BEST AVAILABLE TECHNIQUES AND OPERATING TECHNIQUES DOCUMENT

Increased Tonnage Permit Variation Application

Prepared for: enfinium Parc Adfer Operations Limited

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1.0 Introduction

Enfinium Parc Adfer Operations Limited (PAOL) is proposing to increase the annual throughput tonnage of the Parc Adfer Energy Recovery Facility (ERF) from 200,000 tonnes as applied for in the original permit application in 2015, to the design maximum of 232,000 tonnes per year. This requires a substantial variation to the existing environmental permit. This report forms part of the permit variation application and updates the original Best Available Techniques and Operating Techniques (BATOT) document submitted as part of the original environmental permit application (Section 6) to take into account the potential increased capacity.

The ERF is a listed activity under Schedule 1 of The Environmental Permitting (England and Wales) Regulations 2016 (as amended); Section 5.1 "Incineration & Co-incineration of Waste" and subject to the requirements of the Industrial Emissions Directive (IED). The ERF is subject to an Environmental Permit, permit reference EPR/AB3092CV, issued by Natural Resources Wales (NRW).

This report should be read in conjunction with the Non-Technical Summary Report, ref: 410.08986.00003_NTS to explain the rationale.

1.1 Site Location and Access

The site is located to the south east of the Dee Estuary within the Deeside Industrial Estate, over 2km south west of the nearest settlement, Puddington. Access to the site is via Weighbridge Road which runs parallel and adjacent to the western boundary of the site. Weighbridge Road can be accessed off the A548 located north of the site.

1.2 Site Setting and Sensitivity

The site is centred on National Grid Reference SJ 310 716. The site is surrounded by industrial land, being located within the Deeside Industrial Estate. Areas of open space lie approximately 50m to the north of the site. There are no residential properties within 500m of the site; the closest residential receptors are associated with Puddington to the north of the site. The Borderland railway line lies adjacent to the east of the site.

Surface water drains lie adjacent to the west and east of the site. Surface water reservoirs are located to the north and west of the site. The closest of these is located 170m to the north. Searches on the Multi-Agency Geographic Information for the Countryside (MAGIC) website confirm that there are the following European or International sites located within 2km of the site boundary:

- Special Areas of Conservation (SAC);
- Inshore Special Protection Areas with Marine Components (ISPAM);
- Sites of Special Scientific Interest (SSSI); and
- RAMSAR.

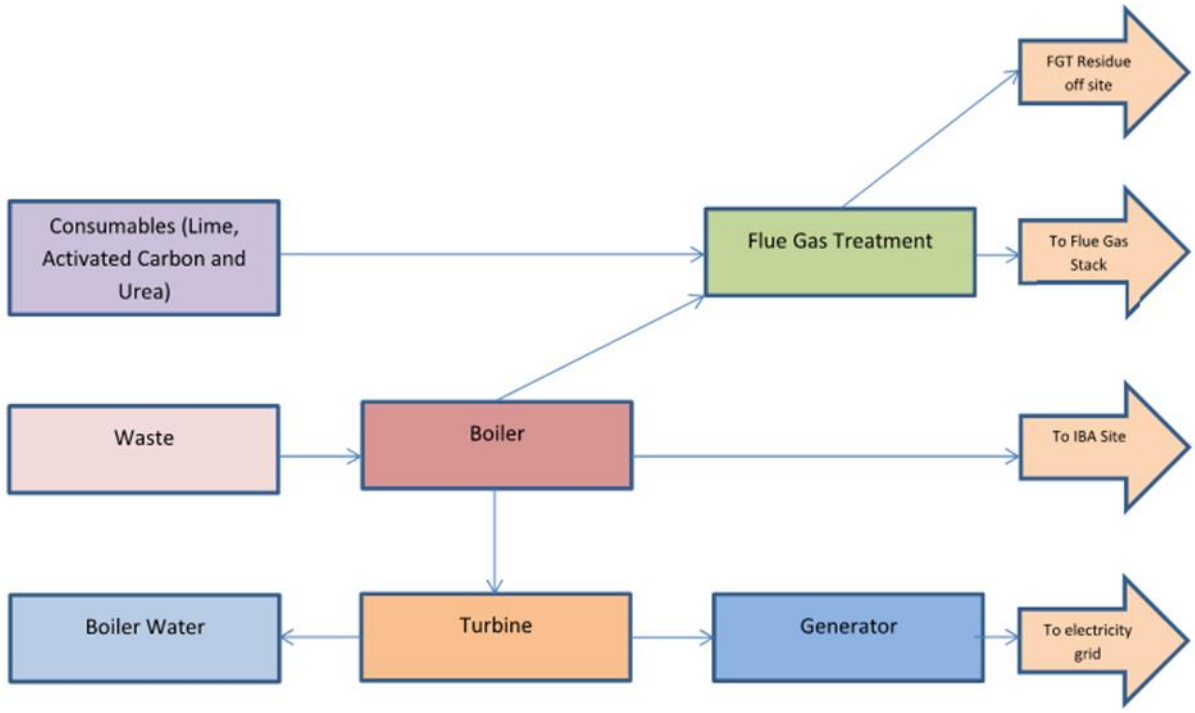
Further details of these sites were set out in full in Table 1 of the H1 environmental risk assessment and on supporting Drawing 004 provided as part of the original permit application.

1.3 Summary of Facilities at Parc Adfer ERF

A summary of the facilities at the site is provided below. A full process description is given in Section 5 of this document.

The ERF consist of a CHP enabled plant for the recovery of energy from waste by combustion and steam generation as a solution to diversion from landfill. Bottom ashes produced as a by-product to the incineration process will be stored on site prior to their recovery off site to produce aggregates for use in the construction industry. Figure 1 below illustrates a simple flow diagram of the process:

Figure 1
Simple Flow diagram of the treatment process at Parc Adfer ERF



An overview of the different technologies and treatment capacities is provided below.

1.4 Waste Reception and Storage

Up to 232,000 tonnes of waste per annum will be received in the waste reception hall where the waste delivery vehicles will discharge into a bunker for the temporary storage of waste. Waste will be mixed in the bunker and then fed into a feed hopper using one of two overhead cranes.

1.5 Energy Recovery Facility

The ERF processes municipal, industrial and commercial waste, and has the capacity to treat up to approximately 232,000 tonnes of waste per annum.

The facility will process waste using Constructions Industrielles de la Mediterranee (CNIM) air cooled, moving grate technology. The energy recovered from the combustion of waste using this technology is utilised (in the form of high-pressure steam) to produce electrical power through a steam turbine and generator unit. The facility also has CHP capability through a blanking flange and uncontrolled heat/steam export from the turbine.

The key components include, but are not limited to:

- A furnace/boiler unit incorporating moving grate technology and steam boiler with an energy recovery system;
- FGT system comprising selective non catalytic reduction (SNCR), dry reactor and bag house filters;
- Steam turbine/generator set with the capability for CHP operation;
- Condensate system, including ACCs;
- Residue handling and storage facilities;
- Electrical equipment associated with the facility and its connection to the national grid;

- Continuous emissions monitoring system (CEMS); and
- Auxiliary equipment.

The facility has been designed to generate approximately 19.8MW and export approximately 17.5MW of electricity to the National Grid.

2.0 Management

This section describes the system of management that are implemented at the site to ensure that all appropriate pollution prevention and control techniques are delivered reliably and on an integrated basis.

2.1 Design and Construction Quality Assurance

All relevant elements of the facility were designed in accordance with recognised standards, methodologies and practices.

The design process used a risk-based approach and were appropriately documented using drawings, specifications and method statements to provide an adequate audit trail.

Construction Quality Assurance (CQA) plans governed all construction activities. These CQA plans were prepared by competent and suitably qualified persons and detail the assurance and validation process for relevant elements of the facility, which included:

- material selection;
- handling, storage and installation;
- conformance and performance testing; and
- Inspection and validation.

A competent and suitably qualified person supervised the construction activities and prepared a validation report confirming that the construction activities have been carried out in accordance with the CQA plan.

PAOL required subcontractors to work within acceptable quality and environmental standards. The requirements were be set out in PAOL's Integrated Management System which will be accredited to ISO14001 standard.

2.2 Environmental Issues

Environmental issues were considered during the construction phase of the project and where possible, recycled and "environmentally friendly" products were used.

Details on waste streams, recycling opportunities, disposal routes and responsibilities were included in a Site Waste Management Plan which was implemented to cover all construction activities.

2.3 Management Systems

PAOL operate the site using an Environment Management System accredited to ISO14001 Standard. The EMS was certified within 12 months of the site becoming operational.

The management system ensures that:

- the risks that the activities pose to the environment are identified;
- the measures that are required to minimise the risks are identified;
- the activities are managed in accordance with the management system;
- performance against the management system is audited at regular intervals; and

- the environmental permit is complied with.

The management system is reviewed at least once every four years or in response to significant changes to the activities, accidents or non-compliance. The management system is supplemented by this BATOT document which outlines the operating techniques at the site and demonstrates conformance with the requirements of NRW guidance.

2.4 Management Structure and Responsibilities

The Plant Manager has overall responsibility for the establishment of environmental policy, objectives and allocation of resources for the operation of the site.

The Plant Manager is responsible for ensuring that:

- operational personnel are trained and familiar with procedures and requirements;
- operations comply with regulation and permit conditions;
- activities conform with company policy;
- procedures, logs and records are followed and maintained, as required; and
- aspects for potential improvement are identified and reported back to the site manager.

The Plant Manager is also responsible for ensuring:

- awareness of potential environmental consequences of activities and operations;
- familiarity with site procedures and work instructions;
- working in compliance with procedures;
- reporting unsafe conditions and potential or actual release arising from unsafe or insecure operational procedures; and
- cleaning up and reporting spillages or releases.

In addition to the Plant Manager, the ERF has a designated supervisor / managers who is responsible for control of operations at that part of the site.

2.5 Technically Competent Management

The site is supervised by designated technically competent managers who hold the appropriate certificate of technical competence.

2.6 Environmental Policy, Objectives and Targets

Details including environmental targets and objectives and the company's environmental policy and improvement programme are contained within the management system.

2.7 Management Techniques

2.7.1 Operational Control, Preventative Maintenance and Calibration

Compliance with operating procedures ensures effective control of site operations.

As part of the environmental management system, procedures are established covering the following general topics:

- management and training;
- environmental protection and risk assessment;

- equipment registers and calibration;
- defects, non-conformance and complaints; and
- operations control and equipment maintenance.

A maintenance programme for all equipment is implemented at the site. This follows the inspection and maintenance schedule recommended by the manufacturer. The maintenance programme is reviewed annually to ensure any necessary changes are implemented.

Also held on site are any operation and maintenance manuals as provided by the equipment manufacturer covering:

- machinery associated with the operation of the ERF and IBA facilities;
- routine maintenance procedures and requirements;
- environmental protection; and
- emergency procedures.

Where necessary, all monitoring and process control equipment is calibrated in accordance with manufacturers' recommendations.

2.7.2 Monitoring, Measuring and Reviewing Environmental Performance

A formalised management structure reviews environmental performance and ensures any necessary actions are taken.

The Plant manager reviews the facility's environmental performance on a regular basis to ensure policy commitments are met, that policy remains relevant, and to ensure that actions to improve environmental performance are identified. Records of environmental performance are maintained within an appropriate filing system at the Plant managers office (or appropriate alternative), or on an electronic system.

2.7.3 Staffing Competence and Training

The Plant manager is responsible for ensuring that training levels for operational staff are adequate, relevant and up to date.

Staff employed on site benefit from training, which ensures their professional and technical development. There is a commitment for staff at all levels to continual improvement, prevention of pollution and compliance with legislation. The training ensures that staff are aware of:

- the skills and competencies required for each site job;
- regulatory implications of the permit for the site and their specific work activity;
- potential environmental effects from operations under normal and abnormal circumstances; and
- prevention of accidental emissions and action to be taken should accidental emissions occur.

Staff receive training in:

- control of point source and fugitive emissions to air;
- control of odour;
- waste handling, minimisation, recovery and/or disposal;
- noise;
- monitoring; and
- health and safety.

Training records are maintained by the Plant manager and held in the site office.

2.7.4 Communication & Reporting of Actual or Potential Non-Compliance & Complaints

All staff report non-compliances to the Plant manager, whose responsibility it is to ensure that these are rectified and future incidents prevented. The following aspects are considered:

- actual or potential non-compliance;
- suppliers or subcontractors breaking agreed operating rules;
- incidents, accidents, and emergencies; and
- other operational system failure.

The remedial actions taken in response to the non-compliance may include:

- obtaining additional information on the nature and extent of the non-compliance;
- discussing and testing alternative solutions;
- modifying procedures and responsibilities;
- seeking approval for additional resources and training;
- contacting suppliers and contractors to seek alterations to the way they operate; and
- informing Natural Resources Wales.

2.7.5 Auditing

A formal internal audit is carried out by the Plant manager, or suitably qualified nominated personnel to check that all activities are being carried out in conformity with the requirements of the environmental permit. Site audits ensure that the progress of corrective and preventative action are regularly monitored and reviewed.

2.7.6 Corrective Action to Analyse Faults and Prevent Recurrence

The Plant manager deals with all environmental complaints and other incidents of non-conformance. These include:

- system failure discovered at internal audit;
- incidents, accidents, and emergencies; and
- other operational system failures.

Environmental non-compliances, including remedial action taken and any changes to operation made to avoid re-occurrence are recorded. Complaints are reported to and investigated by the Plant manager and remedial measures implemented as required. Changes to prevent future complaints will be proposed and implemented where appropriate. Written records of non-conformances, complaints and other incidents are maintained in the site log in which the date, time and nature of the event, together with the results of investigations and remedial action taken, are recorded.

2.7.7 Reviewing and Reporting Environmental Performance

Senior management review environmental performance annually and ensure that action is taken to ensure that policy commitments are met and that policy remains relevant.

2.7.8 Managing Documentation and Records

The Plant manager is responsible for ensuring commitments to site audits and reviews and for ensuring that documents relevant to the environmental permit are issued, revised and maintained in a consistent fashion.

An appropriate filing system is maintained to ensure that all records relating to environmental monitoring, maintenance, reviews and audits are adequately maintained and updated. All records are held within the site office.

3.0 Accident Management Plan

PAOL recognise the importance of the prevention of accidents that may have environmental consequences and that it is crucial to limit those consequences.

An accident management plan is implemented and maintained at the site to ensure the site's staff are fully prepared for such incidents. The accident management plan is reviewed at least every four years or as soon as practicable after an incident with changes made accordingly to minimise the risk of occurrence.

The following accident management plan describes the techniques that are implemented to minimise the risks posed to the environment. Activities affecting the health and safety (H&S) of operatives, contractors and visitors are separately managed in compliance with H&S regulation and company H&S policy.

3.1 Action to Minimise the Potential Causes and Consequences of Accidents

Action will be taken at the site to minimise the potential causes and consequences of accidents. These actions will include:

- a list of substances that would harm the environment if they were to escape is maintained;
- raw materials and waste are checked for compatibility with other substances with which they may come into contact;
- raw materials, products, residues and wastes are securely stored to prevent their escape into the environment;
- where appropriate, barriers have been constructed to prevent vehicles from damaging equipment;
- primary and secondary containment is provided to prevent the escape of potentially polluting materials;
- tanks for the containment of fuels are fitted with level measurements to prevent overfilling;
- site security is in place to minimise the risk of unauthorised access;
- a log will be maintained of all incidents and near misses;
- responsibilities for managing accidents are clearly defined. Clear instructions on the management of accidents is maintained; and
- appropriate equipment is maintained to limit the consequences of an accident.

3.2 Hazard Identification

The following hazards have been identified:

- waste storage failure
- incoming waste or raw material handling/storage failure
- waste charging failure
- furnace control failure

- residues handling/storage failure
- air pollution control equipment failure
- unauthorised waste receipt and processing:
- fire;
- explosion;
- asphyxiation and toxicity;
- loss of containment – spillage and leakage;
- security and vandalism; and
- flooding.

3.2.1 Waste Storage Failure

Failure to store waste materials securely with appropriate containment could result in the release of litter to the environment or the contamination of land.

Risk Reduction

To prevent the likelihood of littering or the contamination of land at the ERF:

- waste are stored within the bunker which will benefit from impermeable surfacing;
- the site's surfacing and drainage system is subject to routine inspection to ensure their integrity;
- the doors to the waste reception building are kept closed when not in use.

3.2.2 Incoming Waste or Raw Material Handling/Storage Failure

Inappropriate storage or handling of incoming waste or raw materials could lead to spillage of materials, the overfilling of containers and/or putrefaction leading to odours and/or fire risk.

Risk Reduction

PAOL apply a number of measures to prevent incoming waste or raw material handling/storage failures. These include:

Spillage

- *containment system:* tanks containing potentially polluting liquids are constructed so that any leaks/spillages are contained. Tanks are surrounded by a leakage containment bund capable of containing at least 110% of the volume of the largest tank;
- *storage vessels:* storage tanks are constructed to the appropriate British Standard;
- *inspection:* tanks are inspected visually on a regular basis by the site staff to ensure the continued integrity of the tanks, and identify the requirement for any remedial action;
- *spill kits*: materials suitable for absorbing and containing minor spillages are maintained on site;
- *monitoring techniques:* Site staff undertake regular monitoring for evidence of spillage and leakage. Alongside regular visual inspections, the tanks are fitted with level indicators to prevent overfilling; and
- *building design:* the facility buildings, in which potentially polluting materials are located, drain directly to an internal foul drainage system.

Overfilling

- *high level alarms:* tanks containing potentially polluting liquids have high level alarms installed to prevent the overfill of containers.

Putrefaction leading to odours and/or fire risk

- *processing of waste*: the waste storage bunker has provision for the storage of waste for up to a maximum of nine days; and
- *fire detection and fire management:* refer to section 3.2.9 for details of the fire detection and management measures which are in place at the facility.

3.2.3 Waste Charging Failure

A failure with the waste charging system has the potential to upset combustion conditions within the chamber and lead to unfavourable emissions to air. The ERF has a number of measures in place to manage the risk of a waste charging failure, including:

- use of an automatic system to prevent waste feed at start-up, if temperature within the combustion chamber were to not be maintained at 850ºc and where continuous monitors identify that an emission limit is exceeded;
- interlocking waste charging and auxiliary fuel oil firing with furnace conditions;
- ensuring that the charging operation is as airtight as possible and control of the induction fan in relation to pressure within the furnace during charging, to avoid the escape of fumes or excess air flows;
- interlocking the loading of the feed hopper with regard to conditions in the combustion chamber;
- mass throughput rates will be adjusted to ensure optimum conditions are maintained for combustion and wastes are retained within the chamber to ensure sufficient residence;
- the application of a planned preventative maintenance programme; and
- the inspection of wastes to ensure their suitability for treatment and the removal of unsuitable wastes such as oversized materials.

3.2.4 Furnace Control Failure

A failure to control combustion within the furnace has the potential to lead to suboptimal combustion conditions within the chamber leading to unfavourable emissions to air and possible plant shutdown.

Combustion control takes place using a number of different plant features. The main features include the following;

- primary air system;
- secondary air system;
- waste feed system;
- additive dosing system;
- auxiliary fuel firing system; and
- acoustic pyrometry.

Further detail on how these features control the combustion process is provided in Section 5.1.5.

3.2.5 Residue Handling/Storage Failure

The ERF produces the following products and residues:

- incinerator bottom ash (IBA) for recycling with a small proportion to landfill; and
- air pollution control residues (APCRs) and fly ash from the economiser section of the boiler.

Appropriate handling and storage of these materials is required to limit the likelihood of a release to the environment which could result in the contamination of land, damage to aquatic systems and release to air. Measures are in place to ensure the appropriate handling and storage of process residues at the facility to limit the potential for these impacts to occur. These include:

Bottom Ash

- handling bottom ash in a wet state with appropriate drainage controls to manage run off as described in section 6.3.
- ensuring the combustion process is controlled such that total organic content (TOC) within the bottom ash is less than 3% or loss on ignition (LOI) is less than 5% of the dry weight of the material.

Fly Ash

- managing fly ash with regard to its pollution potential. As such:
    - fly ash from second, third and fourth boiler passes will be incorporated with the IBA for recovery as an aggregate; and
    - fly ash from the economiser section of the boiler will be incorporated with APCRs.
- the two distinct fly ash streams will be handled and stored in accordance with the procedures for IBA and APCRs respectively.

Air Pollution Control Residues

- handling of APCRs as a hazardous material;
- storage of APCRs within sealed silos;
- transport of APCRs by enclosed conveyor;
- the ducting of displaced air to dust arrestment plant during silo and container filling; and
- the handling of APCRs within sealed containers for off-site treatment/landfill.

3.2.6 Flue Gas Treatment (FGT) System Failure

There are a number of potential sources of failure of FGT systems at ERFs including power failure, reagent shortage, blockage and equipment damage. Failure of the air pollution control equipment can lead to its ineffectiveness at flue gas treatment and a resultant exceedance of emission limits and plant shutdown.

As such, PAOL employ a number of measures to avoid failures of the facilities' FGT system, including:

- low level reagent alarms fitted to the reagent storage silos;
- a programme of preventative maintenance is employed;
- suitable redundancy in the event of a failure; and
- the cleaning of the filter bags by pulses of compressed air to prevent blockage.

3.2.7 Unauthorised Waste Receipt and Processing

Acceptance of unauthorised materials could result in unacceptable wastes being present at the site. Emissions to air may be unacceptable with consequences dependent on the nature of the waste.

Risk Reduction

PAOL have in place strict waste acceptance procedures drafted in line with relevant Sector Guidance Notes and with due regard to the Duty of Care legislation, to prevent unauthorised waste arriving on site.

In the event that unauthorised waste is accepted at the site, the waste is segregated and stored in a designated quarantine/isolation area prior to export from site. A quarantine area is provided and takes the form of a skip situated on impermeable surfacing with containment to prevent any leakage to drains.

3.2.8 Plant Failure

An unexpected breakdown at the ERF could result in emissions to air that may be unacceptable with consequences dependent on the nature of substances emitted.

Risk Reduction

Should any problems, malfunctions or breakdowns occur within the ERF resulting in a breach of the Permit, treatment is stopped until such time as the problems are rectified.

Section 10 of this document details the measurement and monitoring systems that are in place to ensure that all relevant parameters are recorded and that any operating faults can be detected. When detected, action is taken and this may involve the use of standby equipment. For example, in cases such as start-up, shutdown, overload or trip of the turbine, all or part of the steam flows into the air-cooled condenser via the turbine bypass system. The thermal capacity of the air-cooled condenser is high enough to condense the steam in bypass mode.

