FICHTNER
Consulting Engineers Limited

Redcar Energy Centre

Redcar Holdings Limited

EP Application Supporting Information

ENGINEERING CONSULTING

Document approval

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Contents

1 Introduction

Redcar Holdings Limited (Redcar Ltd) is developing the Redcar Energy Centre (REC) which will comprise a fuel preparation facility, Energy Recovery Facility (ERF) to incinerate incoming non-hazardous waste, and an IBA treatment/processing facility (IBA facility). REC will be located at the Redcar Bulk Terminal, approximately 4.5 km west of Redcar town centre and 8.5km northeast of Middlesbrough city centre.

This document and its appendices contain the supporting information for the application for an Environmental Permit (EP) for REC. They should be read in conjunction with the formal application forms. An overview of the waste treatment activities to be undertaken at REC is provided in section 1.4. Further information and detail on each component at REC is provided is provided in sections 2, 3 and 4, mostly in response to specific questions raised in the application forms.

1.1 The Applicant

Redcar Holdings Limited (Redcar Ltd) is a joint venture between investment company Low Carbon and waste management company PMAC Energy. The team brings together substantial expertise in the design, funding, construction and operation of energy assets in the UK.

Low Carbon is a renewable energy developer and investor. The Low Carbon waste portfolio currently consists of six UK assets at varying stages of development. The team has a multimillion investment fund, mandated to provide construction finance to renewable energy assets with the aim of providing low carbon electricity to the grid and heat to local offtakers.

PMAC Energy has a 25-year background in waste processing and procurement and is involved in moving waste fuel around the UK and Europe for energy recovery and recycling. PMAC Energy was the original promoter of the project before creating the SPV with Low Carbon.

1.2 The Site

REC will be located on approximately 10 hectares of land at the Redcar Bulk Terminal, approximately 4.5 km west of Redcar town centre and 8.5km northeast of Middlesbrough city centre. REC will be located at an approximate National Grid Reference of NZ 55890 26032, with the nearest postcode listed as TS10 5QW.

The site was previously heavily industrialised as it formed part of the former Teesside Steel Works (the Steel Works). The Redcar Bulk Terminal was a port used for the shipment of coal, coke and other bulk goods, and for importing iron ore.

The eastern boundary of the site is formed by coke ovens associated with the Steel Works, with a further area of the Steel Works located to the southeast of the site. The north and northeastern boundaries of the site are formed of a high earth bund, beyond which lies an area of sand dunes which are part of the Bran Sands. The western boundary of the site is not enclosed or marked but a further storage area of the Redcar Bulk Terminal and the Tees Estuary lies beyond it.

Access to REC will be via a series of internal access roads which serve the industrial area, with a link to the A1085 which provides a strategic access to Middlesbrough and beyond via the A19.

A site location plan and installation boundary drawing are presented in Appendix A.

1.3 The Activities

REC will consist of a combination of Schedule 1 installation activities (as defined in the Environmental Permitting Regulations) (EPR) and directly associated activities. The activities to be undertaken at the site include the following:

1. a fuel preparation facility to process incoming waste to produce a residual waste-derived fuel for treatment at the ERF or transfer off-site;
2. a twin-line Energy Recovery Facility (ERF) to recover energy from waste;
    a. generation of power for export to the National Grid and the potential to export heat;
    b. production of an inert bottom ash material that will be transferred to the on-site IBA facility (see below), or an off-site IBA processing facility;
    c. generation of an air pollution control residue that will be transferred off-site to a suitably licensed hazardous waste facility for disposal or recovery; and
3. an Incinerator Bottom Ash (IBA) Recycling facility (the IBA facility) which will process bottom ash from the ERF and imported IBA from other waste incineration facilities in the local area, as well as blending with other imported inert wastes delivered directly to the IBA facility to create a secondary aggregate, referred to as Incinerator Bottom Ash Aggregate (IBAA).

Each component of REC will be able to operate both independently, and in collaboration with each other. For example:

- The fuel preparation facility will send treated waste to the ERF for processing. There may also be some residual/reject waste transferred off-site for processing.
- The ERF can receive residual waste directly from the fuel preparation facility but also from off-site sources.
- The IBA Recycling Facility will process IBA directly from the ERF, but will also import IBA from off-site sources.

It is expected that incoming waste and raw materials will be received by road, but given the location of the site, there is also the potential to receive waste and materials via the rail and port infrastructure in the wider area. 'In' and 'out' weighbridges with a gatehouse will be located at the main access road serving REC. The layout of REC provides a one-way circulation around the site, with direct access to each of the waste treatment activities.

Table 1 lists the Schedule 1 and directly associated activities.

Table 1: Scheduled and directly associated activities

Type of Activity	Schedule 1 Activity	Description of Activity	Limits of specified activity
Installation	Section 5.1 Part A(1) (b)	Line 1 – The incineration of non-hazardous waste in a waste incineration plant with a capacity of 3 tonnes per hour or more	From receipt of waste to treatment and emission of exhaust gas and disposal of any residues arising, including operation of the materials recycling facility, and the storage and processing of incinerator bottom ash. Waste types for the ERF as specified in Table 8.

Type of Activity	Schedule 1 Activity	Description of Activity	Limits of specified activity
Installation	Section 5.1 Part A(1) (b)	Line 2 – The incineration of non-hazardous waste in a waste incineration plant with a capacity of 3 tonnes per hour or more	From receipt of waste to emission of exhaust gas and disposal of waste arising. From receipt of waste to treatment and emission of exhaust gas and disposal of any residues arising, including operation of the materials recycling facility, and the storage and processing of incinerator bottom ash. Waste types for the ERF as specified in Table 8.
Installation	Section 5.4 Part A(1) (b) (ii)	**D13:** Blending or mixing prior to submission to any of the operations numbered D1 to D12 **R1:** Use principally as a fuel or other means to generate energy **R3**: Recycling/reclamation of organic substances which are not used as solvents **R4**: Recycling/reclamation of metals and metal compounds **R5**: Recycling/reclamation of other inorganic materials	Treatment consisting of shredding, de-baling, and storage – for subsequent recovery in the ERF or transfer off-site for recovery or disposal. Waste types as specified in Table 3.
Installation	Section 5.4 Part A(1) (b) (iii)	**D13:** Blending or mixing prior to submission to any of the operations numbered D1 to D12 **R5**: Recycling/reclamation of other inorganic materials **R4**: Recycling/reclamation of metals and metal compounds	Treatment of non-hazardous incinerator bottom ash of the types listed in Table 17. The ash separation and screening process shall take place inside a building. The purpose of treatment is to improve ash quality in order to generate a material that has the potential for recovery (e.g. for use as a secondary aggregate material in road construction) and mechanically separate and collect the ferrous and non-ferrous metal fractions for further recycling.
Directly associated activities			
Directly Associated Activities		Energy generation	Generation of electrical power using a steam turbine, with electricity exported to the National Grid, and the potential

Type of Activity	Schedule 1 Activity	Description of Activity	Limits of specified activity
			to export heat to local heat users from energy recovered from the flue gases
Directly Associated Activities		A medium combustion plant comprising a diesel generator	For providing emergency electrical power to the plant in the event of supply interruption. Operation for no more than 50 hours per year for testing purposes (unless in emergency situations).
Directly Associated Activities		Surface water management	From collection of uncontaminated surface water drainage to the discharge to sewer.
Directly Associated Activities		**R13**: Storage of wastes pending any of the operations numbered R1 to R12 (excluding temporary storage, pending collection, on the site where it is produced) **D15:** Storage pending any of the operations numbered D1 to D14 (excluding temporary storage, pending collection, on the site where it is produced)	Secure storage of wastes listed in Table 17. The receipt, handling and storage of non-hazardous incinerator bottom ash of the types of waste listed in Table 17.
Directly Associated Activities		**R13**: Storage of wastes pending any of the operations numbered R1 to R12 (excluding temporary storage, pending collection, on the site where it is produced) **D15:** Storage pending any of the operations numbered D1 to D14 (excluding temporary storage, pending collection, on the site where it is produced)	Secure storage of wastes listed in Table 3. The receipt, handling and storage of the types of waste listed in Table 3.

1.4 REC

1.4.1 Fuel preparation facility

The fuel preparation facility will include the following key components: main building including storage bays and storage bunkers, process equipment (including moving floor feeder, conveyors, de-baler, shredder). Baled waste will be stored in concrete bays.

There will also be a tipping area within the building for reject material from the ERF.

1.4.1.1 Incoming materials – Fuel preparation facility

The fuel preparation facility will be capable of processing up to 200,000 tonnes per annum of non-hazardous waste, expected to be a mixture of municipal solid waste (MSW) and commercial and industrial (C&I) waste that has been pre-treated to remove recyclates prior to arriving at the fuel preparation facility in a baled form. Bulky waste will also be accepted for shredding. The purpose of the fuel preparation facility will be to process the incoming waste into a waste-derived fuel or Refuse Derived Fuel (RDF), which would be transferred for processing either within the adjacent ERF or off-site.

1.4.1.2 Process – Fuel preparation facility

The fuel preparation facility will use a de-baler (bale breaker), and a shredder for bulky waste, to process the waste into RDF.

Whilst it is subject to detailed design, the fuel preparation facility is expected to include the following process equipment:

- de-baler (bale breaker)
- shredder;
- walking floor feeder;
- storage bunker(s) and bay(s); and
- conveyor(s).

All process equipment will be located within the fully enclosed fuel preparation facility building. Roller shutter doors will be fitted to the fuel preparation facility building to allow HGVs access to import waste and export materials.

Further detail on waste processing is presented within section 2.2.4.

1.4.1.3 Storage – Fuel preparation facility

The layout of the fuel preparation facility will allow for a number of dedicated waste storage bays, constructed of reinforced concrete. The bays will stored baled waste and will have a maximum capacity of 450 m^3. At this stage, 6 bays of 450m^3 capacity are anticipated, although this is subject to detailed design. Assuming a density of 1,100 kg/m^3 for baled waste, this equates to approximately ~3,000 tonnes of baled material storage. Waste storage bays will have sufficient capacity to allow effective buffering between waste deliveries and processing. The waste storage bays will be segregated by fire walls and fitted with appropriate fire detection and prevention measures (such as temperature detectors, water cannons or a sprinkler system, etc).

There will also be a tipping area for reject material from the ERF to be stored prior to transfer off-site. The 'tipping area' for rejected material from the ERF will have a capacity of up to 450 m^3. Assuming a density of 350kg/m^3, this equates to approximately 157 tonnes of storage capacity.

It is proposed to provide the EA with a full summary of the storage arrangements (including capacities) for the fuel preparation facility via a pre-operational condition.

1.4.2 ERF

The main activities associated with the operation of the ERF will be the combustion of waste to raise steam and the generation of electricity in a steam turbine/generator, with the potential to export heat subject to commercial and economic viability.

The ERF will include the following key components/infrastructure:

- waste reception and storage areas;
- reagent and raw material tanks and silos;
- residue silos and storage areas (including wastewater storage facilities);
- water, fuel oil and air supply systems;
- two incineration lines;
- boilers;
- steam turbine/generator set;
- facilities for the treatment of exhaust or flue gases;
- flues with associated stack; and
- devices and systems for controlling combustion operations and recording and monitoring conditions.

In addition to the following ancillary equipment/infrastructure:

- offices, control room and staff welfare facilities;
- site fencing, security barriers, gates and landscaping;
- drainage infrastructure;
- lighting and CCTV;
- external hard standing areas for vehicle manoeuvring/parking;
- internal access roads and car parking;
- transformer and sub-station enclosure; and
- fire water tank and water treatment plant.

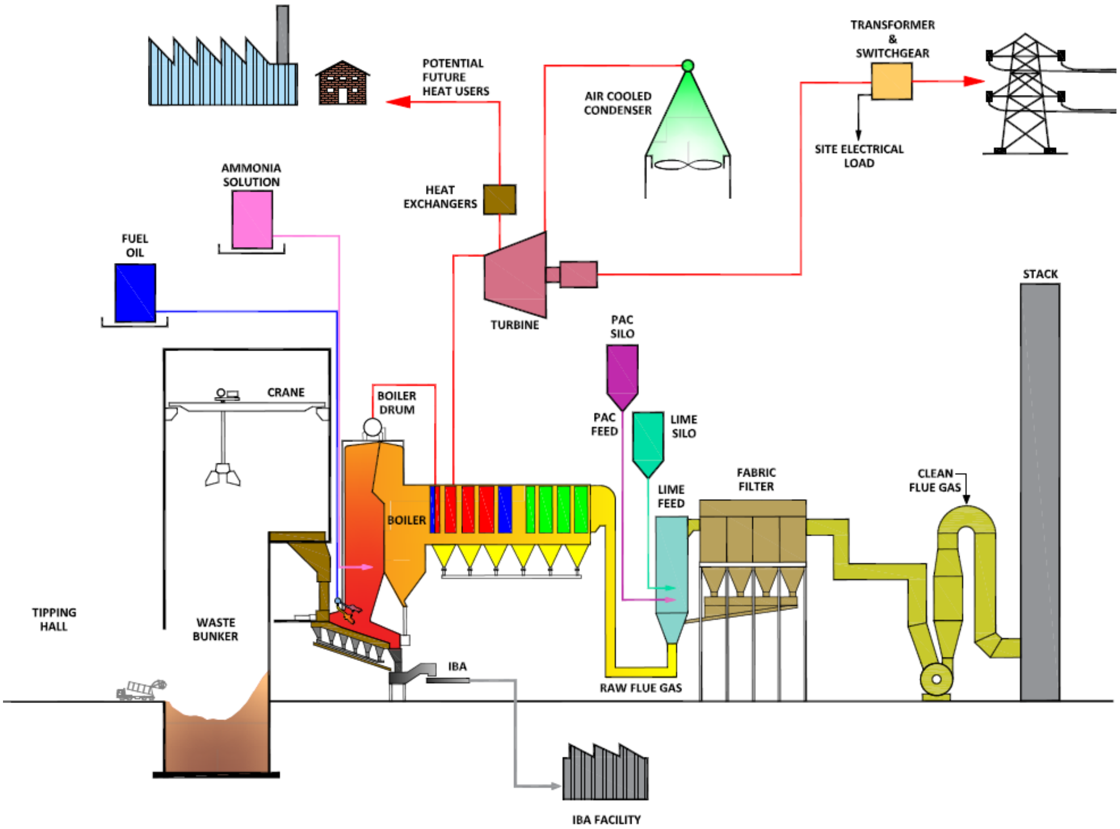
The ERF will be designed to process approximately 450,000 tonnes per annum of waste, based on a processing capacity of 28.1 tonnes per hour per line with a design NCV of 10.5 MJ/kg and an availability of 8,000 hours. However, the ERF will be capable of processing wastes with a range of NCVs, typically between 7.5 – 11 MJ/kg. It is expected that the maximum capacity of the ERF will be approximately 500,000 tonnes per annum of waste. A firing diagram for the ERF is presented within Appendix A.

The ERF will have an aggregated thermal input capacity (combined boiler capacity) of approximately 164 MWth. The ERF has been designed to export power to the National Grid. The ERF will generate up to approximately 49.9 MWe of electricity, with a parasitic load of approximately 5 MWe. Therefore, the export capacity of the ERF, with average ambient temperature, will be approximately 44.9 MWe.

The ERF will be constructed as 'CHP Ready' and will have the capacity to export approximately 10 MWth of heat. The CHP assessment (refer to Appendix G) has identified that there are opportunities to export an annual average load of approximately 10 MWth. The exact amount of heat exported will depend on the heat demand of the heat users/wider Teesworks development and will be subject to commercial agreements with heat users.

An indicative process diagram for the waste incineration process is presented in Figure 1 below. A larger copy is also included in Appendix A.

Figure 1: Indicative Schematic of the Waste Incineration Process



1.4.2.1 Raw materials – ERF

The ERF will receive deliveries of waste by road with the potential to also receive waste deliveries via rail or via the port. The ERF will also use consumables including lime, activated carbon, ammonia solution (or urea – subject to the detailed design of the facility), auxiliary fuel, water treatment chemicals and various maintenance materials (oils, greases, insulants, antifreezes, welding and firefighting gases etc).

Waste will be stored within a dedicated waste bunker. The waste bunker will have an equivalent storage capacity for up to 5 days continuous operation (approximately 18,000 m^3 or 6,300 tonnes). However, allowing for extended periods of shutdown, the maximum period of time that waste will be stored in the bunker is expected to be up to 4 weeks.

Consumables (lime, ammonia solution or urea, and activated carbon) are expected to be delivered to the ERF by road, with the potential for rail or port deliveries.

Further detail on the storage arrangements for reagents and raw materials at the ERF are presented in section 3.1.2.

1.4.2.2 Combustion process – ERF

The combustion process will utilise conventional moving grate technology which will agitate the fuel bed to promote a good burnout of the waste and a uniform heat release. The moving grate will enable the waste to be moved from the feed inlet along the grate to the ash discharge.

The furnaces will be designed to ensure that the exhaust gases are raised to a minimum temperature of 850°C, with a minimum of 2 seconds flue gas residence time at this temperature to ensure the destruction of dioxins, furans, PAHs and other organic compounds. An adequate air supply will also be maintained to give the correct volume of oxygen for optimum combustion. The main source of airflow will be controlled through the grates. Gas temperatures will be continually monitored and recorded. Audible and visible alarms will trigger in the control room, and the auxiliary burners will fire, if the temperature starts to fall towards 850°C The control system will regulate combustion conditions and control the boilers.

Primary combustion air will be drawn from the waste bunker area to maintain negative pressure in this area with the extracted air being fed into the combustion chambers beneath the grate to create turbulence and ensure complete combustion. Secondary combustion air will be injected into the flame body above the grate to create turbulence and facilitate the complete combustion of waste on the grates whilst minimising levels of oxides of nitrogen (NOx) emissions. Both primary and secondary air will be regulated by a combustion control system.

A NOx abatement reagent will be injected into the high temperature region of the boilers, as part of the SNCR de-NOx system. The reagent will react with the oxides of nitrogen formed in the combustion process forming water, carbon dioxide and nitrogen. By controlling the dosing rate of the reagent introduced into the gas stream, the concentration of NOx will be reduced to achieve the proposed emission limits.

The combustion chamber will be provided with auxiliary burners of a low NOx design, which will combust low sulphur fuel oil. The auxiliary burners will raise the combustion chamber temperature to the required 850°C prior to the feeding of waste. The auxiliary burners will typically operate for up to 16 hours during a start-up event and 2 hours during a shutdown event. It is anticipated that there will be less than 5 start-ups per year per line due to planned maintenance activities. There will be interlocks preventing the charging of waste until the temperature within the combustion chamber has reached 850°C. During normal operation, if the temperature falls below 850°C, the burners will be initiated to maintain the temperature above this minimum. Air flow for combustion is controlled by measuring excess oxygen content in the flue gas. This is set to maximise the efficiency of the heat recovery process while maintaining the combustion efficiency.

1.4.2.3 Energy recovery – ERF

The heat released by the combustion of the waste will be recovered by means of steam boilers, which are integral to the furnaces and will produce (in combination with superheaters) high pressure superheated steam at approximately 430°C and approximately 60 bar(a). As the ERF comprises a twin line system there will be two boilers working in parallel. The steam from the boilers will then feed a high-efficiency steam turbine which will generate, at the design point, approximately 49.9 MWe. The turbine will have a series of extractions at different pressures that will be used for preheating air and water in the water/steam cycle. The site electrical (parasitic) load will be approximately 5 MWe, assuming no heat is exported, resulting in approximately 44.9 MWe of power available for export at the design point.

The remainder of the steam left after the turbine will be condensed back to water to generate the pressure drop to drive the turbine. A fraction of the steam will condense at the exhaust of the turbine in the form of wet steam; however, the majority will be condensed and cooled using an air-cooled condenser. The condensed steam will be returned as condensate to the feedwater tank and from there again as feedwater to the closed-circuit pipework system to the boilers.

The ERF will have the capacity to export approximately 10 MWth of heat to local heat users (anticipated to be the wider Teesworks development). Dependent on the requirements of the heat users, either hot water or high-pressure steam could be exported. High-pressure steam could be extracted from the turbine and piped directly to the heat users. Alternatively, low-pressure steam exiting the turbine would pass through an onsite heat exchanger to heat up water for use in a heat network.

1.4.2.4 Flue gas treatment – ERF

The flue gas treatment system will consist of the following:

- selective non-catalytic reduction (SNCR);
- lime and activated carbon injection (dry system); and
- a fabric filter.

The abatement of oxides of nitrogen (NOx) will be achieved by careful control of combustion air and an SNCR system. An adequate supply of primary air will be maintained to give the correct volume of oxygen for optimum combustion. Oxygen will be monitored, alongside the temperature in the primary combustion chamber. The combustion control systems will maintain stable combustion conditions within the boiler; therefore, optimising the combustion process. In addition, the combustion chamber will be provided with low-NOx auxiliary burners which will be initiated if the temperature within the combustion chamber falls below the required levels.

The NOx abatement reagent will be injected into the high temperature region of the boilers to further reduce the amount of NOx in the gas stream. For the purposes of this application, it is assumed that the NOx abatement reagent will be ammonia solution. However, this is subject to detailed design, and it is proposed that an Improvement Condition is included within the EP requiring the Operator to confirm the NOx reagent following completion of detailed design. The NOx abatement reagent will be injected at the combustion chamber through a bank of nozzles installed at different places to provide flexibility of dosing, directly into the hot flue gases above the flame. The SNCR process will chemically reduce the NOx to nitrogen, carbon dioxide and water.

The temperature window at which the SNCR system operates will be selected based on the effectiveness of abatement – reactions will take place between 850 – 1,050°C; however, maximum efficiency will be achieved between 850 – 950°C. Secondary air will be preheated to help maintain a high temperature level in the secondary combustion zone, with the control systems maintaining the required temperatures within the secondary combustion zone. Secondary air injection is therefore optimised to ensure that the SNCR system is operating at optimal temperatures.

Lime and powdered activated carbon (PAC) will be injected into the flue gases in a reaction chamber upstream of the fabric filter in order to abate acidic gases, heavy metals and any remaining dioxins and furans. The lime will abate the emission of acidic components, including hydrogen fluoride, hydrogen chloride and sulphur dioxide, via neutralisation reactions. The activated carbon will abate emissions of volatile metals (mercury), organic compounds and dioxins and furans. The lime and activated carbon will be stored in separate silos adjacent to the FGT system, with the lime dosing rate controlled by upstream acid gas concentration measurements and proportioned to the volumetric flow rate of the flue gases. The lime and activated carbon dosing systems will have separate control systems for the injection into the flue gas stream, but they may be injected via the same injection points.

Following the injection of lime and activated carbon, the flue gas will then pass through a bag/fabric filter arrangement, which will remove the particulates, reaction products and unreacted reagent solids, collectively known as Air Pollution Control residues (APCr). The APCr cakes the outside of the filter bags with the units periodically cleaned by a reverse jet of air, displacing the filtered solids into chutes beneath and recycling them back into the flue gas stream or storing them in a silo. A proportion of the APCr will be recycled back into the flue gas stream to minimise the amount of fresh reagents required to be added. As fresh reagents are dosed into the acid gas abatement system, an equivalent amount of residue collected from the bag filters will be removed.

The bag filter arrangement will be divided into separate compartments to allow for maintenance. There will be online monitoring of the pressure drop within bag filter compartments to identify when there has been bag filter failure. If a pressure drop is identified, bag filter compartments will be isolated to prevent uncontrolled emissions and repaired before being brought back on-line. The plant would be capable of operating at full capacity with one compartment off-line whilst maintenance activities are being undertaken. Spare bags / plugs will be held on site and installed when a failure occurs.

Bag filters will be subject to regular preventative maintenance to assess wear and tear and will be replaced on a periodic basis to minimise the risk of failure.

The cleaned flue gas will be monitored for pollutants and discharged to atmosphere via two 90m stacks.

1.4.2.5 Emissions monitoring and stack – ERF

The cleaned flue gas will be monitored for pollutants and discharged to atmosphere via the stack.

A Continuous Emission Monitoring System (CEMS) will be installed to monitor concentrations of the following pollutants in the flue gas:

- particulates;
- sulphur dioxide;
- hydrogen chloride;
- carbon monoxide;
- nitrogen oxides;
- ammonia; and
- VOCs, expressed as total organic carbon.

In addition, periodic sampling and measurement will be carried out for:

- hydrogen fluoride;
- Group 3 heavy metals: antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), vanadium (V);
- cadmium (Cd) and thallium (Tl);
- mercury (Hg)[1];
- nitrous oxide;
- dioxins and furans;
- dioxin-like PCBs; and
- PAHs.

Periodic measurements will be carried out once every 6 months. In the first year of operation, monitoring may be carried out more frequently as required by the EP.

The Continuous Emission Monitoring System (CEMS) will be MCERTS approved. There will be a duty CEMS on each line and a stand-by CEMS capable of operating on either line. This will ensure that there is continuous monitoring data available even in the event of a problem with the duty CEMS.

[1] Subject to agreement with the Environment Agency.

1.4.3 IBA recycling facility

The IBA recycling facility will include the following key components: conveyor systems, storage/reception bunker, hopper, mechanical processing equipment (including vibrating screens, magnetic and eddy current separation), storage yard, containers for recovered metals. The IBA recycling facility will be capable of processing up to approximately 180,000 tonnes of IBA and other materials for blending each year, delivered from both the adjacent ERF and off-site sources.

1.4.3.1 Incoming materials – IBA facility

The quenched ash from the ERF will be transferred, via a conveyor system, to the IBA facility. The ash will be wet from quenching, minimising the potential for the release of dust emissions off site. IBA will also be transferred directly to the IBA facility from off-site sources.

1.4.3.2 Storage and processing – IBA facility

IBA from the ERF would be transferred by an enclosed conveyor to a bottom ash reception bunker, where it will be stored prior to being transferred to the process building. Any IBA delivered by road or port would be first weighed and then deposited into the bottom ash reception bunker. The storage period will take several weeks, where the moisture content will be adjusted to maximise metal extraction in the processing stages but also reduce dust emissions. The storage bunker will likely comprise several discrete bays, to allow this process to take place in batches.

IBA would then be transferred by conveyor from the reception bunker to the process building, where it will undergo mechanical processing to extract metals, separate out size fractions, etc.

Ferrous and non-ferrous metals would be extracted for further processing and reuse, and will be stored in containers prior to transfer off-site. Any unburnt material that is identified would be returned to the ERF for re-processing. Blending of the processed IBA material with other materials may be undertaken to improve the quality of the aggregate product.

The processed IBA material would be moved from the process building, by bucket loaders, into an external storage area. The external storage area would comprise a large concrete storage yard, surrounded by a high concrete wall which would serve as a push wall for the operation of the IBA facility. The storage period (expected to be between 2 – 4 weeks) would allow for pH stabilisation of the IBA via a series of naturally occurring chemical reactions (such as carbonisation and hydration) which will reduce the pH of the IBA and improve the material. The IBA would then be transferred off-site in covered vehicles as a secondary aggregate (IBAA) for use in the construction industry.

1.4.4 Site drainage

1.4.4.1 Surface water

Surface water run-off from buildings, roadways and areas of hardstanding will be discharged into the site surface water drainage system. The surface water drainage system will be fully separated from the process effluents to ensure that only uncontaminated surface water is discharged off-site. Surface water will be discharged to an attenuation pond located at the northwest of the site, prior to discharge to the River Tees. The attenuation pond will have a capacity of approximately 4,500m^3 – this has been designed in accordance with SUDS requirements. Oil interceptors would treat surface water prior to discharge off-site. There will be provisions in place for the isolation of the surface water drainage system (such as penstock valves) in the event of an emergency (e.g. a fire or significant spill).

It is expected that pipework for the surface water drainage system will generally be vitrified clay, with cast iron pipework when laid below or cast within foundations/building structures.

During construction and commissioning, quality assurance checks will be undertaken to prove the structural integrity of the surface water attenuation storage. This will minimise the potential for damage during operation of REC. Regular preventative maintenance as part of documented management systems at the site will ensure that the integrity of both the surface water attenuation storage and any penstock valves is maintained throughout the lifetime of REC. Preventative maintenance could include for periodically emptying drainage systems including tanks and/or attenuation systems, and undertaking visual inspections of the material from which they are constructed. Should it be identified that damage has occurred to the structures, repairs will be undertaken to ensure that integrity is suitably maintained.

In addition to the above, rainwater harvesting (i.e., collecting rainwater from building roofs and using this to 'top up' the process water demand, e.g., for the ash quench) would be examined during detailed design.

An indicative water flow diagram for the surface waters and domestic effluents at REC is presented in Figure 2.

1.4.4.2 Foul water

It is expected that foul water systems (domestic effluent) will discharge separately to foul sewer.

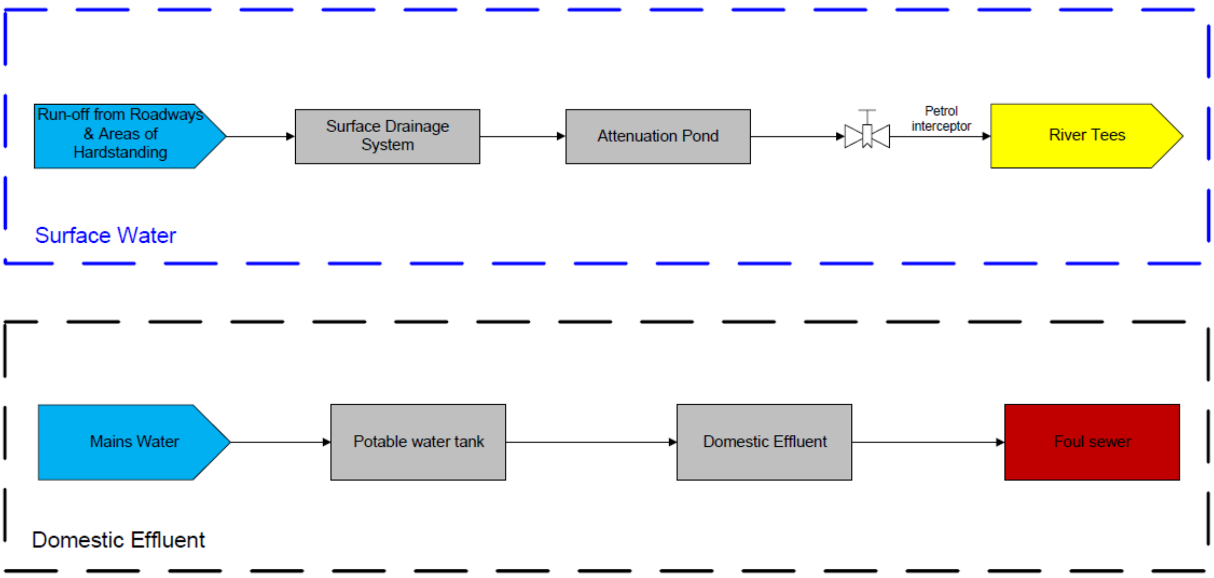


Figure 2: Indicative Water Flow Diagram - Surface Water and Domestic Effluents

1.4.4.3 Process effluents

Further details on process effluents for each component at REC are presented within sections 2.3.1.2, 3.3.1.2 and 4.3.1.2 for the fuel preparation facility, ERF and IBA facility respectively.

Process Drainage

The floor of the fuel preparation facility building will be concrete hardstanding and will include grated drains to collect process effluent. Process effluent would be directed to the ERF wastewater pit and re-used on site where possible, with any excess process effluent either tankered off-site for disposal or discharged to sewer in accordance with a Trade Effluent Consent.

During normal operation, the ERF will not give rise to process effluents and will be classified as a 'zero discharge' process. However, in the event that excess effluents are generated (such as during emptying of the boiler), these will either be tankered off-site for disposal or discharged to sewer in accordance with a Trade Effluent Consent.

With regards the IBA facility, the drainage from the external storage yard would be collected by a sealed drainage system and stored within a concrete settlement lagoon, before being re-used in the process. Any excess process effluents would be tankered off-site to a licensed facility for treatment.

Regular preventative maintenance as part of documented management systems at the site will ensure that integrity of drainage systems (including storage facilities) is maintained throughout the lifetime of REC. Preventative maintenance will include for periodically emptying pits/tanks and undertaking visual inspections of the concrete or other material from which the pit/tank is constructed. Should it be identified that damage has occurred to the structure, repairs will be undertaken to ensure that integrity is suitably maintained. These measures will ensure that liquids do not leak from the drainage pit and contaminate the underlying groundwater.

1.4.4.4 Contaminated firewater

In the event of a fire, contaminated water used for fighting fires will be collected through the site drainage systems. Although the site drainage systems are subject to detailed design, it is anticipated that the primary source of firewater containment will be the waste bunker at the ERF. Site drainage for external areas will be fitted with an isolation valve (e.g. at the exit to the site attenuation pond) to prevent the discharge of contaminated water from the surface water drainage system in the event of a fire. Sufficient storage capacity for external firewater will be available from both site kerbing and the attenuation storage.

