waste.

Should the temperature within the secondary combustion zone fall below 850°C, an audible and visual alarm will be generated by the control system to alert operators. An automatic interlock will prevent further waste feed to the furnace until the temperature increases above the minimum requirement. This interlock will also be initiated at start-up until the minimum temperature is achieved, and whenever the CEMS indicates an exceedance of an emission limit value.

In the event of the control system detecting monitored parameters outside of pre-set conditions, the system will trigger an alarm event. Some alarms and events will require operator intervention, whereas others will automatically shut the plant down if considered to be safety critical. The design of the control and alarm system will enable a single operator to manage the entire plant from the control room. The system will present the information to the operator in a clear and logical way to enable the operator to make the right decisions in any fault scenario.

Table 4-4 reviews the proposed design and operation of the EfW CHP Facility against the indicative BAT requirements in EPR 5.01 for furnace requirements.

Table 4-4 Comparison of proposed design against sector specific indicative BAT requirements for furnace types

No	Indicative BAT requirement	Comparison with proposed design
Legislative requirements under WID		
1	The gases resulting from combustion of non-hazardous wastes must be maintained at above 850°C for at least 2 seconds.	The plant will be designed to ensure these requirements are met. This will be demonstrated prior to commissioning using CFD modelling and validated with actual measurements during commissioning trials.
2	The gases resulting from the combustion of hazardous wastes with halogen content greater than 1% (as chlorine) must be maintained at above 1,100°C for at least 2 seconds.	Not applicable as hazardous wastes will not be accepted.
3	It should be noted that excessive residence times may result in insufficient turbulence in the combustion chamber. WID allows for derogation of requirements 1 and 2 above, where such derogations can be justified as BAT and achieve the overall aims of WID.	The detailed design of the combustion chamber will ensure that there is sufficient turbulence to achieve complete combustion of the waste gases and maintain the residence time requirements. The secondary chamber will act as a semi stirred rector ensuring satisfactory turbulence at all times.
4	WID does not specify oxygen concentrations. You should note however that BAT will require sufficiently oxidising conditions at the final combustion stage to provide for good combustion, and that you will need to justify your choice of oxygen concentration. You will also be expected to consider the consequence of releases if the oxygen level were to fall below your proposed minimum.	The control system for the furnace will measure the oxygen levels at different points within the system. Control levels will be set during commissioning to ensure that there is sufficient oxygen for complete combustion of waste gases. These levels will be included in the post commissioning report.
5	Incinerators must be provided with auxiliary burners to achieve and maintain the required temperatures. This does not apply to co-incineration unless BAT requires them.	The design of the furnace will include auxiliary burners to maintain the temperature while waste is being combusted. The final arrangement of burners will be determined by the EPC Contractor during detailed design.
6	You must validate the combustion temperature and residence time, and the oxygen content of the stack gases, at least once, and under the most unfavourable operational conditions.	Validation of these requirements will be demonstrated as part of the commissioning trials and reported within the post commissioning report.
7	You must minimise residues (ash) in their amount and harmfulness.	The design of the moving grate will ensure that there is sufficient waste duration on the grate to achieve the required burnout. This will minimise the quantity and harmfulness of the ash generated from the grate.

No	Indicative BAT requirement	Comparison with proposed design
8	Incinerator slag and bottom ashes shall not exceed 3% total organic carbon (TOC) or 5% loss on ignition (LOI) (dry weight). This does not apply to co-incineration, where BAT for the sector (as defined by the sector specific guidance) will apply.	The detailed design for the moving grate furnace will be to achieve these levels.
9	Installations should not give rise to any significant ground level air pollution.	The impact assessments in Section 6.1 and Appendix A7 demonstrate there will be no significant impact on local air quality as a result of emissions to air from the EfW CHP Facility.
10	Whilst it is recognised that these requirements set high technological standards, you will still need to consider the use of techniques that may further reduce releases to demonstrate that your installation uses BAT.	The detailed design phase will include BAT at the heart of the design development, ensuring that the BAT Conclusions and indicative BAT requirements of EPR 5.01 are incorporated as relevant. An initial BAT assessment is provided in Appendix A4.
Grates and primary air		
11	Ensure residence time of the waste in the furnace is long enough to ensure complete burnout and is controllable.	The residence time of the waste is controlled by the speed of the moving grate. The speed of the grate can vary and is automatically controlled by the combustion control system to ensure combustion is optimised and burnout requirements are met at all times. Testing of the ash for TOC during the commissioning phase will be used to demonstrate these requirements are met.
12	For gasification and pyrolysis plants, WID 3% TOC requirement applies to the “ash” produced at the subsequent combustion stage rather than the initial reaction stage, which may be set up to deliberately produce a high carbon char for subsequent use as a fuel or other use. Where this char is used as a fuel the 3% TOC will apply to that process (along with other WID requirements). If the char produced is not put to any beneficial use (e.g. it is disposed of to landfill) the pyrolysis / gasification installation will be expected to process the char to meet the 3% TOC requirement and to recover energy from it (e.g. using water gas reactor or combustion stage).	Not applicable as the treatment technology is based on combustion, not gasification or pyrolysis.

Logika Noise Air Quality CONSULTANTS

No	Indicative BAT requirement	Comparison with proposed design
13	Generally, designs which increase turbulence in the primary combustion chamber reduce NOx formation, secondary air requirements and overall flue gas volumes.	CFD modelling will be used in the detailed design of the primary combustion chamber to ensure there is sufficient turbulence and mixing of the combustion air and waste gas products to control NOx formation and flue gas volumes.
14	For most designs of furnace (fluidised beds may be an exception), you should control primary air both to minimise NOx production and minimise velocities and entrainment of particulate. Starved air systems can be very effective in controlling these while maintaining low levels of CO.	Primary combustion air flows will be monitored and automatically controlled by the combustion control system to ensure these requirements are met.
15	Ensure proper distribution of air and fuel, avoiding hot zones, to reduce the amount of inorganic material volatilised.	This will be a design consideration as part of the detailed design phase by the selected EPC Contractor.
16	Higher primary air flow through grates may be required to reduce temperature. The use of water-cooled grates may minimise the airflow.	The grates will be air cooled but will be designed with optimum waste bed depth (to protect against radiated heat) and flow rates to ensure complete combustion of the waste whilst minimising overall system volume flows.
Combustion chambers, secondary air system designs and supplementary burners		
17	You should maintain combustion chambers, casings, ducts and ancillary equipment as gas-tight as practicable. They should be designed to prevent both the release of gases and disturbance of combustion conditions during waste charging, and maintained under slightly reduced pressure. Control of the induced draft fan, primary air and the feed rate should be balanced.	The combustion unit and associated infrastructure will be designed to prevent gas leakage and an ID fan will automatically maintain a slight negative pressure to prevent fugitive releases.
18	Continuously monitor and record the gas temperature in the primary zone and at the entry and exit points from the secondary combustion chamber. Install audible and visual alarms that are triggered when the temperature falls below the minimum specified. Interlock the charging system with the validated combustion temperature to automatically prevent additional waste feed: • at start up, until the combustion temperature is reached; • whenever the relevant combustion temperature is not maintained; and • whenever the continuous emission monitors show breaches of the	This will be included in the specification for the detailed design and EPC Contractor selection process. The control system will monitor and control temperature at various points within the system and, if outside of pre-set parameters, alarm events will be automatically activated and recorded. The system will include an automated interlock to ensure waste is not fed to the furnace for the three scenarios described.

No	Indicative BAT requirement	Comparison with proposed design
	emission limit values (over the appropriate averaging period).	
Supplementary burners and fuels		
19	Supplementary burners must be provided at all incineration installations in order to achieve and maintain the required combustion temperatures. Co-incineration plants are not required to include supplementary burners under EC legislation but they may be required by BAT for the particular sector (see relevant sector guidance): • the burners must be capable of supporting the combustion temperature under all conditions when there is waste in the furnace • the burners may be used for initial start-up, temperature maintenance and final shut-down • in your application you should state the start up and shut down sequence, including the temperatures at which the waste will be introduced, and prevented, and at what temperature the supplementary burners will trigger • automated systems should be used to trigger the supplementary burners and to prevent additional waste feed until the required temperature is re-established.	These requirements will be included in the specification for the detailed design and EPC Contractor selection process. Auxiliary burners will be installed that will operate to maintain combustion temperatures whenever waste is present on the grate. The burners will also operate at start-up and shut-down and will prevent waste being fed to the grate if the temperature is below 850˚C. During normal operation if the temperature is falling and reaches a set point temperature (typically 860-870˚C) the burners will automatically start until stable operation is reached. The set points will be determined during commissioning and be operator adjustable.
20	Use supplementary fuels which produce release levels no worse than those from burning gas oil as defined by Directive 75/716/EEC (as amended).	The supplementary fuel will be low sulphur diesel oil or equivalent.
21	Supplementary fuels may only be wastes if combustion temperatures are greater than those outlined below (or any other temperature specified in the Permit where WID derogation has been invoked); i.e. waste derived fuels cannot be used for start-up, but may be used for maintaining temperatures above the minimum.	The only supplementary fuel used will be low sulphur diesel oil or equivalent.

No	Indicative BAT requirement	Comparison with proposed design
22	Use the following techniques to ensure efficient combustion of furnace gases: • adequate oxygen content to ensure complete combustion • sufficient temperature to promote combustion • sufficient time to complete the combustion reactions • turbulence to promote mixing	These techniques are included in the outline design and will form a component part of the detailed design once a preferred EPC Contractor has been selected. The design will be optimised using CFD modelling.
23	All incineration plant should be equipped and operated in such a way that the temperature of the combustion gas is raised to that specified in Table 2.2, after the last injection of air, in a controlled and homogeneous fashion and even under the most unfavourable conditions anticipated, for at least two seconds.	This will be included in the specification for the detailed design and EPC Contractor selection process. The detailed design will utilise CFD modelling of the combustion to demonstrate this requirement is met.
24	You must maintain these temperatures during operation and at the end of an incineration cycle and for as long as combustible waste is in the combustion chamber. You must maintain oxygen levels at a level demonstrated to be adequate to ensure oxidative combustion and hence destruction of organic species at the final combustion stage. For many installations this will be approximately 6% oxygen by volume. You are expected to justify the minimum oxygen level that you propose. This includes considering the consequence for releases if the oxygen level were to fall below your proposed minimum.	This will be included in the specification for the detailed design and EPC Contractor selection process. The detailed design will utilise CFD modelling of the combustion to demonstrate this requirement is met. The minimum oxygen requirements will be determined during commissioning. If oxygen levels fall below the pre-set values, the combustion air flow will be increased and/or the waste feed rate reduced as determined by the control system. Continuing falling oxygen levels would result in an alarm event.

4.6 Validation of combustion conditions

Computational fluid dynamics (CFD) modelling for the design has not yet been completed as a final design and EPC Contractor has not been selected.

The EPC contract specification will include the requirement for the vendor to provide a combustion chamber with a qualifying zone that will achieve a residence time greater than two seconds at a temperature greater than 850°C across all modes of operation of the plant capacity firing diagram and, in particular, under the most unfavourable conditions of throughput and CV.

This requirement will be a performance guarantee of the contract and will require modelling of the residence time within the qualifying secondary combustion zone using CFD modelling with subsequent validation of the residence time once the plant is in 'hot commissioning'. The validation methodology will follow the procedures set out in the Environment Agency Guidance Technical Report P4-100/TR, or any updated version or new guidance introduced at the time of commissioning, or alternative validated procedure in agreement with the EA. In particular, the validation testing will aim to assess the EfW CHP Facility performance over a range of operating conditions defined by the plant capacity firing diagram.

It is proposed to include CFD modelling as a pre-commissioning condition with the modelling to be completed and submitted to the Environment Agency prior to the commissioning of the installation. The methodology for validation of the qualifying secondary combustion zone CFD model and actual residence time will be included in a commissioning plan agreed with the Environment Agency prior to the tests being carried out.

Table 4-5 reviews the proposed design and operation of the EfW CHP Facility against the indicative BAT requirements in EPR 5.01 for validation of combustion conditions.

Table 4-5 Comparison of proposed design against sector specific indicative BAT requirements for validation of combustion conditions

No	Indicative BAT requirement	Comparison with proposed design
Indicative BAT		
1	At the **design stage**: • Use a representative Computerised Fluid Dynamics (CFD) model where practical to demonstrate that the residence time and temperature requirements will be met in the chosen design and to identify the ideal (or best practicable) locations for temperature monitoring for the purposes of validation measurements • Outline the assumptions and inputs used in the CFD modelling and explain how these are representative of the chosen design • Identify the qualifying zone over which the residence time and temperature will meet the residence time and temperature requirements • Use a model that is representative of the real flow situation in the qualifying zone (this is most likely to be a combination of plug flow and stirred reactor flow rather than one extreme) • Taking account of this guidance and BAT report, confirm the details of the method that will be used to validate temperature and residence time modelling, including identification of	This will be included in the specification for the detailed design and EPC Contractor selection process. A detailed report presenting the results of the CFD modelling and all assumptions will be presented to the Environment Agency prior to the commissioning of the EfW CHP Facility.

No	Indicative BAT requirement	Comparison with proposed design
	the worst case conditions under which the test(s) will be carried out including waste type etc.	
2	At the **operational stage** use validation techniques in agreement with the Agency that: • Measure worst case gas residence time using a time of flight method; • Use multiple traverse measurements of gas temperature to identify (or confirm) the lowest gas temperature location at, or shortly after, the qualifying secondary combustion zone; • Confirm that 95% of the one-minute mean temperatures (continuously monitored at the identified lowest temperature location over a period of at least one hour) exceed the stated minimum temperature requirement); and • Use suction pyrometers to measure temperatures (acoustic pyrometers or shielded thermocouples may only be used if calibrated against suction pyrometers).	This will be included in the specification for the detailed design and EPC Contractor selection process. These requirements will be undertaken/addressed as part of the commissioning using a method agreed with the Environment Agency prior to commissioning.
3	The "**qualifying zone**" over which the temperature and residence time shall be required to comply is defined as follows: • It should not include areas where primary combustion occurs but relate to the completion of combustion • It should commence at a location after the last injection of secondary (or over fire) air and will therefore generally exclude residence time achieved in the primary combustion unit or zone • It would not be reduced where support burners are located within the qualifying zone provided they maintain temperature above the required level • It would be reduced where tertiary air is added within the qualifying zone	These requirements are noted and will be addressed in the detailed design once the EPC Contractor has been selected.

No	Indicative BAT requirement	Comparison with proposed design

4	The test conditions for validation measurements should be:
	• Carried out over a range of operational conditions include the "most unfavourable" and normal operation
	• The "most unfavourable" condition is considered to arise as a consequence of a combination of:
	  ○ Waste type being at the boundary of the design envelope in respect of it combustion related parameters (e.g. CV, moisture); and
	  ○ The process operating at the limits of its operational range as defined by the plant firing diagram
	• Each condition should be tested twice during the validation programme
	• The monitoring within each test period should last at least one hour
		These requirements are noted and will be addressed as part of the commissioning trials and reported to the Environment Agency in the post commissioning report.
		The methodology for the validation tests will be agreed in advance with the Environment Agency as part of the commissioning plan.

5	For more detailed guidance on validation methodologies refer to BAT report on validation of combustion conditions.	The validation methodology will follow the procedures set out in the Environment Agency Guidance, Technical Report P4-100/TR, or any updated version approved by the Environment Agency, or alternative validated procedure in agreement with the EA.
Measuring oxygen levels		
6	The oxygen level should be reported on a wet basis, and should be sufficient to ensure adequate combustion. In practice, this is likely to be about 6%.	This requirement is noted and will be addressed during the detailed design for the monitoring and reporting of process parameters. It is likely the combustion chamber will operate with a minimum excess oxygen content of 5% (design point is 6-7%) but an optimum level will be determined as part of the commissioning trials.
7	Set the oxygen control point at a level which takes account of the speed with which the control system can introduce more secondary air in response to fluctuations in the rate of combustion on the grate. The larger the fluctuations and slower the rate of response of the control system the larger the margin of excess oxygen must be.	This is noted and will be addressed during the detailed design and the commissioning trials.

No	Indicative BAT requirement	Comparison with proposed design
Combustion control		
8	You must maintain optimum control of the combustion process at any instant, especially when burning wastes of very variable moisture content and calorific value and those which cannot be readily charged to the furnace at a steady rate.	The EfW CHP Facility will be operated using an advanced automated combustion control system which will continuously monitor key variables and make corresponding changes to operational aspects such as primary and secondary combustion air rates, ram feeder speed, grate speed etc., to ensure combustion is optimised and a stable steam production rate is maintained at all times. Bunker mixing procedures will ensure waste that is fed to the furnace is as homogeneous as possible.
9	Ensure that the largest perturbation (e.g. the addition of a single drum to a chemical waste incinerator (ChWI), or the tumbling of a mass of waste in a municipal incinerator (MWI)) is small compared with total mass being burned.	This is not considered applicable as the processing lines will not burn drum or chemical wastes and the mass of waste being burnt is large compared to the potential tumbling mass thus reducing the variation within the combustion system.
10	Because waste feed rate is a relatively slow acting control parameter, you need to control shorter term fluctuations, especially during stoking, by primary and secondary air flow rates and burner operation.	The combustion control system will have the ability to monitor and control primary and secondary air flow rates in addition to ram feeder speed.
11	The shortest-term fluctuations are usually caused by sudden conflagrations of the non-homogeneous wastes and take place in the order of seconds. You must use fast response measuring/control systems (such as CO or oxygen sensors) to avoid emission spikes (particularly of CO and unburned hydrocarbons).	This requirement is noted and will be addressed in the detailed design and operational control procedures. Prior to waste being fed on to the grate it will be well mixed in the waste bunker to minimise the variation in moisture and CV. The secondary chamber and flue gas treatment system will be designed to minimise the impact of any short-term fluctuation in emissions.
12	You should demonstrate e.g. by reference to existing plants of the same configuration, how your control system will deal with both: • The largest normal perturbation • The shortest duration perturbation which is significant in the particular process	The operational control system and procedures will be developed based on MVV's substantial experience in operating related facilities in the UK and Europe.

No	Indicative BAT requirement	Comparison with proposed design
13	Potentially the response time of CO detector systems may be brought down to the microsecond level. Alternatively rapid response can be obtained by taking measurements just above the bed, using acoustic (which can be expensive) or optical/infra-red temperature monitoring. On some plants, this alone has shown significant reductions in CO releases. Better control also improves efficiency and can save fuel where burners are regularly employed. Such techniques can be valuable for improving performance on existing plants.	Subject to the completion of the detailed design, infra-red temperature monitoring of, and above, the bed to supplement other temperature, oxygen and CO monitors to ensure combustion is optimised at all times.
14	To be effective, rapid monitoring needs to be combined with a secondary air supply arrangement which can also respond rapidly. Techniques to improve air supply response time include: • Keeping secondary jets clear of slag and operational, particularly in MWIs. Jet performance can be monitored by simple air flow or pressure instrumentation, backed up with viewing windows; • Oxygen injection, via lances. This has been used for merchant ChWI in the US and Germany with significant reductions in the number of high CO events; and • Provision of excess capacity in the air supply ductwork upstream of the jets (by use of higher pressure fans) and use of a damper opening behind the jets. On opening of the dampers, there will be an immediate increase in air flow through the jets which may provide a much faster response than that obtained by simply controlling the fan speed.	This requirement is noted and will be addressed in the detailed design and operational control procedures for the processing lines.

4.7 Combined incineration of different waste types

The indicative BAT requirements in EPR 5.01 for the incineration of different waste types are not deemed to be applicable for the EfW CHP Facility as only residual HIC waste will be accepted, i.e., clinical waste, chemical waste etc., will not be accepted by the EfW CHP Facility. Whilst individual HIC waste deliveries may vary in composition, the bunker mixing procedures will ensure that the waste fed to the furnace is homogenous in terms of its moisture and CV content.

4.8 Flue gas recirculation

Flue gas recirculation (FGR) is one of several techniques available to reduce NO_x formation. It achieves NO_x reduction by displacing a portion of the secondary air that would otherwise be used to ensure adequate levels of turbulence with an equivalent volume of air that is deficient in oxygen and contains higher concentrations of 'inert' components, such as nitrogen and carbon dioxide (relative to typical ambient air). Consequently, the recirculated flue gas acts as a diluent, reducing the peak combustion temperature and also reducing the oxygen content available at peak combustion temperature.

However, FGR on its own cannot be guaranteed to meet the BAT-AEL and, consequently, in situations where FGR is used, this is generally in combination with another NO_x control technique, such as SNCR or SCR. Potential concerns with corrosion may also limit its application.

The BAT assessment in Appendix A4 has demonstrated that SNCR + FGR is associated with a higher specific reduction cost (£/tonne) than SNCR alone, whilst SNCR in isolation can meet the BAT-AEL. Consequently, it is not proposed to incorporate FGR at this outline design stage. However, this decision will be reviewed during detailed design once an EPC Contractor has been appointed.

Table 4-6 reviews the proposed design and operation of the EfW CHP Facility against the indicative BAT requirements in EPR 5.01 for flue gas recirculation.

Table 4-6 Comparison of proposed design against sector specific indicative BAT requirements for flue gas recirculation

No	Indicative BAT requirement	Comparison with proposed design
1	Consider using FGR for NO_X control. If you propose not to use FGR, you must submit a site specific justification of the alternative NO_X control technique by comparing FGR against other alternatives and particularly by addressing the points below: • more secondary air is required to provide turbulence than is needed simply for supplying oxygen. The resulting excess oxygen encourages both NO_X and dioxin formation. FGR replaces 10-20% of secondary air (with N2 and CO2) reducing oxygen and peak temperatures thereby reducing NO_X generation • FGR gives around 20% NO_X reduction. In combination with repositioning air inlets (using CFD to optimise locations) and improved control it can give 25-35% reduction • higher re-circulation rates may give rise to corrosion. At lower levels we do not expect this to be significant enough to	The BAT assessment has demonstrated that SNCR + FGR is associated with a higher specific reduction cost (£/tonne) than SNCR alone, whilst SNCR in isolation can meet the BAT-AEL. Consequently, it is not proposed to incorporate FGR at this outline design stage. However, this decision will be reviewed during detailed design once an EPC Contractor has been appointed.