Full details are included in Section 10. In addition, abnormal emissions have been assessed in the detailed air quality modelling which is included in this EP variation application.

3.2.9 Fire

Fire is a risk when receiving and storing large volumes of combustible waste. The following fire hazards have been identified for the proposed facility:

- storage of waste (fuel) in the bunker;
- electrical equipment that could provide an ignition source;
- electrical appliances and other sources of ignition in the switch room together with materials that may burn;
- waste oil that may support combustion;
- maintenance activities on plant and equipment that may represent a potential fire risk if necessary precautions are not taken; and
- loss of containment of contaminated firewater.

Risk Reduction

To prevent and minimise the potential impact of fire within the ERF, the following actions are taken:

- fire detection measures are in place;
- incompatible materials are stored apart;
- the size of stockpiles of combustible materials is limited;

- Should a vehicle be found to be carrying a smouldering load, it is directed to the fire bay and the fire service called to deal with the vehicle;
- In the event that a batch of waste is found to be smouldering or alight once tipped in the residual waste reception bunker, the waste would be doused with the fire cannon;
- the plant inspection schedule includes checks of electrical equipment within the site to ensure that any faults are identified and repaired;
- fire extinguishers are provided at designated locations;
- smoking is not permitted in the operational areas of the site;
- the operators working practices ensure assessment of fire hazards and training of employees in fire prevention, e.g. the use of fire extinguishers and emergency procedures;
- NRW are advised of all incidents of fire as soon as practicable; and
- no wastes are burned on site and any fire at the site is treated as an emergency.

The site is equipped with fire hoses and extinguishers. The locations and types of extinguishers have been agreed with the local Fire Officer. Manually operated emergency fire alarms are positioned at strategic points throughout the building. These alarms are connected to an audible and visual (stroboscopic) signal. Standard operating procedures and the site EMS incorporate specific procedures associated with the avoidance of fires.

In the unlikely event of a fire, the volume of fire water required would be minimised by the use of targeted firefighting devices (e.g. sprinklers, mists, inert gases and foams).

Water for firefighting is taken from local rising mains and can be discharged to either the waste bunker and/or a primary containment tank. Provision has been made for re-circulation for firefighting water and removal for discharge to sewer or to tanker for disposal off-site at an appropriately licensed facility, (subject to confirmatory quality testing and treatment). Secondary containment (in accordance with PPG18) has been provided within the SuDS pond. An emergency shut-off valve and low permeability lining (e.g. engineered clay or similar) of the SuDS pond (upper section) are provided, so that in the event of a fire at site, water can be contained in the SuDS pond until appropriate treatment or collection by tanker for off-site treatment and disposal at an appropriately licensed facility is organised.

In the event of fire, the following action will be taken:

- the fire service will be notified immediately and NRW as soon as practicable;
- the burning area will be isolated and attempts will be made to extinguish the fire utilising the onsite fire extinguishers if safe to do so;
- contaminated site drainage will be prevented, if possible, from entering any un-surfaced ground; and
- the site will be evacuated if the fire is not containable.

3.2.10 Explosion

Explosion is a potential risk at energy from waste facilities.

Risk Reduction

The site has in place measures to prevent explosions. Measures include;

- storage of incompatible substances separately;
- due regard to chemical and raw material safety data sheets;
- training of all operatives to understand the risks;

- implementation of fire precaution measures and a fire management plan; and
- operation of the site in accordance with the conditions of the EP.

3.2.11 Asphyxiation and Toxicity

Accumulation of flue gas in enclosed spaces can pose a direct risk to humans due to asphyxia.

Some of the constituents of flue gases can have toxic effects if present in high enough concentrations. These include carbon dioxide and a number of trace components.

Risk Reduction

The site operates a permit to work system to ensure entry into confined spaces is controlled and appropriate inspections, monitoring and other safety measures as appropriate are carried out prior to entry into enclosed spaces. Employee training ensures awareness of risks associated with working alongside biogas.

3.2.12 Loss of Containment - Spillage and Leakage

Loss of containment could result in potentially polluting liquids, being discharged to groundwater or surface water.

Risk Reduction

The following mitigation measures are in place which would reduce the potential risk to the surface water run-off regime:

- surface water management controls the drainage from the site using sustainable drainage techniques (SuDS);
- where possible rainfall runoff is harvested for use in on-site processes;
- runoff from areas of roof that cannot be harvested are discharged off site at controlled rates following attenuation;
- Surface water runoff from the raw IBA area is passed directly to the dirty water tank within the main plant for re-use. This tank includes flood attenuation;
- surface water is discharged to the drainage channel on the eastern boundary, from where it is discharged via a culvert beneath the railway line into the drainage network serving the wider industrial area;
- runoff from areas of external kerbed hard standing are passed through a hydrocarbon interceptor and silt trap prior to being discharged off site at controlled rates and following appropriate attenuation to the north eastern drainage channel;
- surface water discharges from the bund in the eastern section of the site are collected in a toe drain from where it is discharged off-site at controlled rates following appropriate attenuation;
- minor areas which are located at a lower level (<10m AOD) adjacent to the site access discharge surface water runoff direct to the storm drain (north eastern drainage channel) via a separate piped drainage system;
- drainage from all waste handling areas (inc. the bunker) are positively drained to sealed tanks (which are subject to routine inspection), with water re-circulation within the process. Any disposal is to sewer or to tanker for disposal off-site at an appropriately licensed facility;
- in the unlikely event of a fire, the volume of fire water required is minimised by the use of targeted firefighting devices (e.g. sprinklers, mists, inert gases and foams);
- water for firefighting is taken from local rising mains and discharged to either the waste bunker and/or a primary containment tank. Provision has been made for re-circulation for firefighting water and

removal for discharge to sewer or to tanker for disposal off-site at an appropriately licensed facility, (subject to confirmatory quality testing and treatment). Secondary containment (in accordance with PPG18) is provided within the SuDS pond; and

- an emergency shut-off valve and low permeability lining (e.g. engineered clay or similar) are provided to the SuDS pond (upper section) so that, in the event of a fire at site, water can be contained in the SuDS pond until appropriate treatment or collection by tanker for off-site treatment and disposal at an appropriately licensed facility can be organised.

The following measures will be implemented to prevent loss of containment from containment systems on site;

- *containment system:* tanks containing potentially polluting liquids are constructed so that any leaks/spillages is contained. Tanks are surrounded by a leakage containment bund capable of containing at least 110% of the volume of the largest tank within the bund;
- *storage vessels:* storage tanks are constructed to the appropriate British Standard;
- *inspection:* tanks are inspected visually on a regular basis by the site staff to ensure the continued integrity of the tanks, and identify the requirement for any remedial action;
- *spill kits*: materials suitable for absorbing and containing minor spillages are maintained on site;
- *monitoring techniques:* Site staff undertake regular monitoring for evidence of spillage and leakage. Alongside regular visual inspections, the tanks are fitted with level indicators to prevent overfilling; and
- *building design:* the facility buildings, in which potentially polluting materials are located, drain directly to an internal foul drainage system.

In the event of any potentially polluting leak or spillage occurring on site, the following action would be taken:

- minor spillages would be cleaned up immediately, using sand or proprietary absorbent. The resultant materials placed in a container for offsite disposal to a suitable facility; and
- in the event of a major spillage, which is causing or is likely to cause polluting emissions to the environment, immediate action would be taken to contain the spillage and prevent liquid from entering surface water drains and the un-surfaced ground. The spillage would be cleared immediately and placed in containers for off-site disposal, and NRW will be informed.

3.2.13 Security and Vandalism

There is the potential for unauthorised access and vandalism.

Risk Reduction

Supervision by means of CCTV cameras of both internal and external areas is provided. It is intended that this system provides a means of surveillance to meet the security needs of the site.

The security system was designed in accordance with the Association of Chief Police Officers (ACPO) guidelines and is approved by the Local Planning Authority.

The CCTV system is designed to fulfil the following requirements:

- monitor vehicle and pedestrian movements in key areas of the facility;
- provide boundary security day and night;
- achieve prosecution quality (head and shoulders) images;
- provide colour images and recording during the day; black and white at night;
- pan and tilt cameras with a zoom facility in specific locations;

- not dependent upon security lighting for its functionality, and
- includes a remote monitoring facility.

A vehicle gate on the outer security fence is used to control the incoming and outgoing traffic. An adjacent gate controls pedestrians and cyclists. All the gates of the outer security fence are open during the operational hours of the facility and when the weighbridge is staffed. These access control gates are primarily closed only during out of office hours. During office hours weighbridge personnel control entry and exit into the facility. For vehicles this shall be achieved with barriers. Authorised pedestrians make use of personal swipe cards to gain entry. Non-authorised pedestrians make use of the intercom to communicate with the weighbridge in order to gain entry.

The staff arriving out of office hours in vehicles, on foot or by bicycle use their personal swipe cards to open the gates. In all other cases the intercom and CCTV coverage allow the staff to control all incoming traffic and open these gates remotely from the control room.

There is an additional security fence line (the inner fence) which is located inboard of the outer fence. Vehicle barriers are provided at the weighbridge and weighbridge bypass lanes to control all vehicle access. The barriers are closed at all times and allow staff to block the admission of unauthorised vehicles into the heart of the Site, including the main car park. Staff control the barriers with their swipe cards and visitors use the CCTV and intercom to communicate with the gatehouse/control room. Non-authorised vehicles are directed to make a U-turn at the roundabout and safely exit the site.

The staff/visitor car park is accessible only via the main entrance which allows it to be closed outside of the main delivery periods which include evenings and weekends. The car park is fenced and controlled by barriers for vehicles and gates for pedestrians. This access control ensures that after entering the car park the visitors can access the visitor reception of the Facility. Staff allow visitors to enter the car park with the assistance of the intercom and CCTV while staff use their personal swipe cards.

CCTV cameras are positioned to give clear surveillance around the perimeter of the site. In the event of a breach of security at the site, the cause would be investigated and appropriate mitigation measures implemented. Records maintained include inspections and maintenance of security fencing and gates, breaches of security, investigations and actions taken.

3.2.14 Flooding

A review of the NRW website and the Development Advice Maps for Wales confirmed that the application site is located within Flood Zone A, areas ‘Considered to be at little or no risk of fluvial or coastal / tidal flooding.’

The principal risk of flooding is therefore that associated with overland flow within the site and from offsite areas.

The site increases the extent of hard-standing surfaces; therefore it is likely that surface water runoffs have increase.

Risk Reduction

Flooding resulting from overburdening of the drainage system, the blockage of gullies and drains may be a possibility, however appropriate design of the drainage and attenuation system, provides sufficient mitigation against flooding of this type on site and downstream.

A hydrological and hydrogeological assessment has been carried out as part of the planning application and was included as Appendix H1_3 of the original permit application.

External design levels are such that surface water run-off is directed away from buildings. Sustainable drainage (SuDS) techniques are implemented to satisfy surface water management and water quality criterion and objectives.

Rainwater falling directly onto the building roof areas is harvested and reused where practical.

Process water used by the plant is recycled and recovered where practical within the central water treatment and recovery plant. The plant has been designed to recover grey water as well as utilise all water from the building operations, internal drains and rainwater (see Section 6.3 of this report).

4.0 Authorised Activities

4.1 Permitted Activities

The following Schedule 1 activities of the Environmental Permitting (England and Wales) Regulations 2016 (as amended) are conducted on site:

- Section 5.1 A1(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.
- Section 5.4 A1 (b)(iii) - Recovery or a mix of recovery and disposal of non-hazardous waste with a capacity exceeding 75 tonnes per day involving one or more of the following activities covered by Council Directive 91/271/EEC; treatment of slags and ashes.

The following Directly Associated Activities are also conducted on site:

- Electricity generation;
- Discharge to controlled waters at emission point W1;
- Offsite transfer of process water and site drainage unsuitable for discharge to controlled waters at emission point W1; and
- Auxiliary diesel generator.

4.2 Permitted Categories and Types of Wastes

A full list of individual waste types categorised in accordance with the European Waste Catalogue (EWC) codes was included as Appendix B3_1 to the Application Forms in Section 1 of the original EP application.

4.3 Processing Capacity

The site will accept up to 232,000 tonnes per annum (tpa) of non-hazardous residual municipal waste and industrial and commercial wastes. There are two activities listed under Schedule 1 of the EP Regulations; incineration and the IBA treatment process.

Process capabilities for the incineration process and IBA treatment process will be as detailed in Table 1.

Table 4-1
Individual Facility Process Capabilities

Facility	Processing Capacity (tpa)
Energy Recovery Facility	232,000
IBA storage facility	70,000

4.3.1 Storage Capacity

In the event of plant shutdown, the waste bunker has the capacity to store between eight and nine days of waste (at plant capacity of 232,000 tpa). In the event that an outage is anticipated to extend beyond this period, waste may be removed off site for treatment or disposal at an alternative permitted facility.

Maximum storage capacities of the different stages of the process are detailed in Table 2.

Table 4-2
Maximum Storage Capacities

Facility	Maximum Storage at Plant Capacity (days)	Maximum Storage Capacity (m^3)
ERF Waste Bunker	8.5	4,491
IBA storage facility	45	7,879
Air Pollution Control Residue	5	320

4.4 Operating Hours

The waste management process is a continual one thus needs to be able to operate 24 hours a day, 365 days a year.

The opening hours for waste deliveries are controlled by the Planning Authority under the relevant planning consent.

5.0 Facilities and Process Description

5.1 Energy Recovery Facility

5.1.1 Waste processing and electricity production

Waste enters the process via the facility tipping bays and is stored in the waste bunker. The waste is mixed and fed into the boiler waste feed hopper using an overhead crane. The waste travels down the feed hopper and adjoining feed chute and is pushed onto the boiler grate by ram feeders.

The boiler comprises a combustion and steam generating unit. In the combustion unit, waste undergoes thermal treatment in line with the European Union (EU) Industrial Emissions Directive (IED) requirements. The boiler steam generating unit comprises a piping network fed with demineralised water. The combustion of waste releases thermal energy which is captured by the boiler water at various stages. The boiler uses this energy to turn water into high pressure, high temperature steam. This steam is used to produce electricity in the turbine-generator and/or to provide heat/steam export.

5.1.2 Emissions control and process by-products

The combustion of waste releases flue gases which are treated in order to comply with the emission limit requirements set out under IED.

Urea is injected into the boiler's combustion chamber to reduce nitrogen oxides (NOx). Lime and powdered activated carbon (PAC) are also be used within the FGT system. The lime reduces acid gas emissions while the activated carbon reduces mercury and the formation of dioxins/furans. The by-products from both FGT reactions are captured in the fabric filter as air pollution control residues (APCR). The treated flue gases then leave the facility through the stack.

Incinerator bottom ash (IBA) remains after combustion of the input waste. This ash is discharged from the end of the combustion grate directly into the ash quench bath. The IBA is mixed with the fly ash collected from the first to fourth boiler passes. The mixed ash is transferred by means of conveyor to the IBA site for storage.

Fly ash from the boiler fifth pass (economiser pass) is mixed with the hazardous fly ash to form the APCR and is conveyed to silos for storage. These silos are emptied with the APCR sent for further treatment/landfill.

5.1.3 Plant capability

The facility will be operated at an annual availability of approximately 8,000 hours. At an annual throughput of 232ktpa (A) the facility will have an hourly throughput rate of approximately 29tph at a net calorific value (NCV) of 8.5MJ/kg. This equates to a thermal load of 68.47MW. See Figure 2 for the combustion diagram and Table 3 for data regarding the corresponding operating points.

Figure 2
Combustion Diagram for Parc Adfer ERF

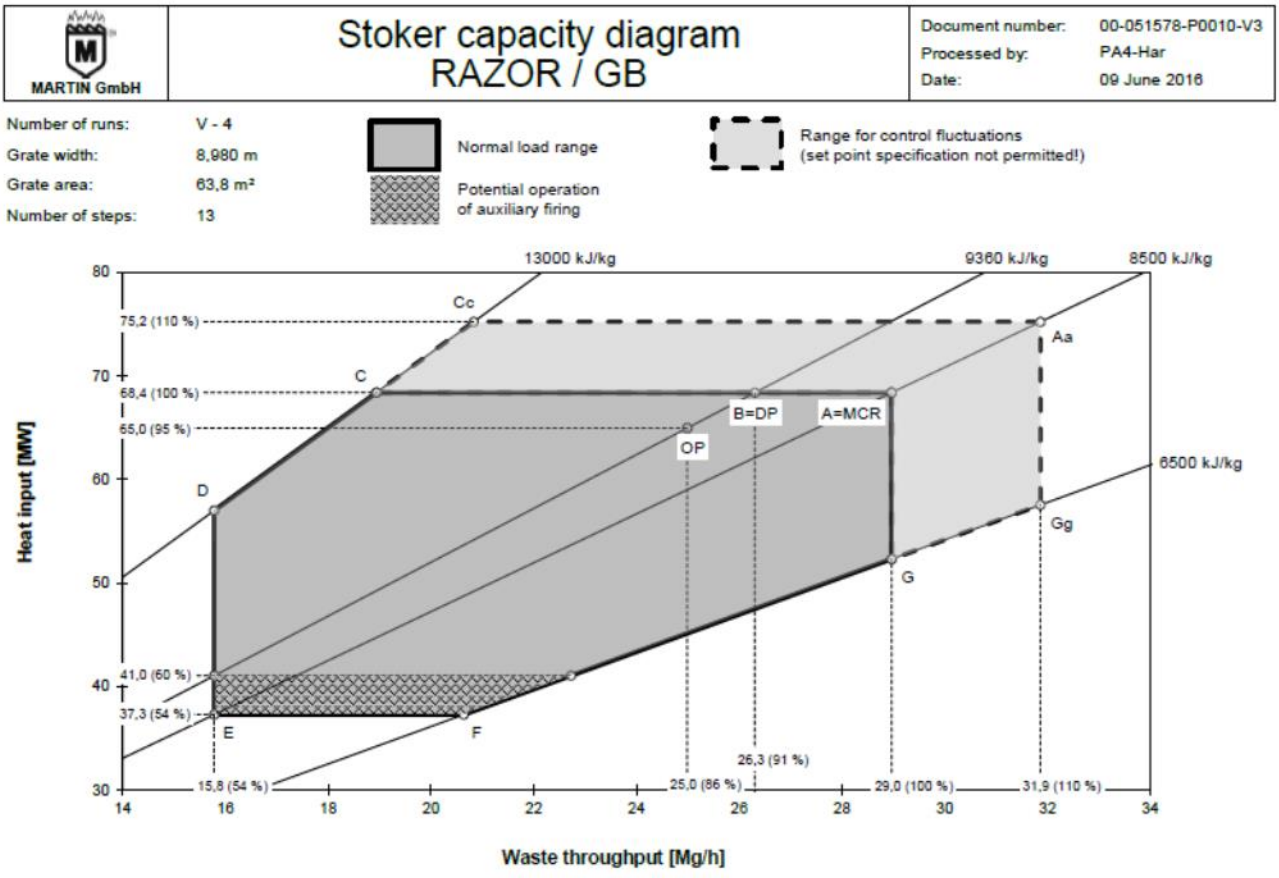


Table 5-1
Combustion Diagram Data Points

Data Point	Waste Throughput (t/h)	Waste NCV (MJ/kg)	Waste energy input	
			(MWh/t)	(MW)
DP	26.30	9.36	2.60	68.38
OP	25.00	9.36	2.60	65.00
A	29.00	8.50	2.36	68.47
B	26.30	9.36	2.60	68.38
C	18.94	13.00	3.61	68.40
D	15.80	13.00	3.61	57.06
E	15.80	8.50	2.36	37.31
F	20.66	6.50	1.81	37.30
G	29.00	6.50	1.81	52.36
Aa	31.90	8.50	2.36	75.32
Cc	20.82	13.00	3.61	75.20
Gg	31.90	6.50	1.81	57.60

5.1.4 Facility Performance

Flow modelling has been undertaken in the design process for Parc Adfer ERF. A summary of key performance indicators is provided in Table 4.

Table 5-2
Energy Recovery Facility Plant Performance at Point A

Parameter	Unit	Value
Annual Waste processing availability	tonnes	232,000
Calorific value	MJ/kg	8.5
Operating hours	hours	8,000
Throughput consumption	tph	29
No. of lines	No.	1
Thermal load	MW	68.47
Gross power generated	MW	19.8
Gross plant efficiency	%	28.9
Bottom ash production	tonnes	70,000
Bottom ash production	%	30.0
Air pollution control residues	tonnes	11600
Air pollution control residues	%	5.0

5.1.5 Detailed Process Description

Waste reception

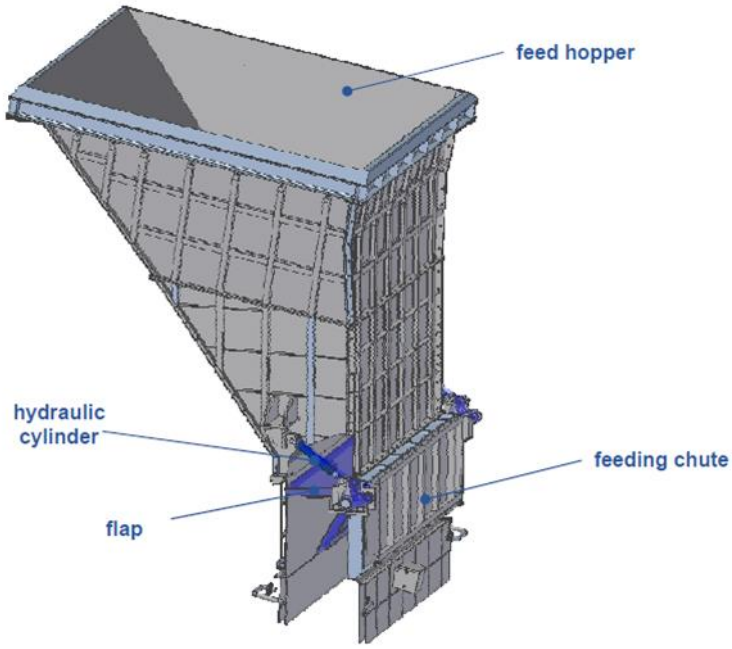
Authorised vehicles delivering waste to the ERF will be directed from the weighbridge to the manoeuvring area. Vehicles will manoeuvre and reverse into the tipping hall's enclosed tipping bays. Vehicles will then position in order to discharge waste into the bunker. A vehicle will enter a tipping bay only when the crane operator has ensured that the bunker is clear at the particular tipping position. This will ensure that the waste load can be safely tipped into the bunker without overflowing onto the tipping floor or compromising crane operations.