Containment measures are outlined in further detail in the Fire Prevention Plan (Appendix H).

1.4.5 Ancillary operations

REC

Water for firefighting will be stored in a firewater storage tank(s) with a duty electric pump and standby diesel pump.

ERF

The ERF will require a top-up water supply of approximately 6.6 tonnes per hour – to be confirmed following detailed design of the Facility. The primary requirement of mains water is to maintain the water level in the boiler system (steam cycle) and cool down the boiler blow-down water. A water treatment plant will produce high quality demineralised make-up water for the boilers. Various chemicals would be required for the demineralisation process and for boiler water dosing.

Auxiliary burners, fired on low sulphur fuel oil, will support start up and shutdown operations at the ERF by raising the temperature of the furnaces during start up and maintaining required temperatures during shutdown periods.

An emergency diesel generator will be provided at the site to enable safe shut-down of the ERF in the event of a loss in grid connection. The diesel generator would only be expected to operate for short-term periods (i.e. <50 hours per year) for testing purposes. It is expected that the diesel generator will have a capacity of around 10 MWth. The use of an EDG will ensure that, in the case of a breakdown, operations are closed down as soon as practicable until normal operations can be restored.

The ERF will not have "black-start" capability. Black start capability would allow for start-up of the ERF without reliance on imported electricity from the local distribution network (i.e. in the event of a total loss in grid connection). A black start generator would be able to provide the full auxiliary load and hence the ERF would not need to be shut down in the event of a loss in grid connection. However, as indicated above, the ERF would not have this capability, and would hence require a shutdown (safely enabled by the diesel generator(s)) in the event of a loss in grid connection.

An alternating current (AC) uninterruptible power supply (UPS) will be provided for essential functions (such as the primary control systems) that require continuous electricity supply even for a very short period of time (such as the starting-up of the emergency diesel generators).

1.4.6 Emissions Points

The source of point source emissions from REC are presented in the table below. Non-regulated point source emissions include the emergency diesel generator exhaust and the diesel fire pump – these are used for emergency purposes only and should not be subject to any emission limits.

Table 2: Proposed emission points

Emission Point Reference	Source
Regulated	
A1	Air emissions stack – Line 1 ERF
A2	Air emissions stack – Line 2 ERF
W1	Surface water drainage to River Tees
S1	Process effluents to sewer (*location TBC*)
Non-regulated	
A3	EDG exhaust (*location TBC*)
A4	Diesel fire pump
A5	Diesel fire pump
S2	Domestic/foul effluent to foul sewer (*location TBC*)

The locations of A3, S1 and S2 are subject to the detailed design of the Facility (including detailed design of the drainage systems).

As such, the emissions point drawing in Appendix A may be updated to reflect the 'true' emissions points and any changes upon completion of detailed design of REC.

2 The fuel preparation facility

2.1 Raw Materials

The primary 'raw material' to be stored at the fuel preparation facility will be non-hazardous waste – refer to section 2.2 for further details on the quantities and storage arrangements.

Small quantities of maintenance materials will also be kept at the fuel preparation facility (oils, greases, insulants, antifreezes, welding and firefighting gases etc) for the operation and maintenance of plant and equipment on site. These will be supplied to standard specifications offered by main suppliers. All chemicals will be handled in accordance with COSHH Regulations as part of the quality assurance procedures and full product data sheets will be available on-site.

Should any liquid maintenance materials require storage at the site, these would be stored within bunded areas, with the secondary containment having a volume of 110% of the stored capacity. Any gas bottles used on-site will be kept secure in dedicated area(s).

Periodic reviews of all materials used will be made in the light of new products and developments. Any significant change of material, where it may have an impact on the environment, will not be made without firstly assessing the impact and seeking approval from the EA. A detailed inventory of raw materials used on-site will be maintained, and procedures implemented for the regular review of new developments in raw materials.

2.2 Incoming waste management

2.2.1 Waste to be processed in the fuel preparation facility

The fuel preparation facility will process incoming non-hazardous waste into a waste-derived fuel or RDF.. The European Waste Catalogue (EWC) codes for the waste to be accepted at the fuel preparation facility are presented in Table 3.

Table 3: Waste to be processed in the fuel preparation facility

EWC Code	Description of Waste
WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION AND PROCESSING	
02 01	**wastes from agriculture, horticulture, aquaculture,forestry, hunting and fishing**
02 01 03	plant-tissue waste
02 01 04	waste plastics (except packaging)
02 01 07	wastes from forestry
WASTES FROM WOOD PROCESSING AND THE PRODUCTION OF PANELS AND FURNITURE, PULP,PAPER AND CARDBOARD	
03 01	**wastes from wood processing and the production ofpanels and furniture**
03 01 01	waste bark and cork
03 01 05	sawdust, shavings, cuttings, wood, particle board and veneer otherthan those mentioned in 03 01 04
03 03	**wastes from pulp, paper and cardboard production and processing**

EWC Code	Description of Waste
03 03 01	waste bark and wood
03 03 08	wastes from sorting of paper and cardboard destined for recycling
WASTES FROM THE LEATHER, FUR AND TEXTILE INDUSTRIES	
04 02	**wastes from the textile industry**
04 02 09	wastes from composite materials (impregnated textile, elastomer,plastomer)
04 02 15	wastes from finishing other than those mentioned in 04 02 14
04 02 21	wastes from unprocessed textile fibres
04 02 22	wastes from processed textile fibres
WASTES FROM ORGANIC CHEMICAL PROCESSES	
07 02	**wastes from the MFSU of plastics, synthetic rubber and man-made fibres**
07 02 13	waste plastic
07 02 15	wastes from additives other than those mentioned in 07 02 14
07 02 17	wastes containing silicones other than those mentioned in 07 02 16
07 05	**wastes from the MFSU of pharmaceuticals**
07 05 14	solid wastes other than those mentioned in 07 05 13
WASTES FROM SHAPING AND PHYSICAL AND MECHANICAL SURFACE TREATMENT OF METALS AND PLASTICS	
12 01	**wastes from shaping and physical and mechanicalsurface treatment of metals and plastics**
12 01 05	plastics shavings and turnings
WASTE PACKAGING, ABSORBENTS, WIPING CLOTHS, FILTER MATERIALS AND PROTECTIVECLOTHING NOT OTHERWISE SPECIFIED	
15 01	**packaging (including separately collected municipal packaging waste)**
15 01 01	paper and cardboard packaging
15 01 02	plastic packaging
15 01 03	wooden packaging
15 01 04	metallic packaging
15 01 05	composite packaging
15 01 06	mixed packaging
15 01 07	glass packaging
15 01 09	textile packaging
15 02	**absorbents, filter materials, wiping cloths and protective clothing**
15 02 03	absorbents, filter materials, wiping cloths and protective clothingother than those mentioned in 15 02 02
WASTES NOT OTHERWISE SPECIFIED IN THE LIST	
16 01	**end-of-life vehicles from different means of transport (including off-road machinery) and wastes from dismantling of end-of-life vehicles and vehicle maintenance (except 13, 14, 16 06 and 16 08)**

EWC Code	Description of Waste
16 01 19	plastic
16 03	**off-specification batches and unused products**
16 03 04	inorganic wastes other than those mentioned in 16 03 03
17 02	**wood, glass and plastic**
17 02 01	wood
17 02 03	plastic
17 03	**bituminous mixtures, coal tar and tarred products**
17 03 02	bituminous mixtures other than those mentioned in 17 03 01
17 09	**other construction and demolition wastes**
17 09 04	mixed construction and demolition wastes other than thosementioned in 17 09 01, 17 09 02 and 17 09 03
WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE	
19 02	**wastes from physico/chemical treatments of waste (including dechromatation, decyanidation, neutralisation)**
19 02 03	premixed wastes composed only of non-hazardous wastes
19 02 10	combustible wastes other than those mentioned in 19 02 08 and 19 02 09
19 05	**wastes from aerobic treatment of solid wastes**
19 05 01	non-composted fraction of municipal and similar wastes
19 05 02	non-composted fraction of animal and vegetable waste
19 09	**wastes from the preparation of water intended for human consumption or water for industrial use**
19 09 01	solid waste from primary filtration and screenings
19 12	**wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified**
19 12 01	paper and cardboard
19 12 04	plastic and rubber
19 12 07	wood other than that mentioned in 19 12 06
19 12 08	textiles
19 12 10	combustible waste (refuse derived fuel)
19 12 12	other wastes (including mixtures of materials) from mechanicaltreatment of wastes other than those mentioned in 19 12 11
MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELYCOLLECTED FRACTIONS	
20 01	**separately collected fractions (except 15 01)**
20 01 01	paper and cardboard
20 01 10	clothes
20 01 11	textiles

EWC Code	Description of Waste
20 01 38	wood other than that mentioned in 20 01 37
20 01 39	plastics
20 03	**other municipal wastes**
20 03 01	mixed municipal waste
20 03 02	waste from markets
20 03 07	bulky waste

Checks will be made on paperwork accompanying each delivery in accordance with the documented waste pre-acceptance and acceptance procedures in place at the fuel preparation facility– refer to section 2.2.2.1. Waste which arrives at the fuel preparation facility which is not in accordance with the specifications listed above will be rejected and will not be accepted for processing at the fuel preparation facility.

2.2.2 Waste handling

2.2.2.1 Waste acceptance and pre-acceptance procedures

Documented procedures for pre-acceptance and acceptance of all wastes will be developed prior to the commencement of operation, in accordance with the documented management systems for the fuel preparation facility. This will ensure that only suitable waste is accepted for processing at the fuel preparation facility. Redcar Ltd would propose to provide the EA with a summary of the documented procedures prior to commencement of operation, as typically required for EPs of this nature.

Waste acceptance is broadly divided into two key stages:

- 'Stage 1' procedures undertaken prior to delivery of the waste to the site (waste pre-acceptance); and
- 'Stage 2' procedures undertaken upon delivery of waste to the site (waste acceptance).

The procedures and waste tracking system will be designed in accordance with the requirements of sector guidance note S5.06 and EA guidance '*Non-hazardous and inert waste: appropriate measures for permitted facilities*'.

Waste pre-acceptance

The waste pre-acceptance or 'screening' stage will involve the provision of information and representative samples of the waste, to allow Redcar Ltd to initially determine the suitably of the waste before arrangements are made to accept the waste at the site.

Contracts will be held with waste suppliers and also local authorities that will supply waste to the fuel preparation facility. The contracts will ensure that the waste suppliers provide the waste in accordance with the EWC codes listed within the EP.

For each new waste enquiry with a new waste supplier, a comprehensive characterisation of the waste will be undertaken. Verifications of written information provided by the waste producer will be undertaken, and a visit made to the waste producer if required. Representative samples of the waste will be undertaken to determine the composition, with any deviations from the initial characterisation of the waste fully investigated and justified. Samples will not be taken in the case that sampling and analysis has already been completed by a third party and Redcar Ltd has sufficient written information from them.

In addition to the above, Redcar Ltd would obtain information relating to the type of process producing the waste, the expected quantities of waste, the form the waste takes (solid/liquid etc), any obvious hazards and storage requirements. Following the overall characterisation of the waste, an assessment will be made of its suitability for processing at the fuel preparation facility.

With each waste enquiry, a record will be raised and given a unique reference number. Should the enquiry result in waste arriving at the fuel preparation facility, the reference number will 'follow' the waste during acceptance checks. Once the waste has entered the main waste processing stages at the fuel preparation facility, the tracking of individual waste loads will not be feasible.

Waste transfer notes or similar identifying documentation will accompany the waste deliveries to the site. The waste transfer note will typically contain information relating to the following aspects of the waste:

- waste composition;
- type and quantity of waste;
- contact details for waste carrier and identify of waste producer/collector;
- any handling requirements or particular hazards; and
- applicable EWC codes.

Should the accompanying transfer note not provide comprehensive and detailed information relating to the waste, the waste delivery will be rejected, and the waste carrier contacted.

Furthermore, should the transfer note identify the waste as being unacceptable for processing (i.e. not in accordance with the permitted wastes for the fuel preparation facility), the waste delivery will be rejected. Information taken during waste pre-acceptance checks will be recorded and retained at the site for cross referencing and verification at the second stage of waste acceptance. It is expected that records will be kept for a period of 3 years.

Regular audits will be undertaken of waste suppliers to ensure that only waste under the agreed specifications is delivered to the fuel preparation facility. This will include more detailed checks of the waste types produced and will ensure a representative analysis of the waste produced.

Waste acceptance

The second waste acceptance stage relates to acceptance procedures when the waste arrives at the site. The majority of waste characterisation work is undertaken during pre-acceptance checks (as outlined above), with the second stage of waste acceptance serving to confirm the characteristics and nature of the waste identified during pre-acceptance checks.

It is expected that a booking system will be implemented at the fuel preparation facility so that waste arrives during scheduled delivery slots. In addition to the pre-acceptance checks, this will minimise the time the delivery vehicle is kept waiting.

Upon arrival at the fuel preparation facility, the date and time of the receipt of waste will be recorded and the waste type/unique identification number confirmed. The accompanying waste transfer note (or similar documentation) will be reviewed to confirm the waste quantities, producer, EWC codes etc.

The waste delivery vehicle would be weighed at the weighbridge to confirm the quantity of the waste that is being delivered to the site. Procedures will be implemented on site for the periodic inspections of wastes at the weighbridge against the agreed specifications. This verification and compliance testing will serve to confirm identity of the waste, including consistency with pre-acceptance information.

Waste would not be accepted at the fuel preparation facility and will be rejected if sufficient storage/processing capacity is not available (for example if the waste processing equipment is not operational).

2.2.2.2 Receiving waste

Waste will be delivered to the fuel preparation facility in enclosed waste delivery vehicles. Once the delivery vehicle has undergone the relevant acceptance checks and weighing at the weighbridge, it will proceed to the main fuel preparation facility building. The waste reception and storage area within the main fuel preparation facility building will be enclosed.

Once within the main building, the waste delivery vehicles will deposit the waste in the main waste storage areas. The layout of the fuel preparation facility would comprise multiple concrete waste storage bays. Once a delivery has been made, road delivery vehicles exiting the site will then be weighed again upon exit in order to determine the mass of waste that has been delivered to the fuel preparation facility. It can be confirmed that waste deliveries will be supervised by suitably trained staff and will take place within areas covered by CCTV.

The fuel preparation facility building will be fitted with fast acting roller shutter doors, which will be kept closed when waste deliveries are not occurring. Routine waste inspections will take place within the quarantine area of the fuel preparation facility building. It can be confirmed that waste will be received, handled and stored within the main fuel preparation facility building, which will have impermeable hardstanding with contained drainage with links to the process drainage system. A high standard of housekeeping will be maintained in all areas and spill kits will be available in suitable locations. Should a significant spillage occur which has the potential to contaminate the surface water drainage system, an isolation valve will prohibit the release of any contaminated effluent off-site.

2.2.2.3 Unacceptable wastes

Redcar Ltd will have clear and unambiguous criteria set out for the rejection of wastes, alongside a written procedure for tracking and reporting non-compliance. This will include notification to the waste producer/customer, and in the unlikely event that the waste has already been accepted at the site for processing, notification to the EA.

'Unacceptable' wastes may include, but not be limited to, the following:

- liquids and slurries;
- hazardous waste;
- salts;
- explosives;
- radioactive wastes;
- fine dusty materials; and
- batteries.

The wastes listed above are not in accordance with the list of permitted wastes for the fuel preparation facility. Waste identified as unacceptable when reviewing the accompanying paperwork during acceptance checks will be immediately rejected from the site. In the unlikely event that unacceptable waste is accepted at the site, further measures will be in place for the segregation and subsequent transfer off-site of the waste, described below.

A clear policy will be in place for the subsequent storage and disposal of unacceptable wastes. The policy will include identification of any hazards posed by rejected wastes and labelling of rejected wastes with information necessary to allow proper storage and segregation. Records will be kept of unacceptable wastes to enable Redcar Ltd to contact the supplier to prevent reoccurrence. Clear and unambiguous criteria will be applied for the rejection of wastes together with a written procedure for tracking and reporting non-conformance, including notifying the waste supplier.

A dedicated quarantine area will be reserved for the storage of 'unacceptable' waste that has been identified once it has already been unloaded at the site, prior to transfer off-site. The quarantine area will be situated on impermeable hardstanding and will have contained drainage. It is expected that the quarantine area will be a discrete bay located in the 'tipping area' within the building for reject material from the ERF.

If technically feasible, non-permitted material will be removed to a suitably licensed facility within 7 days, unless otherwise agreed in writing with the EA. The non-permitted waste will be removed in accordance with Duty of Care requirements utilising properly completed transfer notes and registered waste carriers. Any hazardous wastes will be removed following the requirements of the current hazardous waste legislation.

In the unlikely event that non-compliant waste is unloaded into the processing equipment (conveyors, moving floor feeder, storage bunkers, de-baler or shredder) at the fuel preparation facility, the system will be halted, and the non-compliant waste removed and stored in the quarantine area prior to transfer off-site.

2.2.3 Waste storage

The layout of the fuel preparation facility will allow for a number of dedicated waste storage bays, constructed of reinforced concrete. At this stage, 6 bays of 450m^3 capacity are anticipated, although this is subject to detailed design. Assuming a density of 1,100 kg/m^3 for baled waste, this equates to approximately ~3,000 tonnes of baled material storage. Waste storage bays will have sufficient holding capacity to allow effective buffering between waste deliveries and processing rates. The bays will be segregated by fire walls and will be fitted with appropriate fire detection and prevention measures (such as temperature detectors, water cannons or a sprinkler system, etc).

The 'tipping area' for rejected material from the ERF will have a capacity of up to 450 m^3. Assuming a density of 350kg/m^3, this equates to approximately 157 tonnes of storage capacity.

It is proposed to provide the EA with a full summary of the storage arrangements (including capacities) at the fuel preparation facility via a pre-operational condition.

'Older' waste would be prioritised first for waste processing, to reduce fire and odour risks from the storage of waste. Frequent visual checks will also be undertaken of waste storage areas, to ensure that any incompatible wastes are easily identified and removed. Regular washdown of waste storage areas will be undertaken, with drainage contained with links to the process drainage system.

As described in section 2.2.2.3, there will also be a dedicated quarantine area set aside for the storage of 'unacceptable' waste.

Regular preventative maintenance as part of documented management systems at the site will ensure that the integrity of the waste storage areas is maintained throughout the lifetime of the fuel preparation facility. Preventative maintenance will include for periodically emptying the storage bays and undertaking visual inspections of the concrete from which they are constructed. Should it be identified that damage has occurred to the structure(s), repairs will be undertaken to ensure that integrity is suitably maintained. These measures will ensure that liquids (such as leachates from waste) do not leak and contaminate the underlying groundwater. In addition, a high standard of housekeeping will be maintained in all areas and spill kits will be available in suitable locations.

2.2.4 Waste processing

Incoming waste will be processed promptly upon receipt, resulting in relatively short retention times for incoming waste stored at the fuel preparation facility.

From the waste storage bays, the baled waste will be loaded into the bale breaker using a wheeled loader. Once de-baled, the 'liberated' material will be held in an intermediate storage bunker prior to loading into a moving floor feeder using a wheeled loader. The moving floor feeder will feed into a bridge conveyor system, which will transfer the fuel to the adjacent ERF for processing.

Bulky waste received would be fed into a stand-alone shredder. Shredded waste would be held in an intermediate storage bunker prior to loading into a moving floor feeder using a wheeled loader. The moving floor feeder will feed into a bridge conveyor system, which will transfer the fuel to the adjacent ERF for processing.

Should waste be identified which is deemed unsuitable for processing or subsequent recovery in the ERF, this will be transferred to a dedicated quarantine area prior to transport off-site to a suitably licensed waste management facility. Where feasible, incoming waste unsuitable for processing in the fuel preparation facility will be identified and extracted by operatives.

An indicative process flow diagram is presented within Appendix A which sets out the waste processing stages described above.

2.3 Water Use

2.3.1 Overview

The main use of water at the fuel preparation facility will be washdown water to clean the waste storage and handling areas within the main fuel preparation facility building.

- The water system will be designed with two key objectives:
  - minimal process water discharge; and
  - minimal consumption of potable water.
- Where practicable, waste waters generated from the process will be reused/recycled within the process, for example in the ash quench system at the ERF.
- In the event that excess process effluents at the site are generated, these will either be tankered off-site to a suitably licensed waste management facility or discharged to sewer in accordance with a Trade Effluent Consent – to be confirmed.
- Surface water from external areas of hardstanding and roadways will be discharged into the on-site surface water attenuation pond. Oil interceptors would treat surface water prior to discharge off-site to the River Tees.
- Firewater will be provided by an on-site water tank(s) connected to the mains water supply.
- The site will have separate process water, foul water and surface water systems.

2.3.1.1 Potable and Amenity Water

Water for drinking supplies for the offices and welfare facilities will come from a potable water supply. The quantity of this water is expected to be small compared to the other water uses on site.

Foul and domestic effluents from showers, toilets, and other mess facilities will be discharged to foul sewer.

2.3.1.2 Process Water

The primary source of process effluents at the fuel preparation facility will be washdown from waste storage and handling areas. These may introduce the potential for a wide variety of contaminants. Process effluents will be recycled (for example, washdown water from the fuel preparation facility would be directed to the 'dirty water pit' at the ERF and subsequently used in the ash quench).

An indicative water flow diagram for process water at the fuel preparation facility is presented in Figure 3 below, with indicative drainage diagrams for overall surface water and domestic effluent management at REC presented in section 1.4.4. Larger versions of these drawings are included within Appendix A.

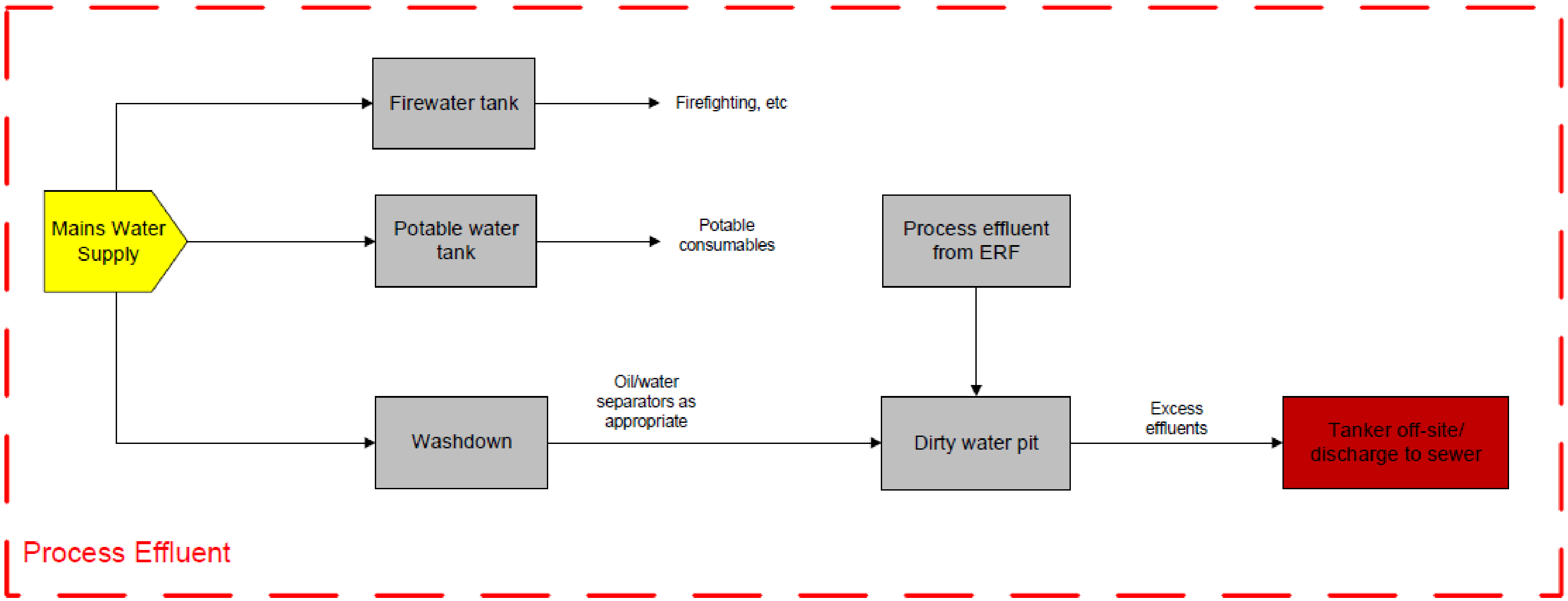


Figure 3: Indicative water flow diagram – process water – fuel preparation facility

2.4 Emissions

A consolidated table detailing the proposed emissions points at the site is presented in section 1.4.6.

2.4.1 Point source emissions to air

It is not anticipated that the operation of the fuel preparation facility will lead to any point source emissions to air in addition to those described within section 1.4.6 for the ERF.

2.4.2 Fugitive emissions to air

2.4.2.1 Waste handling and storage

Fugitive emissions of dust and litter have the potential to occur during waste unloading, processing and storage operations, however these will be minimised wherever possible. Waste reception, handling and storage at the fuel preparation facility will be undertaken in an enclosed building, to prevent the release of litter and dusts. Fast-acting roller shutter doors will be in place at the entrance to the main fuel preparation facility building. Good housekeeping will also be employed at the fuel preparation facility to minimise the build up of dust and litter (such as regular washdown activities).

Mobile plant and vehicle operators at the site will be provided with suitable training for the equipment they are operating. Supervision of mobile plant operation and regular site inspections will ensure that any leaks, trailing or tracking of residues from vehicles are quickly identified and suitably addressed. During prolonged periods of dry weather, the site roads would be damped down / washed if the potential for fugitive dust impacts resulting from traffic movements are identified by the site 'general manager'.

In addition to those measures outlined above for the prevention and reduction of fugitive emissions to air of dust and litter, the speed of vehicles on-site will also be limited to further reduce dust emissions.

The measures described above are considered to provide sufficient dust control at the fuel preparation facility and it is not considered that additional dust suppression measures will be required. In the unlikely event that dust poses a significant problem during the operational phase of the fuel preparation facility, the use of dust suppression equipment (such as misting sprays) will be re-examined and will be employed if required, subject to agreement with the EA.

2.4.3 Point source emissions to water and sewer

Further detail on the site drainage is presented within section 1.4.4. However, the following provides a summary of the proposed containment and drainage measures at the fuel preparation facility.

During normal operations, process effluents from the fuel preparation facility (such as washdown water) will be reused within the site (e.g., for the ash quench at the ERF). In the event that excess process effluents are generated, these will either be tankered off site or discharged to sewer in accordance with a Trade Effluent Consent – to be confirmed.

Waste handling will be undertaken on areas of hardstanding with contained drainage. In addition, waste handling will be undertaken within an enclosed building. These measures will prevent the release of any process water from the fuel preparation facility to the site surface water drainage system.

Surface water run-off from buildings, roadways and external areas of hardstanding will be discharged into the surface water drainage system. The surface water drainage system will drain surface water into attenuation storage prior to discharge to the River Tees via petrol interceptors. In the case of a fire or a significant spill occurring at the site, an isolation valve will prohibit the discharge of contaminated effluent off-site.

It is proposed to discharge foul effluents from domestic facilities to sewer.

2.4.4 Contaminated water

Waste unloading and processing will take place within the main fuel preparation facility building, which will have impermeable hardstanding and contained process drainage. As described in section 2.1, any chemicals or oils/lubricants used for maintenance activities will be stored in bunded areas, with liquid chemicals having secondary containment capacity to contain whichever is the greater of 110% of the tank capacity or 25% of the total volume of materials being stored, in case of failure of the storage systems.

In the unlikely event of a spillage or leak that has the potential to cause environmental harm, site management will be informed and the event recorded in accordance with the documented management systems for the site. The relevant regulatory authorities (Environment Agency / Health and Safety Executive) will be informed if required (i.e. if the spillage or leak is significant) in accordance with management procedures. The effectiveness of the emergency response procedures will be subject to management review and will be revised and updated as appropriate following any major spillages.

Spill kits will be located at easily accessible locations. A site drainage plan, including the location of process and surface water drainage, will be made available on-site following completion of detailed design.

2.4.5 Noise

Further details on noise impacts and noise mitigation at REC are presented in the noise assessment – refer to Appendix C.

2.4.6 Odour

The storage and handling of waste is considered to have potential to give rise to odour. The fuel preparation facility will be designed in accordance with the requirements of EA Guidance Note H4: Odour. The fuel preparation facility will include a number of controls to minimise odour during operations – such as all waste processing being undertaken within the main building, and roller shutter doors to the building being kept shut unless waste deliveries are occurring.

An Odour Management Plan for the fuel preparation facility has been developed (refer to Appendix J), which provides further detail on the odour prevention, reduction and mitigation measures proposed for the fuel preparation facility.

2.5 Monitoring Methods

2.5.1 Emissions monitoring

2.5.1.1 Monitoring emissions to air

As stated within section 2.4.1, it is not anticipated that the operation of the fuel preparation facility will lead to any point source emissions to air in addition to those described within section 1.4.6 for the ERF.

2.5.1.2 Monitoring emissions to water and sewer

Under normal operation, there will be no emissions of process effluent from the fuel preparation facility. Process effluents, such as washdown water, would be directed to the ERF wastewater pit for reuse in the process. In the unlikely event that excess process effluents are generated, it is intended to tanker these off-site for treatment at a suitably licensed waste management facility or discharge these to sewer in accordance with a Trade Effluent Consent, with any monitoring of process effluents undertaken in accordance with the requirements of the Sewerage Undertaker.

It is not proposed to undertake monitoring of uncontaminated surface water from the site.

Foul/domestic effluent from welfare facilities would be discharged to foul sewer in accordance with a Trade Effluent Consent, with any monitoring undertaken in accordance with the requirements of the Sewerage Undertaker.

2.5.2 Monitoring of process variables

It is expected that the following process variables would be monitored at the fuel preparation facility:

1. Waste throughput will be recorded to enable comparison with the design throughput. As a minimum, daily and annual throughput will be recorded.
2. Water use will be monitored and recorded regularly to help highlight any abnormal usage. This will be achieved by monitoring the incoming water supplies.
3. Electricity consumption will be monitored to highlight any abnormal usage. Annual reports of process variables (such as water and electricity consumption) will be submitted to the EA in accordance with the requirements of the EP.

2.6 The Legislative Framework

Appropriate measures will be taken to ensure that the waste hierarchy (in accordance with Article 4 of the Waste Framework Directive) is applied to the generation of waste as a result of activities undertaken at the fuel preparation facility. Waste derived fuel following processing at the fuel preparation facility will be transferred to the ERF for recovery, meaning that it avoids disposal.

The requirements of sector guidance note S5.06 and also the recently published EA guidance '*Non-hazardous and inert waste: appropriate measures for permitted facilities*' have been taken into consideration for the design and operation of the Facility, with sections 2.2 and 2.4 (and the environmental assessments presented within the Appendices to this report) providing further detail on measures in place at the site to reduce pollution.

An additional requirement introduced by EA guidance '*Non-hazardous and inert waste: appropriate measures for permitted facilities*' was that the potential impacts of climate change should be considered when selecting a site. Accordingly, a climate change risk assessment has been undertaken and is presented with the supporting Application Forms to this application. Furthermore, the guidance states that access doors on buildings should be opposite to sensitive receptors where possible. Due to the industrial setting of the site, and lack of sensitive receptors in the surrounding area, it is considered that this requirement does not apply to REC. Finally, the guidance describes how a contingency plan or similar must be implemented to allow for periods of shutdown and maintenance. It can be confirmed that documented procedures as part of the site management systems will allow for contingency measures during periods of shutdown, including the following;

- continued compliance with permit limits;
- procedures to stop accepting waste until the site has restarted or has the capacity to process the waste;
- knowledge and co-ordination where possible of planned shutdowns at the different facilities at REC; and
- consideration of whether facilities that waste may be redirected to in periods of shutdown can take waste at short notice/are authorised to do so.

Contingency measures will also be in place for waste treatment equipment (such as the shredder at the fuel preparation facility) Spare parts will be kept on site as appropriate, and regular preventative maintenance will be undertaken.

Other than the requirements described above, the majority of the guidance includes for the same measures as described in S5.06. It can be confirmed that the operation of the Facility will be undertaken in accordance with the requirements of both EA guidance notes.

2.6.1 Requirements of the Waste Treatment Industries BREF

The Waste Treatment Industries BREF (referred to as the Waste Treatment BREF) was published on 10 August 2018. As some of the waste will undergo shredding at the fuel preparation facility, some of the legislative requirements of the Waste Treatment Industries (WTI) BREF will apply to the fuel preparation facility. A review of the relevant BAT conclusions listed within the WTI BREF has been undertaken and is presented in Table 4 below.