No	Indicative BAT requirement	Comparison with proposed design
	prevent the routine use of this emission reduction technique • thermal efficiency of the installation may be increased by re-circulation of the already warmed stack gases. This additional heat retention will need dissipation to prevent increased furnace temperatures altering the thermal profile of the operational plant. In new plant this may be addressed at the design stage (e.g. by providing a larger heat capacity boiler). Existing plants may find increasing heat removal rates highly capital intensive, although this may be recovered through increased heat recovery. Reductions in waste throughput could also reduce thermal load, but this will also be expensive and may be impractical in some situations • the costs of retrofitting FGR may be prohibitive for existing plant owing to the space required for the ducting and other factors (heat removal and throughput). Such situations will be assessed on a site specific basis • the injection of ammonia or urea (SNCR), which converts both NO and NO_2 to nitrogen and water, can further reduce NO_X levels (typically by 35-45%). Its use in conjunction with FGR has shown total reductions of up to 80% and may represent BAT in many situations. The use of the two techniques in combination also reduces reagent consumption for SNCR.	

4.9 Dump stacks and bypasses

The indicative BAT requirements in EPR 5.01 for dump stacks and bypasses are not considered applicable since the EfW CHP Facility will not contain any dump stacks or bypasses relating to flue gas i.e., flue gases will pass through the flue gas treatment plant at all times. There will be a steam turbine bypass and various steam pressure relief valves, but these will not affect emissions or impacts from the EfW CHP Facility.

4.10 Cooling systems

EfW facilities generally operate under the Rankine cycle whereby heat energy is supplied to a boiler and a working fluid (water) is converted to high pressure steam to drive a steam turbine. After the turbine, the fluid is condensed back to a liquid state, rejecting waste heat, before the cycle begins again. The condenser and the cooling system are, therefore, key parts of the EfW CHP Facility and can have significant impacts on its efficiency and availability.

Cooling systems are required in all EfW facilities to remove the condensation energy from the steam, or the unusable energy of the process, and allow the release of non-recoverable heat to the environment. Cooling systems can be categorised by their design and by the main cooling principle, which typically involves using water or air, or a combination of water and air, as coolants. There are three principal categories of cooling systems:

- Once through sea or river water cooling systems;
- Closed circuit wet evaporative cooling systems; and
- Air cooled condensers;

Each type of system has its own relative advantages and disadvantages. Following an options appraisal of the different cooling methods in the BAT assessment in Appendix A4, air cooled condensers (ACC) have been selected as the BAT option. Whilst the efficiency of an ACC is less than a once through cooling system or closed circuit wet evaporative cooling system, an ACC will minimise water consumption compared to a once through cooling system and has fewer cross media effects than a closed circuit wet evaporative cooling system.

The ACC will be of a finned-tube design and operated under vacuum to extract the maximum practical mechanical energy from expansion in the steam turbine. It will consist of:

- Tube bundles in carbon steel with aluminium fins;
- Cooling fan system including adjustable blade pitch, frequency regulated electric motors and direct drive reduction gear;
- Screening of the air intake and exit openings to reduce visual and noise impacts; and
- Steel support structure;

The ACC is designed with 15% cooling reserve and to allow full load operation of the EfW CHP Facility at ambient temperatures between -10 to +35°C. At temperatures greater than 35°C, the EfW CHP Facility is still able to operate but at a reduced efficiency and/or load. Due to the criticality of the ACC in achieving high levels of availability of the EfW CHP Facility, redundancy is built into other areas of its design, e.g., redundancy in the main condensate pumps.

The ACC heat exchanger surface will be optimised to minimise air flow restrictions and will include vibration monitoring and two temperature monitors per segment that will be relayed to the control system. Energy efficient fans with frequency converter load control will be installed with the possibility to shut-down certain fans for partial load conditions.

Noise is the main cross media effect for an ACC and noise performance guarantees will be specified in the EPC contract.

The indicative BAT requirements in EPR 5.01 for cooling systems are not considered applicable since these relate to wet, evaporative cooling systems, whereas the cooling system proposed for the EfW CHP Facility is based on a dry cooling system using ACCs. Justification for the selection of a dry cooling system is provided in the BAT assessment in Appendix A4.

4.11 Boiler design

The boiler design has a critical role in recovering the heat generated by the combustion of waste to maximise the efficiency of the EfW CHP Facility, whilst also reducing the (re)formation of pollutants such as dioxins and furans. The boiler design will be a key part of the vendor specification and the subsequent detailed design process. As a minimum, the boiler will comply with the IED, BAT Conclusion and EPR5.01 indicative BAT requirements.

The boiler will recover the heat in the form of high pressure steam. The main components of the steam system are likely to include, subject to final detailed design:

- Feed water pre-treatment/demineralisation system;
- Water chemical dosing system;
- Feed water tanks;
- Feed water pumps;
- Economiser;
- Heat recovery steam generator (boiler and superheater);
- Boiler blow down system;
- Single steam turbine connected to both lines;
- Deaerator;
- Air cooled condenser system;
- Condensate tank; and
- Condensate pumps;

Table 4-7 provides the overall expected performance data for the steam system.

Table 4-7 Estimated steam system performance data

Parameter	Units	Value
Flue gas flow (nominal operation, per boiler)	Nm^3/h (wet)	177,000
Boiler inlet flue gas temperature	°C	< 1,150
Boiler outlet flue gas temperature	°C	145

Parameter	Units	Value
Feed water temperature	°C	131
Steam production rate (per boiler)	kg/h	125,700
Steam temperature	°C	380
Steam pressure	barg	45
Steam turbine power output (nominal)	MW_e	60

The sections below provide an outline description of the expected heat recovery system. The exact details will be confirmed during design once an EPC Contractor has been appointed and the Environment Agency will be provided with updated details as part of the pre- and post-commissioning reports.

4.11.1 Feed water treatment system

Demineralised water will be required to feed the boiler for steam production. A total combined maximum flow of $80m^3/h$ of demineralised water can be continuously fed to the boilers, although in normal operation this will be much lower at approximately $5m^3/h$. This water flow will be to replace the boiler water lost via steam traps and boiler blowdown. Blowdown is an essential safety operation, preventing the build-up of corrosive salts in the boiler drum that can cause corrosion and premature failure of the boiler tubes. The maximum flow of $80m^3/h$ will only be required to provide make up in a full CHP configuration where condensate is not returned from the off-site steam consumers.

4.11.2 Chemical dosing system

The chemical dosing systems control the pH-value of the boiler water and, along with the deaerator which removes any free oxygen, these minimise internal corrosion of pipework. The systems will inject the chemicals downstream of the feed water pumps. Chemicals likely to be used will include ammonia for basic alkalisation of the feed water and potassium and/or sodium hydroxide for conditioning.

4.11.3 Feed water tank

The feed water tank will supply feed water to the boiler drum and ultimately the steam system. The tank will act as a buffer tank for treated water and condensate return from the condenser. The feed water tank will be equipped with a deaerator for the removal of oxygen. Steam is likely to be added for temperature and pressure control of the water in the feed water tank. The tank will be equipped with a pressure safety valve for overpressure protection and will be vented to atmosphere. The tank and associated pipework will be fully insulated to minimise heat losses.

Feed water quality will be monitored and the chemical dosing adjusted to maintain the boiler feed water and, hence, steam quality.

4.11.4 Feed water pumps

The feed water pumps will supply feed water to the boiler system and will have 3 x 50% capacity of the required demand subject to final detailed design. This allows two pumps to operate continuously with the third remaining on standby. The pumps will be changed between duty/standby use at regular intervals to allow maintenance and ensure availability.

The feed water pumps will include high efficiency components and will be equipped with a frequency converter to allow appropriate operation within the entire firing capacity diagram. Feed water pumps will be connected to an uninterruptable power supply (UPS).

Strainers, with isolation valves, will be positioned at the inlet to the boiler feed water pumps with differential pressure transmitters feeding back to the control system to allow periodic cleaning of the strainers.

The pump discharge pipe will be equipped with a back flow line to circulate water around the pumps to avoid overheating when the feed water valve is closed.

4.11.5 Steam boiler

Subject to the completion of detailed design, the steam boiler is likely to consist of a natural circulation steam generator, removing heat from the hot flue gases using a series of boiler tubes filled with water. The initial section of the boiler is likely to be a membrane wall section using water tubes mounted in the walls to remove radiant heat from the flue gas. The remaining sections will include superheater and economiser tubes mounted across the flue.

The transition between the different boiler passes and the separation wall between the radiating passes are designed to allow the separation of ash from the flue gas and provide uniform flow distribution. Computational fluid dynamics modelling will be carried out in the detailed design stage to ensure that there are no stagnant areas for flue gas flow, and that the boiler section will remove the heat to 145°C after the economisers prior to entering the flue gas treatment system. The outlet temperature will be controlled by the system.

Although the boiler will be specifically designed to minimise dust deposition, low levels of dust will inevitably be present which may accumulate over time and lead to fouling. Consequently, an online boiler cleaning system will be included in the design which includes a combination of high pressure shower cleaning in the 1^{st}, 2^{nd} and 3^{rd} boiler paths, a rapping system in the horizontal 4^{th} boiler path, and ball shot cleaning in the economiser(s).

The geometry of the boiler will be designed to minimise areas where excessive corrosion could occur. In the areas that cannot be protected by refractory lining, the metalwork will be protected by layers of Inconel.

The steam boiler will evaporate water to produce steam at a pressure of approximately 45barg and a superheated steam temperature of 380°C. The water level in the boiler will be controlled by a level control valve upstream of the economiser during start-up and shut-down only and feed pump speed control at all other times to maximise efficiency. The boiler will be equipped with pressure safety valves to protect the boiler system from overpressure. These will discharge steam to atmosphere via a silencer, but this discharge would only be a critical safety function release and infrequent in nature.

The boiler will have instruments for recording water level, steam pressure and flow, and the system will also be equipped with alarms for high and low water level and high steam pressure. All alarm systems and boiler controls will be routed via the main control system.

During any stop of the steam turbine, steam by-pass valves will open and steam will be passed through a pressure reducing valve to the condenser to avoid pressure build up in the boiler system.

4.11.6 Superheater

The superheater section will be located in between the evaporative section of the boiler and the economiser. The superheater will increase the temperature of the steam to approximately 380°C to maximise the efficiency of electrical generation in the steam turbine.

Superheated steam will be fed to the steam turbine for power generation.

4.11.7 Economiser

The economiser is the part of the boiler system that will preheat the water from the feed water pumps before it enters the boiler drum and reduce the temperature of the flue gases to the level required by the flue gas treatment plant. The economiser, subject to final detailed design, will consist of water tubes in counter current flow with the flue gas.

An economiser bypass valve may be included in the design to control the flue gas temperature to the flue gas cleaning system during start-up of the EfW CHP Facility and as the boiler fouls during prolonged periods of operation.

4.11.8 Blowdown tank

The boiler system will have an automated blowdown function to remove deposits and impurities from the boiler water. A conductivity meter will be installed with continuous boiler water sampling and this will initiate boiler water blowdown at conductivities above a pre-set level. Blowdown water would be re-used in the ash handling system (quench tank). Heat recovery systems may be installed on the boiler blowdown system subject to final design.

4.11.9 Steam turbine

Superheated steam leaving the superheater on each line will be routed to the steam header prior to the common steam turbine. The steam turbine will convert superheated steam to rotational movement by utilising the high pressure and temperature of the steam in a multistage bladed turbine. Steam at low temperature and reduced pressure will leave the steam turbine for condensation in the ACC. The specification of the steam turbine will allow for steam to be extracted from the system and controlled at the required temperature to feed any future district heating and/or industrial customers.

The control of the steam turbine can be achieved by steam pressure control or power control from the generator. Separate hydraulically operated steam emergency stop valves will isolate the steam delivery to the steam turbine during emergency shutdown; these are a critical safety release function and infrequent in nature.

4.11.10 Condenser system

Low pressure steam from the steam turbine will be completely condensed to low pressure hot water in the condenser by heat exchange with ambient air in the ACC. Downstream of the condenser, a condensate tank will collect the condensate and condensate pumps will return condensed water back to the boiler feed water tank (hotwell). All steam and condensate pipework, valves and flanges will be insulated.

4.11.11 Measures to minimise the reformation of dioxins

The furnace will be designed to operate at a sufficiently high temperature and for an appropriate residence time to ensure effective destruction of any material containing dioxins and furans present in the waste. However, there is the potential that dioxins and furans could re-form from precursor components as the temperature of the flue gases reduces through the boiler.

There are two main mechanisms by which this could occur:

- The interaction between an aromatic precursor and chlorine donor promoted by a transition metal catalyst on a reactive fly ash surface. Precursors from the flue gas can adsorb to the surface of combustion fly ash, or entrain in the gas phase within the flue gases. Transition metal catalysts promote the chemical reaction on the surface of fly ash, with copper being particularly effective; and
- De-novo synthesis is the process by which dioxins can form from heterogeneous reactions on fly ash involving carbon, oxygen, hydrogen, chlorine and copper (or another transition metal catalyst).

It is possible for both of these mechanisms to occur simultaneously. In addition to common aspects such as the reactions being catalysed on the surface of fly ash, both reactions are temperature sensitive, with formation optimised between a temperature range of 200 – 450°C.

The boiler convective section will be designed so that the retention time in the temperature range whereby dioxin and furan reformation can take place is minimised through sufficiently high velocity of the flue gas. Furthermore, the boiler passes will be designed such that the peak flue gas velocity will increase from 7m/s in the first boiler pass to 10m/s in the fourth boiler pass.

As dust/fly ash promotes the re-formation of dioxins and furans by acting as a carrier for transition metal catalysts, the measures to minimise the build-up of boiler deposits described in Section 4.11.5 will also represent an effective control mechanism to minimise the re-formation of dioxins.

The combustion gases will cool rapidly as they pass over the superheaters. This maintains heat transfer efficiency, minimises erosion and minimises ash deposits on the tubes. The rapid cooling of the flue gases in the boiler, coupled with minimal ash deposits, helps to minimise the reformation of dioxins and furans.

4.11.12 Normal operation of the steam system

During normal operation, flue gas from the furnace will be routed through the boiler. Feed water will be pumped from the feed water tank via the economiser to the boiler steam drum. The amount of feed water will be controlled by the water level in the boiler steam drum.

Water will pass from the steam drum to the membrane walls for steam production. This saturated steam will then pass to the steam drum and from there to the superheater section.

Steam from the superheaters will leave the boiler at high pressure (~45barg) and high temperature (380°C).

The steam flow will be measured and routed to the header for the steam turbine. The two lines will have separate steam boilers combining at the steam header to feed the single multistage steam turbine generator. The exhausted steam from the turbine is then fed to the ACC.

In normal operation, the steam turbine will control the pressure within the boiler. The vacuum in the condensing section of the turbine will be kept as low as practicable to recover as much energy as possible from the steam whilst minimising erosion of the end blades.

4.11.13 Island mode

The EfW CHP Facility will be capable of operating in island mode in the event that the connection to the external off-site electrical system becomes unavailable. Upon notification from the external network provider that the connection is available, the main turbine/generator would be re-synchronised to the grid and the system load re-applied automatically. The steam by-pass control system would be progressively closed thereby increasing power generation and hence export until stable operation was achieved.

Table 4-8 reviews the proposed design and operation of the EfW CHP Facility against the indicative BAT requirements in EPR 5.01 for boiler design.

Table 4-8 Comparison of proposed design against sector specific indicative BAT requirements for boiler design

No	Indicative BAT requirement	Comparison with proposed design
1	Minimise dioxin production by boiler design and operation.	The boiler will be specifically designed and operated for this requirement. CFD modelling will be used to confirm and optimise the final boiler design.
2	Avoid slow rates of combustion gas cooling to minimise the potential for the de novo formation of dioxins and furans.	The boiler will be designed to ensure that flue gases are rapidly cooled through the de-novo synthesis temperature range.
3	The primary temperature zone of concern is between 450 and 200°C. However dioxins will still be formed outside this range at a decreasing rate as the temperature moves further away from this core range.	The critical temperature range is noted. It will be a key design requirement to rapidly cool the gases through the boiler to approximately 145°C at the outlet of the economiser.
4	Dioxin control should primarily be by preventing formation, rather than by subsequent abatement. As the waste heat boiler is one of the primary sites for formation, its design and operation are important. The main techniques involve maximising the rate of decrease of gas temperature, which is achieved by: • ensuring that the steam/metal heat transfer surface temperature is a minimum (around 170°C) where the flue gas is in the de novo synthesis temperature range, subject to acid dew point considerations • CFD is used to confirm that there are no pockets of stagnant or low velocity gas	The detailed design and EPC Contractor selection process will include these requirements. CFD modelling will be used to confirm there are no pockets of stagnant or low velocity gas. The boiler passes will be designed such that the peak flue gas velocity will increase from 7m/s in the first boiler pass to 10m/s in the fourth boiler pass.

No	Indicative BAT requirement	Comparison with proposed design
	• boiler passes are progressively decreased in volume so that the gas velocity increases through the boiler • boundary layers of slow moving gas are prevented along the boiler surfaces.	
5	A balance must be maintained, to ensure that these design measures are not made at the expense of a major effect on boiler efficiency.	The detailed boiler design will achieve minimisation of dioxin and furan production whilst maintaining an appropriate efficiency level. Both of these objectives will be confirmed during the commissioning trials.
6	Boiler deposits contain substances which catalytically enhance dioxin formation. Municipal waste, in particular, leads to deposits of sodium and potassium sulphates, and to a lesser extent chlorides. Fly ash can then adhere to these deposits to compound the problem. In the initial stages the material is easily removed by an on-line soot blower. As the fouling increases the deposits become fused and can only be removed off-line. Control methods include: • design features to maintain critical surface temperatures below the sticking temperature. This includes not only the arrangement of cooling surfaces, but also avoiding peak combustion temperatures by good waste mixing (where relevant) uniform waste feed and good primary and secondary air control • additives to prevent sodium and potassium depositing (mixed success); or • on-line cleaning by: ○ boiler tube rapping, by striking the tubes (limited success) or lifting and dropping whole banks of tubes (limited experience); ○ continuously allowing steel shot to fall through the tubes (applied successfully to economiser sections); ○ steam or compressed air soot blowing; and ○ off-line cleaning.	The boiler will be designed to minimise boiler deposits and fouling and will be equipped with an online boiler cleaning system incorporating: • High pressure shower cleaning system in the first, second and third boiler pass; • Rapping system in the fourth boiler pass; and • Ball shot cleaning in the economiser. Periodically, the boilers will be taken off-line for more comprehensive cleaning under procedures developed in the IMS. The boiler has sufficient inspection and access hatches to allow off-line cleaning.

No	Indicative BAT requirement	Comparison with proposed design
7	NO_X reduction techniques may also help to minimise dioxin emissions.	This is noted.
8	Boiler blow-down contains small amounts of solids plus water treatment chemicals. These are mainly phosphates with possibly small amounts of alkalis, hydrazine and ammonia used for pH control and de-aeration.	The volume of boiler blowdown will be regularly reviewed and minimised to ensure safe and efficient operation of the boiler. Once the blowdown has had any useful energy recovered, it will be collected and used within the quench pit for the bottom ash management.
9	Water treatment and de-ionisation plant effluent usually comprises separate acid and alkali streams which are mixed together and pH adjusted for discharge. Soluble and suspended solids content will depend on the original water supply, be it towns water, river or estuary water. Soluble sulphates are also likely to be present from the use of sulphuric acid for regeneration of the ion exchange material. You should consider the presence of salts in the release.	This will be considered in the detailed design of the boiler water treatment plant. During normal operation, there would be no discharge of effluent from the water treatment plant. However, there will be an intermittent release from online maintenance activities associated with the regeneration of the ion exchange unit. These effluents will be mixed in a neutralisation tank equipped with pH monitoring prior to discharging to the bottom ash quench system or to sewer under a Trade Effluent Discharge Consent.
10	Wash water and cleaning solutions, containing for example citric acid, sodium hydroxide, alkali phosphates, iron oxides in suspension, hydrochloric or hydrofluoric acids, may be generated during maintenance. Complex toxic corrosion inhibitors may be present in these liquors.	Wash water from cleaning operations will be collected and used in the bottom ash quench.
11	All these liquors should be neutralised or treated on- or off-site to produce an acceptable waste before discharge or disposal to a licensed facility.	Provision is included in the design to allow neutralisation of effluents from regeneration of the ion exchange unit, prior to re-use within the bottom ash quenching system or discharge to sewer under a Trade Effluent Consent.

4.12 Start-up and shut-down

Detailed procedures for start-up, planned shutdowns and emergency shutdowns will be developed prior to the commissioning of the EfW CHP Facility. However, a summary overview of the expected procedures is described below.

4.12.1 Start-up

The EfW CHP Facility will use low sulphur gas oil for start-up. Low NO_x auxiliary burners in the furnace will be used to bring the entire system up to the required temperatures before waste is fed onto the grate. The start-up process is carefully controlled to gradually raise the temperature in the furnace and boiler to avoid adverse thermal shock and stress on the system. The start-up process is expected to take between 10 to 12 hours from cold.

During the start-up process, small quantities of steam will be vented from the boiler house roof vent as the systems are warmed up and filled with steam over a period of approximately 4 hours. No other emissions will occur from this vent. Following this initial 4 hour period, a continuous flow of steam would be vented for another 4 hours as sufficient pressure is generated to divert to the ACC and close the start-up valve. The vent is equipped with a silencer designed for 110% of maximum load and adverse noise impacts are not expected as a result.