The waste will be mixed in the bunker in order to achieve a homogenous fuel and feed into the waste feed hopper using an overhead crane. Two cranes will be provided to perform this function with each crane rated at 100% in order to provide sufficient redundancy. This means that each crane will be able to perform all actions in order to maintain waste throughput, namely:

- clearing the tipping positions;
- mixing the waste; and
- delivering waste to the waste feed hopper.

The waste feed chute (Figure 3) will gravity feed the ram pusher which will in turn push the waste onto the air-cooled grate for combustion.

Figure 3
Waste feed hopper and chute



Waste Processing

Constructions Industrielles de la Mediterranee (CNIM) technology will be utilised for the grate. This is a 5-stage reciprocating garte which is designed to mix and transport waste as part of the combustion process. Based on the anticipated contract waste and third-party waste composition, an air cooled reciprocating grate is used at the facility. The grate is designed to process waste with a blended calorific value (CV) of 9.8MJ/kg.

Combustion Control

Combustion control will take place using a number of different plant features. The main features will include the following;

- primary air system;
- secondary air system;
- waste feed system;
- additive dosing system; and
- auxiliary fuel firing system.

Primary air system

The primary air system comprises of the primary air fan and primary air pre-heater. The system controls and delivers primary combustion air to the boiler. Air is drawn in from the waste bunker and is delivered by the primary air fan to the underside of the individual grate zones. The air flow rate is variable across the grate zones and can be adjusted for optimum combustion for each individual grate zone.

If the CV of the waste is low, the air is pre-heated thus allowing sufficient drying of fuel and subsequent combustion. The primary air pre-heater comprises a heat exchanger supplied with low pressure steam from the turbine.

Secondary air system

The secondary air system delivers and regulates secondary combustion air to mix with the flue gases within the first boiler pass and complete the combustion process. This system comprises the air ducts from the intake to the secondary air nozzles in the combustion chamber. Secondary air is drawn from the top of the boiler house and is delivered into the combustion chamber. The secondary air system also comprises a heat exchanger to improve combustion.

Waste feed

The boiler waste feed system comprises the ram feeder and grate speed controllers. These enable the regulation of waste fed onto the grate to ensure optimal combustion. The speed of the ram feeder and grate forward stroke can be continuously controlled and adjusted. With each stroke the waste is pushed onto the grate.

Additive dosing system

In order to control NOx emissions, SNCR is utilised. Urea is injected into the front and side walls of the furnace at various levels. The urea reacts with the NOx yielding nitrogen (N_2), carbon dioxide (CO_2) and steam. Injecting urea at varying heights in the furnace allows for efficient use of the reagent, while minimising NOx emissions.

Auxiliary Fuel Firing System

No natural gas is used on-site. Instead, diesel oil is used within the Facility, as detailed below.

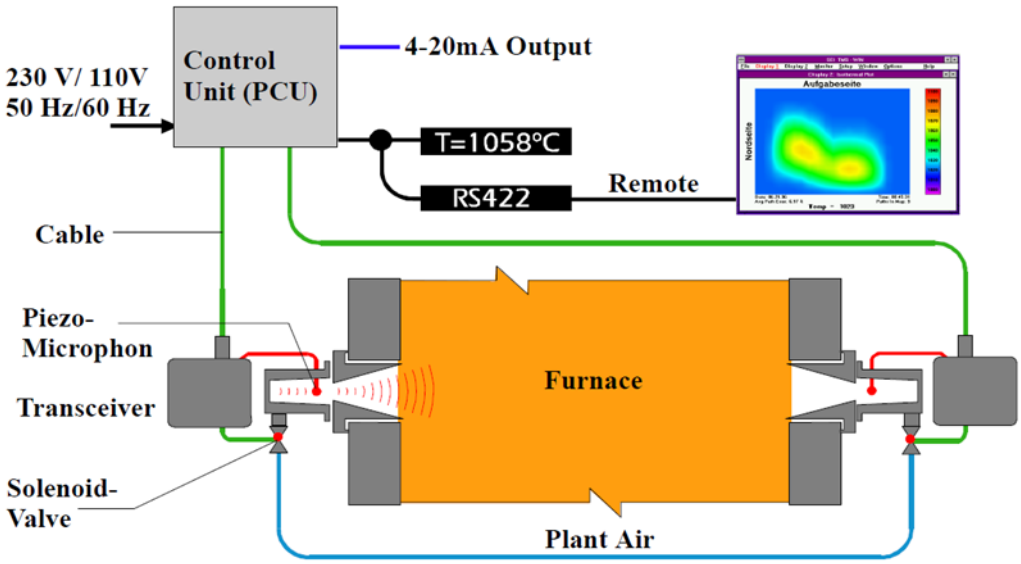
Diesel oil is used for the boiler burners and site vehicles. The boiler has two auxiliary diesel fired burners, which are utilised during start-up, shut down and abnormal operations. During abnormal operating conditions (e.g. feed chute blockage), diesel oil can be used to maintain the process furnace temperature within the required emission limits.

Acoustic pyrometry

The use of acoustic pyrometry determines the temperature profile close to the grate surface and enables better combustion and emissions control e.g. NOx. This technology measures the perceivable gas temperature without the effect of radiation, see Figure 4. The measurement is carried out instantaneously. The principle behind this

technology is to monitor the speed of sound which differs with varying gas temperatures. This allows a cross sectional temperature measurement of the boiler furnace.

Figure 4
Acoustic Pyrometry



Power and heat production

Steam produced by the boiler is sent to a steam turbine-generator unit. The turbine-generator converts thermal energy in the pressurized steam to mechanical energy in the turbine and electrical energy in the generator. This electrical energy is used within the facility (parasitic load) with excess power sold to the external national grid.

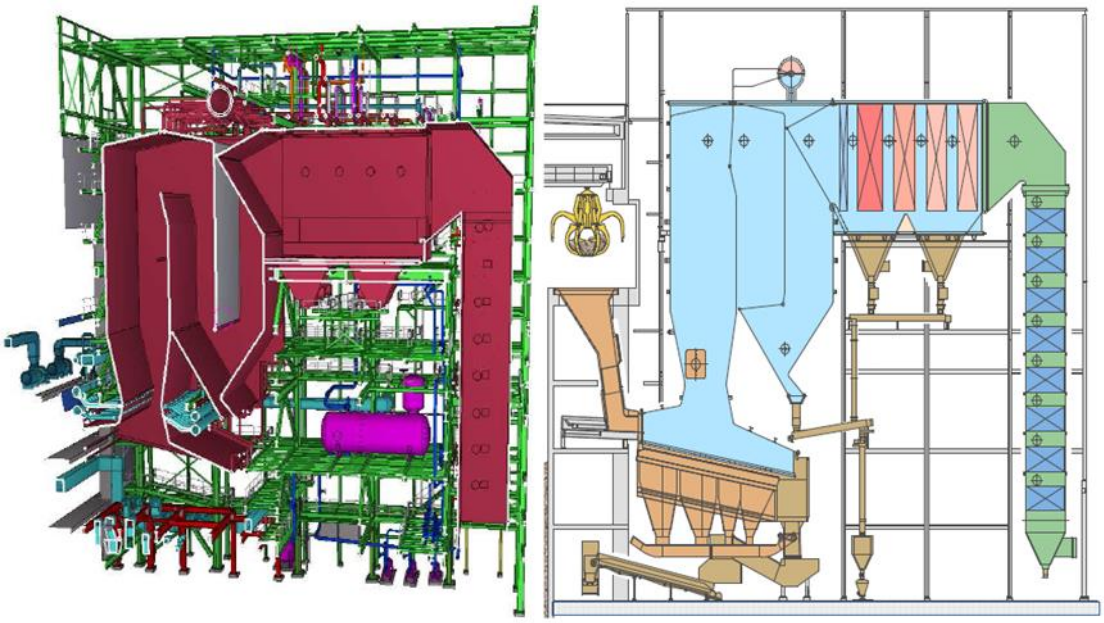
The ERF is designed to generate approximately 19.8MWe and export approximately 17.5MWe without an external heat consumer. The facility is capable of exporting heat; thereby operating as a CHP facility, upon securing a suitable heat customer. Please refer to the Heat Plan submitted with in Section 7 of the original EP application for details of the heat load assessment and flexibility incorporated into the plant's design. The heat off take is modelled at 10MW in order to maintain an efficient split of electrical output and heat output. The facility will be capable of exporting up to 10MWth of steam.

After the steam turbine, the expanded steam is condensed in the air-cooled condenser. The condensate is returned to the feed water tank for re-use within the system. In cases such as start-up, shutdown, overload or trip of the turbine, all or part of the steam will flow into the air-cooled condenser via the turbine bypass system. The thermal capacity of the air-cooled condenser will be high enough to condense the steam in bypass mode.

Energy recovery

Energy transfer between the flue gases and the boiler is undertaken via four vertical passes and one horizontal pass in the boiler, numbered in Figure 5. The height of the boiler ensures that the minimum (2 seconds at over 850°C) residence time for the flue gas is achieved, in accordance with the IED requirements.

Figure 5
Heat Recovery



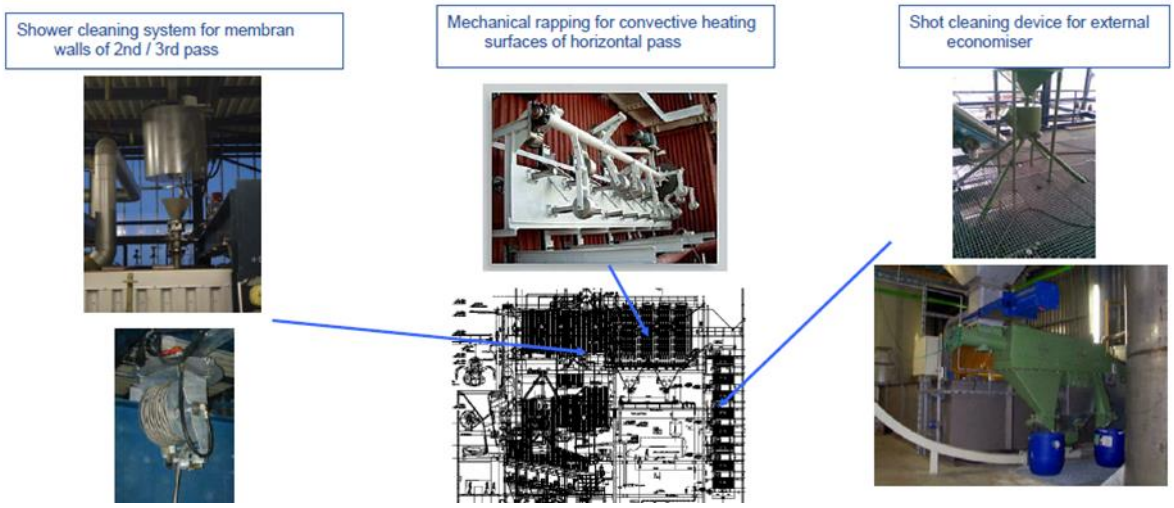
The boiler steam generating system includes, but is not limited to;

- First pass: vertical radiation pass made of evaporator membrane with refractory lining on flue gas side;
- Second/third pass: vertical radiation pass made of evaporator membrane walls;
- Fourth pass: horizontal convection pass made of membrane walls with bundles of superheater heat exchanger surfaces; and
- Fifth pass: vertical pass with bundles of economiser heat exchanger surfaces.

Steam is generated within the evaporator sections of the boiler and the boiler drum. The saturated steam is further heated in the superheaters. The economiser sections of the boiler act to reduce the flue gas exit temperature to the optimum values required for the FGT process.

The boiler surfaces are maintained clean to ensure consistent heat exchange. Boiler cleaning can be undertaken using three different methods according to the area of the boiler, refer to Figure 6. The second and third vertical passes are cleaned by the shower cleaning system. This method uses a flexible hose with a lance at the end which sprays water. The hose is lowered and lifted whilst spraying water resulting in the membrane walls being cleaned.

Figure 6
Boiler cleaning techniques



Mechanical rappers (hammer and ram arrangement) vibrate the superheater tubes in the horizontal pass resulting in the combustion residues falling in the ash hoppers. The last cleaning mechanism, shot cleaning, uses small spherical granules which are fired onto the economiser tubes. The impact of the granules on the economiser tubes removes the slag build up.

Emissions control & monitoring

The FGT and boiler SNCR treatment ensure that all stack emissions comply with the IED. In order to control NOx emissions, SNCR is utilised. Urea is injected into the front and side walls of the furnace at various levels, refer to Figure 7. The urea reacts with the NOx yielding nitrogen (N_2), carbon dioxide (CO_2) and steam. Injecting urea at varying heights in the furnace allows for efficient use of the reagent, while minimising NOx emissions.

SNCR is a proven, economical technology, widely used in the EfW industry which demonstrates the application of best available techniques (BAT). The ERF layout accommodates future inclusion of selective catalytic reduction (SCR) should changes in legislation require NOx emissions to be below the capability of the SNCR technology.

The flue gases exit the boiler and enter the FGT plant at a temperature of between 160°C (clean boiler) to 200°C (fouled boiler). The FGT plant comprises a semi-dry reactor and fabric filter (see Figure 8).

An acid gas abatement report and NOx abatement report wee appended to the original BATOT report as Appendices BATOT3 and BATOT4 respectively.

The first stage of the FGT involves the injection of hydrated lime into the flue gases with the intention to absorb free acids, which include chlorine, fluorine and sulphur laden gases, see Figure 8. This early injection of lime also acts as corrosion protection for the next stage.

The second stage involves reducing the flue gas temperature to approximately 150°C in order to optimise the reaction with the hydrated lime. Compressed air and water are injected for this purpose, see Figure 8.

Figure 7
Urea Injection

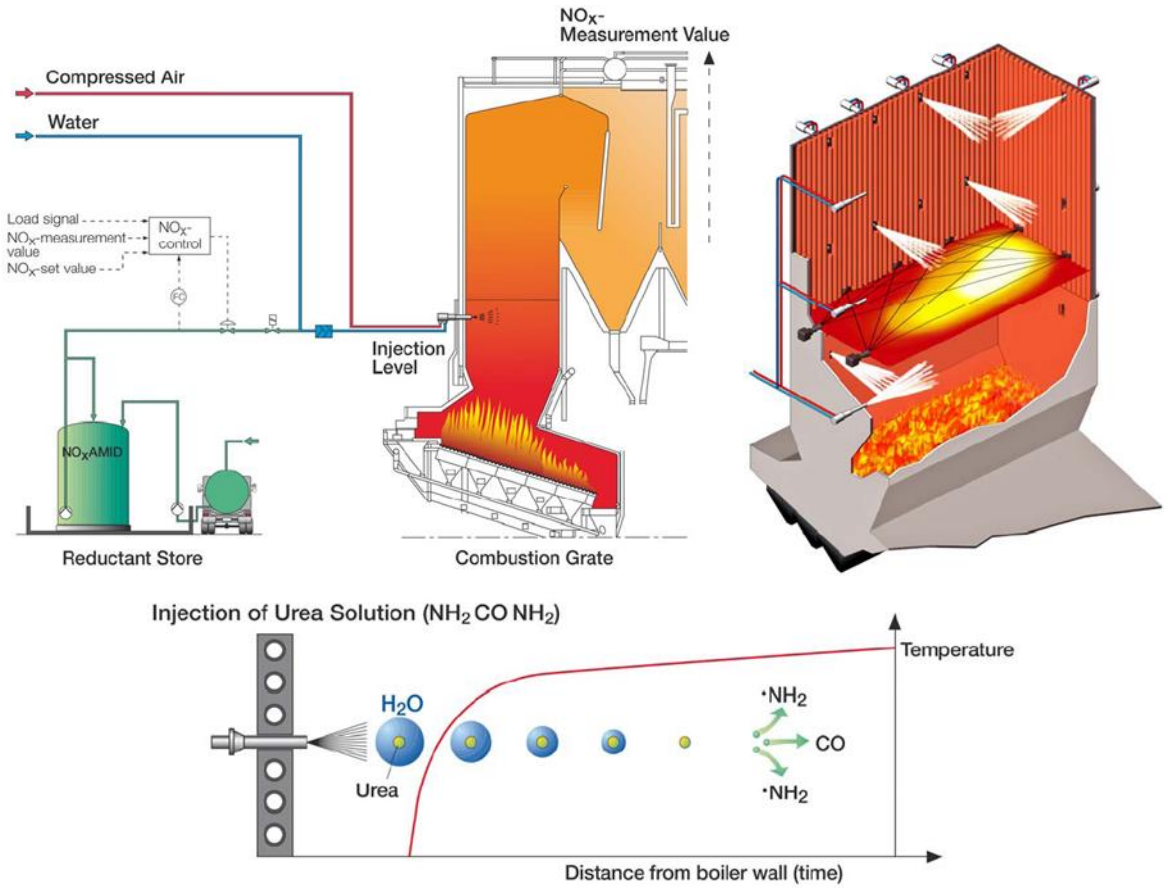
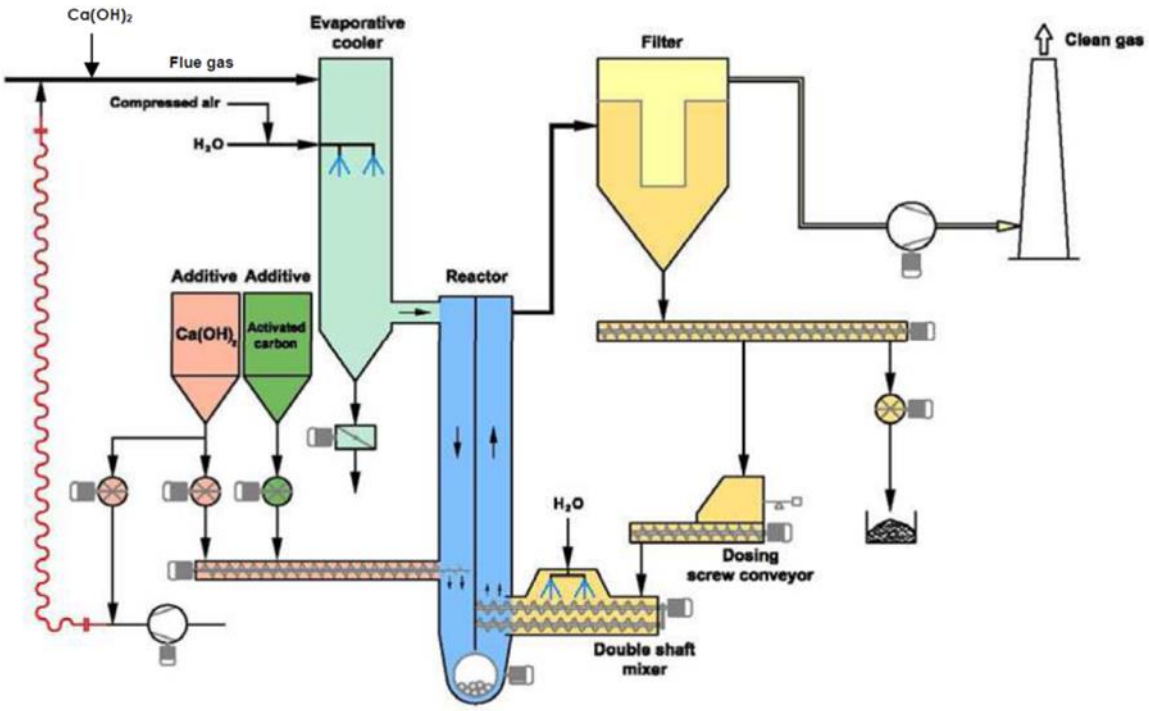


Figure 8
Flue Gas Treatment System

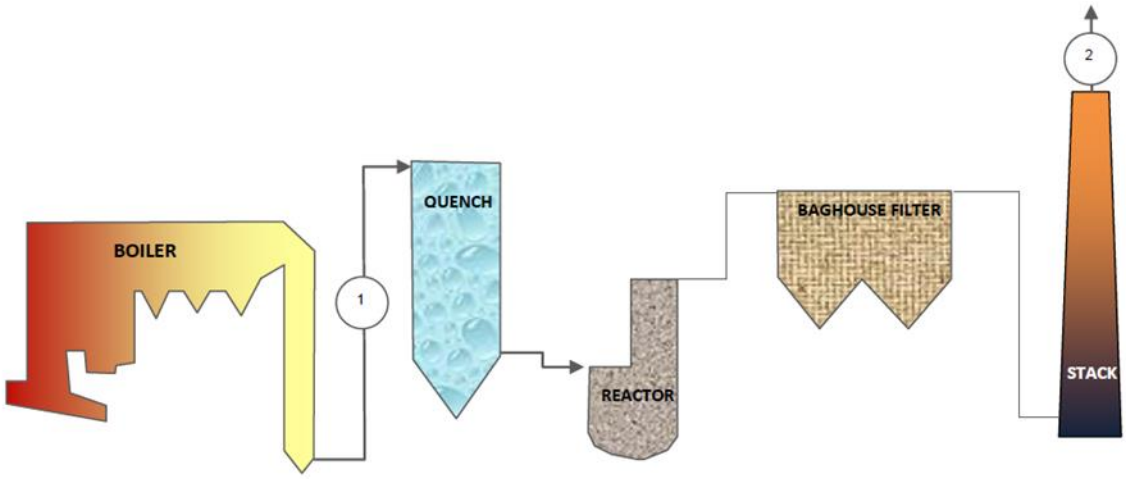


For the third stage of the treatment, additional hydrated lime and activated carbon are added. The activated carbon captures heavy metals such as mercury as well as dioxins, furans and other high-molecular organic compounds. At this stage, particles captured from further downstream of the process are also re-circulated and reintroduced into the flue gases. The flue gas then pass through a conditioning rotor which breaks up large particles and creates a homogeneous distribution of particles (up to 200g/m³).

The final stage of the FGT is the fabric filter. The fabric filter is comprised of vertical filter bags through which the flue gases flow. The induced draught fan draws the flue gases through the filter bags. Particles are deposited on the outside of the bags and the clean flue gases flow through the bags. The particles captured on the outside of the filter bags also form a porous cake providing further filtration as the flue gases flow through it. Since the cake includes lime and activated carbon, a final chemical reaction takes place before the flue gases exit to the stack. Figure 9 provides a simplified diagram of emissions from the stack, before and after flue gas treatment.

The filter bags are cleaned by pulses of compressed air (from the clean side) down the bag. As the bag expands the particles that have built up on the bag drop and collect in a hopper at the bottom of the fabric filter. Part of this residue is re-circulated back to the third stage, see above, in order to maximise the use of the lime and activated carbon injected.