Table 4: Requirements of the Waste Treatment BREF – fuel preparation facility

#	BAT Requirement	How met or reference
1	In order to improve the overall environmental performance, BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the features as set out in the BREF. The scope (e.g. level of detail) and nature of the EMS (e.g. standardised or non-standardised) will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have (determined also by the type and amount of wastes processed).	As detailed within section 5.1, Redcar Ltd will develop an EMS certified to the ISO 14001 standard for the operation of REC. Therefore, the site (including the fuel preparation facility) will be operated in accordance with an EMS as required by BAT 1.
2	In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques set out in the BREF.	Redcar Ltd can confirm that the EMS will include for applicable techniques set out in the BREF. This will include, but not be limited to the following: • Waste characterisation and pre-acceptance procedures; • Waste acceptance procedures; • Waste tracking / inventory procedures; and • Waste segregation procedures. Redcar Ltd proposes that the EP includes an Improvement Condition which requires details of the management systems to be provided to the EA prior to the commencement of operation. This will ensure that the fuel preparation facility (and the rest of the site) is operated in accordance with the requirements of BAT 2.
3	In order to facilitate the reduction of emissions to water and air, BAT is to establish and to maintain an inventory of wastewater and waste gas streams, as part of the environmental management system (see BAT 1), that incorporates all of the features set out in the BREF.	The operation of the fuel preparation facility will not result in any point source emissions to air. Wastewater streams will be described in the site EMS (for example, via the incorporation of site drainage diagrams and water balances). The only stream discharged to surface water will be uncontaminated surface water from the site. Process effluents (such as washdown) will be directed to the ERF wastewater pit before being reused within

#	BAT Requirement	How met or reference
		the process, with any excess process effluents discharged to sewer in accordance with a Trade Effluent Consent. Any excess process effluents discharged to sewer will be monitored in accordance with the requirements of the Trade Effluent Consent. Records of monitoring will be kept as part of site management systems. Taking the above into consideration, Redcar Ltd considers that the fuel preparation facility will comply with the requirements of BAT 3.
4	In order to reduce the environmental risk associated with the storage of waste, BAT is to use all of the techniques set out in the BREF.	The site has been designed so that waste storage areas are, as far is as technically practicable, located away from watercourses and designed to minimise the unnecessary handling of wastes. The maximum waste storage capacity and residence times will be clearly established and not exceeded, with the quantity of waste regularly monitored against the maximum storage capacity. Measures for safe storage operation will be implemented, such as the clear documentation and labelling of waste loading, unloading and storage equipment. It is not anticipated that wastes sensitive to heat, light, air and water will be received at the fuel preparation facility. Furthermore, it is not expected that waste contained within specific containers and drums will be received at the fuel preparation facility. The fuel preparation facility will not receive hazardous waste and hence will not include a dedicated area for storage and handling of hazardous waste. Redcar Ltd considers that the techniques to reduce environmental risk associated with the storage of waste at the fuel preparation facility are in accordance with BAT 4.
5	In order to reduce the environmental risk associated with the handling and transfer of waste, BAT is to set up and implement handling and transfer procedures.	Prior to the receipt of waste at the fuel preparation facility, Redcar Ltd will develop waste pre-acceptance and acceptance procedures.

#	BAT Requirement	How met or reference
		The procedures will comply with the BREF, and include the following elements: • A high standard of housekeeping will be maintained in all areas and suitable equipment will be provided and maintained to clean up spilled materials. • Vehicles will be loaded and unloaded in designated areas provided with impermeable hard standing. These areas will have appropriate falls to the process water drainage system. Delivery and reception of waste would be controlled by a management system that will identify all risks associated with the reception of waste and shall comply with all legislative requirements, including statutory documentation. • Handling and transfer of waste will be undertaken by competent staff with sufficient training. • Incoming waste will be delivered in covered vehicles or containers and unloaded in enclosed waste storage bays at the fuel preparation facility. • The design of equipment, buildings and handling procedures will ensure there is insignificant dispersal of litter. • Any unsuitable wastes identified will be placed in a dedicated storage area in the fuel preparation facility prior to removal off site. • Further inspection of waste will be undertaken by plant operatives during waste unloading. Redcar Ltd considers that the handling and transfer procedures for the fuel preparation facility are in accordance with BAT 5.
6	For relevant emissions to water as identified by the inventory of waste water streams (see BAT 3), BAT is to monitor key process parameters (e.g. waste water flow, pH, temperature, conductivity, BOD) at key locations (e.g. at the inlet and/or outlet of the pre-	There will not be any process or wastewater emissions to surface water from the fuel preparation facility. The only emissions to surface water will be that of uncontaminated surface drainage from the site. Therefore, the monitoring of key process parameters

#	BAT Requirement	How met or reference
	treatment, at the inlet to the final treatment, at the point where the emission leaves the installation).	required by BAT 6 for emissions to water from the fuel preparation facility does not apply.
7	BAT is to monitor emissions to water with at least the frequency given below, 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.	There will not be any process or wastewater emissions to surface water from the fuel preparation facility. The only emissions to surface water will be that of uncontaminated surface drainage from the site. Therefore, the requirements of BAT 7 do not apply to the fuel preparation facility.
8	BAT is to monitor channelled emissions to air with at least the frequency given below, 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.	There will not be any channelled emissions to air from the fuel preparation facility. Therefore, the requirements of BAT 8 do not apply.
9	BAT is to monitor diffuse emissions of organic compounds to air from the regeneration of spent solvents, the decontamination of equipment containing POPs with solvents, and the physico-chemical treatment of solvents for the recovery of their calorific value, at least once per year using one or a combination of the techniques set out in the BREF.	The operation of the fuel preparation facility will not involve the use of solvents – therefore, it is understood that the requirements of BAT 9 do not apply.
10	BAT is to periodically monitor odour emissions.	During periods of shutdown, odour will be monitored at the installation boundary through olfactory checks by site personnel, as described in the Odour Management Plan – refer to Appendix J. Therefore, it is considered that the implementation of olfactory checks during periods of shutdown is in accordance with the requirements of BAT 10.
11	BAT is to monitor the annual consumption of water, energy and raw materials as well as the annual generation of residues and wastewater, with a frequency of at least once per year.	Redcar Ltd will undertake monitoring (at least once per year) of water, energy and raw material consumption, and residues generation (in accordance with the requirements of the EP). Therefore, this will be in compliance with the requirements of BAT 11.

#	BAT Requirement	How met or reference
12	In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to set up, implement and regularly review an odour management plan, as part of the environmental management system (see BAT 1), that includes all of the following elements: — a protocol containing actions and timelines; — a protocol for conducting odour monitoring as set out in BAT 10; — a protocol for response to identified odour incidents, e.g. complaints; and — an odour prevention and reduction programme designed to identify the source(s); to characterise the contributions of the sources; and to implement prevention and/or reduction measures. The applicability is restricted to cases where an odour nuisance at sensitive receptors is expected and/or has been substantiated.	An Odour Management Plan has been developed for the fuel preparation facility – refer to Appendix J. The Odour Management Plan will be reviewed on a regular basis and will form part of the overall site EMS. It can be confirmed that the Odour Management Plan includes for all the elements outlined in the BREF. Taking the above into consideration, it is understood that the fuel preparation facility will comply with the requirements of BAT 12.
13	In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to use one or a combination of the techniques set out in the BREF.	The operation of the fuel preparation facility will aim to minimise residence times of waste both pre-processing and post-processing. Therefore, it is understood that this is in compliance with the requirements of BAT 13.
14	In order to prevent or, where that is not practicable, to reduce diffuse emissions to air, in particular of dust, organic compounds and odour, BAT is to use an appropriate combination of the techniques set out in the BREF. Depending on the risk posed by the waste in terms of diffuse emissions to air, BAT 14d is especially relevant.	It is considered that the fuel preparation facility will have a low risk of diffuse emissions to air of dust, organic compounds and odour. However, it can be confirmed that the design of the fuel preparation facility will include for the following: • Minimise the number of potential diffuse emission sources, such as limiting traffic speed at the site and limiting the drop height of materials (e.g. off conveyors or into storage bays). • Selection and use of high integrity equipment. It can be confirmed that high integrity process equipment will be installed at the fuel preparation facility. • Prevention of corrosion by selecting suitable construction materials. • Storing and handling the waste in enclosed storage bays. • Preventative maintenance on plant equipment.

#	BAT Requirement	How met or reference
		• Regular cleaning of waste handling, storage and treatment areas. Therefore, it is considered that the fuel preparation facility will comply with the requirements of BAT 14.
15	BAT is to use flaring only for safety reasons or for non-routine operating conditions (e.g. start-ups, shutdowns) by using both of the techniques set out in the BREF.	The fuel preparation facility will not include a flare. Therefore, it is understood that the requirements of BAT 15 do not apply.
16	In order to reduce emissions to air from flares when flaring is unavoidable, BAT is to use both of the techniques set out in the BREF.	The fuel preparation facility will not include a flare. Therefore, it is understood that the requirements of BAT 16 do not apply.
17	In order to prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to set up, implement and regularly review a noise and vibration management plan, as part of the environmental management system (see BAT 1), that includes all of the elements set out in the BREF.	A noise assessment is submitted in support of the EP application (Refer to Appendix C). Redcar Ltd will develop an EMS for the operation of the fuel preparation facility (refer to BAT 1). If required or deemed appropriate, the EMS will include for noise management measures.
18	In order to prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to use one or a combination of the techniques set out in the BREF.	The fuel preparation facility will include for the following mitigation measures in accordance with BAT 18: • Appropriate location of equipment and buildings: The layout of the site has been designed to reduce noise impacts where possible (for example, implementing a one-way traffic system, locating 'noisy' equipment inside enclosed buildings, etc). • Operational measures to reduce noise: Regular inspection and maintenance of equipment will be undertaken, doors will be kept closed unless waste deliveries are occurring, equipment will be operated by competently trained staff, waste deliveries will be avoided at night time where possible, etc. • Low-noise equipment will be selected by the EPC contractor where possible. This may include equipment fitted with inherent noise mitigation.

#	BAT Requirement	How met or reference
		• Noisy equipment will be located inside enclosed buildings. It is considered that the proposed noise mitigation measures are in compliance with the requirements of BAT 18.
19	In order to optimise water consumption, to reduce the volume of wastewater generated and to prevent or, where that is not practicable, to reduce emissions to soil and water, BAT is to use an appropriate combination of the techniques set out in the BREF.	The fuel preparation facility will include the following measures to optimise water consumption, reduce wastewater and prevent or reduce emissions to the soil and water environment: • Optimise washdown procedures by the use of trigger controls on all hoses; • Direct process effluents (e.g., those resulting from washdown) to the ERF wastewater pit, for subsequent reuse in the process; • Establish flow diagrams and water mass balances to quantify water consumption; • Monitor water consumption and regularly review measures to reduce water consumption, in accordance with the requirements of the EP; • Construct surfaces of waste reception, storage and handling areas in impermeable hardstanding; • Locate storage tanks/containers of any raw materials or chemicals within secondary containment where appropriate; • Store and treat waste in a covered area (enclosed building) within the fuel preparation facility so that the risk of contaminated rainwater runoff is minimised; • Segregate wastewater streams (such as washdown water and uncontaminated surface water); • Provide adequate drainage infrastructure (including sufficient storage capacity for process effluents and wastewaters); • Employ regular preventative maintenance/inspections of drainage systems to allow easy identification and repair of leaks.

#	BAT Requirement	How met or reference
		It is understood that the techniques to be employed at the fuel preparation facility are in compliance with the requirements of BAT 19.
20	In order to reduce emissions to water, BAT is to treat wastewater using an appropriate combination of the techniques set out in the BREF.	Process effluents would not be discharged to water. Surface run-off from roadways and areas of hardstanding will be treated by a petrol/oil interceptor prior to discharge off-site. Therefore, it is understood that this is in accordance with the requirements of BAT 20.
21	In order to prevent or limit the environmental consequences of accidents and incidents, BAT is to use all of the techniques set out in the BREF, as part of the accident management plan (see BAT 1).	Redcar Ltd will develop an EMS for the operation of the fuel preparation facility, refer to BAT 1. The EMS will include a requirement to develop an accident management plan and suitable emergency procedures, in accordance with the requirements of BAT 21. The accident management plan will include for the techniques outlined in BAT 21.
22	In order to use materials efficiently, BAT is to substitute materials with waste.	The fuel preparation facility will use an insignificant quantity of raw materials, as the only waste treatment to be undertaken at the fuel preparation facility will be shredding. Therefore, it is understood that the requirements of BAT 22 do not apply to the fuel preparation facility.
23	In order to use energy efficiently, BAT is to use both of the techniques (energy efficiency plan and energy balance record) set out in the BREF.	Where possible, the design and operation of the fuel preparation facility will aim to achieve a high energy efficiency. An energy efficiency plan will be incorporated into the operation and maintenance procedures of REC. The plan will be reviewed regularly as part of the EMS. Procedures will be reviewed and amended, where necessary, to include improvements in efficiency as and when proven new equipment and operating techniques become available. These will be assessed on the implementation cost compared with the anticipated benefits.

#	BAT Requirement	How met or reference
		Energy consumption will be monitored and recorded periodically, in accordance with the requirements of the EP. Taking the above into consideration, it is understood that the fuel preparation facility will comply with the requirements of BAT 23.
24	In order to reduce the quantity of waste sent for disposal, BAT is to maximise the reuse of packaging, as part of the residues management plan (see BAT 1).	Where possible, packaging will be reused or will be recycled if appropriate. Therefore, the fuel preparation facility will be operated in accordance with the requirements of BAT 24.
25	In order to reduce emissions to air of dust, and of particulate-bound metals, PCDD/F and dioxin-like PCBs, BAT is to apply BAT 14d and to use one or a combination of the techniques given in the BREF.	Waste will be stored and handled inside enclosed storage bays. It is not anticipated that there will be a significant risk of the emission of dust, metals, dioxins and furans from the fuel preparation facility. Therefore, the techniques listed in BAT 25 do not apply to the fuel preparation facility. However, it is expected that the shredder will be fitted with a dampening system (water injection) or similar to reduce dust generation.
26	In order to improve the overall environmental performance, and to prevent emissions due to accidents and incidents, BAT is to use BAT 14g and all of the techniques set out in the BREF.	In accordance with waste acceptance procedures, waste will be inspected prior to processing in the fuel preparation facility. Should any baled waste be received at the fuel preparation facility, de-baling procedures will allow for detailed inspections of the waste prior to shredding. If any dangerous items are identified (such as gas cylinders), these will be removed prior to treatment of the waste. It is not anticipated that large containers will be treated at the fuel preparation facility. Taking the above into consideration, it is understood that the fuel preparation facility will comply with the requirements of BAT 26.
27	In order to prevent deflagrations and to reduce emissions when deflagrations occur, BAT is to use the techniques set out in the BREF.	The site (including the fuel preparation facility) will include fire prevention and management measures. A Fire Prevention Plan has been developed and is presented in Appendix H. Appropriate fire prevention and management measures will be included within the detailed document management procedures for the fuel preparation

#	BAT Requirement	How met or reference
		facility. Therefore, although a specific 'deflagration management plan' will not be developed for the fuel preparation facility, it is understood that the operation of the fuel preparation facility will be undertaken in accordance with BAT 27.
28	In order to use energy efficiently, BAT is to keep the shredder feed stable.	Procedures will be developed to ensure a stable feed is maintained to the shredder, minimising the risk of blockage or overload. Therefore, the operation of the fuel preparation facility will be in accordance with the requirements of BAT 28.
29	In order to prevent or, where that is not practicable, to reduce emissions of organic compounds to air, BAT is to apply BAT 14d, BAT 14h and to use technique a. and one or both of the techniques b. and c. given below.	It is understood that this BAT conclusion is applicable for the treatment of WEEE containing VFCs and/or VHCs. It can be confirmed that WEEE will not undergo mechanical treatment, such as shredding, at the fuel preparation facility. Therefore, BAT 29 does not apply to the fuel preparation facility.
30	In order to prevent emissions due to explosions when treating WEEE containing VFCs and/or VHCs, BAT is to use either of the techniques set out in the BREF.	It is understood that this BAT conclusion is applicable for the treatment of WEEE containing VFCs and/or VHCs. It can be confirmed that WEEE will not undergo mechanical treatment, such as shredding, at the fuel preparation facility. Therefore, BAT 29 does not apply to the fuel preparation facility.
31	In order to reduce emissions to air of organic compounds, BAT is to apply BAT 14d and to use one or a combination of the techniques set out in the BREF.	The fuel preparation facility will not give rise to emissions to air of organic compounds. Therefore, this does not apply to the fuel preparation facility.
32	In order to reduce mercury emissions to air, BAT is to collect mercury emissions at source, to send them to abatement and to carry out adequate monitoring.	It is understood that this BAT conclusion is applicable for the treatment of WEEE containing mercury. It can be confirmed that WEEE will not undergo mechanical treatment, such as shredding, at the fuel preparation facility. Therefore, this does not apply to the fuel preparation facility.
33	In order to reduce odour emissions and to improve the overall environmental performance, BAT is to select the waste input.	It is understood that this BAT conclusion is applicable for the biological treatment of waste. Therefore, this does not apply to the fuel preparation facility.

#	BAT Requirement	How met or reference
34	In order to reduce channelled emissions to air of dust, organic compounds and odorous compounds, including H2S and NH3, BAT is to use one or a combination of the techniques set out in the BREF.	It is understood that this BAT conclusion is applicable for the biological treatment of waste. Therefore, this does not apply to the fuel preparation facility.
35	In order to reduce the generation of wastewater and to reduce water usage, BAT is to use all of the techniques set out in the BREF.	It is understood that this BAT conclusion is applicable for the biological treatment of waste. Therefore, this does not apply to the fuel preparation facility.
36	In order to reduce emissions to air and to improve the overall environmental performance, BAT is to monitor and/or control the key waste and process parameters.	It is understood that this BAT conclusion is applicable for the aerobic treatment of waste. Therefore, this does not apply to the fuel preparation facility.
37	In order to reduce diffuse emissions to air of dust, odour and bioaerosols from open-air treatment steps, BAT is to use one or both of the techniques given in the BREF.	It is understood that this BAT conclusion is applicable for the aerobic treatment of waste. Therefore, this does not apply to the fuel preparation facility.
38	In order to reduce emissions to air and to improve the overall environmental performance, BAT is to monitor and/or control the key waste and process parameters.	It is understood that this BAT conclusion is applicable for the anaerobic treatment of waste. Therefore, this does not apply to the fuel preparation facility.
39	In order to reduce emissions to air, BAT is to use both of the techniques given in the BREF.	It is understood that this BAT conclusion is applicable for the mechanical biological treatment of waste. Therefore, this does not apply to the fuel preparation facility.
40	In order to improve the overall environmental performance, BAT is to monitor the waste input as part of the waste pre-acceptance and acceptance procedures (see BAT 2).	It is understood that this BAT conclusion is applicable for the physico-chemical treatment of solid and/or pasty waste treatment of waste. Therefore, this does not apply to the fuel preparation facility.
41	In order to reduce emissions of dust, organic compounds and NH3 to air, BAT is to apply BAT 14d and to use one or a combination of the techniques given in the BREF.	It is understood that this BAT conclusion is applicable for the physico-chemical treatment of solid and/or pasty waste treatment of waste. Therefore, this does not apply to the fuel preparation facility.
42	In order to improve the overall environmental performance, BAT is to monitor the waste input as part of the waste pre-acceptance and acceptance procedures (see BAT 2).	It is understood that this BAT conclusion is applicable for the re-refining of waste oil. Therefore, this does not apply to the fuel preparation facility.

#	BAT Requirement	How met or reference
43	In order to reduce the quantity of waste sent for disposal, BAT is to use one or both of the techniques set out in the BREF.	It is understood that this BAT conclusion is applicable for the re-refining of waste oil. Therefore, this does not apply to the fuel preparation facility.
44	In order to reduce emissions of organic compounds to air, BAT is to apply BAT 14d and to use one or a combination of the techniques set out in the BREF.	It is understood that this BAT conclusion is applicable for the re-refining of waste oil. Therefore, this does not apply to the fuel preparation facility.
45	In order to reduce emissions of organic compounds to air, BAT is to apply BAT 14d and to use one or a combination of the techniques set out in the BREF.	It is understood that this BAT conclusion is applicable for the physico-chemical treatment of waste with calorific value. Therefore, this does not apply to the fuel preparation facility.
46	In order to improve the overall environmental performance of the regeneration of spent solvents, BAT is to use one or both of the techniques set out in the BREF.	It is understood that this BAT conclusion is applicable for the regeneration of spent solvents. Therefore, this does not apply to the fuel preparation facility.
47	In order to reduce emissions of organic compounds to air, BAT is to apply BAT 14d and to use a combination of the techniques set out in the BREF.	It is understood that this BAT conclusion is applicable for the regeneration of spent solvents. Therefore, this does not apply to the fuel preparation facility.
48	In order to improve the overall environmental performance of the thermal treatment of spent activated carbon, waste catalysts and excavated contaminated soil, BAT is to use all of the techniques set out in the BREF.	It is understood that this BAT conclusion is applicable for the thermal treatment of spent activated carbon, waste catalysts and excavated contaminated soil. Therefore, this does not apply to the fuel preparation facility.
49	In order to reduce emissions of HCl, HF, dust and organic compounds to air, BAT is to apply BAT 14d and to use one or a combination of the techniques set out in the BREF.	It is understood that this BAT conclusion is applicable for the thermal treatment of spent activated carbon, waste catalysts and excavated contaminated soil. Therefore, this does not apply to the fuel preparation facility.
50	In order to reduce emissions of dust and organic compounds to air from the storage, handling, and washing steps, BAT is to apply BAT 14d and to use one or a combination of the techniques set out in the BREF.	It is understood that this BAT conclusion is applicable for the water washing of excavated contaminated soil. Therefore, this does not apply to the fuel preparation facility.

#	BAT Requirement	How met or reference
51	In order to improve the overall environmental performance and to reduce channeled emissions of PCBs and organic compounds to air, BAT is to use all of the techniques set out in the BREF.	It is understood that this BAT conclusion is applicable for the decontamination of equipment containing PCBs. Therefore, this does not apply to the fuel preparation facility.
52	In order to improve the overall environmental performance, BAT is to monitor the waste input as part of the waste pre-acceptance and acceptance procedures (see BAT 2).	It is understood that this BAT conclusion is applicable for the treatment of water-based liquid waste. Therefore, this does not apply to the fuel preparation facility.
53	In order to reduce emissions of HCl, NH3 and organic compounds to air, BAT is to apply BAT 14d and to use one or a combination of the techniques set out in the BREF.	It is understood that this BAT conclusion is applicable for the treatment of water-based liquid waste. Therefore, this does not apply to the fuel preparation facility.

Taking the above into consideration, it can be confirmed that the fuel preparation facility will comply with the relevant requirements of the WTI BREF.

2.7 Energy efficiency

As described in the response to BAT 23, the design and operation of the fuel preparation facility will aim to achieve a high energy efficiency. It is expected that the most significant energy consumers at the fuel preparation facility will be the conveyors, moving floor feeder, waste processing equipment (including de-baler and shredder).

An energy efficiency plan will be incorporated into the operation and maintenance procedures of the fuel preparation facility. The plan will be reviewed regularly as part of the EMS. Procedures will be reviewed and amended, where necessary, to include improvements in efficiency as and when proven new equipment and operating techniques become available. These will be assessed on the implementation cost compared with the anticipated benefits.

Energy consumption will be monitored and recorded periodically, in accordance with the requirements of the EP.

2.8 Residue Recovery and Disposal

The operation of the fuel preparation facility is not anticipated to give rise to significant quantities of residues. A small amount of reject material (not suitable for recovery at the adjacent ERF) may be produced – this will be transferred off-site to a suitably licensed waste management facility. Process effluents resulting from the fuel preparation facility would be collected in the site process drainage systems and reused within the process.

Any material which is rejected from the fuel preparation facility (‘unacceptable’ waste – refer to section 2.2.2) will be transferred off-site for processing in line with the waste hierarchy.

3 The ERF

3.1 Raw materials

3.1.1 Types and amounts of raw materials

The main raw materials anticipated to be stored at the ERF are presented in Table 5. Information on the potential environmental impact of the primary raw materials is included in Table 6.

Table 5: Types and amounts of raw materials and consumption rate at design load

Schedule 1 Activity	Material	Estimated storage capacity [m^3]	Estimated annual throughput [tonnes per annum] at design capacity	Description
Primary Raw Materials				
Section 5.1 Part A (b)	Low sulphur fuel oil	170 m^3	709 tpa	Fuel for auxiliary burners
	Ammonia solution	84 m^3	2,581 tpa	Ammonium hydroxide, estimated 25% concentration
	Lime	468 m^3	9,806 tpa	Calcium hydroxide, $Ca(OH)_2$
	Activated carbon	75 m^3	135 tpa	Powdered
	Water treatment chemicals	N/A – various storage facilities	<50 tpa	E.g. oxygen scavenger, pH corrector, corrosion inhibitor. Types to be confirmed during detailed design.
**Assuming 4 start-ups/shutdowns per stream per year*				

Table 6: Raw materials and their effect on the environment

Product	Chemical Composition	Estimated annual consumption (tpa)	Relative impact (%)			Impact Potential	Comments
			Air	Land	Water		
Low sulphur fuel oil	-	709	100	0	0	Low impact	Auxiliary fuel for start-up and shutdown of the ERF.
Ammonia solution	$NH_4(OH)$	2,581	100	0	0	Low impact	Reacts with oxides of nitrogen to form nitrogen, carbon dioxide and water vapour. Any unreacted ammonia (a chemical intermediate) is released to atmosphere at low concentrations.
Lime	$Ca(OH)_2$	9,806	0	100	0	Low impact	Lime is injected and removed with the APC residues at the bag filter and disposed of as hazardous waste (or alternatively treated and recovered) at a suitable licensed facility.
Activated Carbon	C	135	0	100	0	Low impact	Injected carbon is removed with the APC residues at the bag filter and disposed of as hazardous waste (or alternatively treated and recovered) at a suitable licensed facility.
Boiler water Treatment Chemicals	Oxygen scavenger, pH control, descaler etc	<50	0	0	100	Low impact	E.g. hydrochloric acid, caustic soda, boiler water dosing chemicals will be used for the demineralized water production and for the treatment of the boiler feedwater. Specific substances to be confirmed during detailed design of the water treatment plant.

Various other materials may be used in small quantities for the operation and maintenance of the ERF. These could include, but not be limited to, the following:

1. hydraulic oils and silicone-based oils, greases, insulants;
2. isolation media within electrical switchgear;
3. refrigerant gases for the air conditioning plant;
4. glycol/antifreeze for cooling;
5. ignition, test and calibration gases;
6. oxyacetylene, TIG, MIG welding gases; and
7. CO_2, foam and other fire-extinguishing agents.

These will be supplied to standard specifications offered by main suppliers. All chemicals will be handled in accordance with COSHH Regulations as part of the quality assurance procedures and full product data sheets will be available on-site.

Periodic reviews of all materials used will be made in the light of new products and developments. Any significant change of material, where it may have an impact on the environment, will not be made without firstly assessing the impact and seeking approval from the EA.

The Operator will maintain a detailed inventory of raw materials used on-site and have procedures for the regular review of new developments in raw materials.

3.1.2 Reagent unloading and storage

3.1.2.1 Unloading of reagents/raw materials

A range of chemical substances and hazardous materials associated with the process, including ammonia solution, lime and activated carbon, will be delivered to the site. Ammonia will be delivered in sealed tankers and off-loaded to an ammonia storage tank via a standard hose connection. The delivery will be supervised by site operatives trained in unloading practices. Regular inspection of the unloading equipment will be undertaken. Spillages will be prevented by good operating procedures such as high tank level alarms or trips. In addition, unloading activities will only be undertaken on areas of hardstanding with contained drainage. These measures will ensure that fugitive emissions of ammonia are contained.

The lime and activated carbon will be transported pneumatically from the delivery vehicle to the correct storage silo. Exhaust air will be de-dusted using a fabric filter located at the top of the silo – cleaning of the filter will be done automatically with compressed air after filling operations, with the filter inspected regularly for leaks. Silos will also be fitted with high-level alarms.

The tanker offloading area at the site will be constructed from an impermeable concrete hardstanding, to create an impermeable layer to the underlying ground and prevent contamination in the event of a spill/leak from the tanker. It can be confirmed that sealed construction joints (water stop joints) will be installed between each concrete slab to ensure the integrity of the hardstanding, reducing the risk for contamination of the underlying ground/groundwater. The tanker offloading area will be constructed in accordance with the requirements of CIRIA 736 and in accordance with recognised standard '*Eurocode 2 – Design of Concrete Structures – Part 3: Liquid retaining and containment structures*'. Quality assurance checks will be undertaken during construction to confirm the integrity of the hardstanding (and drainage systems). A regular preventative maintenance scheme will ensure the integrity of the tanker offloading area is maintained throughout the lifetime of the ERF. Preventative maintenance will include for periodically emptying any sumps in the tanker unloading area and undertaking visual inspections of the concrete or other material from which the sumps are constructed. Visual inspections of the hardstanding will also be undertaken. In the event that the visual inspection identifies that the integrity of the sumps or hardstanding has been compromised, additional pressure tests, leak tests and material thickness checks would be undertaken.

Should it be identified that damage has occurred to any of the structure, repairs will be undertaken to ensure that integrity is suitably maintained. These measures will ensure that liquids do not leak from the tanker unloading area and contaminate the underlying groundwater.

The tanker offloading area will have contained drainage which will ensure that any fugitive emissions are contained. Tanker off-loading of auxiliary fuel and liquid chemicals will take place within areas where the drainage is contained with the appropriate capacity to contain a spill during delivery – this will be achieved by the use of sumps to the ammonia and auxiliary fuel unloading areas (i.e. they will drain to a blind collection point).

Sumps will be:

- Designed to be impermeable and resistant to the liquids collected within them.
- Subject to regular visual inspection, with any contents removed accordingly after checking for contamination.
- Should any concerns regarding the integrity of sumps be raised following programmed visual inspection or maintenance, this will be extended to water testing.
- Any sub-surface tanks and sumps, where appropriate, will be designed with leak detection systems. Preventative maintenance will be implemented for all subsurface structures. This will include (if appropriate) pressure tests, leak tests, material thickness checks, CCTV etc.

Furthermore, adequate quantities of spillage absorbent materials will be made available at easily accessible location(s) where chemicals are either stored or unloaded.

The measures outlined above are considered to be sufficient to prevent in the first case, or mitigate, any leaks from tanker offloading of materials.

3.1.2.2 Storage of reagents/raw materials

A range of chemical substances and hazardous materials associated with the process, including ammonia solution, lime and activated carbon, will be stored at the site. These materials will be stored in accordance with current guidance. All liquid chemicals and raw materials (including ammonia) will be stored in controlled areas, with secondary containment facilities having a volume of 110% of the stored capacity.

Ammonia solution will be stored within a tank in a dedicated storage area, with secondary containment such as bunding. The ammonia storage tank itself will be well-designed and be bunded to 110% of the tank's capacity; therefore, minimising the risk of any fugitive emissions from leaks whilst the ammonia is stored within the tank. Good design of pipework and regular preventative maintenance will allow for the safe transfer of ammonia into the SNCR system.

Lime and activated carbon, used within the flue gas treatment process, will be stored within separate storage silos located to the northof the flue gas treatment system. The storage of these reagents will be in dedicated steel silos with equipment for filling from a tanker through a sealed pipe work system. Lime and activated carbon will be dosed into the flue gas treatment process with separate dosing controls.

Low sulphur fuel oil will be used on site for the start-up and auxiliary support burners and will be stored in a dedicated storage tank with suitable secondary containment.

Boiler make-up water will be supplied from an onsite demineralisation water treatment plant. Boiler water treatment chemicals will be used to control water hardness, pH and scaling and will be delivered in sealed containers and stored in an area with suitable secondary containment (e.g. bunding) within the water treatment room.

Various maintenance materials (oils, greases, insulants, antifreezes, welding and firefighting gases etc.) will be stored in an appropriate manner. Any gas bottles on-site will be kept secure in dedicated area(s).

Further detail on the containment measures for raw material and reagent storage is presented within the Site Condition Report – refer to Appendix B.

3.1.3 Raw materials and reagents selection

3.1.3.1 Acid gas abatement

There are several reagents available for acid gas abatement. Sodium hydroxide (NaOH) or lime (CaO) can be used in a wet FGT system. Quicklime (CaO) can be used in a semi-dry FGT system. Sodium bicarbonate ($NaHCO_3$), lime (CaO) or hydrated lime ($Ca(OH)_2$) can be used in a dry FGT process.