Waste will only be introduced to the furnace under the following circumstances.

- Combustion temperature in the high temperature secondary combustion zone > 850°C;
- Flue gas treatment and ash handling systems fully online and operating at optimum temperatures; and
- No system critical alarms or other warnings are displayed by the control system.

Interlocks in the automated control system will ensure that waste cannot be charged if any of these conditions are not met. At no stage during the start-up sequence will the flue gas treatment systems be bypassed.

4.12.2 Planned shut-down

Planned shut-downs of the EfW CHP Facility will be initiated by the control room. Initially, waste will stop being fed into the feed hopper and grate. As the remaining waste travels along the grate, the primary air flow will automatically reduce. Once the grate is no-longer burning waste, the systems will be turned off. If required, the auxiliary burners will maintain the secondary combustion zone at a minimum 850°C until the system is ready for final shutdown.

Planned shut-downs would always be scheduled in such a way that avoids both lines being off-line simultaneously. Planned maintenance on each line is expected to last for a maximum period of 21 days per line per year. If the planned shut-down is expected to be short in duration, electrical preheating systems will be used to maintain temperatures in the flue gas treatment system and ash handling systems.

There will be periods where shutting down both lines is unavoidable, e.g., to allow maintenance on the common electrical systems and steam turbine generator. It is expected that such periods will be limited to a maximum of 10 days per year, although the actual duration of a simultaneous shutdown is expected to be less than this timescale and is unlikely to happen on an annual basis. Where major turbine maintenance is required which exceeds 10 days, a turbine blanking plate will be installed and one or both boilers restarted for the duration of the maintenance.

4.12.3 Emergency shut-down

Emergency shut-downs will be triggered either by an operator pushing the emergency stop, or if the control system detects any of the following events as an example:

- Low level alarm in the steam drum;
- Low flue gas pressure alarm in the furnace;
- High flue gas pressure alarm in the furnace;
- A single feedwater pump running;

- ID fan not running;
- Low ID fan speed alarm; and
- Low flue gas temperature in the furnace

In these scenarios, the combustion air fans and grate feed systems will be immediately stopped.

4.13 Ancillary equipment

4.13.1 Water treatment plant

The EfW CHP Facility will contain a water treatment plant (WTP) to treat the mains water supply to meet the required quality specifications for the boiler and turbine. The final treatment technology for the WTP is still to be confirmed but is likely to involve a demineralisation plant complete with filtration, ion exchange and a buffer storage tank for the demineralised water prior to its use.

Periodically, the ion exchange unit will need to be regenerated. This will be accomplished using acidic (hydrochloric acid) and alkaline (sodium hydroxide) washes. Effluent generated from regeneration of the ion exchange unit will be neutralised in a neutralisation tank and discharged to sewer under a trade effluent discharge consent with Anglian Water, or re-used within the bottom ash quench. Effluents from backwashing of the filters will be directed to the IBA quenching system dependent on the system levels.

The hydrochloric acid and sodium hydroxide will be stored in a ventilated room within the WTP building with appropriate containment systems in place, including a sump to capture any spillages. The chemical storage area will have chemical resistant floors and walls which act as bunds.

4.13.2 Emergency diesel generator

An emergency diesel generator will be provided to allow the safe shutdown of the EfW CHP Facility in the event that the EfW CHP Facility was disconnected from the electricity distribution network and island mode operation had failed. The emergency generator will be supplied with low sulphur diesel from the main gas oil storage tank.

The emergency generator will have an installed capacity of 2.6MW_e which, dependent on the final model chosen during detailed design, would have a thermal input of ~ 6MW_{th}. As the thermal input is greater than 1MW_{th}, the emergency generator will be a Medium Combustion Plant (MCP) and subject to the requirements of Schedule 25A of the EPR. However, as it will not operate for more than 500 hours per year, it is not required to meet the associated ELVs.

The generator will be tested on a regular basis (at least monthly) for up to one hour in-line with manufacturer recommendations. The aggregated number of testing hours is expected to be less than 60 hours per year.

5 Emissions and monitoring

This section describes how the release of any substance that might cause harm to human health or the environment will be prevented, or reduced, to achieve a high level of protection to the environment. As the final detailed design has not been completed, the description is based on an initial outline specification. The specification may deviate slightly from that considered in this application as a result of refinements during the detailed design process. However, the Environment Agency will be informed of the final detailed design prior to commissioning. The EfW CHP Facility will, as a minimum, achieve the performance levels provided within this document and the minimum legislative requirements under IED and the implementing BAT Conclusions.

The overall design philosophy of the EfW CHP Facility will be to:

- Achieve or exceed the environmental standards applicable under applicable legislation and/or guidance;
- Maximise the protection of human health and the environment by preventing or reducing emissions to a practicable minimum; and
- Be adaptable to changes or evolution in environmental standards or changes in available techniques for emissions control.

The EfW CHP Facility will be designed, operated and maintained to ensure high levels of availability and operational performance. The EfW CHP Facility will be designed to be in continuous and steady-state operation, with an automatic combustion control system ensuring stable operating conditions. The equipment will be specified and maintained to allow continuous operation at a constant and uninterrupted load. Maintenance will be pre-planned to ensure the safe, controlled shutdown of the process. However, within both the control system and operational procedures, provision will be made for responding to abnormal operating scenarios and these are described in more detail in Section 5.7.

5.1 Point source emissions to air

5.1.1 Location and nature of point source emissions to air

Point source emissions to air from the EfW CHP Facility will occur from the main thermal treatment processes, operation of the emergency diesel generator (in the event of loss of off-site power, failure of island mode operation, as well as routine load testing) and, subject to completion of design, the vent discharging air from the shutdown exhaust system. Emissions from the thermal treatment of waste will primarily comprise carbon dioxide, water vapour and nitrogen but low concentrations (parts per million or less) of the following pollutants will be emitted[8]:

- Oxides of nitrogen (NO_x, including nitrogen monoxide (NO) and nitrogen dioxide (NO_2);
- Acid gases (including sulphur dioxide (SO_2), hydrogen chloride (HCl) and hydrogen fluoride (HF));
- Particulate matter (PM_{10} and $PM_{2.5}$);

[8] Emissions from the emergency diesel generator will contain NO_x, CO, PM and SO_2, whilst emissions from the shutdown exhaust system vent will only contain odour.

- Carbon monoxide (CO);
- Volatile organic compounds (VOCs);
- Heavy metals (including cadmium (Cd), thallium (Tl), mercury (Hg), antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni) and vanadium (V));
- Polychlorinated dibenzo-para-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) (collectively referred to as 'dioxins' for simplicity);
- Polychlorinated biphenyls (PCBs);
- Polycyclic aromatic hydrocarbons (PAHs); and
- Ammonia and nitrous oxide (NH_3 and N_2O, from NO_x emissions control).

The EfW CHP Facility will have a sophisticated APC system for controlling emissions to air, designed to ensure compliance with the relevant ELVs prescribed within IED and BAT Associated Emission Levels (BAT-AELs) in the implementing BAT Conclusions for Waste Incineration. These APC techniques are described in more detail in Section 5.1.2.

In accordance with Article 46(1) of IED, the height of the chimneys discharging emissions to air from the main thermal treatment processes has been designed to ensure optimum dispersion and safeguard human health and the environment. The chimney height assessment that demonstrates compliance with this requirement is provided in Appendix A7. Based on this assessment, a chimney height of 84 m has been proposed.

The emergency diesel generator will only operate to provide power to essential equipment to ensure safe shutdown of the EfW CHP Facility in the event of loss of off-site power and failure of island mode operation. It will be operated for less than 60 hours per annum, with emissions controlled by the choice of fuel (low sulphur gas oil or fuel oil) and optimisation of combustion conditions through the engine management system.

Subject to the completion of detailed design, the vent discharging air from the shutdown exhaust system will emit treated building air extracted from the tipping hall and waste bunker to atmosphere after passing this air through a dust and activated carbon filter to control odour emissions. The shutdown exhaust system will only operate infrequently and for a limited period of time during an extended shutdown where both thermal treatment lines are not operating.

Table 5-1 summarises the main point source emissions to air and the nature of their emissions. A site plan showing the location of these emission points is provided in Appendix A3. In addition to these main emission sources, there may be several other minor, periodic releases to air, e.g., steam vents, displaced air emitted from filters on storage silos etc. The environmental impact of these emissions will be negligible and has not been considered further.

Table 5-1 Point source emission to air locations and nature of emission

Emission point reference	Source	Nature of emissions
A1	Treated exhaust gas emissions from Furnace Line 1	CO_2, NO_x, SO_2, HCl, HF, particulate matter, CO, VOCs, heavy metals, dioxins, PCBs, PAHs, NH_3, N_2O
A2	Treated exhaust gas emissions from Furnace Line 2	CO_2, NO_x, SO_2, HCl, HF, particulate matter, CO, VOCs, heavy metals, dioxins, PCBs, PAHs, NH_3, N_2O
A3	Emergency diesel generator	CO_2, NO_x, CO, SO_2, particulate matter
A4	Vent from shutdown exhaust system	Odour

5.1.2 Emission control techniques

The thermal treatment of waste will generate flue gases containing a range of pollutants. These emissions will be controlled by effective process design and control and optimisation of the combustion conditions. The residual emissions will be reduced to levels below the relevant ELVs by the APC system prior to discharge to atmosphere.

The systems that will be provided to achieve these aims (subject to final detailed design and vendor selection) are summarised in Table 5-2. Further information justifying the selection of certain techniques can be found in the BAT assessment in Appendix A4.

Table 5-2 Summary of emission control techniques for point source emissions from A1 and A2

Pollutant	Main emission control technique(s)
Particulate matter	Fabric filter
NO_x	Optimisation of the combustion process using advanced control system, selective non-catalytic reduction (SNCR), optimisation of the SNCR design and operation
CO	Optimisation of the combustion process using advanced control system
VOCs	Optimisation of the combustion process using advanced control system
SO_2	Dry scrubbing using hydrated lime
HCl	Dry scrubbing using hydrated lime
HF	Dry scrubbing using hydrated lime
Metals (excluding Hg)	Fabric filter

Pollutant	Main emission control technique(s)
Hg	Injection of activated carbon
PCDD/Fs and dioxin-like PCBs	Optimisation of the combustion process using advanced control system, boiler design to minimise de-novo synthesis including rapid flue gas cooling and on-line and off-line boiler cleaning, injection of activated carbon
PAHs	Optimisation of the combustion process using advanced control system
NH_3 and N_2O	Optimisation of the SNCR design and operation

Control of particulate matter emissions

Several types of abatement technologies are available for the control of particulate matter in the flue gas:

- Cyclones or multi-cyclones;
- Electrostatic precipitators (ESPs);
- Fabric filters (or 'bag filters'); and
- Wet scrubbing.

Cyclones are generally not considered to be the BAT on their own as they cannot attain the IED ELVs or BAT-AEL with removal efficiencies reducing considerably to near zero for particles less than 2.5µm. Cyclones can generally achieve flue gas concentrations of no less than 200 – 300mg/m^3, although this can be decreased to 100 –150mg/m^3 through the application of a multi-cyclone.

ESPs can either be operated in dry or wet form; the latter typically being used when dry ESPs are not suitable, including where the material collected is wet, sticky, flammable or explosive. Modern ESPs, either dry or wet, will typically achieve removal efficiencies between 90 – 99%. ESPs consist of a series of high voltage electrodes and corresponding collector plate electrodes. The high voltage differential between the electrodes and collector plate causes the particulate matter to become charged and move towards the plate under the influence of the electric field. Periodically, the plate is cleaned by rapping, which dislodges the material before falling to a collection hopper for removal. ESPs are particularly suited for higher temperature applications with high flow rates, and have a lower pressure drop than fabric filters. The disadvantage is the high parasitic electrical load required by the unit. ESPs can achieve concentrations of 15-25mg/m^3, although this is still in excess of the IED ELVs and BAT-AEL.

There are various different designs of wet scrubbers, with removal efficiencies ranging from 40 – 60% for a packed tower design and up to 95% for a venturi scrubber. They are generally not considered to represent BAT for control of particulate matter since they cannot achieve the ELVs and BAT-AEL, whilst also increasing the consumption of water. Furthermore, to maintain scrubbing efficiency, portions of the scrubbing liquor must be removed as wastewater. This wastewater must be treated (neutralisation, removal of heavy metals and suspended solids etc.) before being discharged and, consequently, requires the construction of a dedicated effluent treatment plant.

Fabric filters are proven technology and, in accordance with EPR 5.01, are considered BAT for control of particulate matter emissions from the combustion of municipal waste. Fabric filters are a barrier method, whereby the particulate matter collects on the surface of the filter bag. Over time, a filter 'cake' builds up on the surface of the filter media, further improving the collection efficiency. Research on EfW facilities in Italy[9] has demonstrated that removal efficiencies of 99.99% can be achieved, even for ultrafine particulate matter (generally defined as particulate matter with an aerodynamic diameter less than 0.1µm). The filter cake is periodically dislodged and the APCr collected in hoppers below the filter unit.

The fabric filter at the EfW CHP Facility will contain multiple compartments, each with a set of filter bags allowing isolation for online maintenance or cleaning. Online cleaning will be achieved using a reverse jet compressed air system to periodically dislodge the filter cake. The APCr is removed from the hoppers using an enclosed conveying system and initially stored in an intermediate silo where portions of the residues will be returned to the dry scrubbing reactor to optimise the utilisation of lime. The balance will be conveyed to one of four enclosed APCr silos with a combined capacity of 720m^3 (equivalent to minimum storage capacity of seven days).

Cleaning of the filter bags will be initiated automatically based on the monitored pressure drop across the fabric filter bags. When a set point is reached (high pressure drop), cleaning will commence and, when the differential pressure returns to a further set point (low pressure drop), cleaning operations will cease. Based on operational experience at MVV's other facilities, monitoring of the particulate matter emissions will provide a reliable system for detecting bag filter failures. Isolating individual compartments and monitoring the response in the CEMS allows the affected compartment to be identified, and investigation and maintenance to take place.

Control of NO_x, NH_3 and N_2O emissions

Appendix A4 provides a detailed description of the mechanisms affecting NO_x formation during combustion and the primary and secondary (end-of-pipe) measures for controlling resultant emissions. Based on the options appraisal in Appendix A4, the techniques that have been adopted (subject to completion of the detailed design) to control NO_x emissions from the EfW CHP Facility include:

- Optimisation of the combustion process using an advanced control system;
- SNCR; and
- Optimisation of the SNCR design and operation.

The furnace design will ensure effective mixing of gases formed during the combustion of waste and aims to provide a uniform velocity and temperature profile. This will avoid localised regions of high temperature which can promote thermal NO_x formation. CFD modelling of the final furnace design will demonstrate that this requirement is achieved.

An advanced automated combustion control system will continuously monitor and adjust key operating parameters including waste feed rate, supply of primary and secondary combustion air and grate speed, to

[9] Buonanno, G., Stabile, L., Scungio, M. and Tirler, W. (2011) 'Ultrafine particle emission from incinerators: the role of the fabric filter'. Journal and Air and Waste Management Association, 62, 103-111

achieve stable combustion conditions and minimise the formation of NO_x, CO and VOCs, whilst ensuring complete burnout of the waste.

Urea for the SNCR system will be injected into the furnace using an automated dosing control system that optimises the dosing rate based on the NO_x readings from the CEMS to minimise NH_3 slippage and formation of N_2O, meet the NO_x emission limits, and avoid the unnecessary use of raw materials. The dosing control system will contain flow monitoring and alarms to alert operators in the event of a blockage or malfunction of the system. SNCR port injection locations will be optimised using CFD modelling during the detailed design stage.

Based on the BAT assessment in Appendix A4, flue gas recirculation (FGR) is not currently proposed. The BAT assessment has demonstrated that SNCR + FGR is associated with a higher specific reduction cost (£/tonne) than SNCR alone, whilst SNCR in isolation can meet the IED ELVs and BAT-AEL. Furthermore, FGR will increase the parasitic energy demand and reduce the energy efficiency of the EfW CHP Facility and could increase levels of corrosion and maintenance costs. Consequently, it is not proposed to incorporate FGR at this outline design stage. However, this decision will be reviewed during detailed design once an EPC Contractor has been appointed.

The Environment Agency's *UK Interpretation Document for the 2019 Waste Incineration BAT Conclusions* indicates new plant will be expected to meet a daily average NO_x ELV of 100mg/Nm^3 where practicable. This is lower than the upper range BAT-AEL of 120mg/Nm^3 for new plant. As identified by the BAT assessment in Appendix A4, the only technique that could comfortably achieve this emission level with sufficient headroom would be selective catalytic reduction (SCR). SCR has not been proposed as the cost-benefit analysis in Appendix A4 demonstrates this is a less cost-effective technique (i.e., the specific reduction cost is greater) with greater cross media effects (reduced energy efficiency, increased consumption of raw materials, increased waste generation in the form of spent catalyst, and increased photochemical ozone creation potential), whilst NO_2 impacts on local air quality using SNCR are not predicted to be significant based on the air quality assessment in Appendix A7.

Dependent on the final design, it may be possible to configure the SNCR system and increase the urea dosing rate to meet an emission level of 100mg/Nm^3 but this is likely to increase ammonia slippage and subsequent impacts on the habitat sites assessed in Appendix A7. It will also increase the deposition of ammonia salts in the boiler and APC system, with subsequent concerns relating to corrosion. Consequently, the Operator proposes to conduct trials during the commissioning phase to both optimise the SNCR system and identify the viability of consistently achieving a NO_x ELV of 100mg/Nm^3 with an acceptable level of ammonia slip i.e., one that would not result in an exceedance of the BAT-AEL for ammonia or contribute to significant impacts on habitat sites, and which would not result in excessive deposition of ammonia salts. The Operator proposes to report the findings of these trials to the Environment Agency after completion of the commissioning trials as part of an improvement condition.

Control of acid gas emissions

Appendix A4 provides a detailed description of the techniques available to control emissions of acid gases (i.e., SO_2, HCl and HF). Based on the BAT assessment in that appendix, dry scrubbing using hydrated lime is considered to represent the BAT option because:

- Dry scrubbing achieves a similar level of emissions performance as semi-dry scrubbing and is a more cost-effective technique;
- Dry scrubbing reduces the consumption of water;
- Whilst semi-dry scrubbing has a slightly lower reagent requirement, it has a larger energy requirement than dry scrubbing. Hence, coupled with the reduced consumption of water, there are fewer cross-media effects with dry scrubbing; and
- Dry scrubbing can meet the BAT-AEL and prevents exceedances of relevant environmental benchmarks for ambient air.

Subject to the completion of detailed design, hydrated lime will be injected into a reactor upstream of a fabric filter. The injection rate will be controlled by an automated dosing control system using a screw feeder that optimises the dosing rate based on the HCl and SO_2 readings from the raw gas analyser and the CEMS to prevent unnecessary use of raw materials whilst ensuring compliance with emission limits. As described above, portions of the resultant APCr from the fabric filter will be recirculated back into the reactor to minimise the quantity of unreacted lime.

The hydrated lime will be stored in two silos with a capacity of 330m^3 per line equipped with level measurement systems with high level and low level alarms to prevent overfilling and to notify operators that reagent volumes are running low. Dosing rates will be monitored and alarmed to indicate a blockage or other malfunction.

Hydrated lime has been selected as the preferred sorbent to sodium bicarbonate on the basis of:

- Achieves the BAT-AEL;
- Lower global warming potential;
- Residues which are less prone to leaching;
- Future potential for recycling lime based residues; and
- Lower operational costs.

Control of metal emissions

Many of the heavy metals present in the incoming waste change phase (solid to liquid or gas) in the furnace and almost all will become phase divided; for example, mercury and cadmium typically vaporise in the furnace, whilst lead and antimony become molten. However, by weight, the vast majority of heavy metals in the flue gas are present as solid metal oxides. In practice, the majority of heavy metals form particles, or are adsorbed onto the surface of other particulate matter and, consequently, are removed by the fabric filter.

Unlike the other metals, mercury is present in the flue gases as a vapour. It will be removed from the flue gas through the injection of powdered activated carbon before the dry sorption reactor. In powdered form, the activated carbon provides a large surface area for efficient adsorption of mercury.

The carbon will be stored in two silos with a capacity of ~40m^3 per line. The dosing rate of carbon will be determined by the flue gas flow rate, MVV's experience at other facilities and the results of the commissioning trials. Hence, carbon will be dosed separately to the hydrated lime to allow appropriate control of both acid gases, mercury and PCDD/Fs (see below).

Control of PCDD/Fs and dioxin-like PCB emissions

The levels of PCDD/Fs and dioxin-like PCBs in the incoming waste are expected to be extremely low and the small fraction that could be present will be destroyed by the effective design and operation of the furnace system, particularly within the high temperature secondary combustion zone where gases will be maintained at a minimum temperature of 850°C for a minimum residence time of two seconds. As described previously for the control of NO_x emissions, use of an advanced automated combustion control system will ensure the combustion process is optimised, with CFD modelling used to optimise the design and ensure that the minimum temperature and residence time requirements are met.

Although the furnace will destroy any PCDD/Fs and dioxin-like PCBs in the waste, it is recognised that (re)formation of these compounds can occur in the boiler by *de novo* synthesis. This process, and subsequent measures to reduce the reformation of these compounds, has previously been described in Section 4.11.11. These measures include minimising the time that flue gases spend in the temperature range that promotes *de novo* synthesis by rapid cooling of the flue gases through boiler design, and both on-line and off-line boiler cleaning to reduce the deposition of boiler ash containing adsorbed metals that act as a catalyst for *de novo* synthesis. CFD modelling will be used to optimise the boiler design.

In addition to these primary control measures, the injection of powdered activated carbon prior to the dry sorption reactor will further reduce the concentration of PCDD/Fs and dioxin-like PCBs that may have formed through *de novo* synthesis.