Figure 9
Simplified emissions diagram



1 - RAW GAS EMISSIONS (anticipated)		
Oxygen	10.3 - 10.4	% Vol. (dry)
Hydrogen Chloride	1155 - 1294	mg/Nm^3 (dry)
Sulfur Dioxide	307 - 387	mg/Nm^3 (dry)
Hydrogen Fluoride	2	mg/Nm^3 (dry)
Fly Ash	2265 - 2299	mg/Nm^3 (dry)

2 - CLEAN GAS EMISSIONS (anticipated)		
Oxygen	10.7 - 10.9	% Vol. (dry)
Hydrogen Chloride	10	mg/Nm^3 (dry)
Sulfur Dioxide	50	mg/Nm^3 (dry)
Hydrogen Fluoride	1	mg/Nm^3 (dry)
Fly Ash	10	mg/Nm^3 (dry)

Emission Monitoring System

Continuous emissions monitoring system (CEMS) analysers are located on the stack in compliance with the IED and the Environmental Permit. The CEMS analysers are certified under the Environment Agency's monitoring certification scheme (MCERTS) with adequate spans to allow for accurate emissions monitoring and future calibrations, in line with quality assurance levels (QAL3) and annual surveillance tests (AST).

The CEMS feed live emission data to the plant control system to ensure that emissions are compliant with the environmental permit by adjusting the combustion control process and chemical dosing.

The continuous emission monitoring system measures the following (to meet requirements of IED);

- oxygen;
- particulate;
- total organic compounds (TOC);
- SO_2;
- NO_2;
- NO;
- CO;
- HCl;
- CO_2; and
- H_2O.

5.1.6 Process Offtakes and Storage

Parc Adfer ERF produces the following products and residues:

- Incinerator bottom ash (IBA) for recycling with a small proportion to landfill; and
- Air pollution control residues (APCRs) and fly ash from the economiser sections of the boiler.

The IBA, upon leaving the combustion zone, is quenched and then conveyed to the IBA storage bunker. The IBA includes ash from the grate combustion and fly ash from the second, third and fourth boiler passes mechanically conveyed to the IBA quench. The IBA facility allows for the storage and management of the IBA from the combustion process. The IBA facility comprises of an IBA storage area where untreated IBA will be stored before being sent offsite for further processing.

Fly ash from the boiler fifth pass (economiser pass) is mixed with the hazardous fly ash to form the APCR and is conveyed to silos for storage. These silos are emptied with the APCR sent for further treatment/landfill. APCR is handled as a hazardous material when being transported for treatment or landfill.

5.1.7 Assessment of BAT against BREF Note for Incineration

Table 5 describes how the design and operation of the facility will conform to the requirements of the revised Best Available Technique Reference (BREF) Note for Incineration Processes issued December 2019, making specific reference to the general BAT criteria for Incineration Processes.

Table 5-3
BAT for Parc Adfer Energy Recovery Facility

BAT Requirement		Specific Measure
1	In order to improve the overall environmental performance, BAT is to elaborate and implement an environmental management system (EMS) that incorporates all of the following features.	PAOL have an EMS that is certified to ISO 14001:2015.
1i	commitment, leadership and accountability of the management, including senior management, for the implementation of an effective EMS;	Environmental performance reports submitted to the Board of Directors every month for review and action if necessary. Senior Management involved in setting environmental objectives and targets and regularly reviewing progress in achieving such objectives and targets. Senior Management take responsibility for environmental performance and review any non-conformities. Senior Management promote continual improvement by supporting other relevant management roles related to environmental performance. **Outcome = compliant**
1ii	an analysis that includes the determination of the organisation's context, the identification of the needs and expectations of interested parties, the identification of characteristics of the installation that are associated with	The Business Management System Manual details the context of the organisation and the needs and expectations of interested parties. Site Environment Impacts & Aspects Register details characteristics of the installation which pose a risk to the environment

BAT Requirement		Specific Measure
	possible risks for the environment (or human health) as well as of the applicable legal requirements relating to the environment;	(including legal requirements). Register of applicable environmental legislation is updated quarterly by a third party and reviewed by enfinium. **Outcome = complaint**
1iii	development of an environmental policy that includes the continuous improvement of the environmental performance of the installation;	SHEQ Policy Statement details a commitment to continuous improvement in relation to environmental performance. Policy signed by enfinium group CEO. **Outcome = complaint**
1iv	establishing objectives and performance indicators in relation to significant environmental aspects, including safeguarding compliance with applicable legal requirements;	Annual environmental performance objectives for the installation which are related to safeguarding environmental compliance are set. Key performance indicators such as emission levels and raw material usage are uploaded to a master KPI document every month to allow benchmarking to be undertaken against other enfinium waste incineration plants in the UK. The findings of such benchmarking reviews are discussed in UK Team Meetings and Board Meetings. **Outcome = complaint**
1v	planning and implementing the necessary procedures and actions (including corrective and preventive actions where needed), to achieve the environmental objectives and avoid environmental risks;	EMS documents includes multiple procedures such as: • EMI-ENV-001 Aspects and Impacts Evaluation; • EMI-ENV-004 Permit Compliance Requirements; • ENV-PAR-004 - Environmental Management Plan, and; • ENV-PAR-045 - Management of emissions to air monitoring. These achieve environmental objectives and avoid environmental risks. There is a non-conformity tracker to ensure timely close out of corrective actions. An annual schedule of internal audits is also in place to monitor the performance of the EMS. **Outcome = compliant**
1vi	determination of structures, roles and responsibilities in relation to environmental aspects and objectives and provision of the financial and human resources needed;	The Environment Impacts & Aspects Register lists the persons responsible for the effective implementation and monitoring of the required environmental risk control measures. Leadership environmental commitment made in the SHEQ Policy Statement. Assessment of availability of financial and

BAT Requirement		Specific Measure
		human resources for environmental management is undertaken during management review meetings. **Outcome = compliant**
1vii	ensuring the necessary competence and awareness of staff whose work may affect the environmental performance of the installation (e.g. by providing information and training);	Site has a Training Competency Tracker which lists training requirements and dates of last training event for each member of staff. List of training includes environmental permit awareness training, EN 14181 training, ISO14001:2015 internal auditor training, and general plant operations training. **Outcome = compliant**
1viii	internal and external communication;	The Communication Procedure details the internal and external communication methods that the company uses to circulate information relating to the EMS. Dedicated Communications Manager is in place. **Outcome = compliant**
1ix	fostering employee involvement in good environmental management practices;	Training provided to all staff on the requirements of the environmental permit and what actions are required from each member of staff to ensure compliance. Regular environmental themed toolbox talks and training packages are delivered which demonstrate good environmental management practices. Each significant operations and maintenance task is covered by a safe operating procedure which details how a task is to be completed to ensure environmental risks are adequately controlled. The enfinium group environmental, social, governance strategy and working group aims to improve collaboration opportunities for all interested parties to ensure greater environmental control and awareness. UK Team Meetings and quarterly HSE committee meetings are held to review environmental performance and identify opportunities for environmental performance improvement. **Outcome = compliant**
1x	establishing and maintaining a management manual and written procedures to control activities with significant environmental impact as well as relevant records;	The Business Management System Manual is the overriding management system manual for the facility. Various written procedures and records are included in the EMS to ensure the significant environmental aspects of the organisation are adequately monitored and controlled. The EMS is audited by an external independent certified

BAT Requirement		Specific Measure
		organisation at predetermined frequencies. Document index managed by a permanently employed document controller. **Outcome = compliant**
1xi	effective operational planning and process control;	Various procedures are included in the EMS to ensure the organisation's processes and operations are adequately controlled such as: • ENV-PAR-009 - Odour Management Procedure; • ENV-PAR-045 - Management of emissions to air monitoring, and; • FM-ENV-PAR-019-05 Site Environmental Check and Investigation Record. Suitable and sufficient risk assessments and method statements are in place for all significant tasks. Maintenance strategy in place for all plant and equipment to ensure correct function and high levels of reliability. **Outcome = compliant**
1xii	implementation of appropriate maintenance programmes;	Maintenance programmes for environmentally critical equipment have been established and implemented into the computerised maintenance management system. This ensures that planned preventative maintenance tasks are completed frequently to maintain good plant availability and correct operation to avoid environmental incidents. Site maintenance strategy in place, with service level agreements in place for critical equipment and services. **Outcome = compliant**
1xiii	emergency preparedness and response protocols, including the prevention and/or mitigation of the adverse (environmental) impacts of emergency situations;	Spill Management Procedure and Parc Adfer Emergency Response Plan detail the required response in the event of an environmental incident. The EMS also includes several procedures which detail the requirements to prevent or mitigate any environmental incidents such as Environment Impacts & Aspects Register, Odour Management Procedure and Environmental Management Plan. The environmental aspects register considers potential emergency situations. **Outcome = compliant**

BAT Requirement		Specific Measure
1xiv	when (re)designing a (new) installation or a part thereof, consideration of its environmental impacts throughout its life, which includes construction, maintenance, operation and decommissioning;	Management of change procedure details the environmental factors which must be considered when planning a significant change to the installation or related processes and requires the whole management team to review the change and assess all risks and opportunities from each organisational discipline. This ensures any adverse environmental impacts due to re-design of the plant or processes are identified and controlled prior to significant changes being implemented. **Outcome = compliant**
1xv	implementation of a monitoring and measurement programme; if necessary, information can be found in the Reference Report on Monitoring of Emissions to Air and Water from IED Installations;	Management of emissions to air monitoring procedure covers the emissions to air monitoring programme to ensure conformity to MCERTS, the environmental permit, and EN14181 requirements. The results of the visual monitoring of emissions to water are logged on document Site Environmental Check and Investigation Record. **Outcome = compliant**
1xvi	application of sectoral benchmarking on a regular basis;	The environmental performance of the installation is benchmarked against three other similar energy from waste facilities which are incorporated in the enfinium group. Data is uploaded to a master document every month to compare environmental key performance indicators. Performance is also benchmarked against energy from waste installations external to enfinium through the annual Tolvik EfW report, and through regular Environmental Services Associations (ESA) meetings and consultations. **Outcome = compliant**
1xvii	periodic independent (as far as practicable) internal auditing and periodic independent external auditing in order to assess the environmental performance and to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained;	Internal auditing programme in place for the EMS as per SHEQ Audit Schedule. Independent audits annually conducted by external certified auditing bodies as well as internal members of the enfinium internal audit team. **Outcome = compliant**
1xviii	evaluation of causes of nonconformities, implementation of corrective actions in response to nonconformities, review of the effectiveness of corrective actions, and determination of whether similar	Environmental incident, near miss, and observation online reporting system available to all members of staff. Environmental Officer responsible for non-conformity investigation and corrective action implementation with the Plant Manager and UK SHEQ Manager responsible for overseeing and

BAT Requirement		Specific Measure
	nonconformities exist or could potentially occur;	monitoring this process. All non-conformances are recorded on the online reporting system to ensure adequate and timely close out of non-conformances. **Outcome = compliant**
1xix	periodic review, by senior management, of the EMS and its continuing suitability, adequacy and effectiveness;	Management Review procedure covers the regular review of the effectiveness of the EMS by Senior Management. Formal reviews of the effectiveness of the EMS are undertaken at least bi-annually in line with the requirements of this procedure. More frequent reviews undertaken quarterly during Senior Management meetings where environmental performance indicators, progress made on environmental initiatives, and forthcoming updates are presented to the Board and discussed as part of the Executive Committees. **Outcome = compliant**
1xx	following and taking into account the development of cleaner techniques.	All documents within the EMS are reviewed annually or following a significant change at which point the continuing suitability of techniques is assessed. The organisation has access to the latest information from relevant environmental and energy from waste industry bodies (ESA, STA, CIWM, WISH, IEMA, EfW conference) to ensure the organisation is kept abreast of the development of new cleaner environmental impact control technologies or techniques. Currently attending ESA Regulation, EfW, Climate Change and Carbon Capture Utilisation and Storage working groups. The organisation is currently developing energy saving plans and has several objectives to assess and implement cleaner technologies. Plant energy efficiency and raw material consumption are frequently reviewed and reported to the regulator. Any significant plant improvements are reported to the regulator in the annual performance report. **Outcome = compliant**
2	BAT is to determine either the gross electrical efficiency, the gross energy efficiency, or the boiler efficiency of the incineration plant as a whole or of all the relevant parts of the incineration plant.	BAT-AEEL 20-35% Gross Electrical Efficiency for existing plants applies to the installation. Gross Electrical Efficiency was determined as 29.37% during independent performance tests at 100% BAC. This figure is based on the thermal input of waste being 68.841MWth (using lower heating value) @ 100% BAC as stated in TUV performance test report, and a Gross Power Generation capacity of 20.22MW

BAT Requirement		Specific Measure
		as stated in a letter from the Turbine and Generator installation and commissioning company. The figure of 29.37% demonstrates that the installation currently complies with the BAT-AEEL of 20-35% for Gross Electrical Efficiency for existing Municipal Solid Waste Incinerators. Boiler efficiency calculated to be 85.76% @ 100% BAC during acceptance test. **Outcome = compliant**
3	BAT is to monitor key process parameters relevant for emissions to air and water including those specified.	Duty and Standby Continuous Emissions Monitoring Systems in place to monitor flow, oxygen, temperature, pressure, and water vapour content of the flue gas. Calibrated temperature probes installed to measure combustion chamber temperature and feedback readings to the distributed control system, with interlocks in place to prevent waste feeding if the combustion chamber temperature drops below 850°C. No waste water from flue gas treatment to measure due to installation of dry sorbent injection system. No bottom ash treatment plant installed, and no effluent discharges from site, so no requirement to continuously monitor waste water from bottom ash treatment plants for flow, pH and conductivity. **Outcome = compliant**
4	BAT is to monitor channelled emissions to air with at least the frequency specified and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.	Installation currently monitors all parameters at the stated frequencies in the table under BATc 4 with the exception of Hg. No current continuous monitoring in place for Hg (see BATc 31). Installation planning to continue to monitor Hg at six monthly intervals in conformance with EN 13211 and the site permit. 6 single tests between Feb 2020 - Aug 2021 have shown low level and stable Mercury levels. Six triplicate tests to be undertaken in 2022 and early 2023 to adhere to BRef guidance on demonstrating low and stable Mercury emissions. Although the plant has the capability to continuously monitor HF; HCl emission levels have proven to be sufficiently stable, so six-monthly periodic testing for HF can be maintained, as 6 separate periodic test results have demonstrated that HF levels are below the ELV. 6 monthly compliance test suite to include monitoring for Brominated Dioxins once a fully accredited laboratory can be identified, as the plant is known to be taking receipt of soft furnishings which may contain brominated flame retardants.

BAT Requirement		Specific Measure
		Outcome = non-compliant
5	BAT is to appropriately monitor channelled emissions to air from the incineration plant during OTNOC.	OTNOC management plan to be created. Current abnormal operation management arrangements to be adapted to suit OTNOC. Plant monitors all parameters during OTNOC where possible (unless CEMS failure), and always monitors CO, TOC and Dust during current abnormal operation scenarios. Emissions monitoring survey not completed during start up and shut down scenarios, but CEMS data available for such instances. List of potential OTNOC scenarios to be listed in OTNOC management plan. Further guidance to be provided by regulator. Emissions monitoring survey to be completed during OTNOC/start-up or shut down scenario to monitor concentrations of parameters not recorded by CEMS such as PCDD/F. **Outcome = non-compliant**
6	BAT is to monitor emissions to water from FGC and/or bottom ash treatment with at least the frequency specified and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.	**Not applicable.** No direct emissions to water from FGC and/or bottom ash treatment.
7	BAT is to monitor the content of unburnt substances in slags and bottom ashes at the incineration plant with at least the frequency specified and in accordance with EN standards.	Total Organic Carbon (TOC) and Loss On Ignition (LOI) is currently monitored every three months as per Environmental Permit EPR/AB3092CV requirements. The current TOC limit of 3% in the permit has been consistently complied with since plant start up in 2019. **Outcome = compliant**
8	For the incineration of hazardous waste containing POPs, BAT is to determine the POP content in the output streams (e.g. slags and bottom ashes, flue-gas, wastewater) after the commissioning of the incineration plant and after each change that may significantly affect the POP content in the output streams.	**Not applicable.** Hazardous waste is not processed on site.
9	In order to improve the overall environmental performance of the incineration plant by waste stream management (see BAT 1), BAT is to use all of the techniques specified.	The Waste Acceptance Procedure determines the type of waste that can be incinerated (in compliance with permit conditions). This procedure also details set-up and implementation of waste characterisation

BAT Requirement		Specific Measure
		and pre-acceptance procedures. The Weighbridge and plant data records (midnight readings sheet) detail all the required information regarding the source of the wastes and how much of the waste has been incinerated, or is currently stored in the bunker. Wastes deemed unsuitable for incineration are suitably segregated in accordance with site waste management instructions. **Outcome = compliant**
10	In order to improve the overall environmental performance of the bottom ash treatment plant, BAT is to include output quality management features in the EMS (see BAT 1).	**Not applicable.** Bottom ash is not treated on site.
11	In order to improve the overall environmental performance of the incineration plant, BAT is to monitor the waste deliveries as part of the waste acceptance procedures (see BAT 9(c)) including, depending on the risk posed by the incoming waste, the elements specified.	Weighing and visual inspections of waste deliveries are already established as part of the waste acceptance procedure. Radioactivity detection systems are not installed at the site as the incoming waste streams have been deemed low risk due to the vast majority of the waste originating from municipal sources. BIOMA software used to determine calorific and biogenic/fossil content of the waste. Ash analysis results used to determine metals concentrations of waste. Sewage sludge and hazardous waste are not incinerated at the installation. **Outcome = compliant**
12	In order to reduce the environmental risks associated with the reception, handling and storage of waste, BAT is to use both of the techniques specified.	The waste reception and storage area is constructed of impermeable reinforced concrete with a suitable drainage system installed. Surface water drainage in the waste reception area is directed to the site attenuation pond via two stage interceptors. Groundwater monitoring will be undertaken every 5 years and soil monitoring will be undertaken every 10 years to check for evidence of any breaches of the site impermeable surfaces. The waste storage bunker is designed to store a maximum of circa 6000 tonnes. The quantity of waste stored in the bunker is monitored and recorded each shift to ensure suitable storage of waste. Moisture content of waste in bunker monitored and reported internally daily. Attenuation pond monitored for pH and visual signs of contamination. Site drainage network monitored for visual signs of contamination. **Outcome = compliant**

BAT Requirement		Specific Measure
13	In order to reduce the environmental risk associated with the storage and handling of clinical waste, BAT is to use a combination of the techniques specified.	Minimal amounts of clinical waste are delivered to the facility. When this type of waste is delivered, the operations team ensure the waste is tipped directly into the bunker and is placed into the feed hopper at the earliest convenience. **Outcome = compliant**
14	In order to improve the overall environmental performance of the incineration of waste, to reduce the content of unburnt substances in slags and bottom ashes, and to reduce emissions to air from the incineration of waste, BAT is to use an appropriate combination of the techniques specified.	Waste blending and mixing is completed by overhead cranes in both manual and automatic mode. An advanced combustion control system is installed for the incineration process. Auto controllers are in place for injection of emission control reagents. Auto controllers use data from the raw gas analysers to increase/decrease reagent injection or combustion air. TOC and LOI are monitored every quarter as per the installation environmental permit requirements. **Outcome = compliant**
15	In order to improve the overall environmental performance of the incineration plant and to reduce emissions to air, BAT is to set up and implement procedures for the adjustment of the plant's settings, e.g. through the advanced control system (see description in Section 2.1), as and when needed and practicable, based on the characterisation and control of the waste (see BAT 11).	The plant is fitted with an advanced combustion control system which all the plant operators were trained to operate prior to initial plant start-up. Emission trends and plant performance is monitored and reviewed daily with any required manual adjustments being advised by the installation management team. Warning alarms activate if emission trends increase to allow operators to take appropriate action. Plant is monitored 24/7 by trained and competent operators. Continuous online analysers in the flue gas stream automate abatement plant dosing rates and performance. Instrumentation calibrated and serviced by both internal and external parties. **Outcome = compliant**
16	In order to improve the overall environmental performance of the incineration plant and to reduce emissions to air, BAT is to set up and implement operational procedures (e.g. organisation of the supply chain, continuous rather than batch operation) to limit as far as practicable shutdown and start-up operations.	The installation operates on a continuous basis with only one planned outage occurring per year. Waste inputs are managed to ensure plant capacity is not exceeded and suitable types of waste are sourced. Monthly supplier review meetings are held and the waste acceptance procedure controls waste inputs to ensure non-conforming wastes are identified and rejected where necessary. **Outcome = compliant**
17	In order to reduce emissions to air and, where relevant, to water from the incineration plant, BAT is to ensure that the FGC system and the	The plant was constructed in the time period 2016-2019 with the best available techniques at the time being installed. Pre-acceptance tests during the

BAT Requirement		Specific Measure
	waste water treatment plant are appropriately designed (e.g. considering the maximum flow rate and pollutant concentrations), operated within their design range, and maintained so as to ensure optimal availability.	commissioning phase confirmed that the emissions abatement systems could adequately control the flow and concentrations of the flue gas. The results of such commissioning tests were submitted to, and accepted by NRW. Planned outages and a PPM system ensure the plant is maintained to optimal availability. There are no emissions to water from the flue gas cleaning plant. **Outcome = compliant**
18	In order to reduce the frequency of the occurrence of Other Than Normal Operating Conditions (OTNOC) and to reduce emissions to air and, where relevant, to water from the incineration plant during OTNOC, BAT is to set up and implement a risk based OTNOC management plan as part of the environmental management system (see BAT 1) that includes all of the specified elements.	OTNOC Management requirements to be covered by creating new procedures and modifying current procedures and arrangements in relation to abnormal operations. The requirements in BAT18 will be covered when we put together the required documentation in relation to OTNOC management. **Outcome = non-compliant**
19	In order to increase the resource efficiency of the incineration plant, BAT is to use a heat recovery boiler.	A heat recovery boiler is installed at the facility as the primary purpose of the plant is to recover heat and electricity from the incineration of waste. A heat exchanger plate is also installed to recover heat from the process to heat water for sanitation and heating purposes in the plant ancillary areas. **Outcome = compliant**
20	In order to increase the energy efficiency of the incineration plant, BAT is to use an appropriate combination of the techniques specified.	BAT-AEEL of 20-35% for existing plant applies to the Parc Adfer installation. Gross Electrical Efficiency was determined as 29.37% @100% BAC during independent performance tests in 2020 (as mentioned in BAT 2). Boiler efficiency calculated to be 85.76% @ 100% BAC during performance test. The Reduction of the flue gas flow is achieved through the operation of the flue gas recirculation fan. The boiler is thermally insulated. Net electrical efficiency has been proven to be >20% during both the commissioning and operational phases. The plant is designed to cogenerate heat and electricity. The boiler is cleaned online every quarter by explosive charge. Online cleaning systems such as steam blowing and rapping systems are also operational at the installation. Heat recovery takes place within the furnace through water tube heat exchangers. **Outcome = compliant**

BAT Requirement		Specific Measure
21	In order to prevent or reduce diffuse emissions from the incineration plant, including odour emissions, BAT is to use the techniques specified.	The waste storage bunker is located within an enclosed building maintained under negative pressure by the total air fan extracting air from the waste storage area into the combustion chamber for use as combustion air. A separate extraction system with carbon filtration is used to control odour when the plant is shutdown. A deodorising misting cannon is also installed within the waste storage bunker area to control odour. Waste deliveries are altered to suit storage limitations during shutdown periods to avoid over-storage and subsequent odour issues. **Outcome = compliant**
22	In order to prevent diffuse emissions of volatile compounds from the handling of gaseous and liquid wastes that are odorous and/or prone to releasing volatile substances at incineration plants, BAT is to introduce them into the furnace by direct feeding.	**Not applicable.** Gaseous or liquid wastes are not processed.
23	In order to prevent or reduce diffuse dust emissions to air from the treatment of slags and bottom ashes, BAT is to include in the environmental management system (see BAT 1) the specified diffuse dust emissions management features.	**Not applicable.** Bottom ash is not treated on site, only stored before being sent off-site for treatment.
24	In order to prevent or reduce diffuse dust emissions to air from the treatment of slags and bottom ashes, BAT is to use an appropriate combination of the techniques specified.	**Not applicable.** Bottom ash is not treated on site, only stored before being sent off-site for treatment.
25	In order to reduce channelled emissions to air of dust, metals and metalloids from the incineration of waste, BAT is to use one or a combination of the techniques specified.	Plant is fitted with bag filtration and dry sorbent injection abatement systems to control dust and metals/metalloids concentrations in the flue gas. BAT-AEL's <2-5mg/Nm^3 for dust, 0.005-0.02mg/Nm^3 for Cadmium and Thallium and 0.001-0.3mg/Nm^3 for Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V are applicable to the installation emission point A1. The annual averages for these parameters as detailed in the 2021 annual performance report demonstrates that the installation is currently compliant with the higher end of each BAT-AEL range: • Cd and Tl (2021 annual average - 0.00048mg/Nm^3) • Dust (2021 annual average - 0.14mg/Nm^3) • Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V (2021 annual average - 0.025mg/Nm^3).