The reagents for wet scrubbing and semi-dry abatement are not considered, since these abatement techniques have been eliminated by the BAT assessment in Appendix F section 2.1. Therefore, the two alternative reagents for a dry system – lime and sodium bicarbonate – have been assessed further.

The level of abatement that can be achieved by both reagents is similar. However, different quantities of reagents will be required and different quantities of residues will be generated.

Therefore, a full assessment following the methodology in Horizontal Guidance Note H1 has been undertaken. Whilst it is noted that this guidance has been subsequently withdrawn by the EA, the replacement guidance is not as prescriptive in the methodology required. Therefore, the BAT assessment has been undertaken using the H1 methodology. The assessment is detailed in Appendix F, with the conclusions of the acid gas BAT assessment summarised in Table 7.

Table 7: Acid gas abatement BAT data

Item	Unit	$NaHCO_3$	$Ca(OH)_2$
Mass of reagent required	kg/h	109.0	67.0
Mass of residue generated	kg/h	84.0	85.0
Cost of reagent	£/tonne	280	192
Cost of residue disposal	£/tonne	186	155
Overall Cost	£/op.hr/kmol	46.1	26.0
Ratio of costs		1.77	-

Note: Data based on abatement of one kmol of hydrogen chloride

There is a small environmental benefit for using sodium bicarbonate, in that the mass of residues produced is smaller. However, there are a number of significant disadvantages:

- The residue has a higher leaching ability than lime-based residue, which limits the disposal options;
- The reaction temperature doesn't match as well with the optimum adsorption temperature for carbon, which is dosed at the same time;

- The sodium bicarbonate system has a slightly higher global warming potential due to the reaction chemistry; and
- The overall cost per kmol of reagent required to abate HCl is around 77% higher.

Taking the above into consideration, the use of lime is considered to represent BAT for the ERF.

3.1.3.2 NOx abatement

NOx abatement systems can be operated with dry urea (prills), urea solution or ammonia solution. There are advantages and disadvantages with all options:

- dry urea is safer to handle than ammonia; however, once the ammonia solution is in the storage tank no further handling is required;
- ammonia tends to give rise to lower nitrous oxide formation than urea, hence urea may have a worse climate impact;
- dry urea needs big-bag handling whereas urea and ammonia solution can be delivered in tankers and stored in bulk storage tanks; and
- ammonia emissions (or 'slip') can occur with both reagents, but good control will limit this.

The EA's Sector Guidance on Waste Incineration (EPR5.01) considers all options as suitable for NOx abatement. It is proposed to use aqueous ammonia for the SNCR system, because the climate change impacts of urea outweigh the handling and storage issues associated with ammonia solution. These issues can be overcome by good design of the ammonia tanks and pipework and the use of suitable procedures for the delivery of ammonia. Taking this into consideration, the use of ammonia solution in the NOx abatement system is considered to represent BAT for the ERF.

3.1.3.3 Abatement of volatiles

PAC is the only viable option to remove volatile metals, dioxins and furans by adsorption, and hence alternatives have not been considered.

3.1.3.4 Auxiliary fuel

As stated in Article 50 (3) of the Industrial Emissions Directive:

> *"The auxiliary burner shall not be fed with fuels which can cause higher emissions than those resulting from the burning of gas oil as defined in Article 2(2) of Council Directive 1999/32/EC of 26 April 1999 relating to a reduction in the sulphur content of certain liquid fuels (1) OJ L 121, 11.5.1999, p. 13., liquefied gas or natural gas."*

Therefore, as identified by the requirements of IED the only 'available' fuels that can be used for auxiliary firing are:

1. liquefied petroleum gas (LPG);
2. fuel oil (gas oil); or
3. natural gas.

Auxiliary burner firing on a well-managed waste combustion plant is only required intermittently, i.e. during start-up, shutdown and when the temperature in the combustion chamber falls to 850°C.

LPG is a flammable mixture of hydrocarbon gases. It is a readily available product and can be used for auxiliary firing. As LPG turns gaseous under ambient temperature and pressure, it is required to be stored in purpose-built pressure vessels. If there was a fire within the site, there would be a significant explosion risk from the combustion of flammable gases stored under pressure.

Considering the proximity of the site to other industry, LPG is not considered to be a suitable auxiliary fuel for the ERF due to the explosive risk.

Natural gas can be used for auxiliary firing and is safer to handle than LPG. However, as stated previously, auxiliary firing will only be required intermittently. When firing, this requires large volumes of gas which would be needed to be supplied from a gas main within a reasonable distance from the ERF. Given the small overall gas consumption expected, and fuel oil having the dual benefit of being used for auxiliary firing and also for fuelling site mobile equipment, the use of natural gas is not considered to represent BAT for the ERF.

A low sulphur fuel oil supply tank can be easily installed at the ERF. Whilst it is acknowledged that fuel oil is classed as flammable, it does not pose the same type of safety risks as those associated with gas storage and pipework. The combustion of fuel oil will lead to some emissions of sulphur dioxide, but these emissions will be minimised as far as reasonably practicable through the use of low sulphur fuel oil.

Taking the above into consideration, low sulphur fuel oil is considered to represent BAT for auxiliary firing at the ERF.

3.2 Incoming waste management

3.2.1 Waste to be processed in the ERF

The ERF will be used to recover energy from waste, with European Waste Catalogue (EWC) Codes as presented in Table 8.

Table 8: Waste to be processed in the ERF

EWC Code	Description of Waste
WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION AND PROCESSING	
02 01	**wastes from agriculture, horticulture, aquaculture,forestry, hunting and fishing**
02 01 03	Plant-tissue waste (otherwise unsuitable for alternative processing e.g. due to contamination)
02 03	**wastes from fruit, vegetables, cereals, edible oils,cocoa, coffee, tea and tobacco preparation and processing, conserve production, yeast and yeastextract production, molasses preparation and fermentation**
02 03 04	materials unsuitable for consumption or processing (otherwise unsuitable for alternative processing e.g. due to contamination)
02 05	**wastes from the dairy products industry**
02 05 01	materials unsuitable for consumption or processing (otherwise unsuitable for alternative processing e.g. due to contamination)
02 06	**Wastes from the baking and confectionery industry**
02 06 01	Materials unsuitable for consumption or processing (otherwise unsuitable for alternative processing e.g. due to contamination)
WASTES FROM WOOD PROCESSING AND THE PRODUCTION OF PANELS AND FURNITURE, PULP, PAPER AND CARDBOARD	
03 01	**wastes from wood processing and the production of panels and furniture**
03 01 01	Waste bark and cork

EWC Code	Description of Waste
03 01 05	sawdust, shavings, cuttings, wood, particle board and veneer other than those mentioned in 03 01 04
03 03	**Wastes from pulp, paper and cardboard production and processing**
03 03 01	waste bark and wood
03 03 07	mechanically separated rejects from pulping of waste paper andcardboard
03 03 08	wastes from sorting of paper and cardboard destined for recycling
03 03 10	fibre rejects, fibre-, filler- and coating-sludges from mechanicalseparation
03 03 07	Mechanically separated rejects from pulping of wastepaper and cardboard
WASTES FROM THE LEATHER, FUR AND TEXTILE INDUSTRIES	
04 02	**wastes from the textile industry**
04 02 10	Organic matter from natural products for example grease, wax
04 02 21	Wastes from unprocessed textile fibres
04 02 22	Wastes from processed textile fibres
WASTE PACKAGING; ABSORBENTS, WIPING CLOTHS, FILTER MATERIALS AND PROTECTIVE CLOTHING NOT OTHERWISE SPECIFIED	
15 01	**Packaging (including separately collected municipal packaging waste)**
15 01 01	Paper and cardboard packaging which is contaminated and would otherwise be destined for landfill
15 01 02	plastic packaging
15 01 03	Wooden packaging which is contaminated and would otherwise be destined for landfill
15 01 05	Composite packaging
15 01 06	Mixed packaging which is contaminated and would otherwise be destined for landfill
15 01 09	Textile packaging
15 02	**Absorbents, filter materials, wiping cloths and protective clothing**
15 02 03	absorbents, filter materials, wiping cloths and protective clothingother than those mentioned in 15 02 02
CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES)	
17 02	**Wood, glass, and plastic**
17 02 01	Wood which is contaminated and would otherwise be destined for landfill
WASTES FROM HUMAN OR ANIMAL HEALTH CARE AND/OR RELATED RESEARCH (except kitchen and restaurant wastes not arising from immediate health care)	
18 01	**wastes from natal care, diagnosis, treatment or prevention of disease in humans**
18 01 04	wastes whose collection and disposal is not subject to special requirements in order to prevent infection(for example dressings, plaster casts, linen, disposable clothing, diapers)

EWC Code	Description of Waste
WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE	
19 02	**Wastes from physical/chemical treatments of waste (including dechromatation, decyanidation, neutralisation)**
19 02 03	Premixed wastes composed only of non-hazardous wastes
19 02 10	combustible wastes other than those mentioned in 19 02 08 and 19 02 09
19 05	**Wastes from aerobic treatment of solid wastes**
19 05 01	Non-composted fraction of municipal and similar wastes
19 05 02	Non-composted fraction of animal and vegetable waste
19 05 03	Off-specification compost
19 06	**wastes from anaerobic treatment of waste**
19 06 04	digestate from anaerobic treatment of municipal waste (otherwise unsuitable for alternative processing e.g. due to contamination)
19 06 06	digestate from anaerobic treatment of animal and vegetable waste (otherwise unsuitable for alternative processing e.g. due to contamination)
19 08	**wastes from waste water treatment plants not otherwise specified**
19 08 01	Screenings (not subject to special requirements in order to prevent infection)
19 12	**Wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified**
19 12 01	Paper and cardboard which is contaminated and would otherwise be destined for landfill
19 12 07	Wood other than that mentioned in 19 12 06
19 12 08	Textiles
19 12 10	Combustible waste (refuse derived fuel)
19 12 12	Other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 19 12 11
MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS	
20 01	**Separately collected fractions (except 15 01)**
20 01 01	Paper and cardboard (rejects from materials recovery plants only)
20 01 10	Clothes
20 01 11	Textiles
20 01 38	Wood other than that mentioned in 20 01 37 (rejects from materials recovery plants only)
20 01 39	Plastics (rejects from materials recovery plants only)
20 02	**Garden and park wastes (including cemetery waste)**
20 02 01	Biodegradable waste (otherwise unsuitable for alternative processing e.g. due to contamination)
20 03	**Other municipal wastes**

EWC Code	Description of Waste
20 03 01	Mixed municipal waste
20 03 02	Waste from markets
20 03 99	Municipal Waste not otherwise specified

Some of the EWC codes listed above include for waste plastic materials (such as EWC code 15 01 06 and 20 01 39) and may initially appear suitable for recycling. It can be confirmed that wastes received under these EWC codes would be contaminated or otherwise unsuitable for recycling. The ERF will provide an energy recovery solution for these waste types to avoid disposal of these wastes in a landfill. Furthermore, the quantity of these wastes is anticipated to be small compared to other wastes processed at the ERF.

Furthermore, although it is acknowledged that the combustion of plastics has the potential to release emissions of dioxins and furans, PCBs and mercury, the wastes will be mixed within the waste bunker to ensure a homogeneous waste feed to the furnace. This will lie within the capability of the flue gas treatment system, therefore maintaining emissions to within the limits prescribed by the EP.

Some of the EWC codes relate to wastes which have a relatively high calorific value. However, the wastes will be mixed within the waste bunker to ensure a homogeneous waste feed to the furnace, thereby avoiding upset to the boiler as a result of spikes in CV. The ERF will be designed to process wastes with a range of NCVs – refer to the Firing Diagram presented within Appendix A. Taking the above into consideration, the resulting emissions will be within the capability of the flue gas treatment system, therefore maintaining emissions to within the limits prescribed by the EP.

In addition to the above, some waste codes have the potential to be more odorous than other waste codes. The quantities of these wastes which will be received at the ERF will be small compared to the overall waste capacity of the ERF. Waste acceptance procedures will be developed for all incoming wastes. It is the responsibility of the site management to ensure that odour control can and is maintained. If upon arrival at the site, it is deemed that odour control cannot be maintained due to the nature of the waste, the waste will not be accepted at the site. Finally, there will be odour management procedures in place should odour be deemed a problem at the ERF – refer to section 3.4.4. This may include, for example, back-loading of waste from the bunker during extended periods of unplanned shutdown.

Some of the waste codes (such as 02 01 03) may initially appear more suitable for treatment such as anaerobic digestion or composting. However, should these wastes be rejected for alternative treatment (for example, due to contamination or other issues), an alternative treatment method will be required. The ERF will provide that alternative treatment method in accordance with the waste hierarchy, to avoid the wastes otherwise going to landfill for disposal. Redcar Ltd anticipates that the quantity of waste received at the ERF under these EWC codes will small compared to the other wastes processed at the ERF.

Waste under EWC codes 19 06 04 and 19 06 06 will comprise digestates that are unsuitable for processing in an alternative treatment facility, for example due to contamination. The digestates received will be digestate that does not meet the requirements of PAS 110 (or is otherwise unsuitable for spreading on land as a fertiliser). It is anticipated that the quantity of these wastes will be small compared to other wastes processed at the ERF. These wastes would be mixed with the rest of the waste in the bunker to ensure that it is suitable for incineration. The digestate may need to be dewatered to reduce its moisture content and make it suitable for handling at the ERF, but this would need to occur prior to transfer to the ERF. Taking this into consideration, Redcar Ltd considers that the digestates that will be accepted at the ERF are suitable for combustion in a moving grate system.

With regards EWC codes 18 01 04 and 19 08 01, these are non-hazardous and non-clinical wastes and as such do not require any specific storage, handling or processing requirements. The quantity of waste received under these codes is expected to be small. Both EWC codes will comprise wastes that are not subject to special requirements in order to prevent infection; and therefore, will be suitable for incineration on a conventional moving grate. For example, waste received under 18 01 04 is expected to comprise typical healthcare wastes also found in household municipal waste (for example dressings, plaster casts, linen, disposable clothing, diapers).

3.2.2 Waste handling

3.2.2.1 Waste acceptance and pre-acceptance procedures

Waste supply contracts will be held with waste suppliers that will supply waste directly to the ERF. The contracts will ensure that the waste suppliers provide the waste to in accordance with the waste specification for the ERF.

Documented procedures for pre-acceptance and acceptance of all wastes will be developed prior to the commencement of operation, in accordance with the documented management systems for the ERF. Redcar Ltd would propose to provide the EA with a summary of the documented procedures prior to commencement of operation, as typically required for EPs of this nature.

The pre-acceptance and acceptance checks on wastes being delivered to the ERF may include audits of waste producers and/or suppliers to review their operations to confirm that the waste which they are transferring to the ERF is in accordance with the waste descriptions, specifications and EWC codes that will be provided by Redcar Ltd.

Procedures will be implemented on site for the review of wastes at the weighbridges (i.e. a review of the relevant documentation accompanying the waste) and for periodic inspections of wastes at the weighbridge against the agreed specifications – refer to section 3.2.1.

The waste pre-acceptance and acceptance procedures will comply with the Indicative BAT requirements in EPR5.01, including:

- A high standard of housekeeping will be maintained in all areas and spill kits will be available in suitable locations.
- Vehicles will be loaded and unloaded in designated areas provided with impermeable hard standing. These areas will have appropriate falls to the process water drainage system. Should a significant spillage occur which has the potential to contaminate the surface water drainage system, an isolation valve will prohibit the release of any contaminated effluent off-site.
- Fire-fighting measures will be designed by consultation with the Local Fire Officers, with particular attention paid to the waste storage area. Refer to the Fire Prevention Plan (Appendix H) for further details.
- Delivery and reception of waste will be controlled by a management system that will identify all risks associated with the reception of waste and shall comply with all legislative requirements, including statutory documentation.
- Waste will be:
  - delivered in enclosed vehicles or other appropriate containers; and
  - unloaded in the enclosed waste reception area.
- Design of equipment, buildings and handling procedures will ensure there is insignificant dispersal of litter.

- Inspection procedures will be employed to ensure that any wastes which would prevent the thermal treatment process from operating in compliance with its EP are segregated and placed in a designated storage area pending removal.

Further inspection will take place by the plant operatives during vehicle tipping/waste unloading.

3.2.2.2 Receiving waste

Waste will be delivered to the ERF in enclosed waste delivery vehicles directly from off-site sources, and also from the fuel preparation facility via conveyor. Waste will be delivered in a mixture of RCV's and bulk waste delivery vehicles. Checks will be made on the paperwork accompanying each delivery from external sources to ensure that only waste for which the plant has been designed will be accepted. For externally sourced waste, vehicles will be weighed on one of two incoming weighbridges where the quantity of the waste will be recorded, prior to proceeding to the enclosed waste reception and tipping hall area (herein referred to as the waste reception area). Vehicle loads will be inspected periodically at the weighbridge layby to confirm the nature of the wastes being delivered.

Once within the tipping hall, the waste delivery vehicles will reverse into a vacant tipping bay and tip waste into the bunker. Once a delivery has been made, road delivery vehicles exiting the site will then be weighed again upon exit in order to determine the mass of waste that has been delivered to the ERF.

The tipping hall will incorporate multiple tipping bays, and will be fitted with fast acting roller shutter doors, which will be kept closed when waste deliveries are not occurring. Routine waste inspections will take place within the quarantine area of the tipping hall. It can be confirmed that waste will be received, handled and stored within the main waste reception building, which will have contained drainage with links to the process drainage system.

A crane grab will transfer the waste from the bunker to the feed hoppers/feeding chutes. The crane grab will also be used to remove any unsuitable or non-combustible items which are identified by the crane driver. These items will be removed from the bunker and placed in the quarantine area for further inspection, prior to transfer offsite to a suitable disposal/recovery facility. The waste bunker will allow for back-loading of waste in the event of unplanned periods of prolonged shutdown. Two waste back-loading bays will be at either end of the bunker for the removal of the waste.

The Environmental Management System (EMS) will include procedures to control the inspection, storage and onward disposal of unacceptable waste. Certain wastes may require specific action for safe storage and handling. Unacceptable or unsuitable wastes would be loaded into a bulker or other appropriate vehicle for transfer off-site either to the producer of the waste or to a suitably licensed waste management facility.

The waste bunker will be constructed of reinforced concrete and will be designed as a water retaining structure in accordance with '*BS EN 1992-3:2006, Eurocode 2*'. During construction and commissioning, quality assurance checks will be undertaken to prove the structural integrity of the bunker. This will minimise the potential for damage of the bunker during operation of the ERF.

Regular preventative maintenance as part of documented management systems at the site will ensure that the bunker integrity is maintained throughout the lifetime of the ERF. Preventative maintenance will include for periodically emptying the bunker and undertaking visual inspections of the concrete from which it is constructed. Should it be identified that damage has occurred to the structure, repairs will be undertaken to ensure that integrity is suitably maintained. These measures will ensure that liquids (such as leachates from waste) do not leak from the bunker and contaminate the underlying groundwater.

3.2.3 Waste minimisation audit (Minimising the use of raw materials)

A number of specific techniques will be employed to minimise the generation of residues, focusing on the following:

1. feedstock homogeneity;
2. dioxin & furan reformation;
3. furnace conditions;
4. flue gas treatment control; and
5. waste management.

All of these techniques meet the Indicative BAT requirements from EPR5.01 and the Waste Incineration BREF.

3.2.3.1 Feedstock homogeneity

Improving feedstock homogeneity can improve the operational stability of the ERF, leading to reduced reagent use and reduced residue production. Waste will originate from a variety of sources and suppliers. The mixing of wastes from different suppliers within the waste bunker will improve the homogeneity of waste input to the furnaces.

3.2.3.2 Dioxin & Furan reformation

As identified within EPR5.01 and the Waste Incineration BREF, there are a number of BAT design considerations required for the boilers. The boilers have been designed to minimise the formation of dioxins and furans as follows:

- Slow rates of combustion gas cooling will be avoided via boiler design to ensure the residence time is minimised in the critical cooling section and to avoid slow rates of combustion gas cooling to minimise the potential for de-novo formation of dioxins and furans. The boiler will be designed so that the steam/metal heat transfer surface temperature will be above a minimum of 170°C, where the flue gas is in the de novo synthesis temperature range.
- The residence time and temperature profile of flue gas will be considered during the detailed design phase to ensure that dioxin formation is minimised.
- It is reported in the guidance that the injection of ammonia compounds into the furnaces – i.e. an SNCR NOx abatement system – inhibits dioxin formation and promotes their destruction. An SNCR system to abate emissions of NOx is considered to represent BAT for the ERF, refer to section 3.6.2.
- Computational Fluidised Dynamics (CFD) will be applied to the design, where considered appropriate, to ensure gas velocities are in a range that negates the formation of stagnant pockets / low velocities. A copy of the CFD model will be supplied to the EA prior to commencement of commissioning. It is proposed that this is allowed for via pre-operational condition.
- Minimising the volume in the critical cooling sections will ensure high gas velocities.
- Boundary layers of slow-moving gas along boiler surfaces will be prevented via design and a regular maintenance schedule to remove build-up of any deposits that may have occurred.
- Design features will be optimised to maintain critical surface temperatures below the ‘sticking’ temperatures. The arrangement of cooling surfaces will be optimised, and peak combustion temperatures will be avoided through good waste mixing, uniform waste feed and good primary and secondary air control. This will reduce the level of boiler deposits which would otherwise catalytically enhance dioxin formation.

Taking the above into consideration, it is understood that the ERF will meet the requirements as detailed in EPR5.01.

3.2.3.3 Furnace conditions

Furnace conditions will be optimised in order to minimise the quantity of residues arising for further disposal. In accordance with Article 50(1) of the Industrial Emissions Directive, burnout in the furnace will either reduce the Total Organic Carbon (TOC) content of the bottom ash to less than 3%; or Loss on Ignition (LOI) of the bottom ash to less than 5%, by optimising the waste feed rate and combustion air flows.

3.2.3.4 Boiler conditions

Online boiler cleaning will be achieved through the installation of cleaning systems within the boiler that are capable of operating when the ERF is in operation. The exact specifications of the boiler cleaning systems will be subject to the detailed design of the ERF.

Additional off-line boiler cleaning will also be undertaken as part of scheduled maintenance activities.

3.2.3.5 Flue gas treatment control – acid gases

Close control of the flue gas treatment system will minimise the use of reagents and hence minimise the amount of APCr produced.

Lime usage will be minimised by trimming reagent dosing to accurately match the acid load using fast response upstream acid gas monitoring. The plant preventative maintenance regime will include regular checks and calibration of the reagent dosing system to ensure optimum operation. Back-up feed systems will be provided to ensure no interruption in the lime dosing system. The bag filter is designed to build up a filter cake of unreacted acid gas reagent, which acts as a buffer during any minor interruptions in dosing.

Activated carbon dosing will be based on flue gas volume flow measurement. The activated carbon dosing screw speed frequency control responds automatically to the increase and decrease of flue gas volume. Maintaining a steady concentration of activated carbon in the flue gas and consequently on the filter bags will maintain the adsorption rate for gaseous metals and dioxins.

Activated carbon and lime will be stored in separate silos. The feed rates for the activated carbon and lime dosing systems will have independent controls.

3.2.3.6 Flue gas treatment control – NOx

The SNCR system will require the injection of ammonia solution, into the radiation zone of the boilers at several levels.

The first boiler pass is divided into several segments. Each segment consists of a distribution module and injection nozzles on several levels. The configuration of the nozzles makes it possible to achieve full-area coverage of the injection medium across the entire cross section of the radiation zone.

The optimal adjustment of the SNCR ammonia injection ensures the maximal NOx reduction through the SNCR system.

Following commissioning of the ERF it is proposed to submit to the EA a report which describes the performance and optimisation of the SNCR system and combustion settings to minimise oxides of nitrogen (NOx) emissions within the emission limit values described in the EP.

3.2.3.7 Residue management

The arrangements for the management of residues produced by the installation are presented in section 3.9. In particular, bottom ash and APCr from the flue gas treatment system will be transferred, stored and disposed of separately, i.e. there will be no mixing of these residues.

The procedures for handling of wastes generated by the ERF will be in accordance with the Indicative BAT requirements in EPR5.01 and the Waste Incineration BREF, refer to section 3.2.2.

3.2.3.8 Waste charging

The ERF will comply with the BAT requirements outlined in EPR5.01 and the Waste Incineration BREF for waste charging and the specific requirements of the IED:

- The combustion control and feeding system will be fully in line with the requirements of the IED. The conditions within the furnaces will be continually monitored to ensure that optimal conditions are maintained and that the proposed emission limits are not exceeded. Auxiliary burners fired with low sulphur fuel oil will be installed and will be used to maintain the temperature in the combustion chamber if needed;
- The waste charging and feeding systems will be interlocked with furnace conditions so that charging cannot take place when the temperatures drop below 850°C during operation, or during start-up prior to the temperature being raised to 850°C within the furnaces;
- In the event that emissions to atmosphere are in excess of an emission limit value, other than under abnormal operating conditions, the operators will be required to prohibit the waste charging system (i.e., waste into the hopper) using interlocks. If a period of abnormal operation exceeds 4 hours, the operators will be required to prohibit the waste charging system;
- The isolation doors that prevent the fire burning back up the chute will be double doors and/or have a cooling system, to prevent the ignition of waste in contact with the outside of the door;
- Following loading into the chutes by the grab, the waste will be transferred onto the grates by hydraulic powered feeding units;
- The backward flow of combustion gases and the premature ignition of waste will be prevented by keeping the chutes full of waste and by keeping the furnaces under negative pressure;
- A level detector will monitor the amount of waste in each chute and an alarm will be sounded if the waste falls below the safe minimum level. Secondary air will be injected from nozzles in the wall of the furnaces to control the combustion within the furnaces (flame height and directions of air/flame flow); and
- In a breakdown scenario, operations will be reduced or closed down as soon as practicable until normal operations can be restored.

The waste feed rate to the furnaces will be controlled by the combustion control system. If there is an intermediate waste feed-stop requiring the auxiliary burners to operate to maintain the operation of the ERF without entering shutdown, the flue gas treatment systems will remain in operation.

3.3 Water use

3.3.1 Overview

The main use of water at the ERF will be to make up the water for the boilers. Other water-consuming processes will include cooling of blowdown and the SNCR system. The following key points should be noted:

- The water system has been designed with two key objectives:
  - minimal process water discharge; and
  - minimal consumption of potable water discharge into the drainage systems.
- Where practicable, waste waters generated from the process will be reused/recycled within the process, for example in the ash quench system.
- In the event that excess process effluents are generated, these will either be tankered off-site to a suitably licensed waste management facility or discharged to sewer in accordance with a Trade Effluent Consent – to be confirmed.
- Most of the steam used in the turbine will be recycled as condensate.
  - The remainder will be lost as blowdown to prevent the build-up of sludge and chemicals, in addition to soot blowing, blowdown cooling and flue-gas treatment.
  - Lost condensate will be replaced with high-quality boiler feedwater.
- Surface water from external areas of hardstanding and roadways will be discharged into the on-site surface water attenuation pond. Oil interceptors would treat surface water prior to discharge off-site to the River Tees.
- Firewater will be provided by an on-site water tank(s) connected to the mains water supply.
- The ERF will have separate process water, foul water and surface water systems.

3.3.1.1 Potable and Amenity Water

Water for drinking supplies for the offices and welfare facilities will come from a potable water supply. The quantity of this water is expected to be small compared to the other water uses on site.

Foul and domestic effluents from showers, toilets, and other mess facilities will be discharged to foul sewer.

3.3.1.2 Process Water

Process water use

Mains water will be treated in an on-site water treatment plant to produce high-quality demineralized boiler feedwater. The demineralised water will be used to compensate for boiler blow down losses. It is anticipated that the ERF will consume approximately 6.6 tonnes per hour of mains water.

Process effluents will be recycled (for example, used in the ash quench), to allow a zero-discharge system during normal operations. Process effluents would be temporarily stored within a wastewater pit or similar structure, prior to reuse and recycling within the process.

Integrity of structures

The exact type of structures will be confirmed during the detailed design of the ERF; however, the wastewater pits will be designed and constructed to be impermeable to the liquids that are being stored within them. Therefore, there will be negligible risk of process effluents leaking to the underlying groundwater or surrounding environment. During construction and commissioning, quality assurance checks will be undertaken to prove the structural integrity of the process effluent storage facilities. This will minimise the potential for damage of the structure during operation of the ERF.

In addition to the preventative maintenance systems, the dirty water pit will be designed with a leak detection system. The preventative maintenance systems will include (if appropriate) pressure tests, leak tests, material thickness checks, CCTV etc – to be confirmed during detailed design.

Sources and types of process effluent

It is expected that excess process effluents will include the following sources:

- boiler water resulting from emptying the boiler;
- small quantities of boiler blowdown;
- reject water from the water treatment plant; and
- washdown water from process areas, including the waste reception areas.

As such, there may be small quantities of boiler treatment chemicals present in the process effluent. The exact types of water treatment chemicals to be added to boiler feedwater are subject to detailed design of the ERF. The chemicals will be significantly diluted by other process effluents within the wastewater pit. The following are 'typical' examples of water treatment chemicals:

- sodium hydroxide (NaOH);
- sulphuric acid (H2SO4);
- hydrochloric acid (HCl);
- sodium chloride (NaCl);
- oxygen scavenger;
- sodium phosphate (Na3PO4) (descaler); and
- ammonium hydroxide (NH4OH) (pH control).

An indicative water flow diagram for process water is presented in Figure 4, with indicative drainage diagrams for overall surface water and domestic effluent management at REC presented in section 1.4.4. Larger versions of these drawings are included within Appendix A.

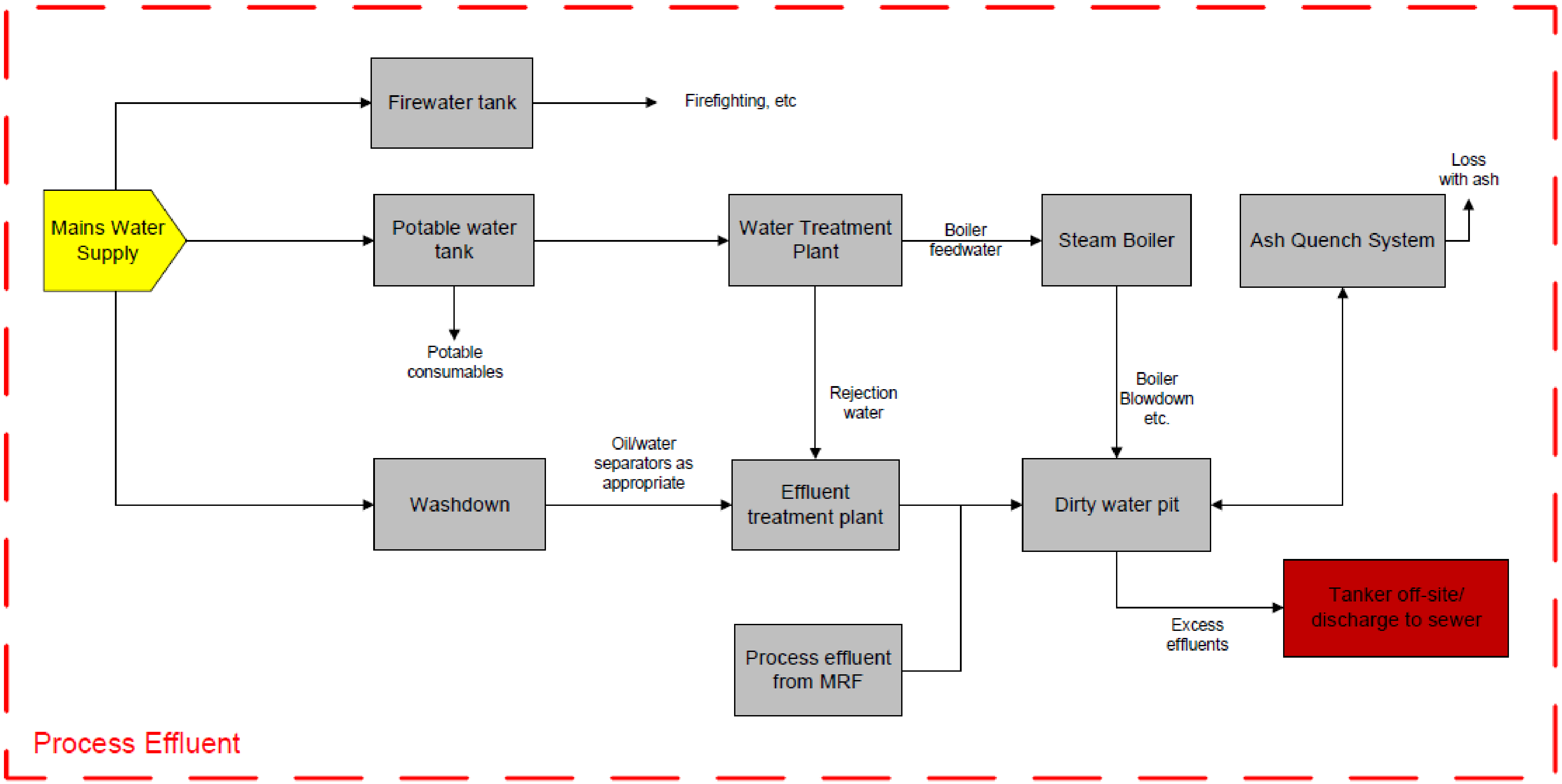


Figure 4:Indicative water flow diagram – process water – ERF

3.4 Emissions

A consolidated table detailing the proposed emissions points at the site is presented in section 1.4.6. Point source emissions to air

The full list of proposed emission limits for atmospheric emissions from the ERF is shown in the table below.