Control of CO and organic compound emissions

Elevated CO and organic compound emissions are a consequence of poor combustion conditions resulting in incomplete combustion. As detailed previously, the furnace will be designed and operated to ensure that complete combustion and destruction of organic compounds occurs without the requirement for further control measures. Certain organic compounds will, however, be additionally removed through the injection of powdered activated carbon for mercury and PCDD/F emission control.

Table 5-3 reviews the proposed design and operation of the EfW CHP Facility against the indicative BAT requirements in EPR 5.01 for controlling emissions to air.

Table 5-3 Comparison of proposed design against sector specific indicative BAT requirements for controlling emissions to air

No	Indicative BAT requirement	Comparison with proposed design
Indicative BAT		
1	Unless you are operating an incinerator exempt from the requirements of WID, you must comply with the emission limit requirements of WID as a minimum. You must demonstrate that	The plant will be specifically designed to ensure that the IED ELVs and BAT-AELs are met during normal operation. In practice, based on experience at other sites operated by the applicant, it is expected that

No	Indicative BAT requirement	Comparison with proposed design
	your techniques are BAT which may result in lower emissions than WID emission limits.	emission levels will be well below these emission limits.
Particulate matter		
2	**Fabric filters** are proven and when correctly operated and maintained provide reliable abatement of particulate matter to below 5mg/m^3 and are likely to be BAT for many applications. They cannot be used at high temperatures (over approx. 250°C) as this may give rise to fire risk.	Fabric filters have been proposed for the EfW CHP Facility and are considered to represent BAT.
3	Use fabric filters with multiple compartments, which can be individually isolated in case of individual bag failures. There should be sufficient of these to allow adequate performance to be maintained when filter bags fail, i.e. design should incorporate capacity for meeting emission limits during on line maintenance.	The fabric filter unit will contain multiple compartments, with individual compartments having the ability to be isolated in case of individual bag failures.
4	Provide bag burst detectors (e.g. differential pressure type) on each compartment to indicate the need for maintenance when a bag fails. This type of system provides better control of emissions than simple observation of emitted particulate levels.	Differential pressure monitors will be installed on the fabric filter unit. Cleaning of the filter bags will be initiated automatically based on the monitored pressure drop across the filter unit. When a set point is reached, cleaning will commence and, when the differential pressure returns to a further set point, cleaning operations will cease. Based on operational experience at MVV's other facilities, monitoring of the particulate matter emissions will provide a reliable system for detecting bag filter failures. Isolating individual compartments and monitoring the response in the CEMS allows the affected compartment to be identified, and investigation and maintenance to take place.
5	Where **wet scrubbing** is used in combination with fabric filters (e.g. HWI), the cool and wet gases may require reheat (using indirect heat exchange from an otherwise waste heat source where practicable) to prevent dew point and other problems.	N/A – wet scrubbing is not proposed.
6	**Ceramic** filters may be used for high temperature applications, although their use has generally been limited to smaller plant owing to the larger gas volumes at higher temperatures. Fabric filters tend to be less susceptible to "blinding" and are therefore generally considered BAT.	Ceramic filters are not proposed. As the temperature of the flue gases will be between 145 - 150°C, conventional fabric filters are suitable.

No	Indicative BAT requirement	Comparison with proposed design
7	**Electrostatic precipitators (EPs)** are not BAT on their own, but they have a low pressure gradient and, by reducing particulate loading on filters, they may reduce the energy consumption of the induced draft fan. However, this energy saving will be minimal where reagents are dosed onto barrier filters as the contribution of the particulate load to the overall pressure drop is itself relatively minor in comparison to that created by the filters themselves and the reagent cake layer formed.	ESPs are not proposed as they cannot meet the IED ELVs and BAT-AEL in isolation. Furthermore, whilst they may reduce the energy consumption of the ID fan, they are, in themselves, an energy consumer and will affect the parasitic energy demand. Fabric filters will ensure the IED ELVs and BAT-AEL can be achieved.
8	Wet scrubbers on their own are not BAT for particulate abatement as they are not able to meet the same emission levels as other techniques. They can, however, help prevent emissions of soluble acid gases and heavy metals, and may represent BAT in combination with barrier filtration techniques as mentioned above. They give rise to liquid effluent, which, if not recycled into the process, requires treatment and disposal. You must consider this in your environmental assessment.	Wet scrubbing has not been proposed due to the significant cross media effects and as it could not meet the IED ELVs and BAT-AEL in isolation.
9	Wet scrubbers are likely to require re-heat to reduce the risk of forming a visible plume. Reheat should use waste heat from the installation. Additional imported energy is unlikely to be BAT.	N/A – wet scrubbing is not proposed.
Primary NO_x measures		
10	If you burn wastes that are nitrogen rich (e.g. sewage sludge), you will need to pay particular attention to the techniques for NOx reduction outlined below.	Measures are included in the design to control emissions from waste types that may be nitrogen rich. The automated control system will adjust urea dosing rates in response to the NO_x emissions monitored by the CEMS.
11	Use low NOx burners for burning liquid waste or for supplementary firing.	Low NO_x auxiliary burners will be used for start-up and supplementary firing if required.
12	Use starved air systems where appropriate to reduce both the oxygen content and the temperature in the area where the NOx is normally formed. They can combine good NOx and good CO performance particularly when used with separate chambers.	There are two main zones where combustion occurs; the primary combustion zone just above the grate and a secondary high temperature combustion zone. Primary and secondary air flows will be monitored and controlled in each zone to optimise the combustion conditions and minimise NO_x and CO emissions.

No	Indicative BAT requirement	Comparison with proposed design
13	Methane (natural gas) addition is an emerging technique, although not yet commercially proven, in which the gas is either injected into the bed where it can suppress the formation of NOx or into the secondary combustion area (termed reburn) where it can reduce the NOx which has already formed back to N_2.	This technique is not proposed as there is no commercially proven application for a facility of this capacity.
14	Fluidised bed combustors (FBC) operate at relatively lower combustion temperatures than other systems. They can therefore produce less thermal NOx than other designs and are commonly used for sewage sludge incineration. They are well suited to wastes of a consistent and small particle size but are not suited to large or heterogeneous waste feeds (e.g. raw municipal waste) unless those are pre-treated. Some waste streams (e.g. mixed raw municipal waste) have been difficult to pre-treat, with breakdowns and fires occurring. The potential NOx reductions of combining FBC and feed preparation must therefore be weighed against these potential difficulties for heterogeneous waste types.	N/A – FBC has not been selected as BAT for the EfW CHP Facility (see Appendix A4 for this justification)
15	Where the emission limit values stated in European Directives can be guaranteed without the need for secondary abatement (e.g. reagent injection), and the waste is suitable, FBC with limited (or no) reagent injection may represent BAT. However, such guarantees are not generally being given. This, and the ability of other non-FBC techniques to meet the required emission levels, and provide optimal reagent reaction conditions (see selective non catalytic reduction below) at slightly higher furnace temperatures means that there is currently little to choose between these technologies. The primary consideration should therefore remain that of waste characteristics.	Appendix A4 provides the justification for the selection of thermal treatment technique for the EfW CHP Facility.
16	Seal all equipment to prevent fugitive air ingress and maintain it under slight negative pressure to allow control of air input and to prevent combustion gas releases.	Combustion air flow will be automatically controlled to achieve complete combustion of the waste and the required burnout of the gases released. The furnace and combustion ductwork will be made gas tight and, in addition, the induced draft fan will ensure a slight negative pressure is maintained above the grate and throughout the system to prevent any leakage of flue gases.

No	Indicative BAT requirement	Comparison with proposed design
17	Optimise primary and secondary air feed so that conditions in the combustion chamber secure oxidative combustion of gases (and hence destruction of organic species), while not being excessive which would result in higher NOx production.	The locations of injection points for primary and secondary air will be optimised through CFD modelling of the final furnace design.
18	For new plant, or when undertaking upgrade of the combustion chamber you must use computerised fluid dynamics (CFD) to optimise your primary and secondary air input. You should provide alternative (multiple) air injection ports and directional injection nozzles to allow for in-service optimisation.	As above, this will be the case.
19	**Pyrolysis and gasification** plants are a special case in that they are specifically designed to operate the initial waste destruction stage at reduced oxygen levels. Pyrolysis itself requires the exclusion of oxygen, and semi-pyrolytic and gasification plant use sub-stoichiometric levels to promote gas evolution. It is important that these "reaction" stages are sealed, and that air flows are well controlled to prevent gas escape and to create optimal conditions. The considerations stated in this section regarding balancing the need for oxidative combustion and NOx prevention are relevant to the subsequent combustion of the products that result from the earlier "reaction" stages.	N/A – the EfW CHP Facility will not adopt pyrolysis or gasification as a technique.
20	Technical guidance for the combustion of products of these processes in internal combustion engines or gas turbines is provided in other guidance. However, it is important to note that their subsequent combustion will be required to comply with WID standards.	N/A – the EfW CHP Facility will not adopt pyrolysis or gasification as a technique.
21	Avoid excessive or uneven temperatures as this may lead to higher NOx formation (note, though, that you must comply with any minimum temperature requirements imposed by WID). Water cooled grates may assist with temperature control.	The furnace design will ensure effective mixing of gases formed during the combustion of waste and aims to provide a uniform velocity and temperature profile. This will avoid localised regions of high temperature which can promote thermal NOx formation. CFD modelling of the final furnace design will demonstrate that this is achieved.

No	Indicative BAT requirement	Comparison with proposed design
21	Use **Flue Gas Recirculation**, which provides an effective means of NOx prevention by replacing 10 to 20% of secondary air with re-circulated flue gases. It has the additional benefit of reducing the consumption of reagents used for secondary NOx control (see below) and may increase overall energy recovery by retaining heat from stack gases. Retrofits at existing plants may prove expensive or impractical due primarily to the space required for ducting.	The BAT assessment in Appendix A4 has demonstrated that SNCR + FGR is associated with a higher specific reduction cost (£/tonne) than SNCR alone, whilst SNCR in isolation can meet the IED ELVs and BAT-AEL. Furthermore, FGR will increase the parasitic energy demand and reduce the energy efficiency of the EfW CHP Facility, and could increase levels of corrosion and maintenance costs. Consequently, it is not proposed to incorporate FGR at this outline design stage. However, this decision will be reviewed during detailed design once an EPC Contractor has been appointed.
Secondary NO_x measures		
23	Secondary measures should be considered after the application of primary NOx reduction measures outlined above. The use of secondary measures without applying the primary measures outlined above (including FGR) is unlikely to represent BAT as the primary techniques will serve to reduce the production of NOx, which in turn will reduce reagent consumption during secondary treatment stages.	The design includes both primary and secondary measures as described in this section.
Selective non-catalytic reduction (SNCR)		
24	Injection of NH_2 -X compounds into the furnace reduces the emission of NOx by chemically reducing it to nitrogen and water. It is also reported to inhibit dioxin formation. Ammonia and urea injection are suitable and either may represent BAT. When dosing is optimised, ammonia tends to give rise to lower nitrous oxide formation (a potent greenhouse gas); however urea may be effective over a slightly wider temperature window and is easier to handle. SNCR relies on an optimum temperature around 900 °C, and sufficient retention time must be provided for the injected agents to react with NO. Port injection locations must therefore be optimised (CFD modelling may be useful and is likely to be essential for all new plant).	Urea will be injected into the furnace using an automated dosing control system that optimises the dosing rate based on the NOx readings from the CEMS to minimise ammonia slippage, meet the NOx emission limits, and avoid the unnecessary use of raw materials. Ammonium hydroxide is a potential alternative to urea for the SNCR system. Use of urea in preference to ammonium hydroxide results in a slightly greater emission of N_2O and a corresponding increase in the Global Warming Potential (GWP) of the EfW CHP Facility. However, there are greater health and safety risks associated with the handling and storage of ammonium hydroxide and, for this reason, urea has been selected as the preferred reagent. Port injection locations will be optimised during detailed design using CFD modelling.

No	Indicative BAT requirement	Comparison with proposed design
25	Poorly optimised reagent injection may give rise to elevated emissions of ammonia. NOx levels should be monitored and the addition of reagent closely controlled to minimise the possibility of ammonia slippage.	The dosing rate of urea will be controlled based on the monitored NO_x emissions from the CEMS to ensure emission limits are met, whilst optimising the consumption of raw materials and minimising ammonia slippage.
26	It is probable that SNCR will be required to ensure that WID standards are met. In order to comply with WID, daily average NOx standards reagent injection rate set points are typically set so that longer term average releases are in the range of 150 to 180mg/m^3. At higher reagent dosing rates further NOx reductions can be achieved but only with increasing cost – reductions significantly beyond WID compliance therefore appear unlikely to represent BAT. This may not be the case at large plant (over 250K te/yr waste throughput) or where local environmental conditions justify additional NOx reduction.	SNCR will be installed to ensure the daily mean BAT-AEL is met at all times. At this concentration, the air quality assessment in Appendix A7 demonstrates there are no significant impacts associated with NO_x emissions.
Selective catalytic reduction (SCR)		
27	SCR reduces NO and NO_2 to N_2 by the addition of NH3 and a catalyst at a temperature range of about 300-400°C. SCR technology can also reduce VOCs, CO and dioxin emissions.	The use of SCR has been considered in the BAT assessment in Appendix A4. It has been discounted as BAT for the EfW CHP Facility after completion of a cost-benefit analysis which indicates that, whilst SCR can reduce emissions further, it is a less cost-effective technique than SNCR for each tonne of NO_x removed, and increases cross media effects by decreasing the energy efficiency, increasing the raw material requirement/waste disposal quantities, increasing photochemical ozone creation potential and increasing global warming potential relative to SNCR.
28	SCR is a proven technology in the waste incineration sector, where NOx emissions of below 70mg/m^3 are achieved.	N/A – as above, SCR is not considered to be BAT for the EfW CHP Facility.

No	Indicative BAT requirement	Comparison with proposed design
29	The additional costs of SCR are derived mainly from the energy requirements of achieving the required temperature range after the other abatement plant. Low temperature SCR techniques have been developed that avoid this and it is claimed that the costs are of the same order as SNCR.	N/A – as above, SCR is not considered to be BAT for the EfW CHP Facility for a range of factors other than just cost.
30	You should include consideration of the use of SCR in your cost benefit assessment and justify if it is not employed. Similarly use of the technique must also be justified against the alternatives (e.g. SNCR) with particular reference to the possibility of reduced energy efficiency with SCR owing to gas re-heat.	Appendix A4 provides this assessment.
Cost/benefit		
31	You must provide a cost/benefit study, using the methodology in Horizontal Guidance Note H1 Environmental Risk Assessment, that demonstrates the relative merits of primary measures, SNCR and SCR for NOx control at the installation. The comparison must show the cost per tonne of NOx abated over the projected life of the plant using the asset lives and typical discount rates given in that document.	Appendix A4 provides this assessment.
Acid gas and halogens		
32	Techniques that may represent BAT to minimise acid gas and halogen releases are summarised below. The technique that represents BAT in one incineration sub-sector may be different from that which provides a solution for another. This will generally relate to the potential of the particular waste stream to give rise to acid gas emissions, their quantity and variability.	No response required.

No	Indicative BAT requirement	Comparison with proposed design
Primary acid gas measures		
33	Use low sulphur fuels <0.2% w/w for start-up and support. During start up, shut down, and to support combustion at a temperature above the minimum specified for the particular waste type, WID prohibits the use of fuels which can cause higher emissions than those of gas oil (as defined by Art 1(1) of Directive 75/716/EEC), liquefied gas or natural gas. In requiring the relevant combustion temperature to be maintained at all times when waste is being burned, WID also effectively prevents the use of wastes as a start up fuel, regardless of specification.	Low sulphur (<0.1wt%) diesel or fuel oil will be used in the auxiliary burners at start-up and shut-down, and if required to ensure minimum temperature requirements are met during normal operation.
34	Because the primary purpose of incineration is the disposal of waste, there may be few opportunities to influence releases through waste selection. It is fundamental that the installation should be designed to cope with the type of waste it is to receive (see abatement design envelope below). However, sometimes a particular waste stream is known to create particular difficulties or the waste stream has changed. An example of this is large quantities of PVC plastics or plaster board where they are not well mixed with other waste at municipal waste incinerators. Where such problems occur, you are expected to take whatever steps are necessary to ensure compliance.	Bunker management procedures will be developed to ensure mixing of the different incoming waste sources to improve the homogeneity of the feed to the furnace. These management procedures will include mixing and turning of incoming wastes using trenching and stacking by the waste bunker crane to blend the incoming waste. Any increases in emissions due to particular waste types will be recorded by the CEMS and dosing rates of hydrated lime automatically increased by the automated control system. Contracts with waste suppliers and pre-acceptance procedures define a list of excluded or problematic waste types.
35	These may include: • upstream waste management to prevent the inclusion of problem wastes • use of front end waste treatment techniques • abatement plant operation trimming • abatement plant redesign and rebuild	As above, bunker management procedures and automated control of hydrated lime dosing rates will ensure compliance with the IED ELVs and BAT-AELs, whilst minimising the consumption of raw materials.
36	These options are discussed further below. The chosen options will depend upon the nature of the particular waste stream and decisions regarding the ability to reliably segregate the problematic fractions.	As above.

No	Indicative BAT requirement	Comparison with proposed design
37	Waste selection or segregation techniques may help to prevent releases of acid gases by: • allowing the removal of problem wastes • homogenising the waste feed to provide for improved process stability	As above.
38	This can give the following benefits: • minimising the quantity of reagent required to treat the acid gases • minimising the amount of waste reagent requiring re-circulation or disposal.	As above.
Abatement design limits		
39	Waste varies in terms of its physical and chemical nature depending upon its source and whether it has undergone any pre-segregation or treatment. You must therefore be clear about the types of wastes you intend to receive and their composition. Your application must very clearly outline the composition of the types of waste that will be incinerated and demonstrate that the installation design takes the full range of likely compositions into account. Existing installations may be able to illustrate this with real data regarding waste types and emissions compliance.	The waste types that the EfW CHP Facility has been specifically designed to accept and treat are provided in Table 4-1 whilst the firing diagram in Figure 4-2 indicates the range of throughput and waste calorific value that can be processed.
40	In particular the abatement plant design envelope must be wide enough to account for the variation in raw flue acid gas concentrations that will be encountered. Particular care must be taken to ensure that short term fluctuations are considered.	The APC plant will be specifically designed to account for these requirements and, in particular, any potential short-term fluctuations in emissions.
41	The design of the acid gas abatement system must take full account of the flue gas loading and the reaction kinetics of the reagent selected in the conditions that will be encountered in the equipment. In-situ temperatures and moisture contents will have a key role in determining the residence time that is required to ensure effective acid gas neutralisation (and removal). Once you have established the abatement plant design you should provide sufficient over-capacity to allow for maintenance or variation in waste composition.	These considerations will be made as part of the detailed design of the APC plant.

No	Indicative BAT requirement	Comparison with proposed design
42	In your application you must pay particular attention in describing how waste will be managed to prevent operation outside the design envelope that could lead to possible breaches of authorised limits. This shall include consideration of: • the breadth of waste composition likely to be encountered in the waste types to be received • identification of any particular wastes which may cause high acid gas loading; this should make reference to any commonly encountered difficulties within the particular sector • measures to be taken to prevent the incineration of the wastes identified, including the upstream management of wastes to prevent their inclusion with other waste; • measures to treat or mix wastes to ensure peaks are smoothed out • plant detection and control measures included to deal with short term high acid gas loading (see below).	As described previously, the EfW CHP Facility will be specifically designed to allow for varying compositions of the waste types in Table 4-1. These waste types will be specified in supply contracts with waste companies supplying waste to the EfW CHP Facility. Bunker management procedures will be developed to ensure mixing of the different incoming waste sources to improve the homogeneity of the feed to the furnace. These management procedures will include mixing and turning of incoming wastes using trenching and stacking by the waste bunker crane to blend the incoming waste. SO_2 and HCl emissions will be continuously monitored. Rapid feedback loops from the CEMS to the DCS will automatically control and alter the dosing rate of hydrated lime to ensure any short-term peaks in acid emissions that do occur, despite these primary measures, will not result in an exceedance of the IED ELVs or BAT-AELs.
Secondary acid gas measures		
43	The advantages of the three main techniques, wet, dry and semi-dry, are shown in Table 3.4 below. You must justify the selected technology by referring to the factors indicated.	The BAT assessment in Appendix A4 has compared the three options. The justification of dry scrubbing as BAT for the EfW CHP Facility can be found in this Appendix.
44	The advantages of the main reagents are shown in Table 3.5 below. You must justify their selection by referring to the factors indicated.	The BAT assessment in Appendix A4 has compared the different reagent options. The justification for the use of hydrated lime as BAT for the EfW CHP Facility can be found in this Appendix.
45	It may be possible for some waste streams of very consistent composition, that can be demonstrated to be reliably very low in halogens (e.g. well segregated non-halogenated waste solvent streams incinerated on the site of production) to be incinerated without alkaline scrubbing. Indeed, to do so where clearly not necessary is itself unlikely to be BAT owing to the unnecessary consumption of reagent. Water scrubbing only may be acceptable in these circumstances.	Whilst bunker management procedures will aim to homogenise the waste feed to the furnace, the inherent nature of residual HIC waste means that there is likely to be at least some variation in composition of halogen content of the waste and, hence, acid gas emissions. Consequently, water scrubbing alone would unlikely be considered BAT and has not been proposed.