BAT Requirement		Specific Measure
		Outcome = compliant
26	In order to reduce channelled dust emissions to air from the enclosed treatment of slags and bottom ashes with extraction of air (see BAT 24(f)), BAT is to treat the extracted air with a bag filter (see Section 2.2).	**Not applicable.** Bottom ash is not treated on site, only stored before being sent off-site for treatment or recycling.
27	In order to reduce channelled emissions of HCl, HF and SO_2 to air from the incineration of waste, BAT is to use one or a combination of the techniques specified.	Installation utilises dry sorbent injection of hydrated lime to control HCl, SO_2 and HF concentrations in the flue gas stream. **Outcome = compliant**
28	In order to reduce channelled peak emissions of HCl, HF and SO_2 to air from the incineration of waste while limiting the consumption of reagents and the amount of residues generated from dry sorbent injection and semi-wet absorbers, BAT is to use the techniques specified.	The installation utilises a recirculation system to limit both the consumption of reagents, and the amount of residue generated from the dry sorbent injection system. HCl and SO_2 are continuously monitored upstream of the flue gas abatement plant in the raw flue gas stream to automatically control reagent dosing ensuring optimisation of automated dosing and reduction of raw material usage. Operation of flue gas residue recirculation screw reduces average reagent consumption by 50%. The BAT-AEL'S for existing plant of <2-8mg/Nm^3 for HCl, <1mg/Nm^3 for HF and 5-40mg/Nm^3 for SO_2 are applicable to the installation emission point A1. The annual averages for these parameters as detailed in the 2021 annual performance report demonstrate that the installation is currently compliant with the higher end of each BAT-AEL range: • HCl (2021 annual average - 5.05mg/Nm^3) • HF (2021 annual average - 0.21mg/Nm^3) • SO_2 (2021 annual average - 18.75mg/Nm^3) **Outcome = complaint**
29	In order to reduce channelled NO_X emissions to air while limiting the emissions of CO and N_2O from the incineration of waste and the emissions of NH_3 from the use of SNCR and/or SCR, BAT is to use an appropriate combination of the techniques specified.	The installation utilises an automated combustion control system to limit emissions of NOx, CO, and N_2O. The plant is also fitted with a selective non-catalytic reduction (SNCR) system to control combustion gases such as NOx. The SNCR system is optimised and designed to ensure NH_3 emissions are controlled. NH_3 is continuously monitored at the stack. Flue gas recirculation fan is installed at the installation to reduce flue gas flow and NOx emissions. The BAT-AEL's for existing plant of 50-180mg/Nm^3 (where SCR is not possible) for NOx, 10-50mg/Nm^3 for CO (current daily ELV in permit is 50mg/Nm^3), and 2-10mg/Nm^3 (current daily ELV in

BAT Requirement		Specific Measure
		permit is 10mg/Nm^3) for NH_3 are applicable to the A1 emission point. The annual averages for these parameters as detailed in the 2021 annual performance report demonstrate that the installation is currently compliant with the higher end of each BAT-AEL range: • NOx (2021 annual average - 174.09mg/Nm^3) • CO (2021 annual average - 8.04mg/Nm^3) • NH_3 (2021 annual average - 0.14mg/Nm^3) **Outcome = compliant**
30	In order to reduce channelled emissions to air of organic compounds including PCDD/F and PCBs from the incineration of waste, BAT is to use techniques specified.	The combustion process is optimised by the automatic combustion control system to limit the concentration of organic compounds in the flue gas such as PCBs and PCDD/F. The boiler is online cleaned every quarter by use of explosive charge in addition to a thorough boiler clean during the annual outage which involves shot blasting to free up debris before removal of debris by vacuum tanker. The flue gas is rapidly cooled from 400°C to below 250°C before the flue gas stream enters the bag filtration system. This cooling prevents the de novo synthesis of PCDD/F. Dry sorbent injection of activated carbon followed by capture of particles in the bag filtration system is also in place to control PCB and PCDD/F concentrations. A furnace temperature of 850°C must be maintained for a minimum of two seconds to ensure complete combustion. Six periodic tests for dioxins and furans have been completed since plant commissioning, with all results being below the emission limit value listed in the permit. The BAT-AEL's for existing plant of <3-10mg/Nm^3 for TVOC and <0.01-0.06ng/Nm^3 for PCDD/F (I-TEQ) are applicable to the A1 emission point. The annual averages for these parameters as detailed in the 2021 annual performance report demonstrate that the installation is currently compliant with the higher end of each BAT-AEL range: • TVOC (2021 annual average - 0.65mg/m^3) • PCDD/F (I-TEQ) (2021 annual average - 0.00815ng/m^3) • The BAT-AEL of <0.01-0.08ng/m^3 for PCDD/F and dioxin like PCB's (WHO-TEQ) is not applicable to the installation. The long term sampling BAT-AEL's are not applicable as the last 6 periodic tests for dioxins and furans have

BAT Requirement		Specific Measure
		been below the current ELV, which demonstrates that the emission levels are low and stable. **Outcome = compliant**
31	In order to reduce channelled mercury emissions to air (including mercury emission peaks) from the incineration of waste, BAT is to use one or a combination of the techniques specified.	Adsorption by injection of activated carbon combined with a bag filter where a reaction layer is created in the filter cake is in place to reduce mercury emissions at the installation. Mercury concentrations are monitored by IBA sample analysis and periodic stack emissions testing. The BAT-AEL for existing plant 1-10µg/Nm^3 for Mercury over a long-term sampling period is applicable to the A1 emission point. The BAT-AEL of <5-20µg/Nm^3 for Mercury as a daily average or average over the sampling period will not be applicable if the installation can demonstrate low and stable Mercury levels. The installation has 6 separate Mercury results which are below 10µg/Nm^3, but these tests were not undertaken in line with EN13211 as required by the BRef. PAOL intends to complete six triplicate tests in line with EN13211 to demonstrate low and stable Mercury levels and continue with periodic monitoring as per the ESA/EA/SEPA/NRW Mercury protocol by the compliance date. **Outcome = partially compliant**
32	In order to prevent the contamination of uncontaminated water, to reduce emissions to water, and to increase resource efficiency, BAT is to segregate wastewater streams and to treat them separately, depending on their characteristics.	Waters are collected separately in the following forms: 1) Uncontaminated surface water collects in the site attenuation pond (fitted with two oil/sludge interceptors) before discharge to an off-site brook. A recirculation water pump is installed in the attenuation pond to pump water back to the process for re-use if required. 2) Rainwater from roof areas is collected in an underground rainwater harvesting tank for re-use as toilet flushing and wash down water on site. 3) Boiler blowdown, ash quenching discharger water, wash down water from process area drains, and surface water from IBA storage areas drains to an onsite decantation pit where it is held for re-use as ash quenching water. 4) Foul sewage from site toilets is collected and treated in an underground waste water treatment

BAT Requirement		Specific Measure
		package plant. The treated water is pumped back to the process for re-use. **Outcome = compliant**
33	In order to reduce water usage and to prevent or reduce the generation of wastewater from the incineration plant, BAT is to use one or a combination of the techniques specified.	A dry sorbent injection system is in place to control flue gas emissions. Waste water from the process is collected in the decantation pit and re-used on site as bottom ash quenching water. Rainwater is collected in an underground rainwater harvesting tank for re-use as toilet flushing and wash down (plant cleaning) water. The surface water attenuation pond is fitted with a pump which is capable of recirculating water from the pond back to the plant for re-use. **Outcome = compliant**
34	In order to reduce emissions to water from FGC and/or from the storage and treatment of slags and bottom ashes, BAT is to use an appropriate combination of the techniques specified, and to use secondary techniques as close as possible to the source in order to avoid dilution.	Water is not used in the flue gas cleaning process. Dry sorbent injection is in place at the installation for flue gas cleaning. Bottom ashes and slags are not treated on site, only stored. A water misting dust suppression system is installed to control fugitive dust emissions from the bottom ash storage area. Water use from this dust suppression misting system is controlled by only activating the system for short periods during dry and windy conditions. **Outcome = complaint**
35	In order to increase resource efficiency, BAT is to handle and treat bottom ashes separately from FGC residues.	Bottom ashes are stored separately from air pollution control residues. The bottom ash is conveyed directly to storage barns and sent off site for further processing, sorting, and subsequent recycling/re-use. The flue gas cleaning residues are stored on site in an enclosed silo which discharges directly into a road tanker to enable off-site disposal of this waste stream. **Outcome = compliant**
36	In order to increase resource efficiency for the treatment of slags and bottom ashes, BAT is to use an appropriate combination of the techniques specified based on a risk assessment depending on the hazardous properties of the slags and bottom ashes.	**Not applicable.** Bottom ash is not treated on site, only stored before being sent off-site for treatment or recycling.
37	In order to prevent or, where that is not practicable, to reduce noise emissions, BAT is	The noisiest items of equipment are installed within acoustic enclosures within the internal areas of the plant. Site door opening is kept to a minimum and fast closing roller shutter doors are in place. The

BAT Requirement		Specific Measure
	to use one or a combination of the techniques specified.	planned preventative maintenance routines ensure plant and equipment is adequately maintained to prevent noise being generated. Noisy tasks are not conducted at night and frequent site boundary noise checks are completed. Noise silencers are fitted to steam release points and fans. The site buildings are well insulated to reduce noise emissions. Occupational noise surveys are conducted by a specialised consultant on an annual basis to verify levels are within the compliance limits. **Outcome = complaint**

5.1.8 Actions required to comply with BAT

As per Table 5, PAOL currently are not compliant with four BATc's 4, 5, 18 and 31. The following section details how PAOL intend to comply with the BATc by the 3 December 2023.

BAT 4 – Hydrogen Fluoride (HF) monitoring

Although PAOL currently have the capability to continuously monitor HF, they intend to continue to test for HF at six monthly intervals in adherence with point 4 on page 312/65 of the BAT conclusions document. They currently continuously monitor Hydrogen Chloride (HCl) and the data which has been collected over two years of operation demonstrates that HCl levels are sufficiently stable. They are seeking confirmation from NRW that this approach is acceptable. If NRW agree to this proposal, PAOL can comply with the HF monitoring BAT requirements immediately.

BAT 4 and 31 – Mercury (Hg) monitoring

PAOL intend to continue to periodically monitor Hg at six monthly intervals rather than install continuous emissions monitoring equipment for Hg monitoring. As per point 5 on page 312/65 of the BAT conclusions, plants with a proven low and stable mercury content can monitor at six monthly intervals in line with EN13211. PAOL have tested the stack flue gas for Hg on 6 separate occasions since the plant was commissioned in December 2019. These tests were completed in adherence with BS EN 14385:2004, with all results being below 0.01mg/Nm^3. BAT 4 requires that Hg is monitored in line with EN13211, therefore PAOL plans to undertake additional Hg monitoring in 2022 in accordance with EN13211 to demonstrate that Hg levels are low and stable, which would remove the requirement for Hg to be continually monitored at the installation. PAOL would like to engage with NRW to agree upon a suitable sampling programme for undertaking additional Hg testing in line with EN13211 to demonstrate compliance with the low and stable limit of 0.01mg/Nm^3. PAOL plan to undertake the 6 required triplicate Hg tests during their monitoring campaigns in 2022 and early 2023 to ensure they have the required data to demonstrate compliance in good time ahead of the BRef conditions becoming active.

BAT 4 – Polybrominated dibenzo-p-dioxins and furans (PBDD/F) monitoring

PAOL recognises that the facility takes receipt and processes waste soft furnishings which have the potential to contain polybrominated dibenzo-p-dioxins and furans. The BAT conclusions do not state a monitoring standard for PBDD/F testing, meaning any current test methods and results are not UKAS or MCERTS accredited. PAOL intend to engage with NRW prior to any PBDD/F testing taking place to ensure all parties agree upon the most suitable monitoring method. Initial investigations have determined that there currently is not a laboratory in the United Kingdom that offers a fully accredited test for PBDD/F. PAOL is willing to undertake PBDD/F testing as soon as a suitably accredited laboratory can be identified, or additional guidance is issued by NRW.

BAT 5 – Polychlorinated dibenzo-p-dioxins (PCDD/F) testing during OTNOC

To date PAOL has not completed any PCDD/F emissions to air monitoring during a start-up or shutdown of the plant. They confirm that they can undertake this testing every 3 years as required by BAT 5, with the first test to be arranged for when the plant is starting-up following completion of the 2022 annual maintenance outage which is planned for 11 to 25 June 2022.

BAT 18 – OTNOC Management Plan

An OTNOC management plan is not currently formally included in the EMS. PAOL intend to combine the current start-up and shutdown philosophy with the various current procedures and systems in place in relation to other than normal operating conditions such as maintenance management arrangements to generate an OTNOC management plan. PAOL intend to create this management plan by the 3 December 2023, following engagement with NRW on the specific requirements for an OTNOC Management Plan.

6.0 Infrastructure and Equipment Inventory

6.1 Site Identification Board

A site identification board which is easily readable from outside the site entrance during hours of daylight is provided at the site entrance.

The identification board is inspected at least once per week. In the event of damage or defect that significantly affects the legibility of the board it will be repaired or replaced within a timescale agreed with the NRW.

The board displays the following information:

- site name and address;
- permit holder;
- permit number;
- emergency contact name and telephone number;
- NRW national telephone numbers; and,
- days and hours site is open to receive waste.

6.2 Engineered Containment System

Surfacing

Operational areas of the site benefit from an engineered containment system comprising an impermeable concrete surface.

Sub Surface Structures

The precise locations of subsurface drains, pipework, interceptors and tanks is established and recorded and relevant documentation maintained in the site office. An inspection and maintenance programme for all subsurface structures is followed and records maintained by the Plant manager.

Bunds

Bunds and or double skinned walls are provided for all tanks containing liquids whose spillage could be harmful to the environment. Containment bunds or double skinned walls are provided to make sure that any leaks/spillages are contained in the event of a leak of the primary containment. As such, containment measures are:

- capable of containing at least 110% of the volume of the largest tank within the bund;
- constructed of materials which are impermeable and resistant to the stored materials in accordance with relevant material safety data sheets (MSDS);
- constructed to the appropriate British Standard and Health and Safety Executive (HSE) guidance;
- of a type suitable for the containment of the materials in the event of leak or spill;
- pipework will be routed within bunded areas so that no penetration of walls or base of the bund takes place; and
- connection points will be located within the bund.

Management and Operational Techniques

Containment engineering prevents the release of potentially polluting liquids to surface water and groundwater. Plant operatives undergo awareness training to ensure a full understanding of the containment engineering which minimises the environmental impact of the site. The engineered containment system is subject to routine visual inspection. Identified breaches in the engineered containment are remedied to ensure continued integrity of the facility, and to prevent pollution of surface or groundwater. Records of inspection and maintenance are maintained by the Plant manager.

6.3 Engineered Drainage and Surface Water Management System

The drainage system is illustrated on Drawing FCA/01A, Outline Drainage Strategy, in Section 4 of the original EP application.

The following mitigation measures are utilised which reduce the potential risk to the surface water run-off regime:

- surface water management seeks to control the drainage from the site using sustainable drainage techniques (SuDS);
- where possible rainfall runoff is harvested for use in on-site processes;
- runoff from areas of roof that cannot be harvested are discharged off site at controlled rates following attenuation;
- surface water is discharged to the drainage channel on the eastern boundary, from where it is discharged via a culvert beneath the railway line into the drainage network serving the wider industrial area;
- runoff from areas of external kerbed hard standing pass through a hydrocarbon interceptor and silt trap prior to being discharged off site at controlled rates and following appropriate attenuation to the north eastern drainage channel;
- surface water discharges from the bund in the eastern section of the site are collected in a toe drain from where it is discharged off-site at controlled rates following appropriate attenuation;
- minor areas which are located at a lower level (<10m AOD) adjacent to the site access discharge surface water runoff direct to the storm drain (north eastern drainage channel) via a separate piped drainage system;
- drainage from all waste handling areas (inc. the bunker) are positively drained to sealed tanks (which are subject to routine inspection), with water re-circulation within the process. Any disposal is to sewer or to tanker for disposal off-site at an appropriately licensed facility;
- in the unlikely event of a fire, the volume of fire water required is minimised by the use of targeted firefighting devices (e.g. sprinklers, mists, inert gases and foams);

- water for firefighting is taken from local rising mains and is discharged to either the waste bunker and/or a primary containment tank. Provision has been made for re-circulation for firefighting water and removal for discharge to sewer or to tanker for disposal off-site at an appropriately licensed facility, (subject to confirmatory quality testing and treatment). Secondary containment (in accordance with PPG18) is provided within the SuDS pond; and
- an emergency shut-off valve and low permeability lining (e.g. engineered clay or similar) are provided to the SuDS pond (upper section) so that, in the event of a fire at site, water can be contained in the SuDS pond until appropriate treatment or collection by tanker for off-site treatment and disposal at an appropriately licensed facility can be organised.

6.4 Plant and Equipment

The key items of process plant and equipment that are used at the site are detailed below. All items of plant and equipment are maintained in accordance with the manufacturer's recommendations.

The key components will include, but are not limited to:

- waste crane and waste storage bunker;
- a furnace/boiler unit incorporating moving grate technology, selective non catalytic reduction (SNCR) and including a steam boiler with an energy recovery system;
- FGT system comprising semi-dry reactor and bag house filters;
- steam turbine/generator set with the capability for CHP operation;
- condensate system, including air cooled condensers (ACC);
- residue handling and storage facilities;
- electrical equipment associated with the facility and its connection to the national grid;
- continuous emissions monitoring system (CEMS); and
- auxiliary equipment.

7.0 Raw Materials

7.1 Inventory of Raw Materials

The raw materials that are used at the installation are detailed in Table 6.

The waste processing plant was supplied by external manufacturers and has recommended maintenance programmes that dictate the use of replacement parts and oils.

Any raw materials will be recorded and assessed for their environmental impact prior to use.

A Control of Substances Hazardous to Health (COSHH) assessment will be undertaken prior to the use of chemicals, and if the chemical is found to present a hazard to health, it will be added to the COSHH inventory.

Material Safety Data Sheets (MSDS) for any potentially hazardous materials or chemicals will be kept on site together with the COSHH register. The MSDS will give information on how chemicals should be handled, stored and disposed of, and what to do in the event of an accident.

Table 7-1
Principle Raw Materials

	Purpose	Consumption		Site Storage		Storage Type
		t/h	t/a			
Waste Fuel	Treatment	29.00	232,000	11151[1]	m^3	Waste Bunker
Water	Process	3.00	24,000	300[2]	m^3	Tank
Sodium Chloride (NaCl)	Demin Water	0.0002	1.36	1	m^3	IBC[3]
Sodium Hydroxide (NaOH)	Demin Water	0.0009	7.27	0.1	m^3	IBC[3]
O_2 scavenger	Boiler conditioning	0.0048	38	0.15	m^3	Tank
Trisodium phosphate (Na_3PO_4)	Boiler conditioning	0.0050	40	0.35	m^3	Tank
Light Fuel Oil[4]	Combustion Support	0.02	194	100	m^3	Tank
Urea Pellets	Flue Gas Treatment	0.05	392	20	m^3	Big Bags
Hydrated lime ($Ca(OH_2)$)	Flue Gas Treatment	0.29	2,304	150[5]	m^3	Silo
Activated Carbon[6]	Flue Gas Treatment	0.01	72	70	m^3	Silo

7.2 Raw Material Selection

Wherever possible, raw materials are selected that minimise environmental impact. Consideration is given to such factors as degradability, bioaccumulation potential and toxicity. Reviews are frequently undertaken to ensure that all raw materials are appropriate for use, that consumption is optimised and that opportunities for reduction and improvements are implemented through an action plan.

Alternative raw materials are evaluated for their environmental impact on an on-going basis and, where there is no overriding quality requirement substitution is given appropriate consideration. The on-going programme of professional and technical development for all site personnel as detailed in Section 2.0 of this BATOT ensures awareness of new developments in product availability and their implications.

7.2.1 Waste Minimisation Audit

The overall objective of the site is the recovery of waste, thereby minimising the volume sent to landfill for disposal. Notwithstanding this, there are waste produced by the processes undertaken at the site.

As described above, the nature of the facility dictates that material usage follows a programme dictated by the plant manufacturer and it is considered that the potential for further minimisation of materials usage is limited.