Table 9: Proposed air emission limit values (ELVs) – ERF

Parameter	Units	Half Hour Average	Daily Average	Periodic Limit	Periodic Limit – Reference period
Emission Points A1 and A2					
Particulate matter	mg/Nm^3	30	5		
VOCs as Total Organic Carbon (TOC)	mg/Nm^3	20	10		
Hydrogen chloride	mg/Nm^3	60	6		
Carbon monoxide	mg/Nm^3	150*	50		
Sulphur dioxide	mg/Nm^3	200	30		
Oxides of nitrogen (NO and NO_2 expressed as NO_2)	mg/Nm^3	400	100		
Ammonia	mg/Nm^3		10		
Hydrogen fluoride	mg/Nm^3			1	Average of three consecutive measurements of at least 30 minutes each
Cadmium & thallium and their compounds (total)	mg/Nm^3			0.02	
Mercury and its compounds	mg/Nm^3			0.02	
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V and their compounds (total)	mg/Nm^3			0.3	
Dioxins & furans	ng I-TEQ $/Nm^3$			0.04	Periodic over minimum 6 hours, maximum 8-hour period
Dioxin & furan-like PCBs	ng WHO-TEQ$/Nm^3$			0.06	

All expressed at 11% oxygen in dry flue gas at standard temperature and pressure.
**Averaging period for carbon monoxide is 95% of all 10-minute averages in any 24-hour period.*

The BAT Reference Document on Waste Incineration (herein referred to as the Waste Incineration BREF) and the European Union Commission Implementing Decision (EU) 2019/2010 dated 12 November 2019 (establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration) were published in December 2019. Therefore, in accordance with the Waste Incineration BAT Conclusions, the ERF is required to comply with the BAT-AELs, for a 'new' facility, from commencement of operation. The emission limits being applied for are in accordance with the upper end of the BAT-AEL ranges for a 'new' facility, with the exception of NOx, where a lower ELV of 100 mg/Nm^3 is applied in accordance with the requirements of the EA's BREF Interpretation Document.

3.4.1 Fugitive emissions to air

3.4.1.1 Waste handling and storage

Waste reception, handling and storage will be undertaken in enclosed areas, with the waste reception area held under negative pressure, to prevent the release of litter and dusts. Fast-acting roller shutter doors will be in place at the entrance to the tipping hall of the ERF. Good housekeeping will also be employed at the ERF to minimise the build-up of dust and litter (such as regular washdown activities).

Primary combustion air will be drawn from the waste bunker area to maintain negative pressure in the waste bunker area and fed into the combustion chamber beneath the grates. Additional bunker management procedures, and the inclusion of regular clean downs of the waste reception areas, will minimise the release of litter and dusts.

Bottom ash would first be dampened and cooled using a water quench prior to transfer to the adjacent IBA facility for storage/treatment/processing. This highly reduces the likelihood of dust being generated from bottom ash handling .

Mobile plant and vehicle operators at the site will be provided with suitable training for the equipment they are operating. Supervision of mobile plant operation and regular site inspections will ensure that any leaks, trailing or tracking of residues from vehicles are quickly identified and suitably addressed. During prolonged periods of dry weather, the site roads would be damped down / washed if the potential for fugitive dust impacts resulting from traffic movements are identified by the site 'general manager'.

3.4.1.2 Silos

All silos will be fitted with bag filter protection to prevent the uncontrolled release of dusts during refilling activities.

Maintenance procedures will be developed for routine inspection and testing of the bag filters.

The APCr silos will be unloaded by a chute system. All unloading operations will be supervised by site operatives. Dusty air from the unloading of the APCr silos will be extracted and vented to atmosphere via bag filters fitted to prevent the release of dusts from silo unloading operations.

The unloading chute from the APCr silo will be designed with an inner core, which will be used for the unloading of APCr of the silo, and an outer 'bellow' which will extract displaced air from the silo and pass it through a filter with the air subsequently vented back into the silo.

The site operatives will assist the delivery driver in positioning the tanker underneath the loading chute. The delivery driver will be responsible for connecting the unloading chute to the tanker. Site operatives will be responsible for checking that the loading chute is closed following completion of unloading and will be required to clear up any spilled material. Cleaning of the tanker is prohibited outside the enclosed loading area. The APCr unloading area will have a dedicated drainage system, with all runoff/leachate collected for reuse as process water within the ERF.

3.4.2 Point source emissions to water and sewer

Further detail on the site drainage is presented within section 1.4.4. However, the following provides a summary of the proposed containment and drainage measures at the ERF.

During normal operations, there will be no emissions of process effluent from the ERF discharged off-site. In the event that excess process effluents are generated, these will either be tankered off site or discharged to sewer in accordance with a Trade Effluent Consent – to be confirmed.

Waste handling, raw material handling and residues handling will be undertaken on areas of hardstanding with contained drainage. In addition, waste handling and the initial quenching and handling of bottom ash will be undertaken within enclosed buildings. These measures will prevent the release of any process water from the ERF to the site surface water drainage system.

Surface water run-off from buildings, roadways and external areas of hardstanding will be discharged into the surface water drainage system. The surface water drainage system will drain into the attenuation storage prior to discharge to the River Tees via petrol interceptors. In the case of a fire or a significant spill occurring at the site, an isolation valve will prohibit the discharge of contaminated effluent off-site.

3.4.3 Contaminated water

3.4.3.1 Containment measures

Storage and containment facilities

Deliveries of all chemicals will be unloaded and transferred to suitable storage facilities. Areas and facilities for the storage of chemicals and liquid hazardous materials will be situated within secondary containment, such as bunds. Secondary containment facilities will have capacity to contain whichever is the greater of 110% of the tank capacity or 25% of the total volume of materials being stored, in case of failure of the storage systems.

All chemicals will be stored in an appropriate manner incorporating the use of suitable secondary and other measures (such as acid and alkali resistant coatings) to ensure appropriate containment and tertiary abatement measures. The exact design of the containment measures is subject to the detailed design of the ERF. However, Redcar Ltd can confirm that all storage and containment facilities will be designed and operated in accordance with relevant guidance relating to the design and construction of containment systems, including the Guidance for Pollution Prevention (GPP) guidance notes and the relevant EA/Government guidance including '*Pollution prevention for businesses'.* Redcar Ltd would be happy to provide details to the EA of the proposed containment measures following completion of detailed design.

The primary containment for raw materials will be the vessel in which the raw material is stored in. Secondary containment will be provided to contain a spill or leak. The secondary containment for liquid materials will provide at least 110% of the storage capacity, in accordance with the EA guidance '*Pollution prevention for businesses*.' Tertiary containment will be any additional measures to ensure that contaminants are not released from the site in the unlikely event that the secondary containment was to fail.

The exact materials from which chemical storage facilities will be constructed from is subject to the detailed design of the ERF. Therefore, it cannot be confirmed whether alkali or acid resistant coatings will be used at this stage. However, with regards liquid chemicals, it can be confirmed that the ammonia and fuel oil tanks will be metal tanks located within an area with secondary containment (i.e. bunding or sumps) which will be able to contain a spill.

Areas of external hardstanding will also incorporate site kerbing to provide additional containment. This provides further ‘protection’ against any potential spills from causing pollution of the ground/groundwater and surface water. The potential for accidents, and associated environmental impacts, is therefore limited.

Adequate quantities of spillage absorbent materials will be made available at easily accessible location(s), where chemicals are stored. A site drainage plan, including the location of process and surface water drainage will be made available on-site following completion of detailed design.

Process water drains within the ERF will drain to a process water tank/dirty water pit or similar prior to re-use within the process, for example within the ash quench. In the unlikely event that excess process effluents are generated, these will be tankered off-site to a suitably licensed waste management facility or discharged to sewer in accordance with a Trade Effluent Consent.

Tanker unloading

With regards the unloading of raw materials and chemicals, tanker off-loading of fuel oil and liquid chemicals such as ammonia will take place within areas where the drainage is contained with the appropriate capacity to contain a spill during delivery. This will include measures such as areas of hardstanding with falls to a gully and/or sump. Other external unloading areas (e.g. for solid raw materials such as lime, activated carbon) will have contained drainage with falls to the process drainage system. In accordance with the EA guidance, delivery pipes will clearly be marked with the tank volume and substance stored to ensure deliveries are made to the correct tanks, reducing the risks of accidents and spillages during unloading operations.

Maintenance and inspections

Operational techniques will be in place to inspect and identify damage to the hardstanding and curbing across the site. The site EMS will contain a preventative maintenance regime for all plant and equipment (including civils such as drainage systems, hardstanding, kerbing etc). For hardstanding and kerbing, visual inspections will be undertaken at defined intervals set out within the preventative maintenance programme. Should it be identified that any damage has occurred to the structures, repairs will be undertaken to ensure that their integrity has been maintained and that there is no compromise in terms of leakage or contamination of the underlying ground/groundwater.

Similarly, regular preventative maintenance of any sumps/containment bunds across the site will be undertaken, which will include for periodically emptying sumps/bunds and undertaking visual inspections of the concrete or other material from which the sumps/bunds are constructed. In the event that the visual inspection identifies that the integrity of the sumps or bunds has been compromised, additional pressure tests, leak tests and material thickness checks may be undertaken. The measures described above will ensure the integrity of containment systems is maintained throughout the lifetime of the site.

It is expected that any secondary containment bunds will meet the CIRIA 736 standard (‘*Containment systems for the prevention of pollution*’). However, should the EPC contractor propose an alternative standard, Redcar Ltd will ensure that this standard is equivalent to CIRIA 736.

With regards the penstock valves to be installed at the site, regular preventative maintenance of these will also be undertaken in accordance with the manufacturers recommendations.

Response to spillages

In accordance with the emergency response procedures which will be developed for the ERF, spillages will be reported to the site management and a record of the incident will be made. The relevant authorities (Environment Agency / Health and Safety Executive) will be informed if spillages/leaks are significant, in accordance with documented management procedures. Spillages will be recorded in accordance with installations inspection, audit and reporting procedures. The effectiveness of the emergency response procedures will be subject to Management Review and will be revised and updated as appropriate following any major spillages.

3.4.4 Odour

The storage and handling of waste is considered to have potential to give rise to odour. The ERF will be designed in accordance with the requirements of EA Guidance Note H4: Odour. The ERF will include a number of controls to minimise odour during normal and abnormal operation, as set out in the following sections.

3.4.4.1 Delivery and storage of waste

Redcar Ltd will have a small number of waste suppliers which will supply waste to the ERF, in addition to waste which is delivered via conveyor from the adjacent fuel preparation facility. Agreements will be in place with the waste suppliers as part of waste acceptance procedures for the ERF, which will identify a waste specification for the incoming waste, which will include information on the composition and 'quality' of the waste which will be accepted at the ERF. If the waste delivered to the ERF is not in accordance with the relevant specification, it will not be accepted at the ERF, and will be returned to the waste supplier. This will include wastes which are particularly odorous – the waste acceptance procedures will define criteria for determining what constitutes a 'malodorous' material. The reasons for the rejection of the waste will be reported to the waste supplier, and they will be requested to undertake an investigation to determine why the 'unacceptable' waste had been transferred to the ERF and implement corrective actions to prevent re-occurrence.

Waste delivered to the ERF would be in enclosed or otherwise covered vehicles, to prevent fugitive emissions of odour and litter during transport. Doors to the tipping hall will be fast-acting roller shutter doors, which will close once a delivery vehicle has entered the tipping hall. This will minimise the time in which they are open and so reduce the potential for fugitive emissions of odour.

All wastes received at the ERF will be unloaded and stored within the waste reception area. The waste reception area will be retained at negative pressure using induced draught (ID) fans located above the bunker. These fans will draw air from the waste reception area into the furnace to be used as combustion air within the process. Negative pressure within the waste reception area will minimise odorous emissions (as well as dust and litters) from escaping the ERF. It is not expected that both incineration lines will be shut down at the same time at any point during the year, as planned maintenance of each line will be undertaken in succession. However, in the very unlikely event that both lines are shutdown due to an unplanned event, waste will be backloaded from the bunker and transferred off-site should odour be deemed a potential issue.

3.4.4.2 Inspections and monitoring

During normal operation of the ERF, daily inspections will be undertaken to monitor for odour and would include, but not be limited to, the following:

- olfactory checks for odour in the waste reception areas and external installation boundary;
  - staff undertaking olfactory surveys will do so upon arrival to site (i.e. before being exposed to odour at the site for a prolonged period of time).

- monitoring the positions of louvres (e.g. ensuring doors are kept shut when no waste deliveries are occurring); and
- monitoring combustion air flow, with odorous air extracted via the boilers and the stack.

During periods of shutdown, the frequency of the above inspections would be extended, including monitoring combustion air flow if the ID fan operation can be maintained, for instance during periods of maintenance. Doors to the waste reception hall would be kept closed. In addition, during shutdown, additional 'sniff test' and inspection around the boundary of the ERF would be conducted. In the unlikely event that odour is detected outside the building or if odour complaints are received from neighbours, full odour surveys would be undertaken. If it is deemed appropriate, operating procedures would be amended to deal with any issues identified at the site.

3.4.4.3 Active mitigation

During normal operation, bunker management procedures will be employed to avoid the development of anaerobic conditions and decomposition in the waste bunker, which could generate further odorous emissions. These management procedures will include the frequent mixing and rotation of waste to ensure regular and well distributed turnover of waste. The process also results in a more homogeneous waste feed, which would increase efficiency in the incineration process.

Prior to periods of planned maintenance, bunker management procedures will reduce the amount of material in the bunker before shutdown. Maintenance would typically be undertaken in succession of the incineration lines – i.e. it is unlikely that both lines will be offline at the same time. In the event that both lines are offline (expected to be an unlikely scenario), the bunker management procedures (mixing of waste) would not normally be implemented, to avoid the generation of odorous emissions especially when waste volumes within the bunker are low. In the event of an extended unplanned shutdown where both lines are non-operational, if odour is identified to pose an issue despite the preventative measures in place, waste will be unloaded from the bunker for transfer off-site to a suitably licensed waste management facility.

3.4.4.4 Other measures

BAT 21 and section 4.2.2.3 of the Waste Incineration BREF list various methods and techniques as representing BAT to prevent or reduce diffuse emissions (including odour emissions) from a waste incineration plant. In addition to the measures already outlined above:

- The operation of the ERF will not give rise to odorous liquid wastes. Therefore, the requirement to store liquid wastes in tanks under controlled pressure and duct the tank vents to the combustion air feed or other suitable abatement system will not apply to the ERF.
- Waste will not be stored in bales at the ERF.

3.5 Monitoring methods

3.5.1 Emissions monitoring

Sampling and analysis of all pollutants will be carried out to CEN or equivalent standards (e.g. ISO, national, or international standards) and in accordance with the Environment Agency's MCERTS scheme. This ensures the provision of data of an equivalent scientific quality.

Methods and standards used for monitoring of emissions will be in compliance with EPR5.01 and the IED. In particular, CEMS equipment will be certified to the MCERTS standard.

The plant will be equipped with modern monitoring and data logging devices to enable checks to be made of process efficiency.

The purpose of monitoring has three main objectives:

1. To provide the information necessary for efficient and safe plant operation;
2. To warn the operator if any emissions deviate from predefined ranges; and
3. To provide records of emissions and events for the purposes of demonstrating regulatory compliance.

3.5.1.1 Monitoring emissions to air

The following parameters for the emissions from the ERF will be monitored and recorded continuously using a Continuous Emissions Monitoring System (CEMS):

1. Carbon monoxide;
2. Hydrogen chloride;
3. Sulphur dioxide;
4. Nitrogen oxides;
5. Ammonia;
6. Volatile organic compounds (VOCs); and
7. Particulates.

In addition, the oxygen and water vapour content, temperature and pressure of the flue gases will be monitored so that the emission concentrations can be reported at the reference conditions required by the Industrial Emissions Directive (IED).

There will be two CEMS systems; one per waste incineration line. There will also be an installed back-up which can operate on both lines in the event of a CEMS failure.

In addition to the CEMS system, the following emissions from the ERF will also be monitored by means of periodic spot sampling at frequencies agreed with the Environment Agency:

1. Hydrogen fluoride;
2. Group 3 Heavy Metals [antimony (Sb), arsenic (As), lead (Pb); chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), vanadium (V)];
3. Cadmium (Cd) and thallium (Tl);
4. Mercury (Hg);
5. Nitrous oxide;
6. Dioxins and furans;
7. Dioxin like PCBs; and
8. PAHs.

The Waste Incineration BREF requires the continuous monitoring of mercury. However, it states that for plants incinerating wastes with a proven low and stable mercury content, continuous monitoring may be replaced by periodic monitoring once every six months. The EA's BREF implementation document makes reference to a protocol which requires operators to demonstrate consistent performance below a threshold limit of 10 $\mu g/m^3$ in order not to require mercury CEMS. The EA's EP permit template, provided through its consultation with the waste incineration sector, includes improvement conditions requiring a programme of monitoring to be undertaken to demonstrate a low and stable mercury content. Taking this into consideration, it is proposed to apply for periodic monitoring of mercury within the EP with this subsequently demonstrated via an improvement condition.

The Waste Incineration BREF also requires continuous monitoring of hydrogen fluoride; however, it is stated that this may be replaced by periodic monitoring if hydrogen chloride levels are proven to be sufficiently stable. With the proposed measures for the control of the abatement of acid gases (refer to section 3.2.3.5), periodic monitoring of hydrogen fluoride is proposed.

The frequency of periodic measurements will comply with the IED as a minimum. The flue gas sampling techniques and the sampling platform will comply with Environment Agency Technical Guidance Notes M1 and M2. Periodic monitoring will be undertaken by MCERTS accredited stack monitoring organisations.

All monitoring results shall be recorded, processed and presented in such a way as to enable the EA to verify compliance with the operating conditions and the regulatory emission limit values within the EP.

Reliability

IED Annex VI Part 8 allows a valid daily average to be obtained only if no more than 5 half-hourly averages during the day are discarded due to malfunction or maintenance of the continuous measurement system. IED Annex VI Part 8 also requires that no more than 10 daily averages are discarded per year. These reliability requirements will be met primarily by selecting MCERTS certified equipment.

Calibration of the CEMS will be carried out at regular intervals as recommended by the manufacturer and by the requirements of BS EN 14181 and the BS EN 15267-3. Regular servicing and maintenance will be carried out under a service contract with the equipment supplier. The CEMs will be supplied with remote access to allow service engineers to provide remote diagnostics. Therefore, the installation and functioning of the CEMS is subject to control and to annual surveillance tests as set out in point 1 of Part 6 of Annex VI.

As previously stated, there will be a CEMS system per incineration line, and a stand-by CEMS in the event of a CEMS failure. This will ensure that there is continuous monitoring data available even if there is a problem with either of the duty CEMS.

Start-up and shut-down

In accordance with the IED, the emission limit values do not apply during start-up and shutdown. However, the abatement plant will operate during start-up and shutdown. Therefore, a signal will be sent from the main plant control system to the CEMS system to indicate when the plant is operational and burning waste. The averages will only be calculated when this signal is sent, but raw monitoring data will be retained for inspection.

Start-up ends when all the following conditions are met:

1. the feed chute damper is open, and the feeder ram, grate and ash extractors are all running;
2. exhaust gas O_2 is less than 15% (wet measurement); and
3. the combustion grate is fully covered with waste.

Shutdown begins when all the following conditions are met

1. the feed chute damper is closed;
2. the auxiliary burner is in service; and
3. exhaust gas oxygen is equal or above 15% (wet measurement).

3.5.1.2 Monitoring emissions to water and sewer

Under normal operation, there will be no emissions of process effluent from the ERF. In the unlikely event that excess process effluents are generated, it is intended to tanker these off-site for treatment at a suitably licensed waste management facility or discharge these to sewer in accordance with a Trade Effluent Consent, with any monitoring of process effluents undertaken in accordance with the requirements of the Sewerage Undertaker.

It is not proposed to undertake monitoring of uncontaminated surface water from the site.

Foul/domestic effluent from welfare facilities would be discharged to foul sewer in accordance with a Trade Effluent Consent, with any monitoring undertaken in accordance with the requirements of the Sewerage Undertaker.

3.5.2 Monitoring of process variables

The ERF will be controlled from a dedicated control room. A modern control system, incorporating the latest advances in control and instrumentation technology, will be utilised to control operations, optimising the process relative to efficient heat release, good burn-out and minimum particle carry-over. The system will control and/or monitor the main features of the plant operation including, but not limited to, the following:

- combustion air;
- waste feed rate;
- SNCR system;
- flue gas oxygen concentration at the boiler exits;
- flue gas composition at the stack;
- combustion process;
- boiler feed pumps and feedwater control;
- steam flow at the boiler outlets;
- steam outlet temperature;
- boiler drum level control;
- flue gas control;
- power generation; and
- steam turbine exhaust pressure.

The response times for instrumentation and control devices will be designed to be fast enough to ensure efficient control.

The following process variables have particular potential to influence emissions:

1. Waste throughput will be recorded to enable comparison with the design throughput. As a minimum, daily and annual throughput will be recorded.
2. Combustion temperature will be monitored at a suitable position to demonstrate compliance with the requirement for a residence time of 2 seconds at a temperature of at least 850°C.
3. The differential pressure across the bag filters will be measured, in order to optimise the performance of the cleaning system and to detect bag failures.
4. The concentration of HCl in the flue gases upstream of the flue gas treatment system will be measured in order to optimise the performance of the emissions abatement equipment.

Water use will be monitored and recorded regularly at various points throughout the process to help highlight any abnormal usage. This will be achieved by monitoring the incoming water supplies and the boiler water makeup.

In addition, electricity and auxiliary fuel consumption will be monitored to highlight any abnormal usage. Annual reports of process variables (such as water and raw material consumption) will be submitted to the EA in accordance with the requirements of the EP.

3.5.2.1 Validation of combustion conditions

As described in Section 1.4.2.2, the ERF will be designed to provide a residence time, after the last injection of combustion air, of more than two seconds at a temperature of at least 850°C. This criterion will be demonstrated using Computational Fluid Dynamic (CFD) modelling during the design stage and confirmed by the recognized measurements and methodologies during commissioning in accordance with Guidance Note EPR5.01.

It will be demonstrated during commissioning that the ERF can achieve complete combustion by measuring concentrations of carbon monoxide, VOCs and dioxins in the flue gases, and TOC or LOI in the bottom ash.

During the operational phase, the temperature at the 2-seconds residence time point will be monitored to ensure that it remains above 850°C. The location of the temperature probes will be selected using the results of the CFD model. If it is not possible to locate the temperature probes at the precise point of the 2-seconds residence time, then a correction factor will be applied to the measured temperature.

Ammonia will be injected into the flue gases at a temperature of between 850°C and 1000°C. This narrow temperature range is required to efficiently reduce NOx and avoid unwanted secondary reactions. This means that multiple levels of injection points will be required in the radiation zone of the furnace. It is acknowledged that the Waste Incineration BREF identifies a narrower effective temperature range of 850 – 950°C for optimum reaction rates. During detailed design of the ERF, the SNCR system will be optimised to achieve a balance between high reaction rates, low NOx emission concentrations and low reagent consumption, and it will be designed to operate within the temperature range stated in the Waste Incineration BREF, where possible.

Sufficient nozzles will be provided at each level to distribute the ammonia correctly across the entire cross section of the radiation zone. CFD modelling will be utilised to determine the appropriate location and number of injection levels as well as number of nozzles to ensure the SNCR system achieves the required NOx reduction for the whole range of operating conditions while maintaining the ammonia slip below the required emission level. The CFD modelling will also be used to optimise the location of the secondary air inputs into the combustion chamber.

3.5.2.2 Measuring oxygen levels

The oxygen concentration at the boiler exits of the ERF will be monitored and controlled to ensure that there will always be adequate oxygen for complete combustion of combustible gases. Oxygen concentration will be controlled by regulating the combustion airflows and the waste feed rate.

3.6 Technology selection (BAT)

This section presents qualitative and quantitative BAT assessments for the following at the ERF:

- combustion technology;
- NOx abatement;

- acid gas abatement;
- particulate matter abatement; and
- steam condenser.

The quantitative assessments, where appropriate, draw on information and data obtained by Fichtner from a range of different projects using the technologies identified as representing BAT from initial qualitative assessment.

3.6.1 Combustion technology

It is proposed that the waste treatment/energy recovery technology for the ERF will be two moving grate furnaces. This is the leading technology in the UK and Europe for the combustion of the waste types likely to be treated by the ERF. The moving grates will comprise of inclined fixed and moving bars that will move the waste from the feed inlets to the residue discharge. The grate movement turns and mixes the waste along the surface of the grate to ensure that all waste is exposed to the combustion process.

The Waste Incineration BREF and the BREF for Large Combustion Plants identify a number of alternative technologies for the combustion of waste. The suitability of these technologies among others has been considered, as follows:

1. **Grate furnaces**

   As stated in the EPR5.01, these are designed to handle large volumes of waste.

   Grates are the leading technology in the UK and Europe for the combustion of biomass and non-hazardous waste, such as that proposed to be treated at the ERF. The moving grate comprises an inclined fixed and moving bars (or rollers) or a vibrating grate that will move the waste from the feed inlet to the residue discharge. The grate movement turns and mixes the waste along the surface of the grate to ensure that all waste is exposed to the combustion process.

   Grate systems are designed for large quantities of heterogeneous waste and so would be appropriate for the waste to be processed at the ERF.

2. **Fixed hearth**

   These are not considered suitable for large volumes of waste. They are best suited to low volumes of consistent waste. Therefore, these systems are not considered suitable for the proposed design capacity and have not been considered any further.

3. **Pulsed hearth**

   Pulsed hearth technology has been used for refuse-derived fuels, as well as other solid wastes. However, there have been difficulties in achieving reliable and effective burnout of the waste and it is considered that the burnout criteria required by Article 50(1) of the IED would be difficult to achieve. Therefore, these systems are not considered practical and have not been considered any further for the ERF.

4. **Rotary and oscillating kilns**

   Rotary kilns are used widely within the cement industry which uses a consistent fuel feedstock and they have been used widely within the healthcare sector in treating clinical waste, but they have not been used in the UK for large volumes of waste derived fuels.

   An oscillating kiln is used for the incineration of municipal waste at only two currently known sites in England and some sites in France. The energy conversion efficiency in these systems is lower than that of other thermal treatment technologies due to the large areas of refractory lined combustion chamber.

In addition, typical oscillating kiln units have a maximum processing capacity of approximately 8 tonnes per hour; therefore, the ERF would require around 7 kilns to attain the maximum throughput. Considering the proposed capacity of the ERF, this is considered impractical and would lead to significant efficiency losses. Therefore, these systems have not been considered any further.

5. **Fluidised bed combustor**

   Fluidised beds are designed for the combustion of a relatively homogeneous fuel. Therefore, fluidised beds are appropriate for waste which has been pre-processed to produce a pre-processed waste fuel, often referred to as RDF.

   While fluidised bed combustion can lead to slightly lower NOx generation, the injection of a NOx reagent is still required to achieve the relevant emission limits specified in IED.

   Fluidised beds can have elevated emissions of nitrous oxide, a potent greenhouse gas. Some fluidised beds have been designed to minimise the formation of nitrous oxide.

6. **Pyrolysis/Gasification**

   In pyrolysis, the waste is heated in the absence of air, leading to the production of a syngas with a higher calorific value than from gasification. However, the process normally requires some form of external heat source, which may be from the combustion of part of the syngas.

   Various suppliers are developing pyrolysis and gasification systems for the incineration of waste fuels such as that proposed for the ERF, however, systems such as these are not considered to be a robust and proven technology for the treatment of residual MSW and C&I waste at the proposed waste processing capacity for the ERF. Therefore, these systems have not been considered any further.

A quantitative BAT assessment for combustion technologies has been undertaken and is presented in Appendix F, section 5. The conclusions of the assessment are summarised in Table 10.

Table 10: BAT assessment – combustion techniques

Parameter	Units	Grate	Fluidised bed
Global warming potential	t CO2 eq p.a.	-136,400	-134,900
Ammonia consumption	t.p.a.	2,600	2,000
Residues (total ash)	t.p.a	118,830	124,230
Annual total materials cost (reagents plus residues)	p.a.	£6,520,000	£7,070,000
Annual power revenue	p.a.	£20,463,000	£20,235,000

All combustion technologies will produce similar quantities of residues, although the fluidised bed produces more residues due to the losses of sand from the furnace.

The material costs are approximately 8% higher for the fluidised bed than the grate, whereas the grate system will have a slightly higher power revenue. However, it is acknowledged that it is marginal. The grate system will be capable of processing a wider range of waste compositions compared to a fluidised bed system which requires a consistent and homogenous waste feed. Therefore, the fluidised bed will require additional treatment of the waste to ensure that it is suitable for processing. It is acknowledged that some level of treatment (e.g., shredding of bulky waste) will be undertaken at the adjacent fuel preparation facility; however, a number of varying waste types will also be delivered directly to the ERF, resulting in a less homogenous mixture of waste in the bunker.

Due to the robustness of grate combustion systems and their ability to process large quantities of heterogeneous waste, Redcar Ltd considers that they represent BAT for the ERF.

3.6.2 NOx abatement systems

As stated within EPR5.01, there are three recognised technologies available for the abatement of emissions of NOx:

- Flue Gas Recirculation (FGR);
- Selective Non-Catalytic Reduction (SNCR); and
- Selective Catalytic Reduction (SCR).

1. **FGR**

   It is currently assumed that the ERF will not employ FGR. However, this is subject to detailed design of the ERF and selection of a technology provider and EPC contractor.

   It is important to understand that FGR is not a bolt-on NOx abatement technique. The recirculation of a proportion of the flue gases into the combustion chamber to replace some of the secondary air changes the operation of the plant in various ways, by changing the temperature balance and increasing turbulence. This requires the boilers to be redesigned to ensure that the air distribution remains even.

   Some suppliers of grates have designed their combustion systems to operate with FGR and these suppliers can gain benefits of reduced NOx generation from the use of FGR. Other suppliers of grates have focussed on reducing NOx generation through the control of primary and secondary air and the grate design, and these suppliers gain little if any benefit from the use of FGR.

   It is also important to emphasise that, even where FGR does improve the performance of a combustion system, it does not reduce NOx emissions to the levels required by IED. Therefore, it would not alleviate the need for further NOx abatement systems.

2. **SNCR**

   SNCR involves distributing a spray containing an aqueous SNCR reagent (ammonia solution in the case of the ERF) into the flue gas flow path at an appropriate location (typically the high temperature region of the boilers). The ammonia will react with the NOx formed in the combustion process to produce a combination of nitrogen, water and carbon dioxide. NOx levels are primarily controlled by monitoring the flow of combustion air.

   Extensive dosing of reagent or low reaction temperatures can lead to ammonia slip, resulting in the formation of ammonia salts downstream in the flue gas path and discharge to atmosphere of unreacted ammonia. Ammonia slip may be controlled by employing systems to control the rate of reagent dosing to ensure that it is kept to a minimum.

   SNCR is widely deployed across waste, biomass and coal power plants in the UK and Europe. It is proposed to use SNCR for the ERF to control NOx levels, in combination with controlling the combustion air through the combustion control system. Ammonia solution will be used as the reagent within the SNCR system.

3. **SCR**

   In an SCR system the SCR reagent is injected into the flue gases immediately upstream of a reactor vessel containing layers of catalyst. The reaction is most efficient in the temperature range 200 to 350°C. The catalyst is expensive and to achieve a reasonable working life, it is necessary to install the SCR downstream of the flue gas treatment plant. This is because the flue gas treatment plant removes dust which would otherwise cause deterioration of the catalyst.