No	Indicative BAT requirement	Comparison with proposed design
Alkaline reagent dosing control		
46	BAT requires optimisation of the alkaline reagent dosing system. This is because a well optimised reagent dosing control system will: • control acid gas emissions within emission limit values • reduce consumption of reagent • reduce production of alkaline residues	This is noted and the final design of the APC plant will aim to ensure these three aims are met.
47	You should optimise the alkaline reagent dosing system, by: • trimming reagent dosing to acid load using fast response upstream HCl or SO_2 monitoring as a trigger • ensuring reagent concentration can be rapidly changed through use of variable speed pumps / screw feeders and / or low volume intermediate silos (which will allow for more rapid concentration changes) • use of small silo load cell systems to provide close control on reagent delivery rates in dry systems • ensuring good (preventative) maintenance of all reagent handling and delivery equipment • providing sufficient absorption buffer capacity retained in abatement system to maintain abatement when feed fails • using multiple or back-up feed systems on standby to maintain reagent feed.	Hydrated lime will be injected into a reactor upstream of a fabric filter using an automated dosing control system that optimises the dosing rate based on the HCl and SO_2 readings from the CEMS to prevent unnecessary use of raw materials whilst ensuring compliance with emission limits. Hydrated lime will be extracted from the raw material storage silos and injected upstream of the reactor using a screw feeder, allowing for fine control of the injection rates. The storage silos will be equipped with level monitoring systems with high level and low level alarms to prevent overfilling and to notify operators that reagent volumes are running low. Dosing rates will be monitored and alarmed to indicate a blockage or other malfunction. The APC system will be subject to regular preventative maintenance, with these procedures established in the IMS.
Cost/benefit		
48	You must provide an acid gas control cost/benefit study using the methodology in Horizontal Guidance Note H1 Environmental Risk Assessment, to demonstrate the relative merits of primary and secondary measures. The comparison must show the cost per tonne acid abated (as HCl) over the projected life of the plant using the asset lives and typical discount rates given in that document.	This assessment can be found in Appendix A4.

No	Indicative BAT requirement	Comparison with proposed design
49	As some technological options will be mutually exclusive, you can assess the overall viable installation design alternatives in relation to that selected, whilst providing comment regarding the reasons why any apparently better individual process stages are not selected on grounds over overall incompatibility.	This assessment can be found in Appendix A4.
Carbon dioxide		
50	All measures that reduce fuel energy use also reduce the CO_2 emissions. The selection, when possible, of raw materials with low organic matter content and fuels with low ratio of carbon content to calorific value reduces CO_2 emissions. In this sector this is only relevant to the support fuels used. In general natural gas will be the preferred option. If not available low sulphur gas oil provides an alternative.	Low sulphur diesel or fuel oil will be used in the auxiliary burners. The use of support fuel will be minimised through effective design and operational management. Measures to optimise the energy efficiency of the EfW CHP Facility are described in Section 3.3.
51	The global warming potential (GWP) of the installation will be derived mainly from the CO2 releases arising from the waste combustion. As it is the purpose of an incinerator to convert wastes into (primarily) water and CO_2 attention should not focus upon these releases but upon the following: CO_2 equivalent releases resulting from N_2O releases. These can contribute in the order of 10% of the GWP, and may be minimised by appropriate selection and optimisation of SNCR reagent injection.	Emissions of N_2O will be minimised through optimisation of the urea dosing rate based on the monitored NO_x emissions from the CEMS.
52	Improving installation energy efficiency (including recovery) will prevent CO_2 release by other installations. This may be demonstrated by providing energy balance (Sankey) diagrams and quoting the net energy production per tonne of waste produced.	The EfW CHP Facility has been designed to maximise the energy generated from the combustion of the incoming waste and minimise the parasitic load. The measures to improve the energy efficiency of the EfW CHP Facility, including a Sankey diagram, are described in Section 3.3.
Carbon monoxide and volatile organic compounds		
53	Elevated CO emissions indicate poorly controlled combustion and may indicate elevated releases of other products of poor combustion.	This is noted. The design of the plant will be to ensure combustion conditions are optimised whenever waste is present on the grate.

No	Indicative BAT requirement	Comparison with proposed design
54	Carbon monoxide emissions are not influenced to any significant extent by the conventionally employed abatement techniques. Reductions in CO may be achieved using catalytic oxidation, pulsed corona or re-burn techniques but these are not known to be used at a commercial scale and would in any event be less preferable to primary techniques for the prevention of CO formation.	Primary techniques, in the form of an advanced automated combustion control system, and high temperature secondary combustion zone, will be used to control emission of CO.
55	VOCs may be removed to some extent by means of wet scrubbing but they are liable to be released from solution.	Wet scrubbing has not been proposed due to the associated cross media effects. VOC emissions will be minimised through primary combustion control techniques, with injection of activated carbon further reducing residual emissions.
56	Reductions in CO and VOC emissions may be achieved by: • ensuring the furnace and combustion requirements outlined earlier in this sector guidance are complied with • securing consistent waste feed characteristics (e.g. CV, moisture) and feed rates.	The combination of bunker management procedures to improve the homogeneity of the waste feed, appropriate design of the furnace described in Section 4, and the use of an advanced automate combustion control system will minimise the emissions of CO and VOCs.
57	Starved air systems such as pyrolysis, semi-pyrolytic and gasification processes by their nature deliberately create combustible gases that will comprise high concentrations of CO and VOCs. These partially oxidised gases will need to be burned before release.	N/A – pyrolysis or gasification will not be used at the EfW CHP Facility.
58	Current evidence concerning the ability of these processes to meet the required standards is contradictory. In all cases you will therefore be required to demonstrate that the chosen combustion stage, either alone or in combination with a secondary combustion stage, will be capable of meeting WID and the relevant emission limit values.	N/A – pyrolysis or gasification will not be used at the EfW CHP Facility.

No	Indicative BAT requirement	Comparison with proposed design
Dioxins and furans		
59	Although dioxins can be removed by abatement, the primary method of minimising releases is by careful control of combustion conditions. The gas residence times, temperatures and oxygen contents at the combustion stage must be such that any dioxins/furans should be efficiently destroyed.	Whilst injection of powdered activated carbon will provide further reductions in dioxin emissions, the main control techniques for dioxins are those primary measures described in this section i.e., use of an advanced automated control system to achieve the minimum temperature and residence time requirements, minimising the time that flue gases spend in the temperature range that optimises *de novo* synthesis by rapid cooling of the flue gases through boiler design, and both on-line and off-line boiler cleaning to reduce the deposition of boiler ash containing adsorbed metals that act as a catalyst for de novo synthesis.
60	You should ensure that the conditions for de novo synthesis are avoided by ensuring exit gas streams are quickly cooled through the de novo temperature region between 450°C and 200°C. This should be considered in the design of the energy recovery boiler.	The boiler will be specifically designed to allow rapid cooling of the flue gases through the *de novo* synthesis range. This will be confirmed, and the boiler design optimised, using CFD modelling.
61	As well as a source of organic materials, dioxin/furan formation needs chlorine and thus limiting chlorine input (where this is possible) may have some effect. Where higher concentrations are unavoidable (e.g. HWIs) the prevention of dioxin releases will become a dominant factor in the plant design to an extent that the recovery of energy from the waste stream may be excluded in favour of rapid quench using water. Such quench systems must be designed to achieve a maximum exit temperature of 200 °C (in practice a temperature of approximately 70 °C is likely).	N/A – the EfW CHP Facility is not a HWI.
62	Dioxins tend to adhere to particulate matter and therefore **efficient particulate abatement** will remove dioxin/furans from the gas phase. Bag filters impregnated with catalyst specifically developed for the destruction of dioxins/furans are now commercially available and, where fabric filters are installed, should be used where the benchmarks in Annex 1 cannot be otherwise achieved.	The combination of measures described previously to control dioxin emissions will ensure the IED ELV and BAT-AELs can be achieved. As a result of this, and due to the flue gas temperature being lower than the optimum temperature for catalytic filter bags, standard fabric filters are proposed.
63	**FGR, SNCR and SCR** are all reported to help to prevent dioxin formation and promote their destruction.	SNCR forms part of the proposed design.

No	Indicative BAT requirement	Comparison with proposed design
64	**Carbon injection** has a proven record of reducing dioxin emissions at a wide range of facilities for relatively little cost and is therefore BAT. The carbon is commonly injected into the gas stream with the acid gas abatement reagent, prior to retention upon filtration equipment.	Injection of powdered activated carbon upstream of the sorbent reactor and fabric filter forms part of the proposed design.
Metals		
65	In the case of mercury (Hg) there is some scope for control at CWIs as the main sources would appear to be dental amalgam. Up-stream waste segregation should be encouraged where releases approach emission limits. (We note that you are likely to have little control over the metal content of the wastes received.)	N/A – the EfW CHP Facility is not a CWI.
66	**Carbon injection** gives reliable and effective mercury reductions if Hg is a problem.	Injection of powdered activated carbon upstream of the sorbent reactor and fabric filter forms part of the proposed design
67	For the majority of metals particulate abatement is the main means of ensuring that releases are minimised.	This is noted and the proposed use of a fabric filter will ensure metal emissions are minimised.
Iodine and bromine		
68	When wet scrubber systems are used and plume colouration from iodine or bromine is a problem, sodium thiosulphate can be added to the scrubber to reduce iodine and bromine to the respective halogen hydride. The resulting effluent stream will require treatment.	N/A – wet scrubbing systems are not proposed.

5.1.3 Benchmark emissions and emissions inventory

Table 5-4 through Table 5-7 provide the emissions inventory and proposed benchmark emission limits for the emission to air sources.

Table 5-4 Emission inventory and benchmark emissions (emission point A1)

Release point	Substance	Emissions			Calculated (C), measured (M) or Estimated (E)	Benchmark emission limits	
		mg/Nm³ (except where indicated)	g/s [D]	t/y [E]		BAT-AEL	IED Annex VI
Line 1 (A1)	NOx	120[A]/400[B]	7.46	214.8	E	120mg/Nm³ (daily average)	200mg/Nm³ (daily average) 400mg/Nm³ (30-min average)
	SO_2	30[A]/200[B]	1.86	53.7	E	30mg/Nm³ (daily average)	50mg/Nm³ (daily average) 200mg/Nm³ (30-min average)
	CO	50[A]/100[B]	3.11	89.5	E	50mg/Nm³ (daily average)	50mg/Nm³ (daily average) 100mg/Nm³ (30-min average)
	Particulate matter	5[A]/30[B]	0.31	9.0	E	5mg/Nm³ (daily average)	10mg/Nm³ (daily average) 30mg/Nm³ (30-min average)
	VOC (expressed as TOC)	10 [A]/20 [B]	0.62	17.9	E	10mg/Nm³ (daily average)	10mg/Nm³ (daily average) 20mg/Nm³ (30-min average)
	HCl	6 [A]/60 [B]	0.37	10.7	E	6mg/Nm³ (daily average)	10mg/Nm³ (daily average) 60mg/Nm³ (30-min average)
	HF	1 [A]/4 [B]	0.06	0.3	E	1mg/Nm³ (daily average or average over sampling period)	1mg/Nm³ (daily average) 4mg/Nm³ (30-min average)
	NH_3	10 [A]	0.62	17.9	E	10mg/Nm³ (daily average)	No limit

Release point	Substance	Emissions			Calculated (C), measured (M) or Estimated (E)	Benchmark emission limits	
		mg/Nm³ (except where indicated)	g/s [D]	t/y [E]		BAT-AEL	IED Annex VI
	Cd and Tl	0.02 [C]	0.001	0.04	E	0.02mg/Nm³ (average over the sampling period)	0.05mg/Nm³ (average over the sampling period)
	Hg	0.02 [C]	0.001	0.04	E	0.02mg/Nm³ (daily average or average over the sampling period)	0.05mg/Nm³ (average over the sampling period)
	As, Co, Cr, Cu, Mn, Ni, Pb, Sb, V	0.3 [C]	0.019	0.54	E	0.3mg/Nm³ (average over the sampling period)	0.5mg/Nm³ (average over the sampling period)
	PCDD/Fs	0.04 (ng I-TEQ/Nm³) [C]	$2.5x10^{-9}$	$7.2x10^{-8}$	E	0.04ng I-TEQ/Nm³ (average over the sampling period)	0.1ng I-TEQ/Nm³ (average over the sampling period)
	PCDD/Fs and dioxin-like PCBs	0.06 (ng WHO-TEQ/Nm³) [C,G]	$3.7x10^{-9}$	$1.1x10^{-7}$	E	0.06ng I-TEQ/Nm³ (average over the sampling period)	No limit
	PCBs	0.004 (ng WHO-TEQ/Nm³) [C]	$2.4x10^{-10}$	$6.9x10^{-9}$	M [F]	No limit	No limit
	PAHs	0.47 (µg/Nm³) [C]	$2.9x10^{-5}$	$8x10^{-4}$	M [F]	No limit	No limit
	N_2O	5.4	0.34	9.7	M [F]	No limit	No limit

[A] Daily averaged emission concentration at reference conditions of 273K, 101.3 kPa, 11% O_2, dry gas.

[B] Maximum 30-minute average emission concentration at reference conditions of 273K, 101.3 kPa, 11% O_2, dry gas.

[C] Average emission concentration over the sampling period at reference conditions of 273K, 101.3 kPa, 11% O_2, dry gas.

[D] Emission rate based on daily average concentration.

[E] Annual emission based on daily average emission rate and 8,000 hours of operation per year.

[F] As there is no benchmark data for these emissions, monitored data obtained during 2020 and 2021 from MVV's other EfW CHP Facility in Devonport has been used.

[G] Emissions are not additive with PCDD/Fs in isolation

Table 5-5 Emission inventory and benchmark emissions (emission point A2)

Release point	Substance	Emissions			Calculated (C), measured (M) or Estimated (E)	Benchmark emission limits	
		mg/Nm³ (except where indicated)	g/s [D]	t/y [E]		BAT-AEL	IED Annex VI
Line 2 (A2)	NOx	120[A]/400[B]	7.46	214.8	E	120mg/Nm³ (daily average)	200mg/Nm³ (daily average) 400mg/Nm³ (30-min average)
	SO_2	30[A]/200[B]	1.86	53.7	E	30mg/Nm³ (daily average)	50mg/Nm³ (daily average) 200mg/Nm³ (30-min average)
	CO	50[A]/100[B]	3.11	89.5	E	50mg/Nm³ (daily average)	50mg/Nm³ (daily average) 100mg/Nm³ (30-min average)
	Particulate matter	5[A]/30[B]	0.31	9.0	E	5mg/Nm³ (daily average)	10mg/Nm³ (daily average) 30 mg/Nm³ (30-min average)
	VOC (expressed as TOC)	10 [A]/20 [B]	0.62	17.9	E	10mg/Nm³ (daily average)	10mg/Nm³ (daily average) 20 mg/Nm³ (30-min average)
	HCl	6 [A]/60 [B]	0.37	10.7	E	6mg/Nm³ (daily average)	10mg/Nm³ (daily average) 60mg/Nm³ (30-min average)
	HF	1 [A]/4 [B]	0.06	0.3	E	1mg/Nm³ (daily average or average over sampling period)	1mg/Nm³ (daily average) 4mg/Nm³ (30-min average)

Release point	Substance	Emissions			Calculated (C), measured (M) or Estimated (E)	Benchmark emission limits	
		mg/Nm³ (except where indicated)	g/s [D]	t/y [E]		BAT-AEL	IED Annex VI
	NH_3	10 [A]	0.62	17.9	E	10mg/Nm³ (daily average)	No limit
	Cd and Tl	0.02 [C]	0.001	0.04	E	0.02mg/Nm³ (average over the sampling period)	0.05mg/Nm³ (average over the sampling period)
	Hg	0.02 [C]	0.001	0.04	E	0.02mg/Nm³ (daily average or average over the sampling period)	0.05mg/Nm³ (average over the sampling period)
	As, Co, Cr, Cu, Mn, Ni, Pb, Sb, V	0.3 [C]	0.019	0.54	E	0.3mg/Nm³ (average over the sampling period)	0.5mg/Nm³ (average over the sampling period)
	PCDD/Fs	0.04 (ng I-TEQ/Nm³) [C]	$2.5x10^{-9}$	$7.2x10^{-8}$	E	0.04ng I-TEQ/Nm³ (average over the sampling period)	0.1ng I-TEQ/Nm³ (average over the sampling period)
	PCDD/Fs and dioxin-like PCBs	0.06 (ng WHO-TEQ/Nm³) [C, G]	$3.7x10^{-9}$	$1.1x10^{-7}$	E	0.06ng I-TEQ/Nm³ (average over the sampling period)	No limit
	PCBs	0.004 (ng WHO-TEQ/Nm³) [C]	$2.4x10^{-10}$	$6.9x10^{-9}$	M [F]	No limit	No limit
	PAHs	0.47 (µg/Nm³) [C]	$2.9x10^{-5}$	$8x10^{-4}$	M [F]	No limit	No limit
	N_2O	5.4 [C]	0.34	9.7	M [F]	No limit	No limit

[A] Daily averaged emission concentration at reference conditions of 273K, 101.3 kPa, 11% O_2, dry gas.

[B] Maximum 30-minute average emission concentration at reference conditions of 273K, 101.3 kPa, 11% O_2, dry gas.

[C] Average emission concentration over the sampling period at reference conditions of 273K, 101.3 kPa, 11% O_2, dry gas.

[D] Emission rate based on daily average concentration.

[E] Annual emission based on daily average emission rate and 8,000 hours of operation per year.

[F] As there is no benchmark data for these emissions, monitored data obtained from MVV's operational EfW CHP Facility in Devonport has been used.

[G] Emissions are not additive with PCDD/Fs in isolation

Table 5-6 Emission inventory and benchmark emissions (emission point A3)

Release point	Substance	Emissions			Calculated (C), measured (M) or Estimated (E)	Benchmark emission limit
		mg/Nm^3 (except where indicated) [A]	g/s	t/y [B]		
Emergency diesel generator (A3)	NOx	3,582	6.3	1.4	E	No limit [C]
	SO_2	102	0.2	0.04	E	No limit [C]
	CO	190	0.3	0.06	E	No limit [C]
	Particulate matter	7	0.01	0.002	E	No limit [C]

[A] At reference conditions of 273K, 101.3 kPa, 5% O_2, dry gas

[B] Annual emission based on 60 hours of routine testing per year

[C] As described in Section 4.13.2, as the emergency diesel generator will operate for less than 500 hours per year, under Schedule 25A, Part A, Section 8(1) of the EPR, the MCPD emission limits will not apply

Table 5-7 Emission inventory and benchmark emissions (emission point A4)

Release point	Substance	Emissions			Calculated (C), measured (M) or Estimated (E)	Benchmark emission limit
		ou_E/m^3	m^3/s	ou_E/s		
Vent from shutdown exhaust system (A4)	Odour	3,000 [A]	44.44	133,333	E	No limit

[A] Estimated concentration assuming partial breakthrough of the carbon as a conservative assumption

5.2 Emissions to surface water and sewer

5.2.1 Surface water

Uncontaminated run-off from hardstanding areas of the EfW CHP Facility, including from roads and building roof areas, but excluding process areas where waste or other potentially polluting substances are stored, will be collected in a dedicated surface water drainage system and discharged to the Hundred of Wisbech Internal Drainage Board (HWIDB) drains at two locations:

- W1 – the HWIDB drain that transects the installation; and
- W2 – the HWIDB drain that runs along the eastern boundary of the installation.

The surface water drainage system will be based on the Sustainable Drainage Systems (SuDS) concept comprising oil interceptors, swales, basins and underground attenuation tanks. Penstock valves will be installed at key points on the drainage system and prior to the final discharge to surface water. This will allow the surface water drainage system to be isolated in the event of an emergency (e.g., fire) or spillage, so that the contents of the system can be tested before a decision is made to continue the discharge to the HWIDB drains or, alternatively, to pump the contents to tanker for off-site treatment.

Appendix A3 provides a figure indicating the location of these discharge points, as well as providing a drainage plan.

5.2.2 Foul sewer

During normal operation of the EfW CHP Facility i.e., excluding periods of maintenance, the only discharges to sewer will be domestic effluent from amenity areas (e.g., kitchens, washrooms etc). The EfW CHP Facility will be designed as a 'zero process effluent' process, with process effluents, including boiler blowdown and run-off from washdown operations external to the tipping hall, collected in a separate process water system for re-use in the bottom ash quench. Run-off from washdown operations in the tipping hall and turbine hall will drain to the waste bunker through the appropriate design of kerbing, floor falls and drains. Volumes of run-off from washdown operations in these areas represents a negligible fraction of the total bunker volume and mass of waste in the bunker. As such, based on operational experience at MVV's other facilities, pooling does not occur within the bunker and the CV of the waste is not affected. A large proportion of this water is subsequently lost by evaporation.

The only discharge to sewer, other than domestic effluent from amenity areas, could occur during periodic maintenance; in particular, in the water treatment plant. As described in Section 3, there will be a periodic requirement for the ion exchange unit to be regenerated. This will be accomplished using acidic and alkaline washes. Additionally, the filters will need to be backflushed periodically.

Effluent generated from regeneration of the ion exchange unit will be neutralised in a neutralisation tank and preferentially routed to the process water system for re-use in the bottom ash quench, whilst effluent from the backwashing of filters will also be preferentially discharged to the process water system. However, in scenarios where the process water system is at capacity, these effluents will be discharged to sewer under a trade effluent discharge consent with Anglian Water.

As this is an infrequent release covered by a trade effluent discharge consent, and with the effluent neutralised on-site in the neutralisation tank prior to discharge, no impact assessment of these discharges has been undertaken.

Both domestic effluent and, if required, process effluent from maintenance events, would be discharged to sewer at discharge point S1. Appendix A3 provides a figure indicating the location of this emission point. The estimated volumetric flows through emission point S1 are provided below. These estimated flows will be measured and confirmed during commissioning trials.

- Domestic effluent from amenity areas = $0.65m^3/h$
- Process effluent during maintenance = $0.85m^3/h$

5.3 Emissions to land

There will be no direct or indirect emissions to land or groundwater as a result of the operation of the EfW CHP Facility.

5.4 Fugitive emissions

Table 5-8 identifies potential sources of fugitive emissions during normal operation and provides an environmental risk assessment of these potential discharges. Fugitive emissions during accident and incident scenarios are described in Table 3-4.