As stated in the IPPC Sector Guidance S5.06 waste minimisation can be defined as 'a systematic approach to the reduction of waste at source, by understanding and changing processes and activities to prevent and reduce

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[1] During 'routine operation.'
[2] Includes the combined storage provided for clean and dirty water.
[3] Intermediate Bulk Container or similar
[4] Conservative approach:
The light fuel oil consumed will account for 0.5% of the facility thermal input over 8000h/a.
Light fuel oil CV = 42.6MJ/kg
[5] Net storage volume
[6] Activated coke

waste'. The efficiency of the processes at the site is dealt with in other sections of this report; where it can be seen that effective methods are implemented to reduce waste.

Notwithstanding this, the waste generation at the site is reviewed annually and where necessary an appropriate improvement programme is implemented.

7.2.2 Water Use

The main uses of water at the facility are;

- process water (demineralised water system, ash handling and APC system);
- sanitary fittings and installations (toilets, kitchens, washrooms etc);
- facility wash down;
- safety showers and eyebaths; and
- fire water.

The use of rainwater within the facility provides opportunities to offset town water requirements.

The CNIM system incorporates an air-cooled condenser and the steam / condensate system is a closed circuit requiring minimal water supply resources. Using air cooling, instead of water cooling, saves precious water resources, which would otherwise be consumed in an evaporative condensing system.

The use of water is regularly reviewed to ensure maximum efficiency and ensure that any further potential for reduction in consumption and recycling opportunities are identified.

7.3 Indicative BAT for Raw Materials

Waste Characteristics and Facility Design

The primary feedstock to the plant is municipal waste supplemented with similar industrial and commercial wastes. As received, municipal waste has the potential to vary in terms of composition with respect to its combustion characteristics for example CV and moisture content but is non-hazardous and does not require specialised handling and storage procedures beyond those detailed within sections 3.2.1 and 3.2.2.

Standard operating procedures and the site EMS have been developed so that robust waste acceptance procedures are in place and only permitted wastes are accepted for treatment at the facility e.g. waste inspections and removal of oversize items.

Prior to processing:

- waste is visually inspected in the bunker;
- spot checking of individual deliveries is undertaken; and
- waste is weighed upon the weighbridge as delivered.

The facility has been specifically designed to adapt to the variability of a municipal waste stream's composition. Figure 2 and Table 3 in Section 5.1.3 identify how the facility will be able to adjust waste flow rate with respect to the waste input's CV and the heat throughput rating of the furnace within the boundaries identified in the firing diagram. Waste with a CV between 6.5 MJ/kg and 13.0 MJ/kg can be processed as per the combustion diagram.

During normal operation, the facility operates with a waste thermal input of 68.47MWth. Municipal waste is, however, frequently subject to significant short-term fluctuations in CV, increasing or decreasing the thermal loading on the plant and auxiliary equipment. To accommodate this variability, the facility has a maximum continuous thermal capacity of 75.2MWth, with a 10% overload condition for short periods. This means that

under normal operation, the facility operates at a design point lower than the boiler maximum continuous thermal capacity.

Changes in the composition of municipal waste are compensated for by adjusting commercial and industrial waste input volumes. This blending of commercial and industrial waste with municipal wastes limits the impact of changes in the municipal waste's composition.

Waste is mixed within the bunker and upon the grate and, in addition, PAOL have control of combustion conditions and flue gas treatment via the plant control system. The control of combustion and flue gas treatment is discussed in further detail in Section 5.1.5.

Should the composition of the waste fluctuate, the plant control system adjusts the combustion and flue gas treatment parameters (waste feed rate, air injection, regulation of consumables etc.) in order to maintain stable combustion and operation to ensure compliance with permit conditions. This system adjusts combustion parameters should general waste features such as moisture content change or there are variations in the amount of paper and plastic.

Feedstock Homogenity

Upstream Waste Management

PAOL work with suppliers of commercial and industrial wastes to the facility to improve incoming waste quality. At the pre-acceptance stage, PAOL provide suppliers with information regarding the types of waste which can be accepted at the site and assess the suitability of waste streams for acceptance at the facility. This includes asking the supplier for a compositional analysis of the waste stream.

Procedures for the Removal of Problem Wastes

Standard operating procedures and the site EMS have robust waste acceptance procedures in place and only permitted wastes are accepted for treatment at the facility e.g. waste inspections and removal of oversize items.

Prior to processing:

- waste is visually inspected in the bunker;
- spot checking of individual deliveries is undertaken; and
- waste is weighed upon the weighbridge as delivered.

Where visual inspections, spot checking or radioactivity checks identify wastes which are unsuitable or not permitted for acceptance at the facility, for example oversize materials, these are segregated and stored within a designated quarantine area prior to removal off-site to a suitably licensed facility.

On or Off-Site Waste Treatment/Mixing

Wastes are mixed within the bunker and upon the combustion grate to homogenise the waste prior to combustion.

Furnace Conditions

The combustion grate is a well proven technology which is compliant with 3% TOC criteria. The combustion grate is a forward acting grate with a shallow fall angle of 10 degrees. The combination of these features allows sufficient agitation of the waste for burn out. This is demonstrated through regular sampling and analysis as required by the environmental permit.

To prevent ammonia slip to ash, the dosing rate of urea is optimised with respect to nitrous oxide concentration within the furnace and temperature as illustrated in Figure 7 and explained in Appendix BATOT 4 NOx Abatement Assessment provided in the original EP application. The presence of ammonia within the ash is analysed through regular sampling and analysis as required by the environmental permit.

Flue Gas Treatment Conditions

The facility incorporates the recycling of reagents which collect upon the fabric filters of the FGT system.

Wet scrubbing systems were considered within Appendix BATOT3 Acid Gas Abatement Assessment provided in the original EP application. In summary, the facility was designed to minimise water consumption with little or no effluent discharge. As the wet scrubbing system would require a significant change in approach to the design of the site, it was not considered to represent a best available technique (BAT) for the facility and was not employed at the facility.

The dosing rate of urea is optimised with respect to nitrous oxide concentration within the furnace and temperature.

Please refer to the Emissions Control & Monitoring section, Figure 8 and Figure 9 of Section 5.1.5 Detailed Process Description, Appendix BATOT3 Acid Gas Abatement Assessment and Appendix BATOT 4 NOx Abatement Assessment provided in the original EP application for further details.

Waste Management

Incinerator bottom ash (IBA) is stored separately from APCR so as to enable its recovery. The IBA is mixed with the fly ash collected from the first to fourth boiler passes. The mixed ash is transferred by means of conveyor to the IBA site for storage.

Fly ash from the boiler fifth pass (economiser pass) is mixed with the hazardous fly ash to form the APCR and is conveyed to silos for storage. These silos are emptied with the APCR sent for further treatment/landfill.

8.0 Waste Handling, Recovery or Disposal

Waste present at the site falls into two categories:

- waste delivered to site for processing; and
- waste generated from on-site processes.

The principle objective of the site is to optimise recovery of waste in both categories, with only residual materials incapable of further recovery being sent for disposal to landfill.

All solid waste is managed and disposed of in accordance with the Duty of Care and where applicable the Environmental Permitting Regulations.

All waste recovered or generated during the processes undertaken at the site are removed to a suitable licensed processing or disposal site.

The categories of waste, their storage arrangements on site, and recovery / disposal options are outlined in Table 7 below.

Table 8-1
Waste Storage, Recovery and Disposal

Waste Material	Storage Arrangements	Disposal (D) or Recovery (R)
Wastes delivered to site for processing		
Residual municipal waste	Within waste bunker	R
Low risk industrial and commercial waste	Within waste bunker	R

Waste Material	Storage Arrangements	Disposal (D) or Recovery (R)
Wastes generated from on-site processes		
Incinerator bottom ash	Within IBA storage area	R
Air pollution control residues	Within enclosed silos	D & R
Waste parts from maintenance and repair of equipment	Containers/skips located on drip trays	D & R
Waste oils	Bunded storage tank	R
Redundant oil containers	Containers/skips	R
Oily contaminated residues from plant maintenance	Containers/skips	D
Office waste	Containers/skips	D & R
Process water	Bunded storage tank	D & R

Waste storage on the site is protected from vandalism by site security fencing around the site. The gates are securely locked when there is no on-site presence.

8.1 Indicative BAT for the Avoidance, Recovery and Disposal of Wastes

Bottom Ash Handling

IBA is stored on site prior to being transported and processed at a suitable permitted facility offsite. The IBA storage area is fully engineered to contain the material and minimise any possible environmental impact from its storage.

Fly Ash and APC Residues

Fly ash collected from the first to fourth boiler passes, also known as boiler ash, which is capable of recovery along with IBA is mixed with IBA and kept separate from APCR. The mixed ash is transferred by means of conveyor to the IBA site for storage.

Fly ash from the boiler fifth pass (economiser pass) is mixed with the hazardous fly ash to form the APCR, and is conveyed to silos for storage. These silos are emptied with the APCR sent for further treatment/landfill. During silo and container filling, displaced air is ducted to dust arrestment equipment.

Rejected Feedstock

PAOL work with suppliers of commercial and industrial wastes to the facility to improve incoming waste quality. At the pre-acceptance stage, PAOL provide suppliers with information regarding the types of waste which can be accepted at the site and assess the suitability of waste streams for acceptance at the facility. This includes asking the supplier for a compositional analysis of the waste stream.

Standard operating procedures and the site EMS have been developed so that robust waste acceptance procedures are in place and only permitted wastes are accepted for treatment at the facility e.g. waste inspections and removal of oversize items.

Prior to processing:

- waste is visually inspected in the bunker;

- spot checking of individual deliveries is undertaken; and
- waste is weighed upon the weighbridge as delivered.

Where visual inspections, spot checking or radioactivity checks identify wastes which are unsuitable or not permitted for acceptance at the facility, for example oversize materials, these are segregated and stored within a designated quarantine area prior to removal off-site to a suitably licensed facility as soon as practicably possible.

Recovered Waste Fractions

Please refer to Section 5.1.6 of this BATOT for a description of process off-takes including their storage and onward routes for recovery and disposal as appropriate.

The key methods of ensuring that waste minimisation occurs on site are;

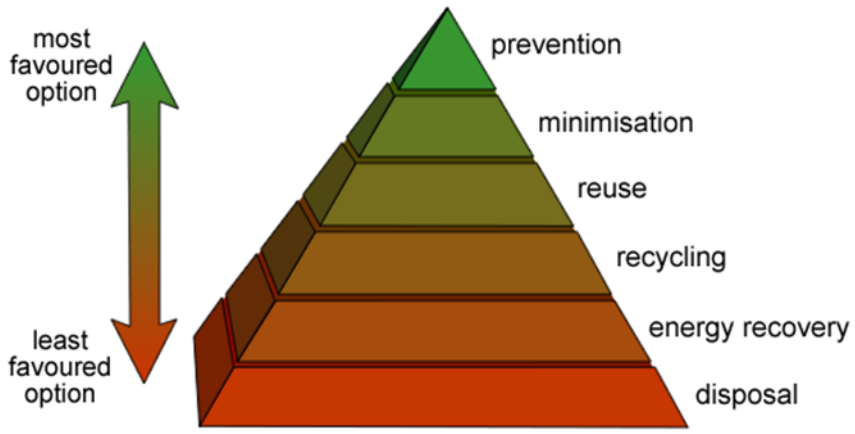
- the ongoing identification and implementation of waste prevention opportunities;
- the active participation and commitment of staff in all areas of the business, including staff suggestion schemes; and
- monitoring of materials usage and reporting against key performance measures.

PAOL take appropriate measures to ensure that;

- the waste hierarchy (referred to in Article 3 of the Waste Framework Directive) is applied in the generation of waste on site by the activities (see Figure 4 below);
- any waste generated by the activities is treated in accordance with the waste hierarchy; and
- where disposal is necessary, as opposed to recovery, that it is undertaken in a manner which minimises its impact on the environment.

Figure 10 below illustrates the Waste Hierarchy, which is applied by PAOL to the generation of the waste. There are six possible methods of waste disposal, from the most favoured to the least favoured, with the prevention of waste being the most and the disposal of waste being the least.

Figure 10
Waste Hierarchy



PAOL review and record at least every four years whether changes to those measures should be made and take any further appropriate measures identified by the review. Waste production is avoided wherever possible. Any waste produced on site will be recovered, unless there are instances whereby it is not technically or economically practicable to do so.

On an annual basis, PAOL complete a waste minimisation audit.

The audit includes;

- waste produced at the site;
- where the waste goes;
- can it be recovered or recycled;
- is it being stored correctly on site;
- are Duty of Care requirements being met; and
- any further comments for future reference.

9.0 Energy

Without an external heat customer, the ERF generates approximately 19.8MWe of renewable energy when operational, of which 17.5MWe is exported to the National Grid. The remaining 2.3MWe being used to run the facility.

9.1 Energy Generation and Consumption

The energy requirements are detailed in full in Section 3 of the Global Warming Potential assessment which is appended to this report as Appendix 1. Please refer to this document.

The installation is not part of a Climate Change Agreement.

9.2 Energy Management Measures

A number of features have been incorporated within the design of the site in order to minimise energy use.

Low energy light fittings are used where practicable.

To optimise energy efficiency, equipment is maintained and serviced as required. Plant and equipment are subject to regular maintenance to ensure it continues to operate at optimum energy efficiency and that energy consumption does not increase due to inefficient performance.

Energy use is monitored and recorded and periodically reviewed to identify areas of improvement and to ensure that any inefficiency is investigated and appropriate actions taken.

Energy use and energy minimisation are included within the management system for the control of resources. Within the management system the review process identifies energy use by source for the different site operations. The results are used to identify potential measures for improving energy efficiency.

Staff undergo awareness training in energy efficient practices.

Due to the nature of the activities undertaken at the site, opportunities for further energy efficiency measures are limited. However, PAOL recognises the importance of minimising energy consumption and so future consideration may be given to further energy saving techniques.

9.3 Indicative BAT for Energy Efficiency

Please refer to Appendix 1 Global Warming Potential Assessment and Section 7 Heat Plan and associated appendices of the original EP application for a description of energy efficiency techniques which are employed at the facility to demonstrate how the facility applies BAT with respect to energy efficiency.

10.0 In-Process Controls

10.1 Waste Acceptance

The only wastes be accepted at the site are:

- residual household waste from kerbside collections; and
- commercial and industrial wastes.

No other waste are accepted.

All wastes delivered in refuse collection vehicles (RCV's) are required to report to the weighbridge facility and site control office. The weighbridges comply with current Weights and Measures Regulations and are maintained and calibrated regularly. Should the weighbridges be out of order all loads are recorded by volume and previous average load weights or appropriate conversion factors are used to determine the weight of the loads.

Duty of Care documentation is checked at the site office. From there vehicles are directed to the appropriate operational area.

Designated personnel are responsible for liaising with both the driver of the waste collection vehicle and the plant operatives to ensure the waste is deposited in the correct area.

Each load of waste is visually inspected by trained personnel following discharge. In the event that non-conforming waste is identified these are segregated and placed in a designated quarantine area for off-site disposal.

10.2 Material storage and Handling

Arrangements for the storage of raw materials are detailed in Section 7.0, and waste storage arrangements are detailed in Section 8.0 of this report.

Table 8 below provides details on the tanks / containers that will be located on the site. The table details the tanks / containers, their contents, capacity and construction material and storage arrangements.

Table 10-1
Treatment Tanks / Containers

Tank / Container	Contents	Total Max capacity (m^3)
Clean water tank	Clean water	100
Dirty water tank	Potentially contaminated water	100
IBA storage area water collection tank	Potentially contaminated water	Sized for 1/100 + 20% rainfall event
Surface water balancing pond	Surface rain water	2000

Tank / Container	Contents	Total Max capacity (m^3)
Activated carbon[7] silo	Activated carbon for use in FGT process	70
Filter residue silo	APCR	320
Fire break tank	Clean firefighting water	1100
Sodium Chloride container	Sodium Chloride	1
Sodium Hydroxide container	Sodium Hydroxide	1
Hydrochloric Acid container	Hydrochloric acid	1
Ammonia tank	Ammonia	0.6
Trisodium Phosphate tank	Trisodium Phosphate	0.6
Light fuel oil tank	Light fuel oil	100
Urea tank	Urea solution	40

The storage procedures that are implemented on site are considered to be best practice for the following reasons:

- all storage tanks will be designed to be fit for purpose, taking into account the nature of the material to be stored and the required design life;
- tanks will be fully quality assured and tested for leakage prior to commissioning;
- storage areas will be clearly marked;
- procedures will be in place for the regular inspection and maintenance of storage areas with any repairs being undertaken as soon as is practicable;
- liquid levels within all storage tanks will be continuously monitored by pressure sensors which will alert the operator to high levels and operate interlocks. Float switches will also be in place that acts to switch off pumps if a high level is reached;
- bulking and mixing will only take place under instruction from appropriately trained personnel; and
- written records of all tanks will be kept, detailing:
    - capacity;
    - construction including materials;
    - maintenance schedules and inspection results;

[7] Activated coke

- fittings; and
- materials stored in the vessel.

10.3 Process Control Monitoring

The waste treatment processes benefits from a number of process control features which ensure adequate control of the treatment process and prevent the development of abnormal operating conditions. Specific measures are detailed in Section 5 of this document alongside details of the treatment processes; however, additional information is provided below.

10.3.1 Control and Monitoring System (CMS)

The ERF is fitted with its own Control and Monitoring System (CMS). The Facility CMS is fully configured, both hardware and software, with the plant and its various controllers. The key function of the CMS is to control, monitor and report the activities of the plant through the direction of the operators. The operators shall interact with the CMS via a Human Machine Interface (HMI) system of the work stations. Normal operation and supervision of the Facility is performed from workstations located in the Control Room. Plant start-up and normal shutdown as well as operation of 'balance of plant' equipment, auxiliary and ancillary systems are carried out either from the local control panels or from the Control Room depending on the application.

For example, the CMS controls and monitors detailed liquid level control by alarm, boiler water maintenance by automatic blow down and critical process conditions that can activate emergency shutdown procedures.

10.4 Inspection, Maintenance and Monitoring

Infrastructure and equipment within the site is inspected on a regular basis and maintained and repaired, as necessary. In addition, the operator undertakes visual checks on all plant and equipment at least once a week and, if deemed necessary, bring forward any planned maintenance or undertake remedial works.

Records of all visual and scheduled inspections and details and certificates (where appropriate) of any maintenance work are regularly updated and maintained. Maintenance schedules for equipment are regularly reviewed and updated.

In the event of damage or deterioration being detected, all maintenance work is carried out in conformance with PAOL's Health and Safety Policy.

Monitoring and recording of conditions within the plant is carried out on a continuous basis by the comprehensive network of sensors and instrumentation as discussed above and displayed via the process control system. This enables continuous mapping of the process in order to ensure efficiency of the process.

11.0 Control of Noise

PAOL recognise that the site should be operated in a manner that minimises or prevents noise and / or vibration nuisance.

11.1 Noise Sources

Details of the locations, sources, frequency and estimated noise levels associated with operations at the site have been addressed as part of the planning application. The planning application was included on CD as an appendix to the application forms in Section 1 of the original EP application. In addition, the noise assessment was appended as Appendix H1_4.

11.2 Noise Assessment

The noise assessment carried out for the planning application considered both the potential for the construction and operational proposals to give rise to noise impacts at the closest noise-sensitive receptors.

The assessment concluded that:

- at all locations assessed the predicted noise rating level is below the prevailing background noise level;
- the cumulative assessment shows that, at worst, there could be a 0.1dB increase in the prevailing ambient noise levels at times; this is an increase which would not be noticeable above everyday fluctuations in the ambient noise levels in the area;
- the cumulative assessment on nearby SPA sites has shown that noise levels are well within the guidance noise levels specified in AQTAG09;
- the increase in ambient noise levels due to operations at the ERF would have a negligible impact at worst; and
- based on the results of the assessment, noise should not pose a material constraint for the ERF.

11.3 Noise Mitigation and Management Measures

Mitigation to reduce the impact to receptors that may be affected by the noise emissions from the site are detailed below.

11.3.1 Operating Hours

Operational hours for the site are governed by the planning consent which is current at the time of operation. The proposed operating hours are detailed in Section 4.4.

11.3.2 Building and Plant Design

Opening of doors is kept to a minimum and fast acting roller shutter doors are installed where appropriate.

Buildings were constructed to attenuate noise in line with the planning permission for the site.

11.3.3 Plant Selection

Quiet plant options were used wherever possible to ensure noise is kept to a minimum.

Plant and equipment are maintained regularly to minimise noise resulting from deterioration and inefficient operation. If any items of plant are found to give rise to unacceptable noise levels, consideration is given to their replacement with quieter designs. If equipment continues to generate unacceptable noise levels, consideration is given to modification to incorporate noise suppression equipment or replacement components.

11.3.4 Summary of Mitigation Measures

The cumulative noise assessment has shown that noise levels generated by the ERF could lead to a negligible increase of 0.1dB in the ambient noise levels at the nearest noise-sensitive properties to the application site. Such an increase would not be noticeable above the normal fluctuations in ambient noise levels in the area.

Based on the results of the assessment, further mitigation measures to reduce any potential noise impacts at the nearby noise-sensitive receptors were considered un-necessary.

11.3.5 Management Measures

The Plant manager is responsible for ensuring that nuisances arising from site noise are minimised. All site personnel are trained in the need to minimise site noise and are responsible for monitoring and reporting excessive noise when carrying out their everyday duties.

11.3.6 Noise Action Plan

In the event that noise is found to be causing a problem, action will be taken to determine the source and to take remedial actions as follows:

- shut down, replace, service or repair equipment to reduce noise levels; and
- modify plant to incorporate noise suppression equipment.

Records relating to the management and monitoring of noise are maintained and include:

- inspections undertaken;
- noise problems (including date, time, duration, prevailing weather conditions and cause of the problem);
- complaints received; and
- corrective action taken and changes to operational procedures to prevent future occurrences.

12.0 Control of Odour

The handling and processing of biodegradable wastes at the facility have the potential to generate odour. The activities that may potentially generate odour are summarised in Table 9.

An Odour Management Plan (OMP) was prepared in accordance with the EA H4 guidance note and was appended as Appendix H1_2 to the original BATOT submitted for the original EP application. Please refer to the OMP for a detailed account of odour sources and abatement technologies contained in the odour treatment equipment at the site. However, a short summary is given below.

12.1 Odour Sources

Table 12-1
Potential Odour Sources

Activity	Odour Risk	What equipment?
Delivering waste	High	Roller shutter doors
Storage of waste	High	Containment with negative air pressure
Vehicles parked on site	Medium	Vehicle wash
Removing recyclables from site	Low	None required
Surface water drainage	Low	Bulk tanker

12.2 Mitigation Measures

12.2.1 General Principles

Odour management at the ERF is based on the following principles:

- the facility is designed to be enclosed with reception and treatment occurring within the confines of the building;
- the building has been designed and constructed to minimise fugitive emissions; and
- the building heights have been minimised to control the total volume of air to be managed by the combustion process.