Since the other flue gas cleaning reactions take place at an optimum temperature of approximately 140°C, the flue gases have to be reheated before entering the SCR system. This requires some thermal energy which would otherwise be converted to electrical power output, reducing the overall energy recovery efficiency of the facility. The catalytic reactor also creates additional pressure losses to be compensated by a bigger exhaust fan, reducing further the overall energy efficiency.

SCR systems are often seen as considerably more complicated and more capital intensive than SNCR systems.

A quantitative BAT assessment of the available technologies has been undertaken and is presented in Appendix F, section 3. This assessment uses data obtained by Fichtner from a range of different projects using the technologies proposed in this application.

Table 11: BAT assessment – NOx abatement

Parameter	Units	SNCR	SCR	SNCR + FGR
NOx released after abatement	t p.a.	320	260	320
NOx abated	t p.a.	800	860	690
Photochemical Ozone Creation Potential (POCP)	t ethylene-eq p.a.	-12,200	-9,900	-12,200
Global Warming Potential	t CO2 p.a.	1,500	5,300	2,100
Ammonia used	t.p.a.	2,580	1,200	2,230
Total Annualised Cost	£ p.a.	£657,000	£3,002,000	£860,000
Cost per tonne NOx abated	£ p.t NOx.	£820	£3,490	£1,250

As can be seen from the table above, applying SCR for the abatement of NOx:

1. increases the annualised costs by approximately £2,345,000;
2. abates an additional 60 tonnes of NOx per annum;
3. reduces the benefit of the ERF in terms of the global warming potential by approximately 3,800 tonnes of CO_2;
4. reduces reagent consumption by approximately 1,380 tonnes per annum; and
5. costs an additional £39,080 per additional tonne of NOx abated compared to SNCR.

The additional costs associated with SCR are not considered to represent BAT for the ERF. On this basis, SNCR is considered to represent BAT.

Including FGR to the SNCR system to abate NOx increases the cost per tonne of NOx abated by approximately 52% compared to SNCR without FGR. It has no effect on the direct environmental impact of the plant, but it increases the impact on climate change by approximately 600 tonnes of CO_2 per annum while reducing ammonia consumption by approximately 350 tonnes per annum compared to an SNCR system without FGR.

However, this is based on the assumption that FGR reduces the NOx generation within the furnaces. This is not necessarily the case for all furnace manufacturers – some designs can achieve lower levels of NOx without FGR and adding FGR may cause additional problems.

The proposed designs do not currently include FGR. However, it is requested that a pre-operational condition is included within the EP to allow details of the NOx abatement system to be confirmed during detailed design of the ERF. Therefore, taking the above into consideration, the use of SNCR with or without FGR is considered to represent BAT for the abatement of NOx within the ERF.

3.6.3 Acid gas abatement system

There are currently three technologies widely available for acid gas treatment on similar plants in the UK.

1. Wet scrubbing, involving the mixing of the flue gases with an alkaline solution of sodium hydroxide or hydrated lime. This has a good abatement performance, but it consumes large quantities of water, produces large quantities of liquid effluent which require treatment and has high capital and operating costs. It is mainly used in the UK for hazardous waste incineration plants where high and varying levels of acid gases in the flue gases require the buffering capacity and additional abatement performance of a wet scrubbing system.
2. Semi-dry, involving the injection of quick lime as a slurry into the flue gases in the form of a spray of fine droplets. The acid gases are absorbed into the aqueous phase on the surface of the droplets and react with the quick lime. The fine droplets evaporate as the flue gases pass through the system, cooling the gas. This means that less energy can be extracted from the flue gases in the boilers, making the steam cycle less efficient. The quick lime and reaction products are collected on a bag filter, where further reaction can take place.
3. Dry, involving the injection of lime or sodium bicarbonate into the flue gases as a powder. The reagent is collected on a bag filter to form a cake and most of the reaction between the acid gases and the reagent takes place as the flue gases pass through the filter cake. In its basic form, the dry system consumes more reagent than the semi-dry system. However, this can be improved by recirculating the flue gas treatment residues, which contain some unreacted lime and reinjecting this into the flue gases.

Wet scrubbing is not considered to be suitable for the ERF, due to the production of a large volume of hazardous liquid effluent and a reduction in the power generating efficiency of the plant.

Dry and semi-dry systems can easily achieve the BAT-AEL emission limits required by the Waste Incineration BREF and both systems have been demonstrated to achieve the proposed emission limits on operational plants in the UK and Europe. Furthermore, both are considered to represent BAT by EPR5.01. The advantages and disadvantages of each technique are varied which makes assessment complex; therefore, the assessment methodology described in Horizontal Guidance Note H1 has been used and is detailed in Appendix F section 2.

For the purposes of this application, a quantitative assessment of the available technologies has been undertaken using data obtained by Fichtner from a range of different projects using the technologies identified within this assessment.

Table 12 compares the options available.

Table 12: BAT assessment – acid gas abatement

Parameter	Units	Dry	Semi-dry
SO_2 abated	t.p.a.	1,430	1,430

Parameter	Units	Dry	Semi-dry
Photochemical Ozone Creation Potential (POCP)	t-ethylene eq	480	480
Global Warming Potential	tn-CO_2 eq p.a.	5,100	10,800
Additional water required in a semi-dry system	t.p.a.	-	47,710
APC residues	t.p.a.	18,730	17,300
Annualised cost	£ p.a.	£11,294,000	£10,807,000

The performance of the options is very similar.

The dry system only requires a small quantity of water for conditioning of the lime so that it is suitable for injection into the reaction chamber, whereas the semi-dry system requires the lime to be held in solution (quick lime). This requires significantly more water than a dry system.

The dry system has a reduced global warming potential and a reduced annualised cost. However, the semi-dry option benefits from medium reaction rates that mean that a shorter residence time is required in comparison with a dry system. In addition, within a semi-dry system recycling of reagent within the process is not proven, but it is proven in a dry system.

Due to the low water consumption and proven capability for recycling of reagents, the dry system is considered to represent BAT for the ERF.

3.6.4 Particulate matter abatement

The ERF will use a multi-compartment fabric filter for the control of particulates. There are a number of alternative technologies available, but none provide the same level of abatement performance as a fabric filter. Fabric filters represent BAT for this type of thermal treatment plant, when compared to the alternative technologies, for the following reasons:

1. Fabric filters are a proven technology and are used in a wide range of applications. The use of fabric filters with multiple compartments, allows individual bag filters to be isolated in case of individual bag filter failure.
2. Wet scrubbers are typically not capable of meeting the same emission limits as fabric filters.
3. Electrostatic precipitators are also not capable of abating particulates to the same level as fabric filters. They could be used to reduce the particulate loading on the fabric filters and so increase the acid gas reaction efficiency and reduce lime residue production, but the benefit is marginal and would not justify the additional expenditure, the consequent increase in power consumption and significant increase in the carbon footprint of the ERF.
4. Ceramic Filters have not been proven for this type of waste incineration plant design and are regarded as being more suited to high temperature filtration.

Fabric/'bag' filters are considered to represent BAT for the removal of particulates for this ERF.

The bag filter will not require a flue gas bypass duct, as the bag filters will be preheated allowing start-up without a bypass, which is considered to represent BAT. Therefore, a bypass system will be included within the design of the flue gas treatment system.

Filter bags containing catalyst materials are also a possible technology for the abatement of particulates and other pollutants. A review of catalytic filter bags is presented within the response to BAT 30 – refer to section 3.7.2.

3.6.5 Steam condenser

There are three potential BAT solutions considered in EPR 5.01 as representing indicative BAT for the ERF, which are:

- Air Cooled Condenser (ACC);
- Once-Through Cooling (OTC); and
- Evaporative Condenser.

Water cooling can be achieved through once-through cooling systems or by a recirculating water supply to condense the steam. Both cooling systems require significant quantities of water, and a receiving watercourse for the off-site discharge of cooling water. In addition, a water abstraction source is needed, with mains water not an economically viable option.

The closest suitable watercourse to the site is the River Tees which lies approximately 800 – 900 m to the west of the site, but this area is designated as a SPA, Ramsar and SSSI. Due to the nature of the development site, there is the potential for new industrial developments to lie in-between the site and the River. As such, groundworks (including potentially culverts for the flow from and return of water to the river) would be required to enable water cooling.

Due to the sensitivity of the receiving waters, water cooling systems are not considered to be 'available' for the Facility, and water cooling systems are not considered to be suitable technology for cooling at the ERF.

ACCs do not require significant quantities of water. It is acknowledged that ACC's can have noise impacts, but mitigation measures can be applied to the design to ensure that the noise impacts associated with the ACC's are at an 'acceptable' level – refer to the noise assessment (Appendix C) for further detail. Furthermore, ACC's do not create a visual impact (visible plume), unlike that from evaporative cooling.

Taking the above into consideration, an ACC is considered to represent BAT for the ERF.

3.7 The Legislative Framework

3.7.1 Specific requirements of the Industrial Emissions Directive (2010/75/EU)

This section presents information on how the ERF will comply with the Waste Incineration requirements of the Industrial Emissions Directive (IED).

Chapter IV of the IED includes 'Special Provisions for Waste Incineration Plants and Waste Co-incineration Plants'. Review of provisions for waste incineration as presented in the IED has identified that the following requirements could be applicable to the ERF:

- Article 46 – Control of Emissions;
- Article 47 – Breakdown;
- Article 48 – Monitoring of Emissions;
- Article 49 – Compliance with Emission Limit Values;
- Article 50 – Operating Conditions;
- Article 52 – Delivery & Reception of Waste;
- Article 53 – Residues; and
- Article 55 – Reporting & public information on waste incineration plants and waste co-incineration plants.

The following table identifies the relevant Articles of the IED and explains how the ERF will comply with them. Many of the articles in the IED impose requirements on regulatory bodies, in terms of the EP conditions which must be set, rather than on the operator. The table below only covers those requirements which the IED imposes on 'Operators' and either explains how this is achieved or refers to a section of the application where an explanation can be found.

Table 13: Summary table for IED compliance – ERF

Article	Requirement	How met or reference
15(3)	The competent authority shall set emission limit values that ensure that, under normal operating conditions, emissions do not exceed the emission levels associated with the best available techniques as laid down in the decisions on BAT conclusions referred to in Article 13(5) through either of the following.	Refer to section 3.4 and 3.7.2.

Article	Requirement	How met or reference
22(2)	Where the activity involves the use, production or release of relevant hazardous substances and having regard to the possibility of soil and groundwater contamination at the site of the installation, the operator shall prepare and submit to the competent authority a baseline report before starting operation of an installation or before a permit for an installation is updated for the first time after 7 January 2013. The baseline report shall contain the information necessary to determine the state of soil and groundwater contamination so as to make a quantified comparison with the state upon definitive cessation of activities provided for under paragraph 3. The baseline report shall contain at least the following information: (a) information on the present use and, where available, on past uses of the site; (b) where available, existing information on soil and groundwater measurements that reflect the state at the time the report is drawn up or, alternatively, new soil and groundwater measurements having regard to the possibility of soil and groundwater contamination by those hazardous substances to be used, produced or released by the installation concerned. Where information produced pursuant to other national or Union law fulfils the requirements of this paragraph that information may be included in, or attached to, the submitted baseline report.	Refer to Appendix B – Site Condition Report.
44	An application for a permit for a waste incineration plant or waste co-incineration plant shall include a description of the measures which are envisaged to guarantee that the following requirements are met: (a) the plant is designed, equipped and will be maintained and operated in such a manner that the requirements of this Chapter are met taking into account the categories of waste to be incinerated or co-incinerated;	Refer to Section 3.2.1 of the Supporting Information which lists the categories of waste to be incinerated at the ERF.
	(b) the heat generated during the incineration and co-incineration process is recovered as far as practicable through the generation of heat, steam or power;	Refer to Appendix G.
	(c) the residues will be minimised in their amount and harmfulness and recycled where appropriate;	Refer to Section 3.9 of the Supporting Information.
	(d) the disposal of the residues which cannot be prevented, reduced or recycled will be carried out in conformity with national and Union law.	Refer to Section 3.9 of the Supporting Information.

Article	Requirement	How met or reference
46 (1)	Waste gases from waste incineration plants and waste co-incineration plants shall be discharged in a controlled way by means of a stack the height of which is calculated in such a way as to safeguard human health and the environment.	Refer to Appendix E – Air Quality Assessment.
46 (2)	Emissions into air from waste incineration plants and waste co-incineration plants shall not exceed the emission limit values set out in parts 3 and 4 of Annex VI or determined in accordance with Part 4 of that Annex.	Refer to section 3.4 of the Supporting Information.
46 (5)	Waste incineration plant sites and waste co-incineration plant sites, including associated storage areas for waste, shall be designed and operated in such a way as to prevent the unauthorised and accidental release of any polluting substances into soil, surface water and groundwater. Storage capacity shall be provided for contaminated rainwater run-off from the waste incineration plant site or waste co-incineration plant site or for contaminated water arising from spillage or fire-fighting operations. The storage capacity shall be adequate to ensure that such waters can be tested and treated before discharge where necessary.	Refer to Appendix B – Site Condition Report, Appendix D – Environmental Risk Assessment and Appendix H – Fire Prevention Plan.
46 (6)	Without prejudice to Article 50(4)(c), the waste incineration plant or waste co-incineration plant or individual furnaces being part of a waste incineration plant or waste co-incineration plant shall under no circumstances continue to incinerate waste for a period of more than 4 hours uninterrupted where emission limit values are exceeded. The cumulative duration of operation in such conditions over 1 year shall not exceed 60 hours. The time limit set out in the second subparagraph shall apply to those furnaces which are linked to one single waste gas cleaning device.	Refer to Appendix E – Abnormal Emissions Assessment.
47	In the case of a breakdown, the operator shall reduce or close down operations as soon as practicable until normal operations can be restored.	Refer to Section 1.4.5 of the Supporting Information.
48 (2)	The installation and functioning of the automated measuring systems shall be subject to control and to annual surveillance tests as set out in point 1 of Part 6 of Annex VI.	Refer to Section 3.5.1.1 of the Supporting Information.
48 (4)	All monitoring results shall be recorded, processed and presented in such a way as to enable the competent authority to verify compliance with the operating conditions and emission limit values which are included in the permit.	Refer to Section 3.5.1 of the Supporting Information.

Article	Requirement	How met or reference
49	The emission limit values for air and water shall be regarded as being complied with if the conditions described in Part 8 of Annex VI are fulfilled.	There will be no emissions from flue gas treatment systems to water/sewer from the waste incineration plant.
50 (1)	Waste incineration plants shall be operated in such a way as to achieve a level of incineration such that the total organic carbon content of slag and bottom ashes is less than 3% or their loss on ignition is less than 5% of the dry weight of the material. If necessary, waste pre-treatment techniques shall be used.	Refer to Section 3.2.3.3 – TOC or LOI testing.
50 (2)	Waste incineration plants shall be designed, equipped, built and operated in such a way that the gas resulting from the incineration of waste is raised, after the last injection of combustion air, in a controlled and homogeneous fashion and even under the most unfavourable conditions, to a temperature of at least 850oC for at least two seconds.	Refer to Section 3.2.3.8 and 3.1.3.3 of the Supporting Information.
50 (3)	Each combustion chamber of a waste incineration plant shall be equipped with at least one auxiliary burner. This burner shall be switched on automatically when the temperature of the combustion gases after the last injection of combustion air falls below the temperatures set out in paragraph 2. It shall also be used during plant start-up and shut-down operations in order to ensure that those temperatures are maintained at all times during these operations and as long as unburned waste is in the combustion chamber. The auxiliary burner shall not be fed with fuels which can cause higher emissions than those resulting from the burning of gas oil as defined in Article 2(2) of Council Directive 1999/32/EC of 26 April 1999 relating to a reduction in the sulphur content of certain liquid fuels (OJ L 121, 11.5.1999, p. 13.), liquefied gas or natural gas.	Refer to Sections 3.2.3.8 and 3.1.3.3 of the Supporting Information.
50 (4)	Waste incineration plants and waste co-incineration plants shall operate an automatic system to prevent waste feed in the following situations: (a) at start-up, until the temperature set out in paragraph 2 of this Article or the temperature specified in accordance with Article 51(1) has been reached;	Refer to Section 3.2.3.8 of the Supporting Information.
	(b) whenever the temperature set out in paragraph 2 of this Article or the temperature specified in accordance with Article 51(1) is not maintained;	Refer to Section 3.2.3.8 of the Supporting Information.

Article	Requirement	How met or reference
	(c) whenever the continuous measurements show that any emission limit value is exceeded due to disturbances or failures of the waste gas cleaning devices.	Refer to Section 3.2.3.8 of the Supporting Information.
50 (5)	Any heat generated by waste incineration plants or waste co-incineration plants shall be recovered as far as practicable.	Refer to Appendix G.
50 (6)	Infectious clinical waste shall be placed straight in the furnace, without first being mixed with other categories of waste and without direct handling.	This requirement will not apply as the ERF will not receive infectious clinical waste.
52 (1)	The operator of the waste incineration plant or waste co-incineration plant shall take all necessary precautions concerning the delivery and reception of waste in order to prevent or to limit as far as practicable the pollution of air, soil, surface water and groundwater as well as other negative effects on the environment, odours and noise, and direct risks to human health.	Refer to Section 3.4 of the Supporting Information and Appendix D.
52 (2)	The operator shall determine the mass of each type of waste, if possible according to the European Waste List established by Decision 2000/532/EC, prior to accepting the waste at the waste incineration plant or waste co-incineration plant.	Refer to 3.2.1 of the Supporting Information.
53 (1)	Residues shall be minimised in their amount and harmfulness. Residues shall be recycled, where appropriate, directly in the plant or outside.	Refer to Section 3.9 of the Supporting Information.
53 (2)	Transport and intermediate storage of dry residues in the form of dust shall take place in such a way as to prevent dispersal of those residues in the environment.	Refer to Section 3.9 of the Supporting Information.
53 (3)	Prior to determining the routes for the disposal or recycling of the residues, appropriate tests shall be carried out to establish the physical and chemical characteristics and the polluting potential of the residues. Those tests shall concern the total soluble fraction and heavy metals soluble fraction.	Refer to Section 3.9 of the Supporting Information.

3.7.2 Requirements of the Final Waste Incineration BREF

The Final Waste incineration (WI) BREF BAT conclusions were published by the European IPPC Bureau in December 2019. Upon adoption of the final BREF, the EA are required to review and implement conditions within all EPs which require operators to comply with the requirements set out in the BREF. As the EA's BREF implementation plan has recently been made available, it is understood that the EA will commence its BREF review process for existing plants in 2022. New plants are required to demonstrate that they meet the requirements of the BREF when applying for an EP. As such, the table below identifies the requirements of the Best Available Techniques (BAT) conclusions as set out in the Final BREF and explains how the ERF will comply with them.

Table 14: Summary table for WI BREF BAT conclusions compliance – ERF

#	BAT Conclusion	How met or reference
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 features as listed in BAT 1 of the BREF.	A general summary of the proposed EMS is presented in section 4 of the Supporting Information. The EMS will be developed throughout the development stage of the project. It is proposed that a pre-operational condition is included within the EP which requires Redcar Ltd to provide a summary of the proposed EMS prior to commencement of operation. The summary will demonstrate how the proposed EMS complies with the requirements as set out in BAT 1.
2	BAT is to determine either the gross electrical efficiency, the gross energy efficiency, or the combined boiler efficiency of the incineration plant as a whole or of all the relevant parts of the incineration plant.	As stated in the greenhouse gas assessment (refer to Appendix E), the gross electrical efficiency of the plant is calculated to be approximately 30.4%. Therefore, Redcar Ltd understand that this is in accordance with the requirements of BAT 2. Further detail on the energy efficiency of the ERF is set out within section 3.8.
3	BAT is to monitor key process parameters relevant for emissions to air and water including those given in BAT 3 of the BREF.	As set out in section 3.5 of the Supporting Information, the process parameters for monitoring of emissions to air are as follows: • water vapour content • temperature; and • pressure. The oxygen content and flow rate of the flue gases will also be monitored. Temperature will be monitored in the combustion chamber. There will be no emissions of water from FGC systems. Furthermore, there will be no emissions to water from the adjacent IBA facility – any process effluents would be contained and re-used in the process. Excess process effluents will either be discharged to sewer in accordance with a Trade Effluent Consent, or tankered off-site for treatment. Taking the above into consideration, the process parameters to be monitored for emissions to water as listed in BAT 3 do not apply. Redcar Ltd can confirm that the ERF will include for monitoring of the key process parameters relevant for emissions to air in accordance with BAT 3.
4	BAT is to monitor channelled emissions to air with at least the frequency given in BAT 4 of the BREF and in accordance with EN standards. If EN standards are not	It is anticipated that emissions to air will be monitored with the following frequency: <u>Continuous Monitoring</u>

#	BAT Conclusion	How met or reference
	available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.	• Oxygen; • Carbon monoxide; • Hydrogen chloride; • Sulphur dioxide; • Nitrogen oxides; • Ammonia; • Volatile organic compounds (VOCs); and • Particulates. Periodic Monitoring • Hydrogen fluoride; • Group 3 heavy metals (Sb, As, Pb, Cr, Co, CU, Mn, Ni, V) – once every six months; • Cadmium and thallium – once every six months; • Mercury – once every six months; • Nitrous oxide – once every year; • Dioxins and furans - once every six months (except long-term sampling of PCDD/F once every month); and • Dioxin-like PCBs (once every six months for short-term sampling, once every month for long-term sampling). As set out in section 3.5.1.1 of the Supporting Information, the methods and standards used for emissions monitoring will be in compliance with EPRS5.01 and the IED. In particular, the CEMS equipment will be certified to the MCERTS standard and will have certified ranges which are no greater than 1.5 times the relevant daily average emission limit. Sampling and analysis of all pollutants including dioxins and furans will be carried out to CEN or equivalent standards (e.g. ISO, national, or international standards). This ensures the provision of data of an equivalent scientific quality.

#	BAT Conclusion	How met or reference
		Redcar Ltd consider that the proposals for monitoring of emissions to air are in accordance with the requirements of BAT 4.
5	BAT is to appropriately monitor channelled emissions to air from the incineration plant during Other Than Normal Operating Conditions (OTNOC).	The EA recently published its BREF implementation plan, which states how monitoring of PCCD/F and dioxin-like PCB mass emissions during a planned start-up and shut-down should be carried out following the successful commissioning of the plant. It is also stated that the test should be repeated once every 3 years. However, it is acknowledged that monitoring of PCCD/F and dioxin-like PCB mass emissions should be done on 'best endeavours' basis, bearing in mind the challenges of coinciding a visit by the monitoring company with the exact time when the plant is starting up or shutting down. Specifically, the implementation document states that no plant will be required to start up or shut down specifically for the purposes of testing, and that where reasonable attempts to monitor fail due to the challenges described above, operators will be expected to attempt to repeat the exercise at the next available opportunity. Taking the above into consideration, Redcar Ltd will apply a 'best endeavours' basis to the monitoring of PCCD/F and dioxin-like PCB mass emissions during start-up / shutdown periods. It is understood that this is in compliance with the requirements of BAT 5 and the EA's implementation plan.
6	BAT is to monitor emissions to water from Flue Gas Cleaning (FGC) and/or bottom ash treatment with at least the frequencies set out in BAT 6 of the BREF 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.	As explained in section 1.4.2.4 of the Supporting Information, the ERF will utilise a dry flue gas treatment system. Therefore, there will not be any emissions to water from the FGC systems. Furthermore, there will be no emissions to water from the IBA facility. Therefore, it is understood that the requirements of BAT 6 are not applicable to the ERF.
7	BAT is to monitor the content of unburnt substances in slags and bottom ashes at the incineration plant with at least the frequency as given in BAT 7 of the BREF (at least once every 3 months) and in accordance with EN standards.	As explained in section 3.2.3.3 of the Supporting Information, Total Organic Carbon (TOC) will be measured in the bottom ash to confirm that it is less than 3%, and/or Loss on Ignition (LOI) will be measured to confirm it is less than 5%. Measurements will be taken at least once every 3 months and will be in accordance with EN standards and would be taken at the adjacent IBA facility where the IBA will be stored.

#	BAT Conclusion	How met or reference
		Redcar Ltd considers that the proposals for monitoring of slags and bottom ashes are in accordance with the requirements of BAT 7.
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.	The ERF will not incinerate hazardous waste. Therefore, Redcar Ltd do not consider that the requirements of BAT 8 are applicable to the ERF.
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 (a) to (c) as listed in BAT 9 of the BREF, and, where relevant, also techniques (d), (e) and (f).	As described in Section 3.2 of the Supporting Information, the ERF will employ the following techniques as required by BAT 9: • Determination of the types of waste that can be incinerated. The ERF will incinerate waste in accordance with the list of EWC waste codes that will be listed in the EP, and waste that falls into the range of calorific values in accordance with the design of the ERF. The list of EWC codes will characterise the physical state, general characteristics and hazardous properties of the waste. • Implementation of waste acceptance procedures. The ERF will accept a mix of wastes delivered both directly to the site and also from the adjacent fuel preparation facility. The Operator will develop acceptance procedures for wastes delivered to the ERF, in order to ensure that only the wastes which the ERF is permitted to receive are received at the ERF. Paperwork accompanying each delivery will be checked. Periodic inspections of the waste will be undertaken as part of the scope where practicable, prior to transfer into the bunker, to confirm that it complies with the specifications of the waste transfer note (WTN). Waste delivered in road vehicles will be inspected by the crane operator as it is tipped into the bunker and mixed. • Redcar Ltd will develop and implement waste pre-acceptance and acceptance procedures at the ERF. The waste acceptance procedures will identify the records required for wastes to be accepted at the ERF and where records associated with the waste should be retained in the document management system which will be employed at the ERF. • Waste acceptance procedures will be used to identify any unacceptable wastes which are not suitable for processing within the ERF and require quarantine and transfer off-site.

#	BAT Conclusion	How met or reference
		It is understood that technique (f) of BAT 9 does not apply as the ERF will not incinerate hazardous waste. Redcar Ltd considers that the proposed arrangements for the receipt and segregation of waste complies with the requirements of BAT 9.
10	In order to improve overall environmental performance of the bottom ash treatment plant, BAT is to set up and implement an output quality management system (see BAT 1).	It can be confirmed that the EMS in place at the site will include for the output quality management features stated in the BREF that are applicable to the bottom ash treatment plant (IBA facility).
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 9c) including, depending on the risk posed by the waste, the elements as listed in BAT 11 of the BREF.	As described in section 3.2.2.1 of the Supporting Information, and explained in relation to BAT 9 above, periodic monitoring of waste deliveries will be undertaken at the ERF. This will include the following elements in accordance with BAT 11: • Weighing of the waste deliveries by use of a weighbridge at the entrance/exit of the ERF. • Periodic visual inspection of waste either prior to being tipped into the bunker, or where this is not practicable, as it is tipped into the bunker by the crane operator. • Periodic sampling of waste deliveries and analysis of key properties, such as calorific value and metal content. – Sampling will be undertaken when accepting a new waste stream at the ERF (e.g. from a new waste supplier), or to determine the NCV of waste sources accepted should the plant be operating outside the permitted range shown on the firing diagram. Periodic sampling of waste will also be undertaken for waste streams to ensure consistency in parameters. It is expected that waste sampling and characterisation would be carried out in accordance with BS EN 14899:2005 '*Characterization of waste - Sampling of waste materials - Framework for the preparation and application of a Sampling Plan*', and will be consistent with any additional requirements imposed by the EP. It is expected that the waste delivery load to be sampled would be tipped onto the tipping hall floor. Sampling will typically be undertaken based on a nominal vehicle load (expected to be around 20 tonnes). Averaging over a larger quantity will not be permitted, as this would not be representative of the load delivered to the site.

#	BAT Conclusion	How met or reference
		A number of separate increments would be taken randomly from the waste delivery load. These would then be combined into a pile. Two representative samples of equal weight would then be taken from the combined pile. One sample would be sent on for laboratory analysis, whilst the other would be kept as a reserve sample. The ERF will not undertake radioactivity detection tests as it is not anticipated that any radioactive waste will be received. Redcar Ltd considers that the proposed arrangements for monitoring the waste deliveries as part of the waste acceptance procedures complies with the requirements of BAT 11.
12	In order to reduce the environmental risks associated with the reception, handling and storage of waste, BAT is to use both of the following techniques: Use impermeable surfaces with an adequate drainage infrastructure; and Have adequate waste storage capacity.	The surfaces of the waste reception, handling and storage areas have been designed and will be constructed as impermeable structures. Adequate drainage infrastructure will be fitted to areas where receipt, handling and storage of waste takes place – these areas will have appropriate falls to the process water drainage system. The integrity of areas of hardstanding will be periodically verified by visual inspection. Regular maintenance of the drainage systems will be undertaken in accordance with documented management procedures to be developed for the ERF. Adequate waste storage capacity will be available on site – the maximum waste storage capacity of the waste bunker will be established and not exceeded. The quantity of waste will be visually monitored against the maximum storage capacity. During periods of planned maintenance, quantities of waste within the bunker will be run down where possible. Redcar Ltd considers that the proposed arrangements for environmental risks associated with the reception, handling and storage of waste comply with the requirements of BAT 11.
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 as listed in BAT 13 of the BREF.	The ERF will not process clinical or hazardous waste. Therefore, Redcar Ltd considers that the requirements of BAT 13 are not applicable to the ERF.
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	Bunker crane mixing and advanced control systems will be employed at the ERF. A modern and advanced control system, incorporating the latest advances in control and instrumentation technology, will be utilised at the ERF to control operations, optimise the process relative to efficient heat release, good burn-out and minimum particle carry over. As described in

#	BAT Conclusion	How met or reference
	waste, BAT is to use an appropriate combination of the techniques given below:	Section 3.5.2 of the Supporting Information, the system will control and/or monitor the main features of the plant operation including, but not limited to the following: • combustion air; • waste feed rate; • SNCR system; • flue gas oxygen concentration at the boiler exits; • flue gas composition at the stack (including HCl measurements); • combustion process; • boiler feed pumps and feedwater control; • steam flow at the boiler outlets; • steam outlet temperature; • boiler drum level control; • flue gas control (including differential pressure across the bag filters); • power generation; and • steam turbine exhaust pressure. Water, electricity and auxiliary fuel usage will also be monitored to highlight any abnormal usage. Redcar Ltd considers that the proposed arrangements for ensuring 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 comply with the requirements of BAT 14.
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, as and when needed and practicable, based on the characterisation and control of the waste.	The ERF will be controlled from a dedicated control room, with an advanced control system to optimise the process. The system will control and/or monitor the main features of the plant operation, as described in the response to BAT 14 above. Emissions to air will be reduced by the adjustment of the plants settings through the advanced control system: for example, ammonia solution dosing will be optimised and adjusted to minimise the ammonia slip. Lime usage will be minimised by trimming reagent dosing to accurately match the acid load using fast response

#	BAT Conclusion	How met or reference
		upstream acid gas monitoring. Activated carbon dosing will be based on flue gas volume flow measurement. Redcar Ltd considers that the proposed control systems will ensure that the ERF is designed to allow for the adjustment of the plant's settings to comply with the requirements of BAT 15.
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 ERF will operate continuously, with planned shutdowns for maintenance limited as far as reasonably practicable (it is expected that each line would be shut down for maintenance in succession – i.e., it would be very unlikely for both lines to be shut down at once). Waste will be kept at suitable levels in the waste bunker to maintain operation during periods when waste is not delivered. Operational procedures will be developed to limit as far as practicable shutdown and start-up operations. Redcar Ltd considers that the operation of the ERF will limit as far as practicable shutdown and start-up operations to comply with the requirements of BAT 16.
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 wastewater treatment plant are appropriately designed (e.g. considering the maximum flow rate and pollutant concentration), operated within their design range, and maintained so as to ensure optimal availability.	The FGC and wastewater treatment systems will be appropriately designed and operated within the design range. The FGC and wastewater treatment systems will be subject to regular maintenance through the implementation of documented management procedures. Redcar Ltd considers that the design and operation of the FGC and wastewater treatment plants will ensure that emissions to air (and water where applicable) are reduced, and will ensure their optimal availability, to comply with the requirements of BAT 17.
18	In order to reduce the frequency of the occurrence of 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 EMS that includes the elements as identified in BAT 18 of the BREF.	The EA's BREF implementation document sets out a definition of OTNOC, and lists requirements for OTNOC management plans. It is acknowledged in the implementation document that further work is required by the EA in relation to the production of guidelines for plant start-up and shut-downs, update of abnormal operation guidance, and clarification of the EAs position on emergency/uncontrolled shutdowns and temporary shutdowns. At the time of writing, the status of these actions is uncertain. Upon finalisation of the EA's position and completion of the actions above, Redcar Ltd would propose to develop an OTNOC based management plan which is in line with the EA's requirements and the elements outlined within the BREF. It is expected that this would be achieved by either a