5.4.1 Emissions to air

Areas involving the handling and storage of wastes and other dusty materials will be enclosed.

The entire tipping hall will be designed to be enclosed to minimise fugitive emissions of dust and odour, further aided by the maintenance of a slight negative pressure by means of the suction created by extracting building air for use as the combustion air requirement of the furnaces.

IBA would be loaded by means of a semi-automatic travelling overhead grab crane into an enclosed or sheeted heavy goods vehicle in the enclosed IBA building. The building will be vented with warm air from the boiler house roof to minimise fogging, with extracted air from the building fed into the combustion chamber as secondary combustion air.

APC raw materials and APCr will be handled in a fully enclosed system with fabric filters on the silo vents, with raw materials and residues discharging via sealed connections from/into fully enclosed vehicles to prevent the release of dust from handling and transfer of the raw materials and residues.

Good housekeeping practices will be implemented to ensure that any spillages of potentially dusty materials are cleared up at the earliest opportunity.

5.4.2 Emissions to surface water, sewer or groundwater

Potential fugitive releases to surface water, sewer or groundwater are only likely to occur as a result of an accident or incident involving the loss of containment and Section 3.2.2 provides a risk assessment of these potential releases.

Table 3-9 provides details of various raw material storage tanks and the containment measures in place. The bulk diesel and urea storage tanks will be located in an enclosed building with additional containment measures in place that meet the requirements of CIRIA C736 *Containment systems for the prevention of pollution*. Level measurement and alarms with additional overfill protection will be in place to prevent the tanks being overfilled. Water treatment chemicals will be stored in a separate ventilated room within the WTP building with appropriate containment systems in place, including a sump to capture any spillages. The chemical storage area will have chemical resistant floors and walls which act as bunds

Further storage and process tanks will be provided for various waters used/recycled in the process. This includes, but is not limited to the process water tank fire water tank, condensate tank etc. These tanks will be designed to be watertight and, subject to the completion of the detailed design, will be constructed out of coated stainless or mild steel[10], and include appropriate lining where required to prevent thermal shock or chemical corrosion.

The tipping and main bunker will be a watertight concrete construction designed to the requirements of *DAfStb Guideline Concrete Construction when handling water-endangering substances* and designed to achieve a minimum tightness class 2 in accordance with the requirements of BS EN 1992-3 *Eurocode 2: Design of concrete structures – Part 3*.

The tipping and main bunker will be subject to integrity tests during commissioning and visual inspection during routine plant outages. Underground surface drains and tanks will also be subject to integrity tests during commissioning and certified as watertight prior to waste being accepted. Periodic CCTV inspections, and longer-term integrity tests, will be performed on drains and underground tanks during operation.

Other general measures to control fugitive emissions to surface water, sewer and groundwater include:

- Spill kits will be available for the clean-up of all materials, including chemicals used for water treatment, and oils (e.g., diesel and lubrication oils);
- All process areas will be located on impervious hardstanding and the integrity of these areas will be regularly checked as part of routine maintenance procedures established under the IMS;
- Drainage onto hard-standing without specific directional flow to a drainage point will not be implemented;
- All areas where reagents or chemicals will be delivered, or where residues are collected and loaded to vehicles, will be provided with suitable bunds/curbed areas with drains fitted only where appropriate;
- All fluids stored in vessels which have a potential impact on the environment will be provided with impermeable secondary containment. Bund capacities will be a minimum of 110% of the vessel volume or, if more than one vessel is located within a common bund, will be a minimum of 110% of the capacity of the largest vessel, or 25% of the total vessel storage capacity, whichever is greatest. The bunds will slope to a sump, such that the

[10] Subject to the completion of detailed design, the process water tank may alternatively be an underground concrete tank. If this is the case, the tank will be lined and watertight, meeting the requirements of BS EN 1992-3 Eurocode 2: Design of concrete structures – Part 3 or any updated design code introduced at the time of construction.

contents of the bund (or rainwater if outdoors) can be pumped out to an appropriate point on the site process water system, or to a tanker for off-site treatment and disposal;

- Pipework and fittings on the site process water drainage system will be chemical resistant and capable of handling water up to 120°C. Boiler blow down drains and associated vessels will be designed to withstand the high temperatures of boiler blow down and prevent thermal shock; and
- The main transformer will be located in a concrete enclosure closed on three sides, with a closed gate on the fourth side. An oil retention basin will be provided below the transformer, with drainage of rain water through an oil interceptor.

5.4.3 Firefighting water

The Fire Prevention Plan in Appendix A10 provides details of the measures in place to prevent, detect, control and extinguish fires, including measures to ensure the containment of firewater run-off.

The fire detection system will be designed and installed by an approved fire engineering company in accordance with NFPA 850, or equivalent standard, and the requirements of the fire risk insurers. Methods to be implemented will likely include a combination of detection systems activated by heat, smoke and infrared flame detection. All alerts will be notified on the detection panel and a dedicated fire alarm Human Machine Interface (HMI) screen in the control room, which is permanently manned. This will allow the rapid identification of the fire location and the action to be taken.

The fire suppression system will also be designed and installed by an approved fire engineering company in accordance with NFPA 850, or equivalent standard, and requirements of the fire risk insurers. A fire ring main will be provided with a large capacity firewater storage tank (the capacity of this tank will be determined during detailed design but is likely to be in the order of 1,500 m^3). The ring main will serve the EfW CHP Facility with an electric firewater pump (and a diesel back up) to ensure that firewater can be delivered when needed.

The tipping hall will be equipped with an automatic spray system. The sprinkler heads will be fitted with Quartzoid bulbs that are set to break at a certain temperature and release the firefighting water. Final firefighting techniques will be determined during the detailed design stage, but for the waste bunker these are likely to include the early detection of fires and manual deluge suppression to extinguish a fire in its earliest stages, supported by water cannons.

The EfW CHP Facility will also be equipped with fixed firewater hose reels and manual alarm activation call points which can be used by site operatives, should it be safe to do so. All operatives will be trained in the identification of fire hazards, how to raise the alarm and how to use firefighting equipment including hose reels and fire extinguishers.

In accordance with the Chubb Guidance document - *Energy from Waste (EfW) – Fire Systems,* the firewater retention provision will be sized to accommodate at least:

- The spill of the largest single container of any flammable or combustible liquids in the area
- The maximum expected number of fire hose lines at a flow rate of 1,890l/min minimum operating for a minimum of 10 minutes

- The maximum design discharge of fixed fire suppressions systems operating for a minimum of 10 minutes.

Subject to detailed design, it is anticipated that the primary infrastructure for containment of firefighting water will be the waste bunker. The waste bunker will be designed and constructed as a water retaining structure in accordance with BS EN 1992-3. This will protect against the leak of contaminated firewater from the bunker and minimise the risk of contamination of groundwater in the event of a fire within the bunker. The waste reception hall and turbine hall will drain to the waste bunker through the appropriate design of kerbing, floor falls and drains. Any firefighting water collected in the waste bunker will be tested before a decision is made on the appropriate disposal route.

The site external drainage system will be sealed by an automatic closing valve activated by the fire alarm on the final connection to the surface water drainage system. This will allow the surface drainage system to be isolated, with the contents of the system tested before a decision is made to continue the discharge or, alternatively, pump the contents to tanker for off-site treatment.

5.4.4 Environmental risk assessment of fugitive emissions

Table 5-8 contains an environmental risk assessment of fugitive emissions. As fugitive emissions to surface water, sewer or groundwater could only occur during an accident or incident, the environmental risks associated with these scenarios are addressed in Table 3-4.

Table 5-8 Risk assessment of fugitive emissions

Hazard What has the potential to cause harm?	Receptor What is at risk? What needs protection?	Pathway How can the hazard get to the receptor?	Risk management What measures are in place to reduce risk? If it occurs, who is responsible?	Probability of exposure How likely is this contact?	Consequence What is the harm that can be caused?	Overall Risk What is the risk that still remains? The balance of probability and consequence
To Air						
Release of particulate matter from waste handling and storage, including IBA	Local residents	Dispersion through air	Loading and storage areas are within enclosed buildings. All waste vehicles will be covered or fully enclosed. Building air is used as primary or secondary combustion air. Bottom ash is handled wet. Incorporation of inspection and maintenance programme into proposed procedures. Spill kits provided. Site management and operational personnel will be responsible for responding to any spills and prevent recurrence.	**Unlikely**	Air quality or amenity impacts **Mild**	**Very low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
Release of particulate material from APC raw material and APCr storage silos during loading/unloading of vehicles	Local residents	Dispersion through air	Loading areas are within an enclosed building. Delivery vehicles are covered/enclosed and will load/offload using a sealed connection. Silos are equipped with fabric filters to capture particulate matter emissions during loading/unloading. Incorporation of inspection and maintenance programme into proposed procedures. Spill kits provided. Site management and operational personnel will be responsible for responding to any spills and prevent recurrence.	**Unlikely**	Air quality or amenity impacts **Mild**	**Very low**
VOCs from deliveries and storage of diesel	Local residents	Dispersion through air	Loading areas are within an enclosed building and delivery vehicles will offload using a sealed connection. The storage tank may have a vent to allow tank breathing. Emissions from this source are not considered to be significant since the material being stored will be relatively non-volatile. The tank integrity will be subject to routine checks as part of regular site inspections. Spill kits will be provided to clean up any spills identified.	**Low likelihood**	Air quality or amenity impacts **Mild**	**Low**

Hazard What has the potential to cause harm?	**Receptor** What is at risk? What needs protection?	**Pathway** How can the hazard get to the receptor?	**Risk management** What measures are in place to reduce risk? If it occurs, who is responsible?	**Probability of exposure** How likely is this contact?	**Consequence** What is the harm that can be caused?	**Overall Risk** What is the risk that still remains? The balance of probability and consequence
VOCs from delivery and storage of transformer oils	Local residents	Dispersion through air	Delivery vehicles will offload using a sealed connection. Transformer oil top-up will be infrequent with a limited amount transferred at any one time. The integrity of the transformer will be subject to routine checks as part of daily site inspections.	**Unlikely**	Air quality or amenity impacts **Mild**	**Very low**

Notes: As fugitive emissions to surface water, sewer and groundwater are primarily related to accidents and incidents, a risk assessment of these emissions can be found in Table 3-4.

5.5 Odour

The Odour Management Plan in Appendix A14 details the primary sources of odour from the EfW CHP Facility and the proposed control measures in place under both normal and abnormal operation. Table 5-9 reviews the proposed design and operation of the EfW CHP Facility against the indicative BAT requirements in EPR 5.01 for odour with an assessment of odour risk presented in Section 6.4.

Table 5-9 Comparison of proposed design against sector specific indicative BAT requirements for odour

No	Indicative BAT requirement	Comparison with proposed design
Indicative BAT		
1	You should minimise odour by: • enclosing odorous waste all the way to the furnace (ACI, CWI) • confining waste to designated areas (all) • ensuring that putrescible waste is incinerated within an appropriate timescale (MWI,CWI, ACI, SSI) • refrigeration of such waste which is to be stored for longer than an appropriate timescale (CWI, ACI) • regular cleaning and (for putrescible wastes) disinfection of waste handling areas (all); • design of areas to facilitate cleaning (all) • ensuring that the transport of waste and ash is in covered vehicles, where appropriate (all) • ensuring good dispersion at all times from any release points (all) • preventing anaerobic conditions by aeration, turning of waste and short timescales (SSI, MWI) • chlorination of waters being returned to STW or in storage (SSI) • drawing air from odorous areas at a rate which will ensure that odour is captured (all); and • treating such extracted air prior to release to destroy the odours - see below:	The following measures will be included to control odour emissions subject to completion of the detailed design. Further details are provided in the OMP: • Waste arriving at the site will use enclosed or covered vehicles. • Waste will only be stored in an enclosed building. Vehicles accessing the enclosed tipping hall will do so via entrances equipped with fast-acting doors. • Waste in the bunker will be regularly mixed by automated cranes to prevent the development of anaerobic conditions. • Air from within the tipping hall will be drawn through the furnace as primary or secondary combustion air. This will also ensure a slight negative pressure is maintained within the tipping hall to prevent fugitive emissions of odour. • Shutdown of each combustion line will be staggered where possible to enable one line to be kept in operation. During a planned maintenance shutdown of one line, air from the waste bunker will continue to be drawn through the primary combustion air fan into the operational combustion line and used as combustion air. • During unavoidable periods where both lines are undergoing extended maintenance, the negative pressure through the waste bunker and tipping hall will be maintained by operating the shutdown fan (subject to completion of

No	Indicative BAT requirement	Comparison with proposed design
	○ The use of these techniques should obviate the need for odour masking or counteractants. ○ ii) You should, as far as possible, feed odorous air into the combustion process. ○ iii) Where further treatment is required, you should consider the following: – scrubbing for odour control typically would use counter current columns with acids or oxidising agents such as potassium permanganate. A 3-stage scrubbing sequence using sulphuric acid, sodium hydroxide/hydrogen peroxide and sodium hydroxide may be effective; – carbon filters are effective, especially where the total quantity of organic compounds is small. Otherwise they can be expensive to run and lead to a significant waste that needs to be treated or disposed of. If it cannot be recovered then preferably spent odour abatement carbon should be fed to the furnace, to destroy the odorous compounds, recover the energy content of the carbon and minimise waste arisings.	the detailed design); this passes air through a dust and activated carbon filter system to remove odorous compounds, prior to being emitted to atmosphere. Prior to the planned shutdown waste inputs will be reduced to lower the level of waste stored within the bunker to a minimum and waste will continue to be received at a reduced capacity for the duration of the outage. • During short shutdown situations of less than 7 days impacting both combustion lines, a waste bunker odour neutralisation system will operate continuously. During this time the shutdown fan system (subject to detailed design) will only be fitted with pre-filters for particulate emission control. Odour control is facilitated by the neutralisation system which atomises an odour neutralisation agent into the waste storage bunker.

5.6 Noise and vibration

An assessment of the impact of noise emissions from the installation is provided in Section 6.5 and Appendix A8.

The design and layout of the EfW CHP Facility has been optimised to minimise noise impacts on local residents. The site layout has been designed such that most of the stationary plant items contributing to noise emissions are located in the northern area of the installation i.e., furthest away from the closest receptors on New Bridge Lane, and located within buildings or acoustic enclosures.

The noise assessment in Appendix A8 and Noise and Vibration Management Plan in Appendix A15 have identified that noise from waste vehicles manoeuvring within the site is the dominant source of noise emissions from activities within the installation boundary. To control noise emissions from vehicles, the following measures will be incorporated into the design:

- Although the EfW CHP Facility will operate 24 hours a day, operational hours for waste acceptance will be limited to the period between 07.00 and 20.00[11];
- Engines will be required to be switched off when not in use;
- On-site mobile plant will be fitted with non-tonal reversing alarms, e.g., broadband movement alarms;
- Site speed limit of 10 mph will be enforced;
- Road surfaces within the installation boundary will be maintained in a good state of repair;
- A one-way system will be in place for waste delivery vehicles, with reversing only taking place once in the enclosed tipping hall; and
- Under the DCO conditions, an acoustic fence will be provided at the nearest noise sensitive receptor at 10 New Bridge Lane which will be maintained by the Operator for as long as this property is in residential use.

In terms of fixed sources of noise, the noise assessment has identified the following fixed plant items and buildings as the most significant contributors to noise outside the installation boundary. The list is ordered in terms of significance, with items towards the top of the list predicted to contribute more to off-site noise impacts than those towards the bottom of the list:

- Air Cooled Condenser;
- Boiler house;
- Tipping hall (during the daytime, below turbine hall during night-time);
- ID fan cabin;
- Bag filter house;
- Water Treatment Plant;
- Cooling water re-cooling system;

[11] There may be some occasions when waste deliveries are accepted outside the normal opening hours, for example in the case of an emergency or to accommodate the delivery of waste where vehicles have been unavoidably delayed, or in other similar circumstances

- Chimney outlets;
- Turbine hall; and
- Compressed air station.

Outline measures (subject to the completion of detailed design) for controlling noise emissions from these sources are presented in the BAT assessment in Appendix A4 and the Noise and Vibration Management Plan in Appendix A15. These measures include:

- Where possible, noise generating equipment will be installed within a building or, where that is not possible, will be housed in suitable enclosures to provide additional attenuation;
- Implementation of a pro-active inspection and maintenance plan through the IMS;
- Equipment to be operated by suitably qualified and experienced staff;
- Closing doors of enclosed areas where possible; and
- All silencers/mufflers are to be inspected to ensure they are in good repair and are correctly fitted.

If identified as a requirement during detailed design to meet the BS 4142 adverse impact descriptors as summarised in the Environment Agency's *Noise and vibration management: environmental permits* guidance, the EPC Contractor will be required to include provision for low-noise compressors, pumps and fans as part of its design. The Environment Agency will be informed of the final noise control measures and an updated assessment of noise impacts prior to commissioning.

The Noise and Vibration Management Plan in Appendix A15 provides procedures for monitoring noise during operation and responding to any complaints

5.7 Abnormal operation

Article 46(6), Article 50(4) and point 2 of Part 3 in Annex VI of IED place obligations on operators of thermal treatment plants during periods of abnormal operation when the ELVs are exceeded. Whilst the design basis of the EfW CHP Facility is to target no exceedances of the ELVs, the Operator will ensure that the EfW CHP Facility will not exceed the maximum permissible operating period allowed under Article 46(6) relating to exceedances of the ELVs during abnormal periods of operation, i.e., the control systems will be designed to prevent the incineration of waste for a period of more than 4 hours uninterrupted where ELVs are exceeded, up to a maximum cumulative duration of 60 hours per year. The control and monitoring system will be designed to record individual events of this nature and calculate the total duration of such events to demonstrate compliance with the IED and permitting requirements.

The EfW CHP Facility is designed with an automated control system containing interlocks which prevents waste feed to the furnace in the following circumstances:

- At start-up until a temperature of 850°C has been reached;
- Whenever the temperature of 850°C is not maintained during operation; and
- Whenever the CEMS indicate any emission limit value is exceeded due to disturbance or failure of the APC system.

If either of the scenarios described in the second and third bullet point occur, a shutdown of the EfW CHP Facility will not automatically be initiated. Rather, the control system will prevent further waste being charged with the auxiliary burners being fired to maintain a minimum temperature of 850°C in the combustion chamber. Only if, after identifying the cause of the event, and determining rectifying measures could not be introduced promptly, would a shutdown be initiated.

Monitoring of emissions during abnormal operation would continue to take place using the CEMS and methods described in Section 5.8.1. Each line will have dual/redundant CEMS, ensuring at least one CEMS is available per line at all times should one of the CEMS fail or require maintenance. During these periods, the EfW CHP Facility will be operated such that emissions of particulate matter, TOC and CO do not exceed the emission levels in Table 5-10.

Table 5-10 Point source emissions to air during abnormal operation

Release point	Substance	Emission Limit (mg/Nm^3)	Reference Period
Line 1 (A1) and Line 2 (A2)	CO	100	30-minute average
	Particulate matter	150	30-minute average
	TOC	20	30-minute average

Note: At reference conditions of 273K, 101.3 kPa, 11% O_2, dry gas

An assessment of emissions during abnormal operation is provided in Section 6.2.5 and Appendix A7.

5.8 Monitoring and reporting of emissions

5.8.1 Emissions to air

Monitoring of emissions to air from A1, A2 and A3 will use a combination of continuous and periodic/extractive monitoring techniques in-line with the Environment Agency's Monitoring Certification Scheme (MCERTS), the requirements of BAT 4 of the waste incineration BAT Conclusions, and the requirements of the Medium Combustion Plant Directive. As emissions from A4 will only include residual odour, no monitoring of emissions is proposed.

Emissions from the thermal treatment process, discharged to atmosphere through emission points A1 and A2, will be monitored continuously. Dual CEMS systems will be installed on each line, i.e., two CEMS systems will be installed on each line to provide redundancy should any component of the CEMS fail or require maintenance. It is expected that the CEMS system will comprise the following components, subject to the completion of the detailed design once an EPC Contractor has been appointed:

- Multi-component analysers including sample probe and heated sample line for continuous monitoring of emissions of NO_x, CO, SO_2, HCl, TOC, N_2O, NH_3, H_2O and O_2. The exact analyser types will be selected during detailed design with the final choice of method taking account of the Environment Agency's *Monitoring stack emissions: techniques and standards for CEMS and automated batch samplers* guidance;
- Particulate matter analyser;
- Ancillary analysers for gas velocity, temperature and pressure; and
- Data acquisition and handling system (DAHS).

All CEMS equipment will be MCERTS compliant, meeting the performance specifications in BS EN 15267-3 and holding QAL1 certification under BS EN 14181. The CEMS will be installed taking account of guidance in the Environment Agency's *Monitoring stack emissions: measurement locations guidance* (formerly Technical Guidance Note (Monitoring) M1), and the requirements of BS EN 15259, including the Environment Agency's Method Implementation Document (MID) for EN 15259.

After installation, the analysers will undergo QAL2 functional tests and calibration with parallel measurements using standard reference methods in accordance with BS EN 14181. The functional tests may be performed by the CEMS manufacturer but the parallel measurements will be taken using a test team accredited to BS EN ISO/IEC 17025. Ongoing automatic QAL3 calibration checks will be made using certified zero and span gases and/or reference spectra. All analysers will be subject to an annual surveillance test per the requirements of BS EN 14181 using a test team accredited to BS EN ISO/IEC 17025.