These general measures are supplemented by additional measures if deemed necessary to achieve effective odour control.

12.2.2 Controlling Odour from Wastes as Received

A variety of vehicles including RCV, RoRo and bulker enter the site and make their way to the tipping hall, through roller shutter doors, where waste is discharged inside the building onto a flat concrete apron and tipped directly into the waste reception bunker. The waste is subject to visual inspection as part of the waste reception protocols to ensure all wastes conform to the agreed Waste Acceptance Criteria (WAC).

Once waste is inside the reception hall, all waste handling and treatment activities take place inside the building which uses a combination of fast acting doors and process air ventilation to prevent fugitive release of odorous air to control and manage odours.

Vehicles entering the tipping hall do so through the fast-acting roller doors, which are closed prior to the vehicles unloading. The doors are capable of opening or closing fully in approximately 30 seconds.

The holding time of waste material stored prior to processing is a significant factor in a site's potential for odour generation. If incoming waste material is tipped in the ERF building and the operator identifies it as being particularly malodorous, it is isolated from other incoming material and then either reloaded into the original delivery vehicle, or immediately passed for processing.

12.2.3 Containment

It is essential that the integrity of the fabric of the main process building is maintained continuously, other than during periods of essential maintenance. The effective operation of fast acting roller doors are therefore checked routinely.

12.2.4 Tipping area - floor cleaning

The vehicles reverse into tipping bays where the waste is tipped directly into the bunker. However, there may, on occasion, where waste is tipped onto the floor for inspection prior to being put into the bunker. There may also be occasions where driver error leads to waste falling onto the floor of the tipping area.

Once a month within two weeks of the start of the calendar month a full clean and disinfect of the tipping floor takes place:

- The date is decided by Plant manager or assistant manager.
- The clean shall take place wherever possible at a weekend or in an evening.
- In the week leading up to a clean the Plant manager shall communicate this to the transport manager.

- The transport manager shall liaise closely with the Plant manager to arrange re-direction of waste to disposal sites and possible alternative tipping locations.
- Alternative tipping locations may be one of the company's other tipping locations or any other legal tipping destination; and
- NRW shall be informed of the date of the intended clean at least seven days before it is due to happen. If the clean is not going to be possible for any reason NRW will be notified immediately with an alternative date.

Odours can be created / disturbed during the clean. All doors are to be kept closed and odour monitoring (using standard internal and external procedures) to take place during a clean.

The air within the reception area building is managed through extraction into the boiler before release through the main stack. In this way negative pressure is maintained within the building and odours are completely oxidised.

12.2.5 Summary

There is no requirement for any further ('end of pipe') dedicated odour control system.

12.2.6 Management and Operational Techniques

The Plant manager is responsible for odour control and daily olfactory monitoring carried out at the site. This includes ensuring that suitable checks are in place for system integrity, ensuring that ventilation systems are fully operational and, where appropriate, carrying out olfactory monitoring. Records are maintained of odour emissions, odour complaints and remedial action taken.

In the event that odour is found to be causing a problem, as determined by off-site complaints or during routine on-site monitoring, the following actions will be taken:

- investigations by the Plant manager to establish the cause of the problem;
- appropriate actions to mitigate the problem; and
- NRW informed.

As detailed above please refer to the supporting Odour Management Plan submitted as Appendix H1_2 to the original BATOT submitted for the original EP application.

13.0 Control of point source emissions to air

13.1 Point Source Emissions

The combustion of waste gives rise to emissions of a number of pollutants which are abated to low concentrations and regulated under the IED. Emissions from the ERF are ducted through a single flue from one process line.

An air quality assessment which includes a detailed dispersion model was carried out in accordance with EA guidance and was appended as Appendix H1_1 to the original BATOT submitted as part of the original EP application. Please refer to the assessment for a detailed account of emission points, emission rates and abatement technologies provided. Also, as part of this permit variation application, additional air quality assessment has been conducted to assess the potential impacts of processing the additional tonnage, please refer to Section 6 of this variation application. Short summaries of the assessments are given below.

The specific pollutants associated with the different sources are detailed in Table 14. The locations of the point source emission points to air are detailed on Drawing 002 submitted as part of the original EP application.

Table 13-1
Emissions from Point Sources (as considered in the assessments)

Source	Pollutants
Main flue stack	Particulates, TOC, HCl, HF, SO_2, NOx, CO, Group 1, 2 and 3 metals, Dioxins and Furans

13.2 Mitigation Measures

Mitigation measures for the point source pollutants are 'designed in' to the source. For example, combustion pollutants in the flue gas are treated prior to being released through the elevated stack.

As detailed above please refer to the supporting air quality assessment submitted as Section 6 of this application, and the Acid Gas Abatement report and the NOx abatement report included as Appendix BATOT3 and BATOT4 to the original EP application.

14.0 Control of Dust and VOC

14.1 Dust Emissions

The handling and processing of wastes at the site have the potential to generate dust and bio-aerosols. However, due to the enclosed nature of the process and the mitigation measures employed, the need for a quantitative bio-aerosol risk assessment has been scoped out.

The operations that may potentially generate dust are summarised in Table 11.

Table 14-1
Potential Dust and Bio-aerosol Emissions

Process	Discharge	Frequency
Receipt and tipping of waste in the reception hall	Fugitive	During operational hours
Storage of waste	Fugitive	Continuous
Transport of IBA	Fugitive	Continuous
Storage of IBA	Fugitive	Continuous
Removal of APCR offsite	Fugitive	During operational hours

14.2 Mitigation Measures

14.2.1 Building design

The design of the buildings is based on the principles of containment, extraction and treatment in order to prevent the fugitive release of dust.

14.2.2 Housekeeping

Given the high degree of designed in mitigation in the form of containment of potential sources of dust and litter from the operations, there are limited sources of dust exposed to the ambient atmosphere, consequently the potential for fugitive release of dust is low.

Good housekeeping is implemented across the site in order to mitigate the potential for dust emissions, including the use of a road sweeper. Water bowsers are also used if appropriate. Hard surfaced areas including access roads are subject to a regular programme of cleaning.

The following mitigation measures have been designed into the ERF to control dust and litter:

- materials (waste, bottom ash) imported or exported from the site are transported in enclosed vehicles. Incoming waste vessels that are not fully enclosed are sheeted (or netted) to ensure no escape of waste materials during transit;
- incoming waste to the site is unloaded directly into the waste bunker inside the waste reception building;
- all vehicle movements take place on hard standing and a programme of periodic road sweeping/cleaning is in place;
- all storage and handling of Air Pollution Control (APC) materials, both raw and used, are undertaken within the building in enclosed vessels and silos, and transported from site in enclosed tankers; and
- the bottom ash from the incineration process is quenched and directed by covered conveyor to the bottom ash storage facility prior to export.

14.2.3 Volatile Organic Carbon Emissions

There are not significant fugitive emissions of VOCs because:

- hydrocarbon usage is minimal and such materials are fully contained;
- the combustion and flue gas treatment process is fully contained such that the emissions are restricted to the stack as described above;
- inspection and maintenance programmes ensure continued integrity of equipment;
- provision of standby plant ensures equipment bypass time is minimised; and
- a spillage action plan requires clean up as soon as possible.

15.0 Control of Emissions to Groundwater, Surface Water and Sewer

15.1 Point Source and Fugitive Emissions to Groundwater

The containment measures in place at the site are described in Section 6.3 and these ensure there are no point source or fugitive emissions to groundwater.

Accordingly, there are no direct or indirect discharges of contaminating materials into groundwater from the site.

15.2 Point Source Emissions to Surface Water

As detailed in Section 6.3 of this report, the only point source emission to surface water is clean run off from non-operational areas of the site. Surface water is captured, passes through an interceptor and held in an

attenuation tank prior to discharge to the surface water highway drainage system. All other potentially contaminated water is re-used in the process or tankered off site to a suitably licensed facility.

The design and containment measures of the facility ensure that there are no point source emissions of potentially polluting substances to surface water.

The discharge point from the site is shown on Drawing FCA/01A included in Section 4 of the original EP application.

15.3 Fugitive Emissions to Surface Water

As detailed in Section 6.3 of this report, the containment and management measures ensure there are no fugitive emissions of potentially polluting substances to surface water.

15.4 Point Source Emissions to Sewer

As detailed in Section 6.3 of this report, there is no discharge of process water to sewer.

15.5 Fugitive Emissions to Sewer

As detailed in Section 6.3 of this report, the design of the site ensures there are no fugitive emissions to sewer.

16.0 Control of Litter, Mud and Pests

16.1 Litter

In order to maintain the site in a tidy condition and prevent the escape of litter onto surrounding land the following measures are in place:

- the Plant manager and operatives inspect the site and surrounding area on a regular basis and collect any litter and return it to the main waste storage areas;
- fast shutting doors assist in the prevention of litter escaping the buildings;
- fencing which surrounds the site acts to prevent litter escaping from the site. If necessary, additional netting can be erected to reduce the escape of wind-blown litter; and
- litter arising from the activities is cleared from affected areas outside the site as soon as practicable.

16.2 Mud and Debris

In order to prevent the deposition or tracking of mud or debris from the site onto public areas and highways the following measures are in place:

- areas of concrete and hard standing are maintained free of significant quantities of mud and debris and free of standing water;
- all operational areas are subject to monitoring by staff throughout the working day to identify accumulations of mud requiring remedial action;
- where necessary road cleaning equipment is deployed to prevent the tracking of mud and debris onto the highway; and
- all waste / commercial vehicles leaving operational areas, before leaving the site, be cleaned as necessary and be checked to ensure that they are clear of loose waste and that any products being exported from the site are secure.

In the event that mud, debris or waste arising from the site is deposited onto public areas outside the site, the following remedial measures are implemented:

- the affected public areas outside the site are cleaned; and,
- traffic is isolated from sources of mud and debris within the site to prevent further tracking of mud and debris, and measures taken to clear any such sources as soon as practicable.

16.3 Pests

In order to prevent infestation by pests the following measures are in place:

- the site is inspected by both site management and operatives for infestations of pests, vermin and insects on a regular basis;
- in the event that specific waste is found to be responsible for attracting scavengers or pests, this waste will be removed from site as soon as practicable or within a maximum of 12 hours of receipt, or will be prioritised for processing; and
- a nominated sub-contractor for the control and monitoring of pests will be appointed.

17.0 Monitoring

The site is subject to a comprehensive programme of monitoring to ensure the site operates to the specified design standards and does not give rise to unacceptable environmental impact.

Monitoring comprises the following:

- general observations
- monitoring of infrastructure and equipment;
- monitoring of process variables; and
- emissions monitoring.

17.1 General Observations

As part of the day-to-day operations routine observations and monitoring are undertaken by site staff to ensure the site operates without causing unacceptable environmental impact.

Routine regular observations include qualitative assessment of noise, dust, litter, mud on the road and odour at the installation, the results of which are entered in the site log.

17.2 Monitoring of Infrastructure & Equipment

Infrastructure and equipment is subject to regular visual inspection. In the event of deterioration or damage, appropriate remedial action is taken to restore the infrastructure and equipment to a satisfactory condition.

17.3 Monitoring of Process Variables

Monitoring of process conditions and variables is discussed in Section 10.0.

17.4 Emissions Monitoring

17.4.1 Monitoring Emissions to Surface Water

The discharge of water from the site is detailed in Section 6.3. Monitoring is carried out on a regular basis and comprise visual inspection for oil and grease and in accordance with the conditions of the environmental permit.

17.4.2 Monitoring Emissions to Sewer

Not Applicable, as there are no discharges to sewer from waste management operations at the site.

17.4.3 Monitoring Emissions to Air

Emissions to air will be subject to a routine monitoring programme, as described below in Table 12 which summarises the BAT-AELs specified in the updated Waste Incineration BRef.

Table 17-1
BAT-AELs and Monitoring Programme

Pollutant	BAT-AELs (mg/m^3)	Reference Period	Proposed Monitoring Frequency
Particulate	< 2 - 5	Daily average	Continuous measurement
Total Volatile Organic Carbon (TVOC)	< 3 - 10		
Hydrogen Chloride (HCl)	< 2 – 8		
Hydrogen Fluoride (HF)	< 1	Daily average or average over the sampling period	Quarterly in first year, then bi-annual
Sulphur Dioxide (SO_2)	5 - 40	Daily average	Continuous measurement
Oxides of Nitrogen NO and NO_2 expressed as NO_2)	50 - 180		Continuous measurement
Carbon Monoxide (CO)	10 - 50		
Group 1 metals – Cd & Th and their compounds	0.005 – 0.02	Average over the sampling period	Quarterly in first year, then bi-annual
Mercury	< 5 - 20		
Group 3 metals – Sb, As, Pb, Cr, Co, Cu, Mn, Ni & V & their compounds (total)	0.01 – 0.3		
Dioxins / furans (I-TEQ)	< 0.0000001 – 0.0000006		
Ammonia	2 - 10	Daily average	Continuous measurement

17.5 Monitoring Standards & Techniques

Monitoring is undertaken in compliance with recognised techniques or using 'standard methods'. Monitoring equipment is calibrated, serviced and maintained in line with manufacturer recommendations.

17.5.1 Monitoring Stack Emissions

Prior to undertaking stack emissions monitoring a Site specific protocol (SSP) is prepared to ensure the monitoring is carried out in accordance with EA Technical Guidance Note M1, Sampling Requirements for Stack Emissions Monitoring and TGN M2 Monitoring of Stack Emissions to Air. Specifically the SSP considers the following aspects:

- selection of the sampling position, sampling plan and sampling points;
- access, facilities and services required; and
- safety considerations.

The SSP ensures that a representative sample is obtained from the stack.

The sampling approach, technique, method and equipment that are chosen ensure:

- a safe means of access to the sampling position;
- a means of entry for sampling equipment into the stack;
- adequate space for the equipment and personnel; and
- provision of essential services such as electricity.

17.6 Monitoring Action Plan

In the event that the monitoring programme identifies a potentially significant release the following actions are undertaken:

- the Plant manager is informed immediately;
- actions to isolate and contain the source of release are undertaken; and
- the causes of the release is evaluated, and where possible, procedures put in place to prevent a recurrence.

In the event that abnormal monitoring results are identified, the operations staff will inform the Plant manager and appropriate action is taken to reduce the process to normal operating conditions. An inspection of the treatment facility is undertaken to identify the cause and necessary remedial action is taken.

17.7 Management, Reporting and Training

All monitoring results are recorded and stored electronically. The Plant manager or his nominated deputy inspects the monitoring records monthly to ensure monitoring is being undertaken in accordance with procedures. Annually results will be examined as part of the site's management review.

Staff involved in sampling and monitoring are trained sufficiently to carry out the set procedures and are trained in the reporting requirements of the environmental permit.

18.0 Closure

18.1 Operations during the period of the Environmental Permit

The waste management and combustion operations at the site should not lead to a deterioration of the land by the introduction of any polluting substances due to the containment and control measures that are implemented to ensure the processes are contained within the appropriate structure / containers.

In the unlikely event of a potentially polluting incident, which impacts the site, the Plant manager records the details of the incident together with any further investigation or remediation work carried out. This ensures that there is a coherent record of the state of the site throughout the period of the permit.

18.2 Design of Site

Records are maintained of the location of facilities, services, and sub-surface structures. During any modifications or alterations on site, care is taken to update these records to ensure easy closure of the site.

Designs ensure that:

- underground tanks for the containment of potentially polluting liquids were avoided;
- there is provision for the draining and clean out of vessels and pipe work prior to dismantling; and
- materials used are recyclable, if practicable (having regard for operational and other environmental protection objectives).

All supporting equipment manuals and documentation is maintained in duplicate in hard copy ring binder and one electronic version of all documentation and manuals are maintained on CD and kept in the Site office.

18.3 Site Closure Plan

Definite closure occurs when the site stops accepting waste. Actions that will be taken at this point to avoid pollution risk and return the site to a satisfactory condition are set out below.

18.3.1 Communication

NRW will be informed in writing of the date of cessation of waste acceptance. This will enable NRW to inspect the site, approve the closure, and to agree the actions that will need to occur following closure.

18.3.2 Access & Security

Security provision will be audited to ensure that the Site is in a secure condition and that unauthorised access is avoided. Site security will be maintained through the use of perimeter fencing and lockable gates. Regular inspections of the fencing and gates will be carried out, and damage will be repaired as soon as practicable. If necessary temporary repairs will be implemented until permanent repairs can be carried out.

18.3.3 Restoration

Storage and treatment vessels and drainage systems will be drained and cleaned prior to dismantling, with all effluent and solid residues being contained and taken to an appropriate treatment or disposal facility. Substances will be removed in such a way as to protect land and groundwater from potentially harmful contents. Containers and other structures will be dismantled in such a way as to prevent pollution risk to the surrounding environment.

Assessment will be undertaken of the site to assess its condition relative to the initial site report. If operations at the site have resulted in deterioration of the land, these areas will be re-examined and returned to their original

state as defined by the initial site report. A final assessment report will be submitted to NRW with a permit surrender application.

19.0 Emissions

19.1 Emissions to Air

Operations at the Parc Adfer ERF site will give rise to emissions to air. These emissions comprise:

- point source emissions from the ERF (nitrogen dioxide (NOX), particulates (PM_{10}), sulphur dioxide (SO_2), carbon monoxide (CO), hydrogen chloride (HCl), organics (dioxins and furans), hydrogen fluoride (HF), group 1, 2 and 3 metals and ammonia;
- odours; and
- fugitive emissions of dust.

Full details on the nature of the emissions and relevant Guidance and Regulatory Standards (benchmarks) are provided in the air quality assessment (Appendix H1_1) provided as part of the original EP application and in Section 4 of this variation application. Management is set out in the Odour Management Plan and H1 Environmental Risk Assessment provided as part of the original EP application.

19.1.1 Greenhouse Gas Emissions

The assessment included as Appendix 1 estimates the global warming potential (GWP100) emissions as carbon dioxide equivalents (CO_2e) for the ERF in accordance with the EA Horizontal Guidance note, H1. Results are summarised in the Appendix.

19.2 Emissions to Water

The drainage arrangements are detailed in Section 6.3.

There are no potentially polluting emissions to groundwater due to the containment measures that are in place at the Site.

19.3 Emissions to Sewer

The Site does not discharge process water to sewer. Process water is re-used in the process and any excess taken off-Site by tanker to a suitably licensed facility for disposal.

20.0 Environmental Impact

20.1 Impact Assessments

A number of impact assessments were undertaken in support of the original EP application and this variation application to demonstrate that the operation of the site will not give rise to unacceptable impact on the environment.

The assessments carried out in line with current NRW and EA guidance are as follows;

- H1 environmental risk assessment Annex A, D, F, G and H (Section 8 of the original EP application);
- air quality dispersion modelling (Appendix H1_1) of the original EP application and Section 4 of this variation application;
- odour management plan (Appendix H1_2) of the original EP application;

- acid gas abatement review (Appendix BATOT3) of the original EP application;
- Global Warming Potential Assessment (Appendix 1) of this document;
- NOx Abatement Review (Appendix BATOT4) of the original EP application ; and
- Human Health Risk Review (Section 9) of the original EP application.

In addition as part of the original planning application a Flood Risk Assessment, Noise Assessment and Ecology Assessment were undertaken. These were also appended to the H1 document in the original EP application.

The conclusions of the assessment are summarised below.

20.1.1 H1 Environmental Risk Assessment

Qualitative risk assessment (Annex a) considered odour, noise, fugitive emissions, dust, releases to water, litter, mud, birds, vermin and insects, and potential for accidents and incidents. The assessment concluded that with the implementation of the risk management measures described above, potential hazards from the site are not likely to be significant.

20.1.2 Air Quality Dispersion Modelling

The Atmospheric Dispersion Modelling / AERA has quantified and assessed the potential air quality impacts associated with combustion emissions from the Installation operating at the Permit Variation Scenario (232ktpa) and based upon the application of BAT-AELs prescribed within Implementing Decision 2019/20207 to the Waste Incineration BREF8, using NRW approved techniques against published standards for the protection of human health and designated ecological sites.

The conclusions of the Atmospheric Dispersion Modelling / AERA are as follows:

- maximum ground level short-term PCs arising from the Permit Variation Scenario are <10% of the applied EAL for all considered pollutants / short-term averaging periods and, therefore, 'insignificant' in accordance with the AERA guidance. There are no predicted exceedences of any short-term standard. In comparison to the Existing Operational Scenario, the Permit Variation Scenario results in a reduction in maximum PCs;
- maximum ground level long-term PCs arising from the Permit Variation Scenario of PM (assessed as PM10 and PM2.5), HF, TOC (assessed as C6H6), Cd, Hg, Sb, Cr, Cr (VI), Cu, Pb, Mn, V and NH3 are <1% of the applied EAL and, therefore, 'insignificant' in accordance with the AERA guidance. Annual mean PCs of NO2, As and Ni are >1% of the applied EAL. However, in comparison to the Existing Operational Scenario, the Permit Variation Scenario results in a reduction in maximum PCs;
- maximum ground-level PCs arising from the Permit Variation Scenario to the NOx CLe at ecological receptors ER2 – ER4 and ER7 result in 'no likely significant effects (alone and in-combination)' (at SAC / SPA designations) and 'no likely damage' (at SSSI designations). Maximum ground-level PCs arising from the Permit Variation Scenario to the NOx CLe are >1% of the NOx CLe at ecological receptors ER1, ER5 and ER6;
- result in 'no adverse effect' (at SAC / SPA) designations and 'no significant pollution' (at SSSI designations). However, in comparison to the Existing Operational Scenario, the Permit Variation Scenario results in a reduction in maximum PCs;
- maximum ground-level PCs arising from the Permit Variation Scenario to the 24-hour mean NOx, annual mean NH3, annual mean SO2 and 24-hour mean HF CLes result in 'no likely significant effects (alone and in-combination)' (at SAC / SPA designations) and 'no likely damage' (at SSSI designations);

- maximum ground-level PCs arising from the Permit Variation Scenario to the nutrient nitrogen CLo are >1% of the applied 'Coastal stable dune grasslands - acid type' APIS relevant critical load class at ER1 and ER5. However, impacts for the existing operational site (200ktpa) are above 1% and were previously concluded by NRW to result in no significant effect. At all other ecological designations, the maximum ground-level PCs to the nutrient nitrogen CLo are <1% of the applied CLo and result in 'no likely significant effects (alone and in-combination)' (at SAC / SPA designations) and 'no likely damage' (at SSSI designations). Further, in comparison to the Existing Operational Scenario, the Permit Variation Scenario results in a reduction in maximum PCs; and
- maximum ground-level PCs arising from the Permit Variation Scenario to the acid CLo result in 'no likely significant effects (alone and in-combination)' (at SAC / SPA designations) and 'no likely damage' (at SSSI designations). Further, in comparison to the Existing Operational Scenario, the Permit Variation Scenario results in a reduction in maximum PCs.