#	BAT Conclusion	How met or reference
		pre-operational or improvement condition in the EP. This is a similar approach that we have seen applied on recent applications. Redcar Ltd considers that the incorporation of a risk-based OTNOC management plan will ensure the ERF's compliance with BAT 18.
19	In order to increase resource efficiency of the incineration plant, BAT is to use a heat recovery boiler.	The ERF will use steam boilers to produce steam which is used to produce electricity. The ERF will also have the provision to export heat to local users. Redcar Ltd considers that the use of heat recovery boilers is in direct compliance with the requirements of BAT 19.
20	In order to increase energy efficiency of the incineration plant, BAT is to use an appropriate combination of techniques as listed in BAT 20 of the BREF.	The ERF will use the following techniques to increase energy efficiency from its operation: • Minimise heat losses via the use of integral furnace boilers – heat will be recovered from the flue gases by means of steam boilers integral with the furnaces; • Optimisation of the boiler design to improve heat transfer – the boilers will be equipped with economisers and superheaters to optimise thermal cycle efficiency without prejudicing boiler tube life, having regard for the nature of the waste that is combusted; • High steam conditions (approximately 430°C and approximately 60 bar(a), subject to detailed design), to increase electricity conversion efficiency; • Cogeneration of heat and electricity – the ERF has been designed as a combined heat and power plant and will have the capacity to provide heat to local users (expected to be located in the wider Teesworks development). Subject to commercial agreements with heat users, a scheme for the export of heat will be implemented. Redcar Ltd considers that the techniques listed above will increase the energy efficiency of the plant and ensure that the ERF will comply with the requirements of BAT 20. Notwithstanding this, a review of techniques b (reduction of flue gas flow), e (low temperature flue gas heat exchangers) and i (dry bottom gas handling) within BAT 20 has been undertaken and is presented below. Technique (b) Technique (b) relates to reducing the flue gas flow rate through either an improvement in the primary and secondary combustion air distribution, or through using flue gas recirculation (FGR). The ERF will be designed to optimise both primary and secondary combustion air distribution to

#	BAT Conclusion	How met or reference
		improve the efficiency of the combustion process. The volume of both primary and secondary air will be regulated by a combustion control system. Primary combustion air will be optimised and improved through the continuous monitoring of process variables, including combustion air flow. Secondary combustion air distribution will be optimised through the use of Computational Fluid Dynamics (CFD) modelling, which will be used to select and optimise the location of secondary air inputs into the combustion chamber, to increase the efficiency of the SNCR system for NOx abatement. The optimisation of the combustion control system, as described above, will reduce the resulting flue gas flow rate by reducing air intake, hence lowering the oxygen content within the furnace and reducing the air output at the boiler exit. However, to ensure that the combustion process remains stable, it is important to maintain a balance between the air intake and the resulting flue gas flow rate. The provision of some excess oxygen is essential to cover any fuel spikes and avoid incomplete combustion, reducing the risk of any spikes in carbon monoxide emissions. FGR has the potential to improve the performance and efficiency of combustion systems, with some grate suppliers gaining benefits of reduced NOx generation from the use of FGR. However, other grate suppliers have focussed on reducing NOx generation through the control of primary and secondary air and the grate design, and these suppliers gain little if any benefit from the use of FGR. Adding FGR may even have the potential to cause additional problems relating to the availability of the plant, which would reduce the overall efficiency through reduced power generation and an increase in the number of shutdowns. As justified within section 3.6.2 of the Supporting Information, the proposed designs do not currently include FGR. However, it is requested that a pre-operational condition is included within the EP to allow details of the NOx abatement system to be confirmed during detailed design of the ERF. Therefore, taking this into consideration, the use of SNCR with or without FGR is considered to represent BAT for the abatement of NOx within the ERF. Redcar Ltd will comply with any Improvement Conditions (ICs) or Pre-operational Conditions (POCs) imposed by the EP, such as confirmation of details on the performance and optimisation of the SNCR system and confirmation of the boiler design through computational fluid dynamics (CFD) modelling. Technique (e)

#	BAT Conclusion	How met or reference
		Technique (e) is to use low-temperature flue gas heat exchangers to recover additional energy from the flue gas at the boiler exit. The recovered heat could then be used for heating purposes and/or internally for preheating of boiler feedwater. It is acknowledged that the use of this technique must be applicable within the constraints of the operating temperature profile of the flue gas treatment (FGT) system. Section 4.4.10 of the BREF states that at temperatures below 180°C, when using low-temperature heat exchangers, there is an increased risk of corrosion in the economiser and of the piping upstream of acid gas scrubbing. Corrosion risks can arise from HCl and SOx in MSW flue gases, which can attack the steel in the (cool) metal tubes of the heat exchanger. The boiler design has assumed a flue gas temperature of approximately 150°C at the exit of the boiler, i.e. prior to the hot gases passing to the flue gas treatment system. As this temperature is below 180°C, this introduces a higher possibility for corrosion risks. It is acknowledged that it is possible to use heat exchangers made of special materials such as enamel to reduce corrosion, or to design the cycle to use a separate waste heat boiler after the main boiler to avoid corrosion conditions. However, this would require the system to be re-designed and may introduce additional capital costs. In addition to the above, when considering the use of heat exchangers, it is important to ensure that the flue gas temperature is not lowered enough to impact the operation of the FGT system. The BREF states that a dry FGT process, such as that proposed for the ERF, can accept flue gas temperatures of around 130 – 300°C, with bag filters generally requiring temperatures in the region of 140 – 190°C. As the temperature of the flue gases at the boiler exit is expected to be approximately 150°C, and assuming a minimum required temperature of 130°C for the FGT process, this would only allow for a maximum temperature 'loss' of 20°C for the flue gases when passing through the heat exchanger. When accounting for efficiency losses in the heat exchanger, this would result in a very low exchange of heat overall. Furthermore, reagent consumption in the FGT system will increase as the temperature of the flue gases decreases due to reduced reaction rates. Should the flue gases be required to be reheated before entering the FGT system, this would be counterproductive from an energy efficiency point of view, allowing for the additional losses from the heat exchanger.

#	BAT Conclusion	How met or reference
		Additionally, lower flue gas temperatures at the stack exit, resulting from the use of additional heat exchangers, would affect plume buoyancy and the dispersion of emissions, resulting in a more visible condensed plumes and potentially result in stack corrosion. Another alternative would be to use a post-abatement heat exchanger (i.e. once the flue gas has undergone treatment); however, this would also introduce low temperatures at the stack exit, resulting in the same problems outlined above. Furthermore, the use of post abatement heat exchangers is only relevant if the extracted heat can be put to use. As described within section 4.3.5 of the WI BREF, the preheating of incineration air in grate-type municipal waste incineration plants is normally done with low-pressure steam and not by heat exchange from the flue-gases (due to complicated air ducts and corrosion problems). Furthermore, the installation of a post abatement heat exchanger would also introduce a high associated capital cost. The heat plan submitted with the application has identified that, at this stage, the ERF will be constructed as 'CHP-ready', and will not export heat from the offset. Taking the above into consideration, the use of a low-temperature heat exchanger is not considered to represent BAT due to the corrosion risks, potential to increase capital costs, potential to affect the efficiency and operation of the FGT system, potential to affect dispersion and introduce a visible plume, and taking into account the fact that the ERF is not expected to export heat from the offset. Technique (i) Technique (i) relates to dry handling of bottom ash using ambient air for cooling, with useful energy subsequently recovered by using the cooling air for combustion. It is acknowledged that this technique is applicable to grate furnaces, such as proposed for the ERF, and can improve energy efficiency and reduce water consumption. However, dry bottom ash handling can introduce a risk of fugitive dust emissions compared to a wet bottom ash handling system which is proposed for the ERF. Overall water use at the ERF will be minimised by the re-use of process effluent (including any leachate or effluent from bottom ash treatment) within the process; thereby minimizing the volumes of effluent generated, which may require off-site treatment prior to discharge to the aquatic environment. Furthermore, in a dry bottom ash handling system, the bottom ash discharger may be required to be flooded with water occasionally to prevent fire hazards.

#	BAT Conclusion	How met or reference
		The additional abatement required for fugitive dust emissions arising as a result of dry bottom ash handling also has the potential to increase the capital costs associated with bottom ash handling. Taking the above into consideration, the use of a dry bottom ash system is not considered to represent BAT for the ERF.
21	In order to prevent or reduce diffuse emissions from the incineration plant, including odour emissions, BAT is to use the methods as stated in BAT 21 of the BREF.	In accordance with the BREF, the ERF will employ the following measures to reduce odour emissions: • Waste in the ERF will be stored in an enclosed bunker area under negative pressure. The extracted air will be used as combustion air for incineration. • The operation of the ERF will not give rise of odorous liquid wastes. Therefore, the requirement to store liquid wastes in tanks under controlled pressure and duct the tank vents to the combustion air feed or other suitable abatement system will not apply to the ERF. • Odour will be controlled during shutdown periods by minimising the amount of waste in storage. Waste will be run-down prior to periods of planned maintenance. In addition, doors to the tipping hall will be kept shut during periods of shutdown. The measures listed above to reduce odour emissions will ensure that the ERF will comply with the requirements of BAT 21.
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 feed them to the furnace by direct feeding.	Gaseous wastes and liquid wastes will not be accepted at the ERF. Therefore, the requirements of BAT 22 do not apply to the ERF.
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 EMS the following diffuse dust emission management features:	A Dust Management Plan has been produced for the IBA facility – refer to Appendix K In accordance with the requirements of the BREF, the following features are incorporated in the dust management plan: • identification of the most relevant diffuse dust emission sources; • definition and implementation of appropriate actions and techniques to prevent or reduce diffuse emissions.

#	BAT Conclusion	How met or reference
		The Dust Management Plan and EMS for the site will be further refined following completion of design, ensuring that the requirements of the BREF have been fully incorporated. Taking the above into consideration, it is understood that the operation of the site will be in accordance with the requirements of BAT 23.
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 as given in BAT 24 of the BREF.	In accordance with the requirements of BAT 24, the IBA facility will incorporate the following techniques: • Equipment will be enclosed/covered as appropriate – mechanical processing/treatment will be undertaken inside an enclosed building. Conveyors transferring bottom ash from the ERF to the IBA facility would be covered. • The height of discharge (e.g. from conveyors) would be limited as appropriate. • Stockpiles would be protected from prevailing winds by the use of concrete push walls. • Water sprays would be available at the IBA facility to manage dust emissions if required. In the IBA reception bunker, this would be in the form of sprinklers, which can be used for dust suppression and also correcting the moisture content of the ash. • The moisture content of the ash would be determined from monitoring of the bottom ash to ensure this is at an optimal level. Ash would be maintained 'wet' from the initial quenching. Taking the above into consideration, it is understood that the operation of the IBA facility will be in accordance with the requirements of BAT 24.
25	In order to reduce channelled emission to air of dust, metals and metalloids from the incineration of waste, BAT is to use one or a combination of the techniques as listed in BAT 25 of the BREF.	In accordance with the BREF, the following techniques will be utilised at the ERF to reduce channelled emissions to air: • Bag filters – to reduce particulate content of the flue gas. • Dry sorbent injection – adsorption of metals by injection of activated carbon in combination with injection of lime to abate acid gases. The concentrations of metals and metalloids will be monitored in accordance with the EP for the ERF. It is considered by Redcar Ltd that the techniques listed above to reduce channelled emissions to air will ensure that the ERF will comply with the requirements of BAT 25.

#	BAT Conclusion	How met or reference
26	In order to reduce channelled dust emissions to air from the enclosed treatment of slags and bottom ashes with extraction of air, BAT is to treat the extracted air with a bag filter.	It is not currently proposed to incorporate an air extraction/treatment system within the main IBA processing building. A Dust Management Plan is presented in Appendix K for the IBA facility which details how dust will be managed at the site. The techniques described in the plan detail how emissions to air of dust will be prevented/reduced at the site.
27	In order to reduce channelled emissions of HCl, HF and SO2 to air from the incineration of waste, BAT is to use one or a combination of the techniques as listed in BAT 27 of the BREF.	BAT 27 of the BREF states that BAT is to use one or a combination of the following techniques: • Wet scrubber; • Semi-wet absorber; • Dry sorbent injection; • Direct desulphurisation (only applicable to fluidised beds); and • Boiler sorbent injection. In a dry sorbent injection system, the reagent is injected into the flue gas stream within the flue gas treatment system, located after the boiler. In direct boiler sorbent injection, the reagent is injected directly into the flue gas stream within the boiler. This only achieves partial abatement of the acid gases and does not eliminate the need for additional flue gas cleaning stages. It is acknowledged that using a combination of both boiler sorbent injection and the additional acid gas abatement system would provide a higher level of abatement than either system alone; however, the operating and maintenance costs and also reagent consumption would be higher. Due to the additional costs and reagent consumption associated with the use of direct boiler injection, this is not considered to represent BAT for the ERF. As stated in section 3.6.3, it is considered BAT for the ERF to utilise a dry sorbent injection system to abate acid gases. The dry system will be designed to ensure that the ERF will operate in accordance with the relevant ELVs, assumed to be the BAT-AELs, without the requirement for any additional abatement measures. The design of the dry sorbent injection system will include the following controls to ensure that the ERF operates in accordance with the relevant ELVs: • A flue gas monitoring system at the exit of the boilers to control reagent dosing rate within the flue gas treatment system; and • Recirculation of a proportion of the flue gas treatment residues to reduce reagent consumption.

#	BAT Conclusion	How met or reference
		It is considered by Redcar Ltd that the use of dry sorbent injection to reduce channelled emissions to air of acid gases is in compliance with the requirements of BAT 27.
28	In order to reduce channelled peak emissions of HCl, HF and SO2 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 optimised and automated reagent dosage, or both the previous technique and the recirculation of reagents.	In accordance with the BREF, the following techniques will be employed at the ERF to reduce peak emissions of HCl, HF and SO_2 whilst limiting reagent consumption and residue generation from dry sorbent injection: • The concentration of hydrogen chloride in the flue gases upstream of the flue gas treatment system will be measured in order to optimise the performance of the emissions abatement equipment, including automated reagent dosage. • A proportion of the APC residues will be recirculated to reduce the amount of unreacted reagent in the residues. • The concentrations of HCl, HF and SO_2 released from the ERF will comply with BREF limits. The techniques listed above to reduce channelled peak emissions to air of acid gases will ensure that the ERF will comply with the requirements of BAT 28.
29	In order to reduce channelled NOx emissions to air while limiting 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 as listed in BAT 29 of the BREF.	The following elements have been incorporated into the design of the ERF: • Optimisation of the incineration process via the use of an advanced control system and monitoring of process parameters (refer to the response to BAT 14); • An SNCR system; and • Optimisation of the design and operation of the SNCR system (through CFD modelling to optimise the location and number of injection nozzles, and optimisation of reagent dosing to minimise ammonia slip). The design elements listed above to reduce channelled NOx emissions to air (whilst limiting emissions of CO, N_2O and NH_3) will ensure that the ERF will comply with the requirements of BAT 29. As justified in section 3.6.2 of the Supporting Information, flue gas recirculation is not currently proposed in the design of the ERF however this will be examined during the detailed design stages. With regards catalytic filter bags, these have the potential to reduce emissions of dioxins and furans, as well as NOx when used in combination with a source of ammonia. It is stated within the BREF that the temperature of the flue gas when entering the filter bags should be above 170 –

#	BAT Conclusion	How met or reference
		190°C for effective destruction of dioxins and furans, and above 180 – 210°C for the effective destruction of NOx. However, the temperature of flue gases at the boiler exit is expected to be approximately 150°C, and further down the process (after FGT and when leaving the stack) the flue gases are expected to be at a temperature of approximately 140°C, as stated within the Air Quality Assessment submitted with the application. Therefore, the flue gases would not be at a high enough temperature for treatment in catalytic filter bags regardless of what stage in the FGT process they are used. It could be possible to reheat the flue gases to the appropriate temperature for treatment in catalytic filter bags; however, this would require an additional energy source, making the ERF less efficient overall.
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 (a), (b), (c), (d), and one or a combination of techniques (e) to (i) given below to reduce channelled emissions to air of organic compounds: a) Optimisation of the incineration process; b) Control of the waste feed; c) On-line and off-line boiler cleaning; d) Rapid flue-gas cooling; e) Dry sorbent injection; f) Fixed-or-moving bed adsorption; g) SCR; h) Catalytic filter bags; and i) Carbon sorbent in a wet scrubber.	The ERF will employ the following techniques to reduce channelled emission to air of organic compounds: • Optimisation of the incineration process – the boilers will be designed to minimise the formation of dioxins and furans as follows: • Minimise residence time in critical cooling section to avoid slow rates of combustion gas cooling, minimising the potential for 'de-novo' formation of dioxins and furans. • Apply CFD modelling to the design where appropriate to ensure gas velocities are in a range that negates the formation of stagnant pockets/low velocities. • Minimise volume in critical cooling sections. • Prevent boundary layers of slow-moving gas along boiler surfaces via good design and regular maintenance. • Online and offline boiler cleaning through a regular maintenance schedule to reduce dust residence time and accumulation in the boiler, thus reducing PCDD/F formation in the boiler. • Dry sorbent injection using activated carbon and lime, in combination with a bag filter. The concentrations of dioxins and furans released from the ERF will comply with BREF limits. As described above, it can be confirmed that the ERF will use techniques (a) – (d) and also technique (e), dry sorbent injection, to reduce channelled emissions to air of organic compounds. The ERF will not use catalytic filter bags.

#	BAT Conclusion	How met or reference
		The ERF will utilise the injection of ammonia in an SNCR system to abate NOx emissions. This is considered to be a proven method to reduce NOx emissions to below the required ELVs and has been successfully used on a number of plants in the UK and Europe. It should be noted that catalytic filter bags are generally used as a replacement for other filter bags which may already absorb dioxins by the injection of activated carbon, as is proposed for the ERF. The removal of activated carbon injection from the process may result in an increase in mercury emissions to air. Therefore, the use of catalytic filter bags may require additional abatement techniques to be installed for the removal of mercury. This is not considered to represent BAT for the ERF. It is stated within the WI BREF that the flue gas temperature when entering the catalytic filter bags should be above 170 – 190°C in order to achieve effective destruction of PCDD/F and prevent adsorption in the media. As stated in the air quality assessment (refer to Appendix E), the temperature of the flue gas leaving the stack is expected to be approximately 140°C. Therefore, the use of catalytic filter bags is not considered to be appropriate for the design of the ERF, as the flue gases would require re-heating which will reduce the efficiency of the process. The techniques described above to reduce channelled emission to air of organic compounds will ensure that the ERF will comply with the requirements of BAT 30. Therefore, the ERF will meet the requirements of BAT 30 without the use of catalytic filter bags.
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 as listed in BAT 31 of the BREF.	In accordance with the BREF, dry sorbent injection of activated carbon will be employed at the ERF in combination with a bag filter. It is considered by Redcar Ltd that the use of these techniques will ensure that the ERF will comply with the requirements of BAT 31.
32	In order to prevent the contamination of uncontaminated water, to reduce emissions to water, and to increase resource efficiency, BAT is to segregate waste water streams and to treat them separately, depending on their characteristics.	There will be separate foul/domestic water, process water and surface water drainage systems at the site. Further information on the drainage arrangements is presented within section 1.4.4, but the following provides a summary of the drainage arrangements at the site to demonstrate segregation of waste water streams. It is expected that foul effluents from domestic sources will be discharged to sewer in accordance with a trade effluent consent.

#	BAT Conclusion	How met or reference
		It can be confirmed that there will be no wastewater arising from flue gas treatment. Drainage from bottom ash handling/storage/processing will be contained with links to the process drainage system. Furthermore, the drainage in the ERF's waste reception, handling and storage areas will be contained and reused within the process. In the unlikely event that excess process effluents are generated, these would either be discharged to sewer or tankered off-site. Uncontaminated water streams, such as surface water run-off, will be segregated from other wastewater streams requiring treatment. Surface water runoff from roadways and vehicle movement areas will pass through petrol interceptors prior to discharge off-site. An indicative water flow diagram depicting the segregation of different water streams for the ERF is presented in Appendix A. It is considered by Redcar Ltd that the segregation and treatment of different wastewater streams, as described above, will ensure that the ERF will comply with the requirements of BAT 32.
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 as listed in BAT 33 of the BREF.	In accordance with the BREF, the following techniques will be utilised at the ERF to reduce water usage and prevent wastewater generation: • Use of a flue gas treatment system that does not generate wastewater – by utilising dry sorbent injection of lime and PAC. • Where practicable process effluents will be re-used within the process. Excess amounts of process effluent (which will rarely be generated) will require discharge; these will either be discharged to sewer in accordance with a Trade Effluent Consent or tankered off-site for treatment at a suitably licensed waste management facility. It is considered by Redcar Ltd that the techniques listed above to reduce water usage and prevent/reduce the generation of wastewater will ensure that the ERF will comply with the requirements of BAT 33. Technique (d) of BAT 33 relates to dry bottom ash handling. As described and justified within the response to BAT 20(i) above, dry bottom ash handling is not considered to represent BAT for the site.
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	There will be no emission to water from FGC. However, it can be confirmed that, in accordance with BAT 34 (a), the incineration process and the FGC process will be optimised to target

#	BAT Conclusion	How met or reference
	techniques as listed in BAT 34 of the BREF, and to use secondary techniques as close as possible to the source in order to avoid dilution.	pollutants such as dioxins and furans, and ammonia – refer to the responses to BAT 29 and 30 above. The risk of emissions to water from the storage and treatment of bottom ash at the site will be minimised. Any overflow from the ash quench will be contained and reused within the process and hence there will not be any release of effluent from the ash quench system. Furthermore, drainage at the IBA facility will be contained with links to the process drainage system, resulting in negligible risk of emissions to water from IBA storage/treatment. Taking the above into consideration, secondary techniques are not considered to be necessary, as there will be negligible risk of any emissions to water from FGC or bottom ash treatment/handling. Therefore, it is considered by Redcar Ltd that the site will comply with the requirements of BAT 34.
35	In order to increase resource efficiency, BAT is to handle and treat bottom ashes separately from FGC residues.	It can be confirmed that bottom ash and APCr will be handled and disposed of separately at the site. Therefore, Redcar Ltd considers that the ERF will comply with the requirements of BAT 35.
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 as listed in BAT 36 of the BREF, based on a risk assessment depending on the hazardous properties of the slags and bottom ashes.	The following techniques will be employed at the IBA facility to increase resource efficiency for the treatment of bottom ash: • Screening and sieving – vibrating screens will be used at the IBA facility to screen, separate and size the IBA; • Recovery of metals – ferrous and non-ferrous metals would be recovered from the IBA using magnetic and eddy current separation; and • Ageing – once the IBA has undergone mechanical processing, it would be stored in a dedicated external storage yard in stockpiles for a period of pH stabilisation. Redcar Ltd understand that the techniques outlined above comply with the requirements of BAT 36.
37	In order to prevent or, where that is not practicable, to reduce noise emissions, BAT is to use one or a combination of the techniques as listed in BAT 37 of the BREF.	In accordance with the requirements of BAT 37, it can be confirmed that the following techniques will be employed at the site to prevent or reduce noise emissions: • Appropriate location of equipment and buildings – in accordance with normal industry practice, the technology provider will implement an efficient layout to result in relatively quiet operational noise levels.

#	BAT Conclusion	How met or reference
		• Operational measures – regular inspection and maintenance of equipment will be undertaken. Doors to buildings will remain closed as far as is reasonably practicable. Waste deliveries will take place primarily during daytime hours. • Low-noise equipment – the proposed technology provider will optimise plant selection, where appropriate, to reduce the noise level. • Noise attenuation – plant rooms will have been acoustically designed for limiting noise emissions to acceptable levels for compliance with relevant workplace regulations. • Noise-control equipment/infrastructure – where appropriate, acoustic cladding will be used on buildings. Refer to the Noise Assessment presented in Appendix C for further details on noise mitigation measures proposed for the site. It is considered by Redcar Ltd that the techniques listed above to reduce noise emissions will ensure that the site will comply with the requirements of BAT 37.

3.8 Energy efficiency

3.8.1 General

The ERF will utilise steam boilers which will generate steam which will be used to supply a steam turbine to generate electricity. The ERF will supply electricity to the grid via a power transformer which increases the voltage to the appropriate level.

The ERF has also a provision for heat take-off to be able to export heat off-site in the future.

In case of failure of the electricity supply, an emergency diesel generator will be provided to safely shut down the ERF and to provide an emergency supply to the rest of the ERF.

In considering the energy efficiency of the ERF, due account has been taken of the requirements of DEFRA and EA guidance titled *'Energy efficiency standards for industrial plants to get environmental permits'*, dated February 2016.

3.8.2 Basic energy requirements

An indicative Sankey Diagram for the waste incineration plant for the 'No heat export' case is presented in Figure 5 below.

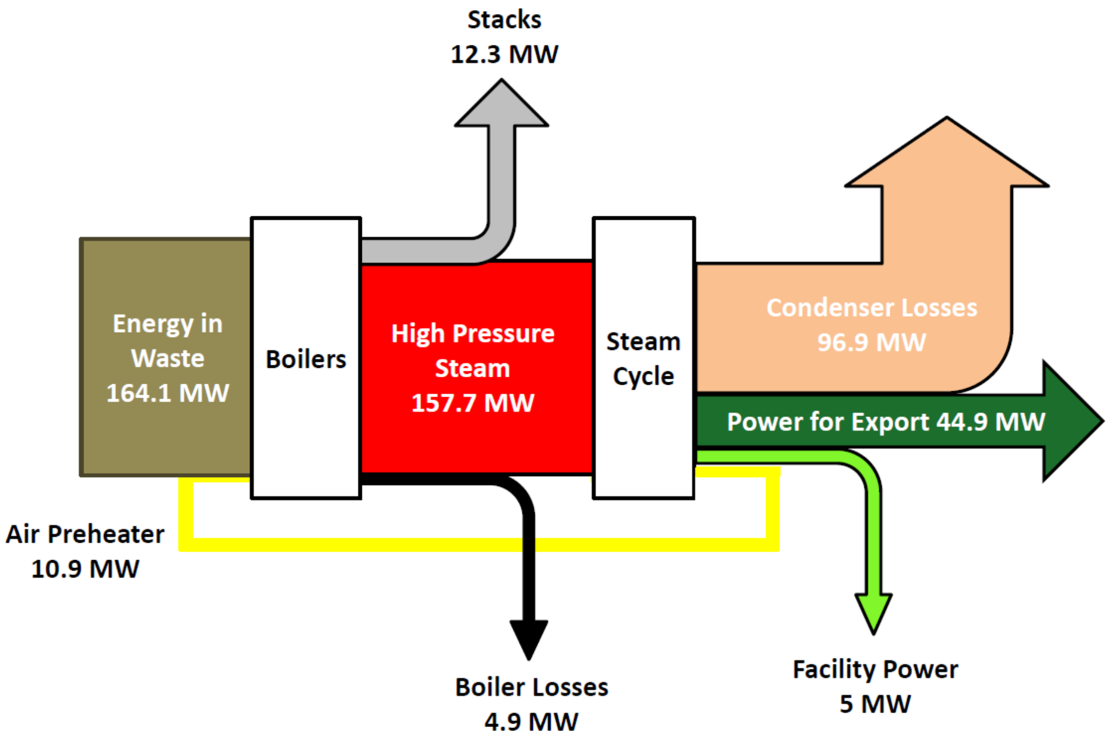


Figure 5: Indicative Sankey Diagram - No Heat Case

The ERF will have the capacity to export approximately 10 MWth of heat, subject to technical and economic feasibility. Refer to Appendix G for further details on the heat export opportunities. The export of heat would reduce the electrical output of the ERF but increase the overall thermal efficiency.

Assuming electricity-only mode and average ambient temperature, the ERF will generate approximately 49.9 MWe of electricity in full condensing mode. The ERF will have a parasitic load of approximately 10% or 5 MWe. Therefore, the export capacity of the ERF with average ambient temperature is approximately 44.9 MWe.

As stated previously, the design capacity of ERF is 28.1 tph per line with a design NCV of 10.5 MJ/kg. Assuming an availability of approximately 8,000 hours the ERF will annually generate approximately 399,200 MWh and export approximately 359,200 MWh of electricity.

As presented in Table 15, the design figures are compared with the benchmark data for MSW incineration plants, given in the Environment Agency Sector Guidance Note EPR5.01 and in the BREF for Waste Incineration (BREF WI).

Table 15: ERF design parameters comparison table

Parameter	Unit	The ERF	Benchmark	Source
Net power generation, design capacity (28.1 tph per line at 8,000 hours availability)	MWh/t waste	0.8	0.6 – 0.9	BREF
Internal power consumption, design capacity (28.1 tph per line at 8,000 hours availability)	MWh/t waste	0.09	0.06 – 0.19	BREF
Power generation (assumed gross) for 100,000 tpa of waste	MWe	11	5 – 9	EPR5.01

3.8.2.1 Energy consumption and thermal efficiency

The most significant energy consumers at the ERF are anticipated to be the following:

- primary and secondary combustion air fans;
- Induced Draft fans;
- boiler feed water pumps;
- ACC fans;
- air compressors;
- waste loading systems; and
- residue conveying systems.

The ERF will be designed with careful attention being paid to all normal energy efficiency design features, such as high efficiency motors, high efficiency variable speed drives, high standards of cladding and insulation etc.

The ERF will also be designed to achieve a high thermal efficiency. In particular:

- The boilers will be equipped with economisers and superheaters to optimise thermal cycle efficiency without prejudicing boiler tube life, having regard for the nature of the waste that is combusted;
- Unnecessary releases of steam and hot water will be avoided, to avoid the loss of boiler water treatment chemicals and the heat contained within the steam and water;

- Low grade heat will be extracted from the turbine and used to preheat combustion air in order to improve the efficiency of the thermal cycle;
- Steady operation will be maintained as required by using auxiliary fuel firing; and
- Boiler heat exchange surfaces will be cleaned on a regular basis to ensure efficient heat recovery.

Due consideration will be given to the recommendations given in the relevant Sector Guidance Notes.

3.8.2.2 Operating and maintenance procedures

An O&M manual will be developed for the ERF. The O&M procedures will include the following aspects.

1. Good maintenance and housekeeping techniques and regimes across the whole plant.
2. Plant Condition Monitoring will be carried out on a regular basis. This will ensure, amongst other things, that motors are operating efficiently, insulation and cladding are not damaged and that there are no significant leaks.
3. Operators will be trained in energy awareness and will be encouraged to identify opportunities for energy efficiency improvements.

3.8.2.3 Energy efficiency measures

An energy efficiency plan will be built into the operation and maintenance procedures of the ERF ensuring maximum, practical, sustainable, safe and controllable electricity generation. This plan will be reviewed regularly as part of the environmental management systems.

During normal operation, procedures will be reviewed and amended to include improvements in efficiency as and when proven new equipment and operating techniques become available. These are assessed on the implementation cost compared with the anticipated benefits.

3.8.3 Further energy efficiency requirements

In accordance with Article 44 of the Industrial Emissions Directive, heat should be recovered as far as practicable. In order to demonstrate this, the following points should be noted.

1. Economisers will be installed to recover flue gas heat, compatibly with the temperature requirements of the flue gas treatment system.
2. The boilers will operate with superheated steam.

The ERF will not be subject to a Climate Change Levy agreement.

A CHP assessment has been developed for the ERF and is presented within Appendix G.

3.9 Residue recovery and disposal

The main residue streams which will arise from the operation of the ERF are:

1. Incinerator Bottom Ash; and
2. Air Pollution Control residues (APCr).

As described in sections 3.9.1 and 3.9.2, the proposed waste recovery and disposal techniques for the residues generated by the ERF, will be in accordance with the indicative BAT requirements.

Prior to the transfer of any residues off-site, where appropriate, the residues will be tested in accordance with the requirements of Technical Guidance WM2: '*Hazardous Waste: Interpretation of the definition and classification of hazardous waste*'.

Any materials which are to be transferred to landfill from the ERF will be Waste Acceptance Criteria (WAC) tested – leachability tested – to ensure that they meet the WAC for the landfill that they are to be transferred to.

In accordance with the requirements of Article 4 (Waste Hierarchy) of the Waste Framework Directive, which sets out the priorities for the prevention and management of waste, Redcar Ltd will review the options for the recovery and recycling of all residues generated by the ERF.

3.9.1 Incinerator Bottom Ash

Ash which is collected in the boiler (boiler ash) will be mixed with ash which comes off the end of the grate (bottom ash – i.e. the burnt-out reside from the combustion process). The mixture of boiler ash and bottom ash, known as IBA, is normally a non-hazardous waste which can be recycled. If the boiler ash were to be mixed with the APCr, the mixture would be defined as hazardous waste and this would restrict the ability of the operator to transfer the boiler ash for recovery. IBA has been used for at least 20 years in Europe as a substitute for valuable primary aggregate materials in the construction of roads and embankments. Redcar Ltd intend to transfer IBA from the ERF to an adjacent IBA processing facility at the site.