The CEMS and DAHS design will be based on satisfying the monitoring, reporting and compliance assessment requirements provided in Annex VI of IED. The DAHS will continuously log analogue and digital signals from the emission monitoring equipment with other signals from e.g., boiler temperature monitoring equipment monitored and recorded by the DCS. The system will have the capability to produce daily, monthly and annual reports of validated emissions data, as well as having functionality for reporting QAL2 and QAL3 data. The system will also be configured so that monitored parameters during start-up or shut-down of the furnace, or when no waste is being burnt, are excluded from the validated data, with only data reported during the effective operating time in accordance with Annex VI, Part 8 of IED. However, the raw data from these periods will still be recorded and stored in the DAHS. The DAHS will meet the storage and data integrity requirements specified in the Environment Agency's *Quality and Performance Standards for Environmental Data Management Software* and/or BS EN 17255.

Periodic extractive monitoring will be performed for those determinands not requiring continuous monitoring under BAT 4. As permitted under Annex VI, Part 6, point 2.3 and footnote 7 of BAT 4, this will also include periodic monitoring of HF in preference to continuous monitoring, as the acid gas abatement system will operate to ensure the HCl emissions are stable and do not exceed the ELV.

Additionally, the Operator considers that the waste specification, controlled through contractual requirements with waste suppliers, will ensure a low and stable content of mercury in the waste, whilst the use of activated carbon in the APC plant will further ensure a low and stable level of mercury emissions. Consequently, in accordance with footnote 8 of BAT 4, the Operator is proposing to monitor mercury emissions using periodic extractive techniques in preference to continuous monitoring. The emissions performance of the EfW CHP Facility, with respect to mercury emissions, and demonstration of low and stable emissions, will follow the Environment Agency's Mercury Monitoring Protocol in the *UK Interpretation Document for the 2019 Waste incineration BAT Conclusions* (or otherwise agreed with the Environment Agency) with six, separate (i.e., samples taken on different days) extractive mercury results obtained during commissioning or, alternatively, a minimum of two tests per month will be taken until six results are available. If the six results are all < 10µg/Nm^3, Hg CEMS will not be installed.

Similar procedures will also apply to emissions of PCDD/Fs where, as per the Environment Agency's PCDD/F Monitoring Protocol in the *UK Interpretation Document for the 2019 Waste incineration BAT Conclusions*, if six separate extractive test results are less than the ELV, a continuous sampler will not be used.

To support the periodic monitoring, and QAL2 parallel measurements, a sampling platform with appropriate access, power supplies, lighting and facilities for lifting heavy items of equipment will be provided. Manual periodic sampling will be through connections in the chimney meeting BS EN 15259 and the Environment Agency's *Monitoring stack emissions: measurement locations* guidance; these requirements will be included in the design specification for the plant.

Periodic monitoring would be undertaken by a MCERTS accredited test team certified to BS EN ISO/IEC 17025. Prior to any periodic sampling being carried out, a site specific protocol (SSP) will be developed by the test team under MCERTS requirements. The SSP and periodic monitoring reports will be provided to the Environment Agency as part of routine reporting.

Emissions from the standby generator (emission point A3) will be monitored periodically by a MCERTS accredited test team certified to BS EN ISO/IEC 17025. As the generator will operate for less than 500 hours per year, periodic emissions monitoring will take place every 1,500 operating hours, or every 5 years, whichever is sooner.

Table 5-11 provides a summary of the monitoring of emissions to air from emission points A1 and A2, whilst Table 5-12 provides a summary of the monitoring of emissions to air from emission point A3.

Table 5-11 Summary of monitoring of emissions to air (A1 and A2)

Release point	Substance	Monitoring method	Monitoring frequency	MCERTS certified?
A1 and A2	NOx	BS EN 15267 parts 1-3 and EN 14181	Continuous	Yes
	SO_2	BS EN 15267 parts 1-3 and EN 14181	Continuous	Yes
	CO	BS EN 15267 parts 1-3 and EN 14181	Continuous	Yes
	Particulate matter	BS EN 15267 parts 1-3 and EN 14181, and BS EN 13284-1	Continuous	Yes

Release point	Substance	Monitoring method	Monitoring frequency	MCERTS certified?
	VOC (expressed as TOC)	BS EN 15267 parts 1-3 and EN 14181	Continuous	Yes
	HCl	BS EN 15267 parts 1-3 and EN 14181	Continuous	Yes
	HF	BS ISO 15713	Quarterly for the first 12 months and 6 monthly thereafter	Yes
	NH_3	BS EN 15267 parts 1-3 and EN 14181	Continuous	Yes
	Cd and Tl	BS EN 14385	Quarterly for the first 12 months and 6 monthly thereafter	Yes
	Hg	BS EN 13211	Quarterly for the first 12 months and 6 monthly thereafter	Yes
	As, Co, Cr, Cu, Mn, Ni, Pb, Sb, V	BS EN 14385	Quarterly for the first 12 months and 6 monthly thereafter	Yes
	PCDD/Fs	BS EN 1948 Parts 1-3	Quarterly for the first 12 months and 6 monthly thereafter	Yes
	Dioxin-like PCBs	BS EN 1948 Parts 1, 2 and 4	Quarterly for the first 12 months and 6 monthly thereafter	Yes
	PAHs [A]	BS ISO 11338 Parts 1-2	Quarterly for the first 12 months and annually thereafter	Yes
	N_2O	BS EN 15267 parts 1-3 and EN 14181	Continuous	Yes

[A] PAHs to be monitored include: Anthanthrene; Benzo[a]anthracene; Benzo[b]fluoranthene; Benzo[k]fluoranthene; Benzo(b)naph(2,1-d)thiophene; Benzo(c)phenanthrene; Benzo[ghi]perylene; Benzo[a]pyrene; Cholanthrene; Chrysene; Cyclopenta(c,d)pyrene; Dibenzo[ah]anthracene; Fluroranthene Indo[1,2,3-cd]pyrene; Naphthalene.

Table 5-12 Summary of monitoring of emissions to air (A3)

Release point	Substance	Monitoring method	Monitoring frequency	MCERTS certified?
A3	NOx	BS EN 14792	Every 1,500 operating hours or every 5 years, whichever is soonest	Yes
	SO_2	Mass balance from fuel analysis	Every 1,500 operating hours or every 5 years, whichever is soonest	N/A
	CO	BS EN 15058	Every 1,500 operating hours or every 5 years, whichever is soonest	Yes
	PM	BS EN 13284-1	Every 1,500 operating hours or every 5 years, whichever is soonest	Yes

5.8.2 Emissions to surface water and sewer

No monitoring of uncontaminated run-off to surface water is proposed.

For discharges to sewer, in order to achieve compliance with the trade effluent discharge consent, continuous monitoring of flow, pH and temperature is proposed. The Continuous Water Monitoring System (CWMS) will include equipment meeting the *MCERTS Performance Standards for Continuous Water Monitoring Equipment, Part 2: online analysers* and the *MCERTS Performance Standards for Continuous Water Monitoring Equipment, Part 3: water flowmeters.* Table 5-13 provides a summary of the proposed monitoring of emissions to emission point S1.

Table 5-13 Summary of monitoring of emissions to sewer (S1)

Release point	Substance	Monitoring frequency	MCERTS certified?
S1	Flow	Continuous	Yes
	pH	Continuous	Yes
	Temperature	Continuous	Yes

5.8.3 Monitoring of waste emissions

An ash sampling and testing protocol will be established in accordance with the Environmental Services Association's *A Sampling and Testing Protocol to Assess the Status of Incinerator Bottom Ash*. This will include sampling and analysis of the variables provided in Table 5-14. The sampling protocol will be agreed with the Environment Agency prior to the commissioning of the installation.

Table 5-14 Summary of monitoring of waste emissions

Waste	Parameter to be measured	Monitoring frequency
Incinerator bottom ash	Total organic carbon or loss on ignition	Every 3 months
	Heavy metals (Cd, Tl, Hg, As, Cu, Co, Cr, Mn, Pb, Zn, Ni, V)	2 samples per month in the first 12 months then every 3 months thereafter
	PCDD/Fs	2 samples per month in the first 12 months then every 3 months thereafter
	Dioxin-like PCBs	2 samples per month in the first 12 months then every 3 months thereafter
	pH and alkali reserve	2 samples per month in the first 12 months then every 3 months thereafter
Air pollution control residues	Heavy metals (Cd, Tl, Hg, As, Cu, Co, Cr, Mn, Pb, Zn, Ni, V)	2 samples per month in the first 12 months then every 3 months thereafter
	PCDD/Fs	2 samples per month in the first 12 months then every 3 months thereafter
	Dioxin-like PCBs	2 samples per month in the first 12 months then every 3 months thereafter
	pH and alkali reserve	2 samples per month in the first 12 months then every 3 months thereafter
All ash and residues	Mass	Each load removed from the installation for recovery or disposal

5.8.4 Process variables

To ensure that the process is operating at optimum performance levels, and to meet the minimum requirements of IED and the permit conditions, monitoring of the following process variables will be performed.

Table 5-15 Summary of monitoring of process variables

Lines	Process variable	Description and monitoring frequency
Line 1 and Line 2	Combustion temperature	Continuous to demonstrate compliance with the minimum temperature requirement as required by IED Article 50(3)
	Combustion chamber oxygen content	Continuous to ensure optimal combustion conditions to minimise NO_x, CO and VOC emissions
	Combustion chamber pressure	Continuous to ensure under pressure is maintained and fugitive emissions are avoided. Also to detect and respond to any overpressure incidents
	Flue gas temperature	Continuous monitoring as required by Annex VI of IED
	Flue gas pressure	Continuous monitoring as required by Annex VI of IED
	Flue gas water vapour content	Continuous monitoring as required by Annex VI of IED
	Flue gas oxygen content	Continuous monitoring as required by Annex VI of IED
	Flue gas flowrate	Continuous monitoring to allow calculation of the mass of pollutants emitted to air
	Reagent dosing rates	Continuous monitoring to ensure optimal consumption of reagents and control of emissions to air
	Pressure drop across fabric filter	Continuous monitoring to detect bag failures and initiate automatic cleaning to maintain plant efficiency
	Mass of waste delivered to the EfW CHP Facility	Recording of the mass of each load delivered to the EfW CHP Facility using the entry weighbridge to demonstrate compliance with maximum permitted throughput
	Mass of waste loaded to the furnace	Recording of mass of each load charged via grab crane to demonstrate compliance with design capacity
	Steam generation (and, where applicable, exported)	Continuous to track plant efficiency
	Total electricity generated	Continuous to track plant efficiency
	Electricity exported	Continuous to track plant efficiency
	Electricity imported	Continuous to track plant efficiency

5.8.5 Environmental monitoring (beyond the installation)

There is proposed to be no environmental monitoring beyond the installation, unless mandated by any planning or permit condition.

5.8.6 Indicative BAT

Table 5-16 reviews the proposed design and operation of the EfW CHP Facility against the indicative BAT requirements in EPR 5.01 for monitoring and reporting of emissions.

Table 5-16 Comparison of proposed design against sector specific indicative BAT requirements for monitoring and reporting of emissions (to water, sewer and air)

No	Indicative BAT requirement	Comparison with proposed design
Indicative BAT		
1	If you operate a WID installation, you must comply with the requirements of WID as a minimum.	The EfW CHP Facility will be designed to meet all requirements in the IED and the implementing BAT Conclusions for waste incineration.
2	In addition, the Secretary of State's direction to the Agency requires that you monitor for polycyclic aromatic hydrocarbons (PAHs) and dioxin-like polychlorinated biphenyls (PCBs) whenever your permit requires you to monitor for dioxins and furans.	PAHs and dioxin-like PCBs will be monitored on a periodic basis.
3	The PAHs to be monitored are: • Anthanthrene; • Benzo[a]anthracene; • Benzo[b]fluoranthene; • Benzo[k]fluoranthene; • Benzo(b)naph(2,1-d)thiophene; • Benzo(c)phenanthrene; • Benzo[ghi]perylene; • Benzo[a]pyrene; • Cholanthrene; • Chrysene; • Cyclopenta(c,d)pyrene; • Dibenzo[ah]anthracene; • Fluroranthene • Indo[1,2,3-cd]pyrene; • Naphthalene.	These PAHs will form part of the suite of PAHs to be monitored during periodic, extractive tests.

6 Impact assessment

The following section assesses the environmental impact resulting from the proposed operation of the EfW CHP Facility. It identifies the nearby receiving environments and sensitive receptors which may be affected by discharges from the activities undertaken at the EfW CHP Facility Site.

The impacts of releases presented in this section from the proposed activities at the EfW CHP Facility present the outputs of the following assessments:

- Risk assessments for your environmental permit (previously H1);
- Air quality impact assessment (dispersion modelling) and human health risk assessment; and
- Noise impact assessment (noise modelling).

6.1 Environmental receptors

The nearest human and ecological receptors considered in the assessment are provided in Table 6-1. More exhaustive lists of relevant receptors can be found in the technical assessments contained within Appendices A7, A8 and A12.

Table 6-1 Identification of nearest relevant human and ecological receptors

Receptor Type	Receptor name	Approximate distance and direction from installation boundary (m)
Human population	10 New Bridge Lane	30m south
Surface water	HWIDB adopted drain River Nene	0 m (intersects the installation) 550m north-west
Ground water	No relevant receptors identified	N/A
Receptors designated under the Habitats Regulations	Nene Washes SPA/SAC/Ramsar Ouse Washes SPA/SAC/Ramsar	6km south-west 12km south-east
Local/non-statutory habitat sites	River Nene CWS	550m north-west
Air Quality Management Areas	Wisbech AQMA No.3	1.2km north-east

6.2 Emissions to air

6.2.1 Criteria for assessing air impacts

The impact assessment covers a number of pollutants emitted to air and calculates:

- The process contribution (PC) from the installation emissions in isolation;

- The predicted environmental concentration (PEC) when the PC is combined with local background concentrations; and
- The percentage contribution of the PC and PEC to relevant air quality standards (AQS), objectives (AQOs) and environmental assessment levels (EALs).

Emission parameters for the emission to air sources are detailed in Section 5 and Appendix A7.

Dispersion modelling has been undertaken to support the impact assessment. This provides a comprehensive assessment and considers emissions from a number of operating scenarios, which are as follows:

- Normal operation: Impacts with the EfW CHP Facility operating normally and discharging at the relevant BAT-AELs and/or ELVs in Annex VI of IED; and
- Abnormal operation: Impacts during periods of abnormal operations as provided under Article 46(6) and point 2 of Annex VI, Part 3 of IED.

The Environment Agency's *Air emissions risk assessment for your environmental permit* guidance (previously Horizontal Guidance Note H1) provides methods for quantifying the environmental impacts of emissions to air. This compares predicted PCs and PECs to both long and short-term environmental standards.

Air emission risk assessments for environmental permits require a three-stage approach to assessing the significance of emissions to atmosphere. The first stage is to 'screen out' insignificant emissions to air using the H1 screening tool; these are emissions which are emitted in such small quantities that they are unlikely to cause a significant impact on ground level concentrations. The Environment Agency's guidance suggests that emissions are insignificant where PCs are less than:

- 1% of a long-term environmental standard; or
- 10% of a short-term environmental standard.

For those emissions that cannot be screened out as insignificant, the guidance indicates that further modelling of emissions may be appropriate for long-term effects where the PEC is greater than 70% of the long-term environmental benchmark. For short-term effects, further modelling of emissions is required where the PC is more than 20% of the difference between twice the (long-term) background concentration and the relevant short-term environmental benchmark (i.e., more than 20% of the model 'headroom').

The above criteria apply to human receptors and Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Sites of Special Scientific Interest (SSSIs) and Ramsar sites. For non-statutory and other local wildlife sites, emissions can be screened as insignificant where the short-term and long-term PC is less than 100% of the relevant environmental benchmark with modelling required where this metric is exceeded.

In the resultant modelling assessment, no further action is required where the assessment shows that both of the following apply:

- Emissions comply with BAT Associated Emission Levels (AELs) or the equivalent requirements where there is no BAT AEL; and
- The resulting PECs will not exceed environmental standards.

6.2.2 Air emissions risk assessment

This section presents the results of the preliminary assessment of emissions to air from the EfW CHP Facility under normal operation using the Environment Agency's H1 software tool (version 2.78). This is a conservative assessment as it only presents maximum concentrations at any location, rather than at specific sensitive receptors, does not consider plume rise, and considers dispersion occurs continuously under 'worst-case' meteorological conditions.

Process contribution using H1 screening (normal operation)

Table 6-2 presents the long and short-term PCs calculated using the H1 software tool and equivalent modelled values at the worst-case receptor location.

Table 6-3 then screens the PCs (based on modelled PCs rather than H1 values) using the criteria defined in Section 6.2.1 against the relevant environmental standards. Table 6-3 also highlights several pollutants which exceed either the 1% long-term or 10% short-term benchmarks, with further assessment against the PEC required.

Table 6-2 Process contributions of emissions to air (normal operation)

Substance	Long-term (µg/m³)			Short-term (µg/m³)		
	EAL	PC	Modelled PC[A]	EAL	PC	Modelled PC[A]
NO_2	40	12.6	0.78	200	26,448	29.79
NO_x (Ecological)	30	12.6	0.33	75	26,448	9.91
SO_2 (15-minute mean)	-	-	-	266	1,367	47.29
SO_2 (1-hour mean)	-	-	-	350	1,367	42.17
SO_2 (24-hour mean)	-	-	-	125	1,367	20.23
SO_2 (Ecological)	10	1.66	0.07	-	-	-
CO	-	-	-	10,000	1,660	20.49
PM_{10}	40	0.258	0.05	50	147	0.16
$PM_{2.5}$	25	0.258	0.05	-	-	-
VOC as benzene	5	0.489	0.09	195	65.2	6.17

Substance	Long-term (µg/m³)			Short-term (µg/m³)		
	EAL	PC	Modelled PC[A]	EAL	PC	Modelled PC[A]
HCl	-	-	-	750	195	18.51
HF	16	0.351		160	22.8	1.23
HF (Ecological, Daily mean)	-	-	-	4.9	13.0	0.04
HF (Ecological, Weekly mean)	-	-	-	0.49	13.0	0.005
NH_3	180	0.489	0.09	2,500	32.6	3.08
NH_3 (Ecological)	1	0.489	0.05	-	-	-
Cd	0.005	0.001	1.9×10^{-4}	-	-	-
Hg	0.25	0.001	1.9×10^{-4}	7.5	0.0652	0.006
As	0.006	0.0147	9.9×10^{-10}	-	-	-
Cr VI	0.0002	0.0147	9.9×10^{-10}	-	-	-
Cr II & III	5	0.0147	6.1×10^{-6}	150	0.978	8.4×10^{-4}
Cu	10	0.0147	1.9×10^{-6}	200	0.978	5.0×10^{-5}
Mn	0.15	0.0147	4.0×10^{-6}	1,500	0.978	4.6×10^{-4}
Ni	0.02	0.0147	1.5×10^{-5}	-	-	-
Pb	0.5	0.0147	3.3×10^{-6}	-	-	-
Sb	5	0.0147	6.1×10^{-6}	150	0.978	1.0×10^{-4}
V	5	0.0147	4.0×10^{-7}	1	0.978	0.002
PCBs	0.2	0.000196	3.6×10^{-11}	6	0.0131	1.2×10^{-9}
PAHs as Benzo(a)pyrene	0.00025	0.0230	4.4×10^{-5}	-	-	-

[A] Modelled PC refers to the PC as predicted by the dispersion model. See Appendix A7 for the methodology and results.

Table 6-3 Air impacts screening (normal operation)

Substance	Long-term EAL (µg/m³)	Short-term EAL (µg/m³)	Long-term (µg/m³)			Short-term (µg/m³)		
			PC[A]	%PC of EAL	>1% of EAL?	PC[A]	%PC of EAL	>10% of EAL?
NO_2	40	200	0.78	2	Yes	29.79	15	Yes
NO_x (Ecological)	30	75	0.33	1	Yes	9.91	13	Yes
SO_2 (15-minute mean)	-	266	-	-	-	47.29	18	Yes
SO_2 (1-hour mean)	-	350	-	-	-	42.17	12	Yes
SO_2 (24-hour mean)	-	125	-	-	-	20.23	16	Yes
SO_2 (Ecological)	10	-	0.07	0.7	No	-	-	-
CO	-	10,000	-	-	-	20.49	0.2	No
PM_{10}	40	50	0.05	0.1	No	0.17	0.3	No
$PM_{2.5}$	25	-	0.05	0.2	No	-	-	-
VOC as benzene	5	195	0.09	2	Yes	6.17	3	No
HCl	-	750	-	-	-	18.51	2	No
HF	16	160	0.35	2	Yes	1.23	< 1	No
HF (Ecological, Daily mean)	-	5	-	-	-	0.04	< 1	No
HF (Ecological, Weekly mean)	-	0.5	-	-	-	0.005	< 1	No
NH_3	180	2,500	0.14	0.1	No	3.09	< 1	No
NH_3 (Ecological)	1	-	0.05	5	Yes	-	-	-
Cd	0.005	-	1.9×10^{-4}	4	Yes	-	-	-
Hg	0.25	7.5	1.9×10^{-4}	< 0.1	No	0.006	< 0.1	No
As	0.006	-	9.9×10^{-10}	< 0.1	No	-	-	-
Cr VI	0.0002	-	9.9×10^{-10}	< 0.1	No	-	-	-
Cr II & III	5	150	6.1×10^{-6}	< 0.1	No	8.4×10^{-4}	< 0.1	No

Substance	Long-term EAL (µg/m³)	Short-term EAL (µg/m³)	Long-term (µg/m³)			Short-term (µg/m³)		
			PC^A	%PC of EAL	>1% of EAL?	PC^A	%PC of EAL	>10% of EAL?
Cu	10	200	1.9×10^{-6}	< 0.1	No	5.0×10^{-5}	< 0.1	No
Mn	0.15	1,500	4.0×10^{-6}	< 0.1	No	4.6×10^{-4}	< 0.1	No
Ni	0.02	-	1.5×10^{-5}	< 0.1	No	-	-	-
Pb	0.5	-	3.3×10^{-6}	< 0.1	No	-	-	-
Sb	5	150	6.1×10^{-6}	< 0.1	No	1.0×10^{-4}	< 0.1	No
V	5	1	4.0×10^{-7}	< 0.1	No	0.002	< 0.1	No
PCBs	0.2	6	3.6×10^{-11}	< 0.1	No	1.2×10^{-9}	< 0.1	No
PAHs as Benzo(a)pyrene	0.00025	-	4.4×10^{-5}	16	Yes	-	-	-

[A] Modelled PC as predicted by the dispersion model

Predicted environmental concentration (normal operation)

For those pollutants where PCs have not been screened as insignificant, the long and short-term PEC has been calculated using the H1 software tool. The PEC is calculated as the sum of the background concentration of the substance in air and the modelled process contribution. The results from the H1 tool are presented in Table 6-4. Two of the pollutants are identified as requiring detailed modelling and these are considered further in Section 6.2.3.