20.1.3 Odour Management

The plan outlined the methods by which PAOL would systematically assess, minimise and prevent potentially odorous emissions from the site in accordance with the requirements of the Environmental Permit for the site. The OMP serves to aid the decision-making process on the choice of controls, general site design, and operational practice in line with current industry best practice.

20.1.4 Acid Gas Abatement Review

The report considered best available techniques for the treatment of acid gases and considered the impacts of various treatment options, along with some of the associated implementation costs. The review focussed on the use of a semi - dry method using water and dry lime as the reagent or dry abatement technologies using either hydrated lime or sodium bicarbonate as the reagent. The report provided a simple summary ranking of performance and costs.

20.1.5 Global Warming Potential Assessment

Global Warming Potential (GWP100) emissions as carbon dioxide equivalents (CO2e) are estimated for the proposed tonnage increase at the ERF in accordance with the Environment Agency's Horizontal Guidance Note, H1. Assessment uses the H1 screening tool, developed to support the H1 Guidance method.

The assessment indicates that when electrical energy generation and heat recovery are taken into account the proposed ERF does not have a significant negative impact on GWP and when fully operational as a CHP plant will have a positive benefit on GWP reduction.

20.1.6 NOx Abatement Review

The assessment was undertaken to establish best available technique for the treatment of NOx and the impacts of various treatment options were considered, along with associated implementation costs. The review focussed on the use of secondary measures including selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR), and the report provided a simple summary ranking of performance and costs.

Results suggested that SCR provides a small improvement in environmental terms but that costs are more significant and overall SNCR marginally provides the better cost-benefit. The differences between the use of either ammonia or urea for SNCR were marginal. It was concluded that SNCR represents BAT for the plant and it was recommended that this was adopted preferentially over SCR.

Both ammonia and urea reagent are considered to represent BAT. There is possibly a marginal advantage to the use of Urea as reagent – but differences are minor and the choice of reagent can depend on operational factors.

20.1.7 Human Health Risk Review

The findings of the assessment were that the predicted risks and hazards as a consequence of emissions from the ERF plant were all within limits for the protection of human health as defined by the Environment Agency, NRW or US-EPA.

This conclusion was considered robust on the basis of the worst-case approach adopted in the characterisation of emissions, the safety factors incorporated into the US-EPA HHRA Protocol, and the hypothetical worst case exposure scenario considered in the assessment.

20.1.8 Flood Risk Assessment

It was demonstrated that the site was unaffected by flooding and that design measures included provided appropriate mitigation against potential impacts both to water quality and flood risk to third party property. It was therefore duly presented that the site met the requirements of planning policy and guidance both at the National (TAN 15) and Local level; fulfilling the aspirations of the Flintshire UDP with regards flooding and environmental considerations relating to the water environment.

20.1.9 Noise Assessment

The cumulative noise assessment showed that noise levels generated by the ERF could lead to a negligible increase of 0.1dB in the ambient noise levels at the nearest noise-sensitive properties to the site. Such an increase would not be noticeable above the normal fluctuations in ambient noise levels in the area.

Based on the results of the assessment, further mitigation measures to reduce any potential noise impacts at the nearby noise-sensitive receptors were considered un-necessary.

20.1.10 Ecology Assessment

The ecological impact assessment found that no significant direct or indirect impacts to designated sites were anticipated as a result of the proposals. In particular, the integrity of the Dee Estuary Ramsar/SPA/SAC/SSSI was considered to be unaffected.

In the short term (three to five years from completion of landscaping) it was anticipated that the site would experience a lowered level of biodiversity, particularly with regard to the terrestrial invertebrate assemblage. This would be an adverse impact at the local level. However, with maturation of the landscaping and management to maintain the open mosaic habitats in the early successional stages (that would otherwise be lost); it was considered that in the long term the overall impact would be a significant positive impact at the local, and potentially district level.

This impact assessment concluded that on the basis of the information available, there will be no likely significant residual effects.

21.0 Information

21.1 Reporting and Notifications

All relevant notifications and submissions to NRW regarding the site are made in writing and quote the permit reference number and the name of the permit holder.

Records are maintained for at least six years, however in the case of off-site environmental effects, and matters which affect the condition of land and groundwater the records will be kept until permit surrender.

21.1.1 Changes in Technically Competent Persons

NRW will be informed in writing of any changes in the technically competent management of the site and the name of any incoming person together with evidence that such person has the required technical competence.

21.1.2 Waste Types and Quantities

A summary report of waste types and quantities accepted and removed from the site for each quarter, is submitted to the NRW within one month of the end of the quarter.

21.1.3 Relevant Convictions

NRW are notified of the following events:

- the operator being convicted of any relevant offence; and,
- any appeal against a conviction for a relevant offence and the results of such an appeal.

21.1.4 Notification of Change of Operator's or Holder's Details

NRW are notified of the following:

- any change in the operator's trading name, registered name or registered office address; and
- any steps taken with a view to the company going into administration, entering into a company voluntary arrangement or being wound up.

21.1.5 Adverse Effects

NRW are notified without delay following the detection of the following:

- any malfunction, breakdown or failure of equipment or techniques;
- any accident;
- fugitive emissions which have caused, is causing or may cause significant pollution; and,
- any significant adverse environmental and health effect.

22.0 Closure

This report has been prepared by SLR Consulting Limited with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of PAOL; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

APPENDIX 1

Greenhouse Gas Emissions and Global Warming Potential

1.0 INTRODUCTION

This document is part of the updated BATOT for the Parc Adfer Energy Recover Facility (ERF). The BATOT has been amended to reflect an increase in capacity of the ERF from 200ktpa to 232ktpa. The ERF is located at Deeside Industrial Park, Deeside, CH5 2LL. The National Grid Reference is SJ 312 718.

The ERF is a listed activity under Schedule 1 of The Environmental Permitting (England and Wales) (Amendment) Regulations 2013; Section 5.1 "Incineration & Co-incineration of Waste" and subject to the requirements of the Industrial Emissions Directive (IED).

The ERF is designed to be capable of processing 232,000 tonnes per annum (tpa) of residual municipal solid Waste (MSW) and commercial and industrial (C&I) Waste. The Design Point (DP) is 210,400tpa. The facility is expected to operate continuously for around 91% of the time (8000 hours/year).

The facility generates about 19.8MW_e of electricity, with around 17.5MW_e or more exported to the National Grid. The plant is enabled as a Combined Heat & Power (CHP) scheme with the capacity to export up to 10MW_{th} as steam or heat to an external user. In CHP mode exporting a typical 10MW_{th} as heat the facility is expected to generate 17.7MW_e & export 15.5MW_e of electricity.

The installation incorporates modern reliable and well understood technologies and is designed in accordance with the requirements of the IED and employing Best Available Techniques (BAT).

An environmental consideration is the emission of greenhouse gases - expressed as the global warming potential (GWP) based on a time horizon of 100 years (GWP100). Factors affecting GWP100 include:

- Choice of technology (landfill, compost, thermal, advanced thermal, etc.);
- Technology options (type of thermal treatment, energy recovery, abatement, etc.); and
- Operational efficiency of the process.

In this document GWP100 emissions are estimated in accordance with the Environment Agency's Horizontal Guidance Note, H1[8]. Assessment has used the H1 screening tool[9], developed to support the H1 Guidance method. H1 screening outputs are given in Appendix A.

Application documents, including the BAT statement (BATOT, August 2014), show how the relevant Sector Guidance Note S5.01 has been taken into account and describes: a) components selected to maximise in-process energy efficiency; b) process control systems to ensure that equipment operates as and when required, and; c) in-process measures to optimise plant efficiency.

These aspects are not considered further in this document.

Nitrogen oxide (NOx) emissions control using selective non-catalytic reduction (SNCR) can generate nitrous oxide (N_2O); a potent greenhouse gas with a global warming potential of 310 times that of carbon dioxide.

GWP from N_2O releases is discussed in Section 4.0.

[8] EA 2018. H1 Environmental Risk Assessment for Permits: Annex H Global Warming Potential
[9] EA H1 Screening Tool 2018.

2.0 OPTIONS AND GREENHOUSE GAS EMISSIONS

2.1 Sources

Error! Reference source not found. summarises the sources of greenhouse gas emissions.

The primary source of greenhouse gases is the combustion process. Additional burdens can include energy associated with construction materials, reagent supply, transport, etc.

Table 2-1
Summary of Greenhouse Gas Emission Sources

Emission	Source	Key Aspect
Direct	Combustion gases from the treatment of waste. Primarily as carbon dioxide CO_2.	Waste Import
Direct	Combustion gases from ancillary fuels to support combustion (start-up & shutdown, low temperature, etc.) or provide back-up for emergency generators, back-up boilers, fire pumps, site vehicle. Primarily as carbon dioxide CO_2.	Gasoil / Diesel
Indirect	Imported energy to supply ancillary aspects of the process for motors, fans, with offsite release of combustion gases. Primarily as carbon dioxide CO_2.	Electricity Import
Direct	Handling and use of substances including reagent losses or conversions during abatement. Generation of Nitrous oxide.	Conversion

2.2 Technology & Process Description

Options for waste treatment include those that recover energy and those that do not. Non-recovery options such as landfill release energy as methane (& CO_2) that is 21 times as potent a greenhouse gas as carbon dioxide. Recovery such as thermal treatment convert the potential methane to carbon dioxide, resulting in lower Greenhouse Gas (GHG) emission and recovering energy that would be generated elsewhere.

The ERF can process waste of varied composition across a wide range of calorific values (CV) between 6.5 MJ/kg and 13.0 MJ/kg. The design point (DP) net calorific value (NCV) of 8.5 MJ/kg is based on the Contract Waste composition and the expected Third-Party waste composition. The ERF is designed with an effective control system to regulate the flow of waste into the combustion chamber; maintaining the heat release at the desired level. When the NCV increases or reduces, the control system decreases or increases the waste feed rate to compensate for the changed NCV.

During normal operation, the ERF is intended to operate with a Waste thermal input of 68.40 MW_{th} (~29tph at NCV of 8.5MJ/kg). Contract waste is, however, subject to significant short-term fluctuations in NCV; changing the thermal loading on the plant and auxiliary equipment.

Full process monitoring and control is provided. The combustion rate is carefully monitored to ensure full fuel burn-out.

The control of combustion and heat recovery within the boiler is integrated to optimise combustion. Two auxiliary, fuel oil-fired support burners enable the temperature are to be maintained at all times to comply with

IED (former Waste Incineration Directive (WID)) requirements. For example, during start-up, shut down and abnormal operations such as feed chute blockage, to maintain process furnace temperatures within IED limits.

The boiler is designed for optimal flue gas flow conditions and with pre-heating for primary, secondary and tertiary air via a total air preheater. The total air pre-heater comprises a heat exchanger supplied with low pressure steam from the turbine. The air is normally supplied from the waste bunker and when not available (e.g. during maintenance), from the boiler house. If the NCV of the waste is too low, primary air can be pre-heated to dry the fuel on the grate. The primary air flow rate is variable across the grate zones and can be adjusted for optimum combustion for each individual grate zone.

Secondary and tertiary air is distributed to various zones in the combustion chamber. Tangential air nozzles create a swirl that homogenizes the flow of combustion flue gases with respect to temperature, velocity and composition and promotes:

- Improved burn-out of the flue gas;
- Uniform temperature profile across the combustion chamber;
- Reduced carbon monoxide (CO) concentrations;
- Temperature stability; minimizing risk of corrosion of unprotected heating surfaces;
- Improved burn-out of fly ash;
- Reduction in the amount of fly ash; and
- Reduction in the formation of dioxins.

Heating surfaces of the horizontal fourth, fifth and sixth pass (economiser) are automatically cleaned during combustion by mechanical rappers and soot blowers.

Selective Non-Catalytic Reduction (SNCR) reduces NOx by injecting urea into the furnace within the appropriate temperature range. Efficient NO_x reduction with low ammonia slip and low reagent consumption is achieved by managing the injection temperature, residence time and mixing with the flue gas.

Urea reacts with NO_x to form water (H_2O), nitrogen (N_2) and CO_2.

- $2\ (NH_2)_2CO + 4\ NO + O_2 \rightarrow 4\ N_2 + 4\ H_2O + 2\ CO_2$

Hydrated lime ($Ca(OH)_2$) and activated carbon is injected to absorb acid gases (SO_2, HCl), heavy metals, dioxins and furans. The contaminants are removed in bag house filters for dust removal. Filter bags are periodically cleaned (on-line) with pulses of compressed air.

The turbine is a proven design comprising a condensing steam turbine with controlled extraction.

Steam generated within the evaporator sections of the boiler and the boiler drum will be further heated in the super-heaters. Economiser sections of the boiler reduce the flue gas exit temperature to the optimum values required for the Flue Gas Treatment (FGT) process.

Steam exiting the turbine is condensed in the air-cooled condensers (ACC) before returning to the process. The ACC is designed with variable speed fans for low power consumption and low noise production. Condensate returns to the steam system and is preheated to be used as part of the feedwater. Feedwater and make-up water are treated and automatically dosed to maintain pH, remove oxygen and dissolved solids; with a small continual blowdown to maintain water quality.

Local Programmable Logic Controllers (PLC) interface with the main system PLC and are connected to a main control panel and operator stations. In the control room each Operator Station is provided with a visualisation software package to provide:

- process visualisation;

- operator checks/instruction during start-up; and
- measurement and calculated process parameters.

Other aspects include civils & building design to minimise the environmental impact and carbon footprint. Buildings are designed to incorporate best practice in the use of materials, energy efficiency, ease of maintenance and ultimately decommissioning.

The turbine hall is designed to be close to the boiler hall for efficiency; the shorter the distance between the boiler and the turbine the lower the energy losses. ACC is also located close to the boiler for efficiency reasons.

The ERF was subject to a detailed testing, commissioning and inspection programme. The site is managed within a recognised management system which has processes and procedures in place for managing:

- Non-conformance issues;
- Corrective actions;
- Inspection and testing;
- Subcontract control;
- Method statements;
- Materials handling and storage;
- Training; and
- Document control.

3.0 GWP FROM THERMAL TREATMENT & ENERGY RECOVERY

GWP100 as CO_2e is estimated and described from the use of the H1 software screening tool (Appendix A). Unless otherwise indicated values are carbon dioxide equivalents (CO_2e) and typically expressed as tonnes per annum (tpa).

In calculating the GWP of emissions H1 indicates that a carbon dioxide emission factor of zero should be used for renewable energy sources such as biomass or waste. More than 60% of the waste fraction is estimated to be biomass waste and therefore a conservative waste CO_2 emission factor of 0.12 is used (0.3 x (100-60%)). [Practical experience shows that an emission factor of 0.3 provides a reasonable estimate of CO_2 released from the combustion of MSW/C&I waste; but this value is used for comparative purposes only.]

Design Point values from the combustion diagram are used for thermal inputs from waste at 8.5MJ/kg.

Input values for electricity & auxiliary fuel have been obtained from the technology provider including the R1 estimation sheet. R1 gives typical mains electricity imports of 380MWh/y and auxiliary fuel oil 354,301 litres (~3,917 MWh/y).

Average outputs are used for electrical power generation and heat and assume replacement of public supply for electricity and fuel oil for heat.

3.1 Estimation of Thermal Treatment GWP Releases

The following tables reproduce the estimation given by H1 in Appendix A that provides extracts from the H1 software module 2 (energy consumption) and H1 section 3.11, GWP. [See notes at the end of this section.]

From Section 1.0 the plant is capable of generating around 19.8 MW_e as electricity and providing 10MW_{th} as heat and for the purposes of assessment these values are used:

- Table 3-1 (Electricity Export only Mode) is based on generating around 19.8MW_e as electricity with no heat export; and
- Table 3-2 (CHP Mode) is with the plant enabled as a Combined Heat & Power (CHP) scheme generating 17.7MW_e of electricity and exporting 10MW_{th} as heat.

Table 3-1 and Table 3-2 indicate values as follows:

- Total Emissions as CO_2 from installation: ~ 66,794 tonnes/year CO_2e.
- Savings from electricity export only: ~ -64,627 tonnes/year CO_2e.
- Savings from CHP: ~ -77,773 tonnes/year CO_2e.

Balance of CO_2e as follows: -

- Total - electricity export only mode: ~ 2,167 tonnes/year CO_2e.
- Total - savings from CHP mode: ~ -10,979 tonnes/year CO_2e.

Table 3-1
GWP100 – H1 Estimation from Thermal Treatment –Electricity Export only Mode

Energy Source	Release	MWh/yr	H1 Estimated CO_2e Release Tonnes	H1 Estimated CO_2e Saving Tonnes
Electricity from public supply	Indirect	380	151	
Fuel oil	Direct	3917	979	
Natural Gas	Direct	0	0	
Waste Energy Import Note 1	Direct	547,200	65,664	
Total CO_2e released			**66,794**	
Recovered Electrical Energy Note 2	Indirect	-158,400		-64,627
Replaced Diesel Generation Note 3	Direct	0		0
Total CO_2e saved				**-64,627**
Residual CO_2e Burden (Tonnes) Note 4			**2,167**	

H1 is modified to show energy inputs as positive values and with energy recovery (savings) as negative values.

Note 1 CO_2e values in () at a factor of 0.3 but omitted from total release estimate as H1 states waste has zero (0) GWP

Note 2. All electrical recovery.

Note 3. Heat recovery as gas oil.

Note 4. Excludes N_2O contributions as CO_2e. These are in addition (Section 4.0).

Table 3-2
GWP100 – H1 Estimation from Thermal Treatment - CHP Mode

Energy Source	Release	MWh/yr	H1 Estimated CO_2e Release Tonnes	H1 Estimated CO_2e Saving Tonnes
Electricity from public supply	Indirect	380	151	
Fuel oil	Direct	3917	979	
Natural Gas	Direct	0	0	
Waste Energy Import Note 1	Direct	547,200	65,664	
Total CO_2e released			**66,794**	
Recovered Electrical Energy Note 2	Indirect	-141,600		-57,773
Replaced Diesel Generation Note 3	Direct	-80,000		-20,000
Total CO_2e saved				**-77,773**
Residual CO_2e Burden (Tonnes) Note 4			**-10,979**	

H1 is modified to show energy inputs as positive values and with energy recovery (savings) as negative values.

Note 1 CO_2e values in () at a factor of 0.3 but omitted from total release estimate as H1 states waste has zero (0) GWP

Note 2. All electrical recovery.

Note 3. Heat recovery as gas oil

Note 4. Excludes N_2O contributions as CO_2e.

H1 does not provide criteria for the determination of GWP significance.

For comparison, government figures indicate that the UK is responsible for releasing around 700-800 million tpa CO_2, the average household is responsible for around 25 tpa CO_2 and a 1km stretch of motorway generates around 3,000 tpa as CO_2 [based on 70,000 vehicles per day at an average release rate of 120 g/km].

4.0 GWP FROM NITROUS OXIDE (NOx TREATMENT)

This section focuses on the potential for Nitrous Oxide, N_2O, to be generated during flue gas treatment (SNCR) for NOx abatement and the GWP100 of such releases.

4.1 GWP100 Assessment for N_2O

Energy inputs and greenhouse gas emissions (as CO_2) are used to enable contributions from N_2O to be comparatively assessed against the GWP of the whole plant.

Where appropriate conservative or 'worst-case' values have been used based on the continuous use of SNCR based on urea. H1 input values have been derived from:

- Emissions and flow rates from the application air quality modelling section;
- N_2O emission concentrations derived from BAT information as above; and
- Additional derived EALs and GWP inputs described below.

Appendix A (H1 Section 3.11) provides the GWP impacts screening. This compares N_2O contributions against the offset GWP for the whole plant. Results are also shown in the Appendix A graphic 'Global Warming - Substance Comparison'.

H1 normalises the global warming potential as 'carbon dioxide'. Results indicate that the total GWP100 contributions of nitrous oxide are around 5,514 tonnes/year (as CO_2e).

A biomass emission factor of zero for 60% of the waste gives a low overall CO_2e emission and therefore the N_2O contribution appears to be a moderate proportion of the overall GWP, being 7.6 % (5514 ÷ (66,794 + 5514) x 100).

N_2O contributions to GWP100:

- 5,514 tonnes/year (CO_2e); and
- 7.6% of total installation GWP.

However, actual total installation CO_2e release would normally be ~169,674 tonnes/year (164,160 for waste (547,200 x 0.3 emission factor) plus 5,514 N_2O contribution). In this instance nitrous oxide contributes around 3.2% to the total GWP100.

5.0 CONCLUSION

Global Warming Potential (GWP100) emissions as carbon dioxide equivalents (CO_2e) are estimated for the Parc Adfer ERF in accordance with the Environment Agency's Horizontal Guidance Note, H1. The assessment uses the H1 screening tool, developed to support the H1 Guidance method.

Energy use information has been obtained from the technology providers and supported by data from BREF notes and experience of similar projects elsewhere. Data includes GWP releases from the combustion technologies and fuel use and savings by recovering energy and reducing GWP from all sources.

Results are summarised in Table 5-1 below and are based on factors from the EA for various energy inputs and exports including waste biomass fraction. This includes releases as carbon dioxide equivalents (CO_2e) for all energy inputs (waste, auxiliary fuel oil, mains electricity) and exports as generated electricity and heat. The use of urea for Selective Non-Catalytic Reduction (SNCR) is likely to increased nitrous oxide (N_2O) releases that also has a CO_2e contribution.

Table 5-1
Summary of GWP as Releases of CO_2e

Aspect	GWP100 as CO_2e tonnes per year	
	Electricity Export Only Mode	CHP Mode
Combustion & Energy Inputs	66,794	
Energy Recovery (Saving)	-64,627	-77,773
N_2O release	5,514	
TOTAL	7,681	-5,464

H1 does not provide criteria for the determination of GWP significance.

For comparison, government figures indicate that the UK is responsible for releasing around 700-800 million tpa CO_2, the average household is responsible for around 25 tpa CO_2 and a 1km stretch of motorway generates around 3000 tpa as CO_2 [based on 70,000 vehicles per day at an average release rate of 120 g/km].

The assessment indicates that when electrical energy generation and heat recovery are taken into account the ERF does not have a significant negative impact on GWP and when fully operational as a CHP plant will have a positive benefit on GWP reduction.

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