Table 6-4 Identifying the need for detailed modelling (normal operations)

Substance	Air bkgrnd conc. µg/m³ ^A	Long-term					Short-term		
		PC^B µg/m³	%PC of headroom	PEC µg/m³	%PEC of EAL	%PEC of EAL >=70%?	PC^B µg/m³	%PC of headroom	%PC of headroom >20%
NO_2	17.03	0.78	3	17.9	45	No	29.83	18	No
NO_x (Ecological)	16.66	0.33	2	17.0	57	No	9.91	24	Yes
SO_2 (15-minute mean)	1.50	-	-	-	-	-	47.29	18	No
SO_2 (1-hour mean)	1.62	-	-	-	-	-	42.17	12	No

Substance	Air bkgrnd conc. µg/m³ [A]	Long-term					Short-term		
		PC[B] µg/m³	%PC of headroom	PEC µg/m³	%PEC of EAL	%PEC of EAL >=70%?	PC[B] µg/m³	%PC of headroom	%PC of headroom >20%
SO_2 (24-hour mean)	1.62	-	-	-	-	-	20.23	17	No
VOC as benzene	0.27	0.09	2	0.361	7	No	6.17	3	No
HF	3	0.35	3	3.36	21	No	1.23	< 1	No
NH_3 (Ecological)	2	0.05	- 5	2.05	205	Yes	-	-	-
Cd	9.0×10^{-5}	1.9×10^{-4}	4	2.9×10^{-4}	6	No	-	-	-
PAHs as Benzo(a)pyrene	6.0×10^{-5}	4.4×10^{-5}	21	1.0×10^{-4}	40	No	-	-	-

[A] Background concentration at location of receptor with highest PC based on dispersion modelling

[B] Modelled PC as predicted by the dispersion model

6.2.3 Dispersion modelling assessment

Point source emissions of all pollutants emitted to air from the EfW CHP Facility have been subject to further assessment using dispersion modelling. The dispersion modelling report presenting the methodology and results of the assessment is provided in Appendix A7.

The results from this assessment demonstrate there are no exceedances of the air quality standards, air quality objectives or environmental assessment levels at any human receptor. In addition, predicted deposition rates of metals are below the respective maximum deposition rates in the Environment Agency's *Air emissions risk assessment for your environmental permit* guidance.

Process contributions in air, and nitrogen and acid deposition rates, at internationally designated habitat sites are predicted to be less than 1% of the relevant assessment level and considered insignificant. Whilst PECs of ammonia in air are predicted to exceed the lower critical level at the nearest local wildlife site, this is a consequence of the background concentration. Process contributions in air, and nitrogen and acid deposition rates, at local wildlife sites are predicted to be less than the relevant assessment level and, under the Environment Agency's *Air emissions risk assessment for your environmental permit* guidance can also be considered insignificant.

Consequently, no significant impact on local air quality is predicted as a result of emissions to air from the EfW CHP Facility.

6.2.4 Human health risk assessment

The human health risk assessment (HHRA) associated with exposure to PCDD/Fs and dioxin-like PCBs is presented in Appendix A7. The HHRA uses the results from the dispersion modelling assessment and applies the risk assessment methodology contained within the US EPA's Human Health Risk Assessment Protocol (HHRAP). This protocol has been assembled into a commercially available model, Industrial Risk Assessment Program (IRAP, Version 5.1.0) and marketed by Lakes Environmental of Ontario.

The approach seeks to quantify the hazard faced by a receptor, the exposure of the receptor to the substances identified as being a potential hazard, and then to assess the risk of the exposure, as follows:

- Quantification of the exposure: an exposure evaluation determines the dose and intake of key indicator chemicals for an exposed person. The dose is defined as the amount of a substance contacting body boundaries (in the case of inhalation, the lungs) and intake is the amount of the substance absorbed into the body. The evaluation is based upon worst case, conservative scenarios, with respect to the following:
    - location of the exposed individual and duration of exposure;
    - exposure rate; and
    - emission rate from the source.
- Risk characterisation: following the above steps, the risk is characterised by examining the toxicity of the chemicals to which the individual has been exposed and evaluating the significance of the calculated dose by a comparison of intakes with the tolerable intake for dioxins/furans and dioxin-like PCBs.

The possible impacts on human health arising from PCDD/F and dioxin-like PCBs emitted from the EfW CHP Facility were assessed under a worst case scenario, namely that of an individual exposed for a lifetime to the effects of the highest airborne concentrations and consuming mostly locally grown food and water. This equates to a hypothetical farmer consuming food grown on a farm situated at the closest proximity to the EfW CHP Facility. Where there are no active farming areas in close proximity, a residential receptor is considered where it is assumed that the resident consumes locally grown vegetables.

The assessment identified and considered the most plausible pathways of exposure for the individuals considered (farmer and resident). Deposition and subsequent uptake of the compounds of potential concern (COPCs) into the food chain is likely to be the more numerically significant pathway over direct inhalation. The risk assessment methodology used in the assessment was structured so as to create worst-case estimates of risk. A number of features in the methodology give rise to this degree of conservatism.

Under these worst-case, pessimistic assumptions, the HHRA identifies that, for the maximally exposed individual, exposure to PCDD/Fs and dioxin-like PCBs is not significant.

6.2.5 Abnormal operation

As described in Section 5.7, whilst the design basis of the EfW CHP Facility is to target no exceedances of the ELVs, under Article 46(6) of IED, the EfW CHP Facility is allowed to operate for up to 4 hours uninterrupted during periods of abnormal operation that might cause an exceedance of an emission limit, up to a maximum total duration of 60 hours per year.

Consequently, impacts have been assessed for several hypothetical abnormal operating scenarios that could contribute to an exceedance of an emission limit value in Appendix A7:

- Failure of a filter bag (affecting particulate matter and metal emissions);
- Failure of the lime dosing system (affecting emissions of acid gases, including SO_2, HF and HCl); and
- Failure of the urea dosing system (affecting emissions of NOx).

Under these scenarios, emissions have been modelled at the emission limits for abnormal periods of operation described in point 2 of Annex VI, Part 3 of IED or, where limits are not defined, based on the typical abatement efficiency.

The assessment in Appendix A7 concludes that during these hypothetical scenarios, predicted environmental concentrations of relevant pollutants would remain below the air quality standards, air quality objectives and other environmental assessment levels and, consequently, no significant impact on local air quality is predicted.

6.3 Emissions to surface water and sewer

The only discharges to surface water will be uncontaminated run-off from roads, roofs and other areas of hardstanding not storing or handling potentially polluting substances. Surface run-off will be collected in a dedicated surface water drainage system incorporating SuDS principles, including oil interceptors. Consequently, discharges to surface water have not been assessed further.

As described in Section 5.2, during normal operation of the EfW CHP Facility there will be no discharges of process effluent, with process effluents routed to the process water system for re-use within the bottom ash quench. The only discharges to foul sewer during normal operation will be domestic effluent from amenity areas.

Potential discharges could, however, occur during intermittent on-line maintenance of the water treatment plant if filter backwash and effluents from regeneration of the ion exchange unit cannot be routed to the process water system due to this system operating at capacity. In this scenario, these effluents will be routed to a neutralisation tank prior to being discharged to foul sewer under a trade effluent discharge consent with Anglian Water.

As this is an intermittent release, with the quality of effluent after neutralisation being subject to a trade effluent discharge consent, no detailed assessment of discharges to sewer has been performed.

6.4 Odour

During normal operation of the EfW CHP Facility, there is expected to be negligible odour impact due to the control measures in place to contain and destroy odours by extracting potentially odorous air through the furnaces as combustion air, as described in more detail in Section 4 and the Odour Management Plan in Appendix A14.

The potential odour impacts during an extended shutdown of both lines, whereby negative pressure through the waste bunker and tipping hall will be maintained by operating the shutdown exhaust fan (subject to completion of the detailed design) and passing the extracted air through a carbon filtration system prior to being emitted to atmosphere, has been assessed using detailed dispersion modelling.

The methodology and results of this modelling can be found in Appendix A7. In summary, the assessment assumed a conservative emission concentration of odour from the carbon filtration system, equivalent to a level whereby partial breakthrough of the carbon has occurred. Under this conservative assumption, the assessment concluded that the maximum predicted off-site odour concentration at any relevant human receptor location would remain below the benchmark odour level for the "most offensive" odours in the Environment Agency's H4 Odour Management guidance.

As described in the Odour Management Plan, maintenance activities will be staggered where possible to minimise the frequency and duration of scenarios that could require an extended shutdown of both lines simultaneously. Prior to an extended planned shutdown, waste inputs will be reduced to lower the level of waste stored within the bunker to a minimum.

6.5 Noise

The detailed assessment providing modelling of noise emissions from mobile and fixed plant items within the installation boundary is provided in Appendix A8.

Specific sound levels due to fixed and mobile plant at the EfW CHP Facility were predicted according to the method provided in ISO 9613 2:1996 using the 3D noise modelling software package SoundPLAN 8.2 and assessed using BS4142:2014+A1:2019 in accordance with the *Environment Agency's Noise and vibration management: environmental permits* guidance.

The noise model used to predict specific sound levels generally assumed flat, acoustically mixed ground, but included topography data for an area 100m beyond the installation boundary. Ground was assumed to be acoustically hard. Existing buildings, outside the installation boundary, were also included. Specific sound levels were predicted at ground floor and first floor level, and the greater of the two were used in the assessment.

The assessment was undertaken in accordance with BS 4142:2014+A1:2019. An initial estimate of impact was first undertaken which compared the predicted specific sound levels, combined with any rating penalties to account for the character of the specific sound, with the representative baseline residual and background sound levels. Following the initial estimate of impact, contextual aspects were considered. The final assessment result, and determination of significance, is dependent on consideration of context. With regard to the consideration of context, BS 4142 states:

"Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.

2) The character and level of the residual sound compared to the character and level of the specific sound. Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the *specific sound with that of the ambient or residual sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/or commercial nature is likely to be perceived and how people react to it. …"*

To inform consideration of context, a noise change assessment was also undertaken. The criteria for increases in ambient noise were based on guidance contained in '*Guidelines for environmental noise impact assessment*'. A change in sound level of +3 dB is considered to be a just noticeable change, for the majority of the population, for sounds of a similar character. As such, increases of up to +2 dB will tend to be imperceptible. On this basis, increases of 0 dB (i.e., no ambient noise increase) indicate an impact of negligible magnitude, increases up to +2 dB are considered to indicate an impact of low magnitude, increases between +3 to +5 dB indicate an impact of medium magnitude and increases equal to, or in excess, of +6 dB indicate an impact of high magnitude.

The results of the assessment indicate that, without additional mitigation, significant adverse impacts are possible at 10 New Bridge Lane during weekday daytimes. Below adverse to low impacts are anticipated at all other receptor locations assessed, at all times. The assessment of turbine bypass mode operations indicates the same conclusion.

To avoid adverse impacts at 10 New Bridge Lane during both the construction and operation phases an acoustic fence is proposed at the property boundary. The assessment indicates that, with the proposed acoustic fence, adverse impacts will be avoided. The provision of the acoustic fence, including provision of full design details, will be secured through a DCO Requirement.

The assessment indicates that, with the proposed acoustic fence to 10 New Bridge Lane, residual impacts would be below adverse during normal and turbine bypass mode operation. Further measures to control noise emissions from within the installation boundary are described in the Noise and Vibration Management Plan in Appendix A15.

The noise assessment and management plan completed for the permit application represents an initial assessment of an outline design and specification. The noise assessment will be updated upon completion of the detailed design and, if further control measures are required to avoid adverse impacts, including e.g., the specification of low noise generating equipment, further attenuation etc., these will be implemented and detailed in an updated Noise and Vibration Management Plan. Both the updated noise assessment and management plan would be provided to the Environment Agency prior to commissioning.

Noise monitoring will take place during commissioning to understand the actual impact of the EfW CHP Facility. These data will be provided to the Environment Agency in a post-commissioning environmental report. This report will also detail any further actions required to control noise emissions to avoid adverse impacts.

6.6 Global warming potential

Table 6-5 presents the calculation of global warming potential for the EfW CHP Facility using the Environment Agency's *Assess the impact of air emissions on global warming* guidance. In accordance with this guidance, direct process emissions of carbon dioxide from waste combustion have been assumed to have an impact of zero on global warming. However, direct process emissions of other pollutants that have a positive global warming potential, e.g., N_2O have been considered.

Table 6-5 Calculation of global warming potential

Substance	Source	Annual rate (MWh/y or t/y)	GWP value per MWh or per t	Annual GWP
CO_2 from energy consumption	Direct emissions from consumption of gas oil	19,507	0.25	4,877
CO_2 from energy consumption	Indirect emissions from electricity consumption	40,353	0.166	6,781
N_2O	Process emissions from A1	9.7	310	2,996
N_2O	Process emissions from A2	9.7	310	2,996
			TOTAL	**17,650**

6.7 Photochemical ozone creation potential

Table 6-6 presents the calculation of photochemical ozone creation potential (POCP) for the EfW CHP Facility. As the H1 software tool includes certain emissions multiple times in its calculation to reflect the different averaging periods for some environmental assessment levels, and for different human and ecological receptors, the actual POCP has been re-calculated from the annual emission quantities provided in Section 5.1.3 and the individual POCP values per tonne in the H1 software tool.

The negative POCP value for nitrogen monoxide reflects the fact that this pollutant is a sink for ozone i.e., it reacts with ozone rather, than reacting to form ozone.

Table 6-6 Calculation of photochemical ozone creation potential

Substance	Total annual emission (t/y)	POCP value per t	POCP
Benzene [A]	35.8	21.8	780.4
Benzo-a-pyrene [B]	0.0017	323	0.5
Carbon monoxide	179.1	2.7	484.7
Nitrogen monoxide [C]	387.9	-42.7	-16,563.3

Substance	Total annual emission (t/y)	POCP value per t	POCP
Nitrogen dioxide [C]	43.0	2.8	120.7
Sulphur dioxide	107.4	4.8	515.7
		TOTAL	**-14,661.3**

[A] Assumes TOC emitted as benzene

[B] Assumes PAHs emitted as benzo-a-pyrene

[C] Assumes NO_x emissions are 90% NO and 10% NO_2

6.8 The Conservation of Habitats and Species Regulations

Protection of certain habitat sites is provided via Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive') and Council Directive 2009/147/EC on the conservation of wild birds (the 'Birds Directive'). These directives are transposed in England on land within 12 nautical miles of the coast through the Conservation of Habitats and Species Regulations 2017, as amended (the 'Habitats Regulations').

The Habitats Regulations implement the EU Bird and Habitats Directives, both of which aim to protect a network of sites in the UK that have rare or important habitats and species. The sites designated under the Birds Directive are known as SPAs and aim to conserve the habitats that support regularly occurring migratory, or certain rare or vulnerable birds, to ensure their survival and reproduction in their area of distribution. Prior to classification by the UK Government, the sites are known as potential SPAs (pSPAs).

The Habitats Directive establishes the process for the designation of SACs; these are sites that support habitats and/or species which are rare or threatened on a European scale. Before the SAC designation is ratified by the European Commission the sites are referred to as candidate SACs (cSACs).

SPAs and SACs are collectively known as 'European sites' or 'Habitats sites' and form part of a European network known as Natura 2000. It is also Government policy for sites designated under the Convention on Wetlands of International Importance (Ramsar sites) to be treated as having equivalent protection status as Natura 2000 sites.

The EPR require that the Habitats Regulations are taken into consideration and, if the installation activity may have a likely significant effect on any of the sites protected under these regulations, the Habitats Regulations require that competent authorities are satisfied that an appropriate assessment on such habitats has been conducted.

The Habitat Regulations define the process for the assessment of the implications of plans and projects on European sites. Whilst it is the responsibility of the competent authority to determine whether it can be concluded there is no significant adverse effect, it is the responsibility of applicants to ensure sufficient information is submitted to enable a robust determination of these issues.

Information that will allow the Environment Agency to reach a judgement on the potential significance of effects on Natura 2000 sites can be found in Appendix A7 and A12. This does indicate that process contributions of relevant concentrations in air and nitrogen and acid deposition rates at sites designated under the Habitats Regulations can be screened as insignificant using the Environment Agency's *Air emissions risk assessment for your environmental permit* guidance.

6.9 Flood risk

The installation is located in a Zone 3a area for flood risk. Consequently, a flood risk assessment (FRA) was completed as part of the DCO application. The FRA is provided as part of the Environmental Statement in Appendix A12.

All potential sources of flooding have been considered in this assessment. Tidal flooding from the River Nene represents the greatest potential flood risk for the EfW CHP Facility. Detailed tidal flooding information provided by the Environment Agency indicates that the EfW CHP Facility would remain dry during the design flood event (0.5% Annual Exceedance Probability (AEP) plus climate change) as it benefits from the protection offered by the raised tidal defences along the banks of the River Nene. The EfW CHP Facility is also predicted to remain dry during the 0.1% AEP tidal overtopping plus climate change event. As the entire EfW CHP Facility is predicted to remain dry during the design tidal flood event, there is no potential for the development to increase tidal flood risk elsewhere.

Parts of the EfW CHP Facility are, however, potentially at residual risk of tidal flooding during 'breach' events, i.e., failure of the raised tidal defences protecting the area. Suitable flood risk management measures have been identified to address the potential residual risks identified. These include the preparation of an Emergency Flood Response Plan and minimum finished floor levels for the essential infrastructure components of the EfW CHP Facility. These measures will ensure that the essential infrastructure elements remain operational (whilst waste and other raw materials are available on site) and safe in times of flood. The Emergency Flood Response Plan will safely take the EfW CHP Facility offline, if required, until access is restored.

7 Improvement programme

Due to the early submission of this application to allow for 'twin-tracking' with the DCO application, which in some instances required outline information to be presented in this application, the Operator is proposing that a small number of pre-operational and improvement conditions are incorporated into the permit to demonstrate the effectiveness of the final design proposals in minimising the impact on the environment. Many of these reflect standard conditions that have been included in other permits for waste incineration activities granted by the Environment Agency.

7.1 Pre-operational conditions (prior to commissioning)

Prior to the commissioning of the EfW CHP Facility, the Operator proposes to provide the following information to the Environment Agency:

- Submit a written report on the details of the CFD modelling used to inform the final boiler design to demonstrate that the design represents BAT, and that the secondary chamber minimum temperature and residence time requirements under the most unfavourable operating conditions can be met;
- Submit a written protocol for the sampling and testing of bottom ash to assess its hazard status;
- Provide a written commissioning plan, including timelines for completion, expected emissions to the environment during different stages of commissioning, expected duration of specific commissioning activities, and actions to be taken to protect the environment and report to the Environment Agency in the event actual emissions exceed expected emissions;
- Provide an updated summary of the EfW CHP Facility IMS procedures;
- Provide a revised noise assessment and an updated noise management plan upon completion of the final design;
- Provide a revised odour management plan upon completion of the final design; and
- Provide a revised fire prevention plan upon completion of the final design.

7.2 Improvement conditions (post commissioning)

Following completion of commissioning of the EfW CHP Facility, the Operator proposes to provide the following information to the Environment Agency:

- Submit a written report within 18 months of the completion of commissioning on the implementation of the IMS and the progress made in the accreditation of the IMS by an external body or, if appropriate, submit a schedule by which the IMS will be subject to accreditation;
- Submit a written report describing the performance and optimisation of the air pollution control system including combustion settings (e.g., minimum oxygen level) and operation of the SNCR system, and the optimisation of dosing rates of hydrated lime and activated carbon. The report will also provide the findings of the commissioning trials to ascertain whether the SNCR system can achieve a NO_x ELV of 100mg/Nm^3 without detrimental effects on ammonia slip and associated impacts on habitat sites and deposition of ammonia salts in the boiler and APC system;

- Submit a written report providing the results of appropriate tests to verify the residence time, minimum temperature and oxygen content of the furnace flue gases whilst operating under the most unfavourable operating conditions;
- Submit a post commissioning environmental performance report which summarises the environmental performance of the EfW CHP Facility against the design parameters set out in the Application and any pre-operational condition submissions;
- Submit a written report to confirm the results of the calibration and validation of the CEMS to demonstrate the requirements of BS EN 14181 QAL1, QAL2 and QAL3 are met; and
- Carry out a review of the noise impact of the installation at the most sensitive receptors once the EfW CHP Facility is fully operational in its first year of operation. The scope of the review will be agreed with the Environment Agency. The review shall include appropriate measurements to verify any modelling work to establish whether any noise emissions are likely to give rise to nuisance or complaints, and an action plan developed and agreed if significant adverse impacts are identified.

8 Appendices

A1 Application forms

A2 Pre-application consultation

A3 Site plans and drawings

A4 BAT assessment

A5 Site Condition Report

A6 Environmental risk assessment

A7 Air quality technical report

A8 Operational noise impact assessment

A9 Climate change risk assessment

A10 Outline Fire Prevention Plan

A11 Combined heat and power assessment

A12 Environmental Statement

A13 Management systems certificates

A14 Outline odour management plan

A15 Outline operational noise management plan

A16 Material safety data sheets