The bottom ash ejector will include for a water quench. The purpose of the ash quench is to cool and moisten the bottom ash to limit particulate emissions (dust generation), reduce fire risk or damage to the conveying equipment and to ensure an airtight seal to the furnaces to avoid air ingress to the combustion chamber from the boiler house.

The initial handling and quenching of the IBA at the ERF will be undertaken in an enclosed building. In addition, any overflow from the ash quench will be contained in the process effluent drainage system, reused and hence will not be released off-site. Furthermore, drainage from the adjacent IBA processing facility will be contained with links to the process drainage system. Therefore, there is little to no risk of contaminated runoff from IBA handling and storage entering nearby watercourses and/or polluting the ground.

The use of an ash quench will limit dust generation within the IBA handling room at the ERF. The IBA will also be transferred to the adjacent IBA facility using covered conveyors. Further specific measures for dust management at the IBA facility are presented within the Dust Management Plan – refer to Appendix K.

Further detail on the processing to be undertaken at the IBA facility is presented within section 4 of this document. In addition, the WI BREF requirements relating to IBA treatment have been considered in section 3.7.2.

3.9.2 Air Pollution Control residue

APCr is predominantly composed of calcium as hydroxide, carbonate, sulphate and chloride/hydroxide complexes. Typical major element concentration ranges for the UK residues are as follows:

- 30-36% w/w calcium;
- 12-15% w/w chlorine;
- 8-10% w/w carbonate (as C); and
- 3-4% w/w sulphate (as S).

Silicon, aluminium, iron, magnesium and fluorine are also present in addition to traces of dioxins and the following heavy metals: zinc, lead, manganese, copper, chromium, cadmium, mercury, and arsenic.

APCr is classified as hazardous (due to its elevated pH) and requires specialist landfill disposal or treatment. Redcar Ltd will examine options for the treatment or re-use of APCr at a specialist facility off-site. Alternatively, if a suitable option for the recovery of APCr cannot be identified, then it would be sent to a suitably licensed hazardous waste storage facility or landfill for disposal as a hazardous waste. The reuse of APCr is an evolving market and Redcar Ltd will continue to explore alternative options for the treatment of APCr throughout the lifetime of the ERF.

APCr will be removed from site in enclosed tankers thereby minimising the chance of spillage and dust emissions. During the tanker filling operation, displaced air released to the atmosphere would first pass through a fabric filter.

3.9.3 Summary

The expected quantities and properties of the main residue streams generated from the operation of the ERF are summarised in Table 13 below.

Table 16: Key residue streams from the ERF

Source/ Material	Properties of Residue	Storage location/ expected storage capacity	Estimated quantity of residue generated (tpa)	Disposal Route and Transport Method	Expected Frequency
IBA	Grate ash (mixed with boiler ash). This ash is relatively inert, classified as non-hazardous.	Refer to section 4.2.3	100,100 tpa	To be transferred to the adjacent IBA facility for processing and recycling into secondary aggregate.	1 – 7 days
APCr	Ash from flue gas treatment, may contain some unreacted lime.	2 x Silos, 702 m^3 total capacity	18,729 tpa	Recycled or disposed of in a licensed site for hazardous waste. Transport occurs by road vehicle.	3 – 7 days

4 The IBA recycling facility

4.1 Raw Materials

The main raw materials stored at the IBA facility will be unprocessed IBA and other aggregate materials received at the site for blending purposes. In addition, the processed IBAA following the IBA treatment process will also be stored at the IBA facility. Further detail on storage arrangements for raw materials and IBAA at the IBA facility are provided in section 4.2.3.

Small quantities of maintenance materials may be kept at the IBA facility (such as oils, greases, antifreezes etc) for the operation and maintenance of plant and equipment, including IBA processing equipment and mobile plant. These materials will be supplied to standard specifications offered by main suppliers, with all chemicals handled in accordance with COSHH Regulations as part of the quality assurance procedures. Full product data sheets (MSDS) will be available on-site.

Should any liquid maintenance materials require storage at the IBA facility, these would be stored within bunded areas, with the secondary containment having a volume of 110% of the stored capacity. Any gas bottles used on-site will be kept secure in dedicated area(s).

Periodic reviews of all materials used will be made in the light of new products and developments. Any significant change of material, where it may have an impact on the environment, will not be made without firstly assessing the impact and seeking approval from the EA. A detailed inventory of raw materials used on-site will be maintained, and procedures implemented for the regular review of new developments in raw materials.

4.2 Incoming waste management

4.2.1 Waste and materials to be processed at the IBA facility

The EWC codes for the waste to be accepted at the IBA facility (including unprocessed IBA from both the ERF and off-site sources, and other aggregate materials accepted for the purpose of blending and mixing) are presented within Table 17.

Table 17: Waste to be processed in the IBA facility

EWC Code	Description of Waste
WASTES RESULTING FROM EXPLORATION, MINING, QUARRYING, AND PHYSICAL AND CHEMICAL TREATMENT OF MINERALS	
01 04	**wastes from physical and chemical processing of non-metalliferous minerals**
01 04 08	waste gravel and crushed rocks other than those mentioned in 01 0407
01 04 09	waste sand and clays
WASTES FROM THERMAL PROCESSES	
10 01	**wastes from power stations and other combustion plants (except 19)**
10 01 01	bottom ash, slag and boiler dust (excluding boiler dust mentioned in10 01 04)
10 01 03	fly ash from peat and untreated wood
10 01 15	bottom ash, slag and boiler dust from co-incineration other thanthose mentioned in 10 01 14

EWC Code	Description of Waste
CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES)	
17 01	**concrete, bricks, tiles and ceramics**
17 01 01	concrete
17 01 02	bricks
17 01 07	mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06
17 05	**soil (including excavated soil from contaminated sites), stones and dredging spoil**
17 05 04	soil and stones other than those mentioned in 17 05 03
17 05 08	track ballast other than those mentioned in 17 05 07
17 09	**other construction and demolition wastes**
17 09 04	mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03
WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE	
19 01	**wastes from incineration or pyrolysis of waste**
19 01 12	bottom ash and slag other than those mentioned in 19 01 11
19 01 16	boiler dust other than those mentioned in 19 01 15
19 01 19	sands from fluidised beds
19 12	**wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified**
19 12 09	minerals (for example sand, stones)
19 13	**wastes from soil and groundwater remediation**
19 13 02	solid wastes from soil remediation other than those mentioned in 1913 01

4.2.2 IBA handling

4.2.2.1 Receipt of IBA and materials

An enclosed conveyor system would transfer IBA from the ERF to the reception bunker at the IBA facility. IBA may also be transferred directly from off-site sources via road, in enclosed/covered vehicles, or by vessels via the Redcar Bulk Terminal.

4.2.2.2 Unacceptable material

Should any material be received at the IBA facility which is not in accordance with the list of approved EWC codes, the delivery will be rejected. If the material has already been accepted at the IBA facility, it will be quarantined for inspection prior to transfer off-site to a suitably licensed waste management facility. The quarantine area will be situated on impermeable hardstanding and will have contained drainage. If technically feasible, non-permitted material will be removed to a suitably licensed facility within 7 days, unless otherwise agreed in writing with the EA. Any hazardous materials will be removed following the requirements of the current hazardous materials legislation.

Unacceptable materials could include hazardous wastes, radioactive wastes, explosives, liquids and slurries, batteries and WEEE etc. A clear policy would be in place for the subsequent storage and disposal of unacceptable materials. The policy will include identification of any hazards posed by rejected materials and labelling of rejected materials with information necessary to allow proper storage and segregation. Records will be kept of unacceptable materials to enable Redcar Ltd to contact the supplier to prevent reoccurrence. Clear and unambiguous criteria will be applied for the rejection of materials together with a written procedure for tracking and reporting non-conformance, including notifying the supplier.

In the unlikely event that non-compliant material is unloaded onto the conveyor for processing at the IBA facility, the system will be halted, and the non-compliant waste removed and transferred to the quarantine area for storage prior to transfer off-site.

4.2.3 IBA and material storage

IBA will be stored within a reception bunker. There will also be a dedicated quarantine area set aside for the storage of 'unacceptable' material that has been accepted at the IBA facility, as described in section 4.2.2.2. The quarantine area will be subject to the detailed design of the IBA facility but is expected to have an equivalent capacity to store approximately 1 vehicle load (e.g. for IBA and material that is accepted from off-site sources).

The external storage yard will store processed IBAA for a period of pH stabilisation and maturation. Other aggregates for blending purposes will also be stored within the external storage yard, alongside extracted metals resulting from IBA processing.

The storage arrangements and capacities at the IBA facility are set out within Table 18 below.

Table 18: Storage arrangements – IBA facility

Material	Storage capacity	Storage arrangements
Incoming IBA (from both adjacent ERF and off-site sources)	40,000 tonnes	Reception bunker in enclosed building.
Processed IBAA	20,000 tonnes	External stockpiles in storage yard.
Aggregates for blending	5,000 tonnes	External stockpiles in storage yard.
Extracted metals	1,000 tonnes	Containers in storage yard.

Regular preventative maintenance as part of documented management systems at the site will ensure that the integrity of the IBA and material storage areas is maintained throughout the lifetime of the IBA facility. Preventative maintenance may include for periodically emptying storage areas and undertaking visual inspections of the concrete/hardstanding from which they are constructed. Should it be identified that damage has occurred to the structure(s), repairs will be undertaken to ensure that integrity is suitably maintained. These measures will ensure that liquids (such as leachates from IBA) do not leak and contaminate the underlying groundwater. In addition, a high standard of housekeeping will be maintained in all areas and spill kits will be available in suitable locations.

4.2.4 IBA processing

Once the IBA has been transferred from the reception bunker to the process building, it will be fed into a hopper where it will then undergo mechanical processing.

The processing stages are set out broadly as follows:

1. The IBA will be fed into a hopper and oversize material (which is material typically above 40mm diameter) will be screened using bars or a screen at the inlet to the hopper. It is expected that larger pieces of material (such as stone and concrete) would undergo crushing at the IBA facility to ensure a more homogeneous product.
2. The screened material will then pass via conveyor belts through the treatment process. An over-band magnet would remove ferrous metals from the IBA, and an eddy current separator would remove non-ferrous metals from the IBA. Ferrous and non-ferrous material would be collected in separate storage bays or containers before transfer off-site for further processing and reuse.
3. The IBA will then undergo separation into different size fractions using a drum screen. A wind sifter may also be used to separate out fine material.
4. Finer particles of ferrous metals would be removed using secondary over-band magnets.
5. Any unburnt material that is identified would be returned to the ERF for re-processing.
6. Blending of the processed IBA material with other aggregate materials may be undertaken to improve the quality of the aggregate product.

The processed IBA would then be moved from the process building, by bucket loaders, and stored in the external storage area for a period of pH stabilisation/maturation (for around 2 – 4 weeks) in the external storage area, before being exported off-site as IBAA. Whilst the IBAA is being stored, it will continue to be weathered by the air and rainwater.

An indicative process flow diagram for the IBA facility is presented within Figure 6 below. The exact type of equipment and order of processing will be confirmed during the detailed design of the IBA facility.

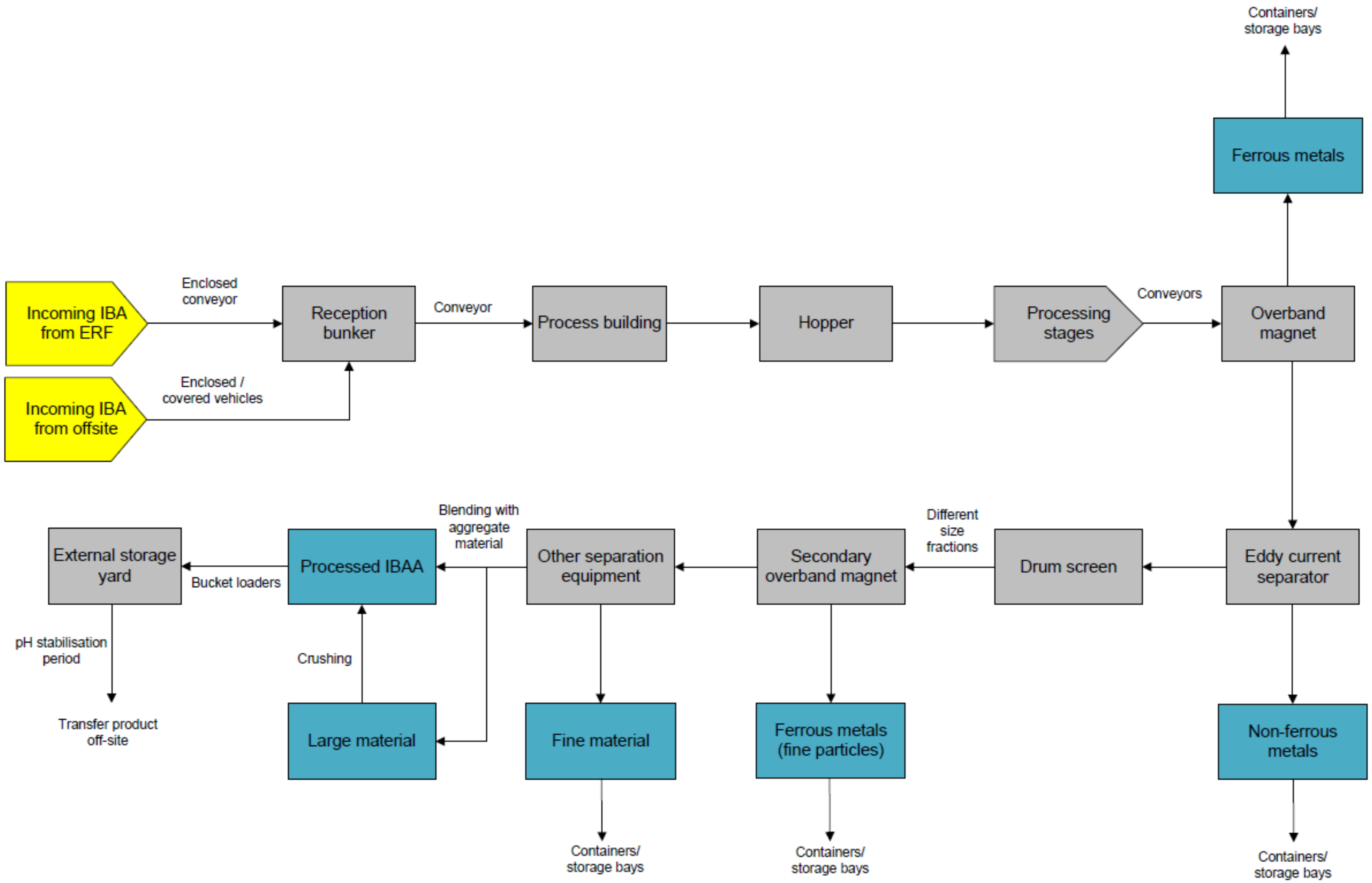


Figure 6: Indicative process flow diagram - IBA facility

4.3 Water Use

4.3.1 Overview

The primary use of water at the IBA facility will be for dust mitigation and washdown activities. As the IBA treatment will utilise a dry treatment system (refer to section 4.6), minimal quantities of water will be required for IBA processing.

- The water system will be designed with two key objectives:
  - minimal process water discharge; and
  - minimal consumption of potable water.
- Where practicable, waste waters generated from the process will be reused/recycled within the process.
- A settlement lagoon will provide interim storage for process waters prior to re-use in the process. Excess effluents from the IBA facility would be directed to the ERF wastewater pit, for use in the ERF process such as the initial ash quench. Overflow from the wastewater pit would either be tankered off-site or discharged to sewer in accordance with a trade effluent consent – to be confirmed during detailed design.
- The site will have separate process water, foul water and surface water systems.

4.3.1.1 Potable and Amenity Water

Water for drinking supplies for the offices and welfare facilities will come from a potable water supply. The quantity of this water is expected to be small compared to the other water uses on site.

Foul and domestic effluents from showers, toilets, and other mess facilities will be discharged to foul sewer.

4.3.1.2 Process Water

Process effluents will be recycled (for example, washdown water would be re-used in IBA processing with any excess directed to the wastewater pit at the ERF and subsequently used in the initial ash quench system).

An indicative water flow diagram for process water at the IBA facility is presented in Figure 7 below, with indicative drainage diagrams for overall surface water and domestic effluent management at REC presented in section 1.4.4. Larger versions of these drawings are included within Appendix A.

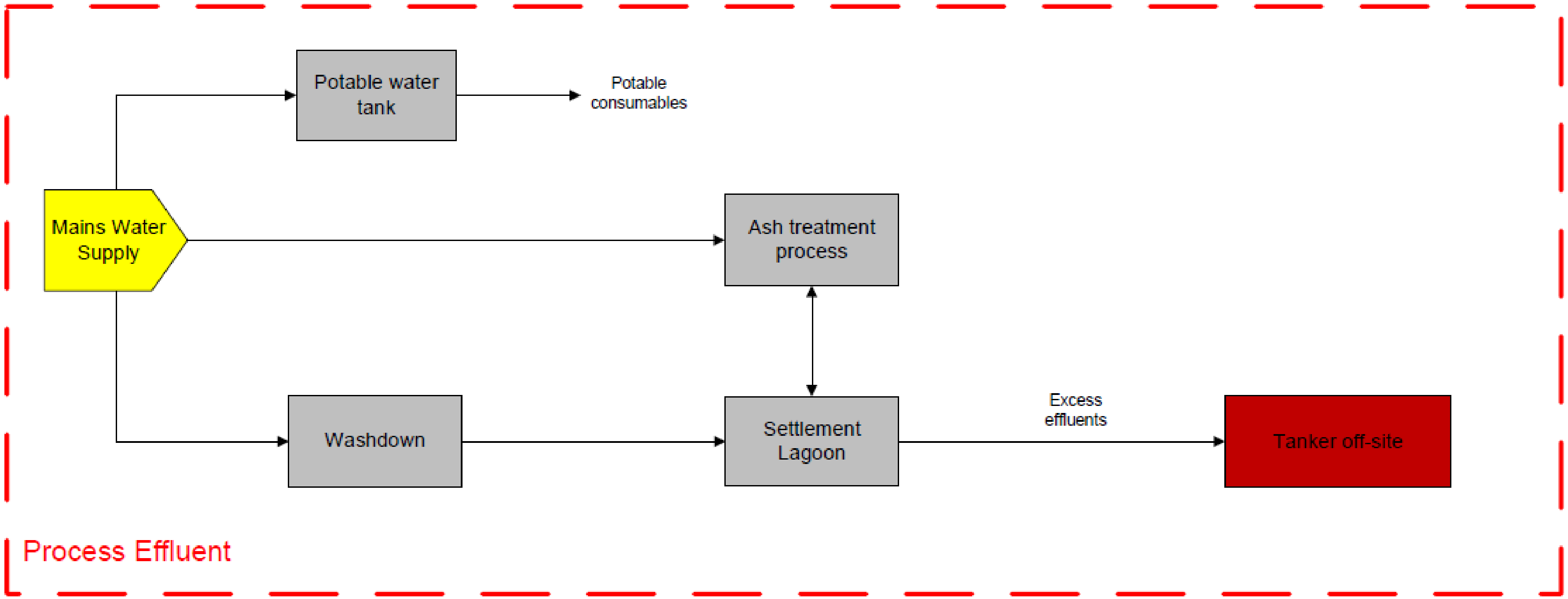


Figure 7: Indicative water flow diagram – process water – IBA facility

4.4 Emissions

A consolidated table detailing the proposed emissions points at the site is presented in section 1.4.6.

4.4.1 Point source emissions to air

It is not expected that the IBA facility will have any point source emissions to air.

4.4.2 Fugitive emissions to air

4.4.2.1 Materials handling and storage

Fugitive emissions of dust have the potential to occur during unloading, processing and storage operations at the IBA facility. IBA will be transferred from the ERF to the IBA facility in enclosed conveyors, with any materials transferred from external sources delivered to the IBA facility in covered vehicles or vessels. Initial storage of pre-processed IBA will be within a bunker in an enclosed building. Processing of the IBA will be undertaken in an enclosed building.

Handling during the external storage of processed IBA will be minimised where possible, and disturbance to stockpiles will also be minimised. The IBA will be maintained wet from initial ash quenching, which reduces the potential for fugitive dust missions from the site.

Regular washdown activities and good housekeeping will also be employed at the IBA facility to minimise the build up of dust.

Mobile plant and vehicle operators at the site will be provided with suitable training for the equipment they are operating. Supervision of mobile plant operation and regular site inspections will ensure that any leaks, trailing or tracking of residues from vehicles are quickly identified and suitably addressed. During prolonged periods of dry weather, the site roads would be damped down / washed if the potential for fugitive dust impacts resulting from traffic movements are identified by the site 'general manager'.

In addition to those measures outlined above for the prevention and reduction of fugitive emissions to air of dust and litter, the speed of vehicles on-site will also be limited to further reduce dust emissions.

A Dust Management Plan is presented within Appendix K which sets out further measures to reduce and mitigate against dust emissions at the IBA facility.

4.4.3 Point source emissions to water and sewer

Further detail on the site drainage is presented within section 1.4.4 and 4.3.1.2. The contained process drainage at the IBA facility will ensure there is negligible risk for contaminated effluent to be discharged from the IBA facility. Excess process effluents would be directed to the ERF wastewater pit, where any overflow would either discharge to foul sewer or be tankered offsite – to be confirmed during detailed design.

Foul effluent from domestic facilities will be discharged to sewer.

4.4.4 Contaminated water

In the unlikely event of a spillage or leak that has the potential to cause environmental harm, site management will be informed and the event recorded in accordance with the documented management systems for the site. The relevant regulatory authorities (Environment Agency / Health and Safety Executive) will be informed if required (i.e. if the spillage or leak is significant) in accordance with management procedures. The effectiveness of the emergency response procedures will be subject to management review and will be revised and updated as appropriate following any major spillages.

Spill kits will be located at easily accessible locations. A site drainage plan, including the location of process and surface water drainage, will be made available on-site following completion of detailed design.

4.4.5 Noise

Further details on noise impacts and noise mitigation at REC are presented in the noise assessment – refer to Appendix C.

4.4.6 Odour

The operation of the IBA facility is considered to give rise to negligible odour impacts, due to the nature of the material that is being handled.

4.5 Monitoring Methods

4.5.1 Emissions monitoring

4.5.1.1 Monitoring emissions to air

As stated within section 4.4.1, it is not anticipated that the operation of the IBA facility will lead to any point source emissions to air in addition to those described within section 1.4.6 for the ERF.

4.5.1.2 Monitoring emissions to water and sewer

Under normal operations, there will be no emissions of process effluent from the IBA facility. Excess process effluents, such as washdown water, would be stored in a temporary 'settlement pit' prior to reuse in the process. Excess process effluents from the IBA facility would be tankered off-site for treatment at a suitably licensed waste management facility.

Foul/domestic effluent from welfare facilities would be discharged to foul sewer in accordance with a Trade Effluent Consent, with any monitoring undertaken in accordance with the requirements of the Sewerage Undertaker.

4.5.2 Monitoring of process variables

It is expected that the following process variables would be monitored at the IBA facility:

1. IBA tonnages and the quantities of other materials received at the site would be monitored and recorded.

2. Potable water use will be monitored and recorded regularly to help highlight any abnormal usage. This will be achieved by monitoring the incoming water supplies.
3. Electricity consumption will be monitored to highlight any abnormal usage. Annual reports of process variables (such as water and electricity consumption) will be submitted to the EA in accordance with the requirements of the EP.

In addition, there will be a monitoring protocol in place for regular sampling and analysis of IBA to confirm that the TOC content is less than 3%, or LOI is less than 5%, and to confirm the non-hazardous status of the IBA. Sampling and analysis will be undertaken in accordance with the Environment Agency (EA) guidance note M4.

4.6 BAT review

There are three potential treatment techniques for IBA as follows:

- thermal treatment (vitrification);
- wet treatment (washing); and
- dry treatment (air maturation).

Thermal treatment systems have a high efficiency in destroying organic compounds and immobilizing other elements harmful to the environment. However, the high temperature required for vitrification means the process is very energy intensive. IBA from the incineration of MSW is a heterogeneous product and as such, the results of vitrification are variable in practice. Therefore, the resulting product can differ in composition, and the level of immobilization of pollutants can vary. Due to the high energy costs and the potential for varying levels of immobilization of pollutants from the IBA, thermal treatment systems are not considered appropriate for the IBA facility at REC.

Wet treatment systems use water to wash soluble salts from the IBA. Wet treatment systems produce large quantities of effluent which require treatment either on-site or offsite and subsequent discharge to water/sewer. There is currently no on-site effluent treatment facility proposed for the IBA facility. Due to the large quantities of effluent produced, wet treatment systems are not considered appropriate for the IBA facility at REC.

Dry treatment of IBA uses small quantities of water and produces comparatively small quantities of effluent compared to a wet treatment system. The effluent can re-used on site, however when there is excess effluent this can be transported off-site to a suitably licensed recovery/disposal facility. At REC, it is proposed to re-use effluent from the IBA facility within the ash treatment process, with excess effluents discharged to the wastewater pit at the ERF (with excess effluents discharged to sewer). The equipment used in dry treatment systems are significantly less energy intensive when compared to thermal treatment systems. Due to the small quantities of effluent produced, and low power consumption compared to other systems, dry treatment of IBA is considered to represent BAT for the IBA facility at REC.

We are not currently aware of any IBA treatment facilities in the UK which employ either wet treatment or thermal treatment techniques. Therefore, Redcar Ltd do not consider these techniques to be a proven technology for the treatment of IBA in the UK. However, there are a number of IBA facilities in the UK which employ the use of dry treatment systems.

Taking the above into consideration, Redcar Ltd considers that dry treatment of IBA through air maturation represents BAT for the treatment of IBA at REC.

4.7 The Legislative Framework

4.7.1 Requirements of the Waste Incineration BREF

A review of the Waste Incineration BREF has been undertaken and is presented within section 3.7.2. This includes a review of the BAT conclusions relevant to the treatment of IBA.

4.8 Energy efficiency

The design and operation of the IBA facility will aim to achieve a high energy efficiency. It is expected that the most significant energy consumers at the IBA facility will be the conveyors and IBA processing equipment.

An energy efficiency plan will be incorporated into the operation and maintenance procedures of the IBA facility. The plan will be reviewed regularly as part of the EMS. Procedures will be reviewed and amended, where necessary, to include improvements in efficiency as and when proven new equipment and operating techniques become available. These will be assessed on the implementation cost compared with the anticipated benefits.

Energy consumption will be monitored and recorded periodically, in accordance with the requirements of the EP.

4.9 Residue Recovery and Disposal

Any unburnt, oversized or unsuitable materials that are found within the IBA will be removed and stored separately for further inspection. This material will either be sent back to the ERF for further combustion or rejected and transported off-site to a suitably licensed waste management facility, in accordance with the waste hierarchy. Further details on procedures to manage 'unacceptable' waste are presented within section 2.2.2 The IBA facility is not expected to give rise to significant quantities of residues overall.

Drainage from all storage areas at the IBA facility would be contained within the site process drainage systems, with process effluents reused within the process.

5 Additional information

5.1 Management

5.1.1 Introduction

Redcar Ltd will demonstrate environmental and social responsibility by operating the site to high environmental, health and safety and professional standards. The site will be designed and constructed following the latest international and national regulations, standards and guidance. In the case of the ERF, this will incorporate risk management techniques such as HAZOP studies prior to construction and thorough commissioning and testing before plant takeover.

As part of its ongoing commitment to sustainable and responsible development and to regulatory compliance, Redcar Ltd will develop and implement a documented EMS at the site. Measures will be undertaken to ensure that this is communicated, understood and effectively maintained throughout the organisation to meet the requirements of the BS EN ISO 14001:2015 Environmental Management System Standard.

A site-specific EMS will be developed following detailed design, which will contain a set of procedures describing how pollution risk will be minimised from the activities to be undertaken at the site. The EMS will be certified to the ISO 14001 standard. The EMS will form part of the site's integrated management system that establishes an organisational structure, responsibilities, practices, procedures and resources for achieving, reviewing and maintaining the company's commitment to environmental protection. Redcar Ltd regards the ISO 14001 certification to be of considerable importance and relevance to a waste treatment site. It is an assurance to the local authority, regulator, neighbours, and others alike that operations are undertaken in strict compliance with the regulations in force and with the management seeking continual improvements. It requires the company to work in a transparent way, to maintain and improve the confidence of regulators and neighbours, and to have a proactive approach to environmental improvement.

Section 5.1.2 below provides a general summary of the proposed site EMS in accordance with Environment Agency (EA) guidance '*Develop a management system: environmental permits*'.

In addition to the EMS, an operating and maintenance (O&M) manual(s) will be developed for the site. The O&M manual(s) will contain the key information required for the operation, maintenance and eventual decommissioning of the site over its lifetime. A summary of the key aspects to be included in the O&M manual is presented within section 5.1.3.

5.1.2 Summary of EMS and management systems

The EMS will clearly define the management structure as well as setting out roles and responsibilities of all staff. The EMS will also include:

- An Environmental Policy;
- Health and Safety Procedures; and
- An operational guidance manual which will include process plant operating procedures for both standard and emergency conditions.

The Construction (Design and Management) Regulations will apply during the construction and commissioning period. In addition, management will undertake inspections and reviews for quality control, performance measurements, and staff appraisals.

5.1.2.1 Scope and structure

The scope of the ISO 14001 certification for the site will cover three key areas. These are:

- The design and development of the site;
- The operation of the site; and
- The processing of controlled waste.

Where applicable, documented procedures will detail specifically how each activity will be controlled. These will be contained in an Environmental Procedures Manual and identified related documents.

The site EMS will contain procedures for accident management that comply with the EA's requirements (for the ERF, these are set out in EPR5.01 and the WI BREF). This will be in the form of an accident management plan that will be developed for the site.

5.1.2.2 General requirements

The scope of the EMS will include, but not be limited to, the following:

- an environmental policy;
- identification of potential environmental impacts;
- documented procedures to control operations that may have an adverse impact on the environment;
- ensuring adequate responsibility, authority and resources to management necessary to support the EMS;
- defined procedures for identifying, reviewing and prioritising items of plant and equipment for which preventative maintenance regimes are appropriate;
- establishing preventative maintenance programmes (and associated auditing) to cover all plant and equipment whose failure could lead to environmental impacts (including infrastructure such as pipework, drainage, bunds etc);
- documented procedures for monitoring relevant emissions or environmental impacts;
- establishing performance indicators to measure the effectiveness of the procedures;
- monitoring, measuring and analysing the procedures for effectiveness; and
- implementing actions as required based on the results of auditing to ensure continual improvements of the processes.

Where applicable, documented procedures will detail specifically how each activity will be controlled. These will be contained in an Environmental Procedures Manual or similar and identified related documents.

Redcar Ltd will adapt and extend the scope of the current environmental policies for each company that make up the joint venture. The resulting environmental policy will act as a commitment to continual improvement of Redcar Ltd's operations including a commitment to comply with relevant legislation.

5.1.2.3 Site operations

The fuel preparation facility will be designed to process approximately 200,000 tonnes per annum of non-hazardous waste. The fuel preparation facility will process the waste (including de-baling, shredding) to produce a refuse-derived fuel for transfer to the adjacent ERF for processing.

The ERF will operate as a CHP plant, with the main activity to be undertaken being the incineration of non-hazardous waste to recover energy. Up to 500,000 tonnes of waste will be processed each year.

The IBA facility will be capable of receiving up to approximately 180,000 tonnes per annum of IBA, from both the adjacent ERF and also from off-site sources. The purpose of the IBA facility will be to produce an aggregate material for use in construction.

All permitted activities will take place within the Installation Boundary. The activities to be undertaken at the site are listed in section 1.3.

Steps to be taken to prevent or minimise risks to the environment from each activity/process – these are described within the Environmental Risk Assessment (presented in Appendix D). The environmental risks will be expanded on and incorporated into the final EMS document upon completion of detailed design.

5.1.2.4 Site plan

Following completion of detailed design, the EMS will include for a detailed plan of the site which highlights where permitted activities are undertaken. The plan will also show the location of the following, in accordance with EA guidance '*Develop a management system: environmental permits*':

- buildings and any other main constructions such as security fences;
- storage facilities for hazardous materials (oil or fuel tanks), chemical stores, waste materials;
- the location of items for use in accidents and emergencies, such as spill kits;
- entrances and exits for use by emergency services;
- any points designed to control pollution (e.g., monitoring points for sewer discharge);
- effluent or water discharge points;
- areas vulnerable to pollution such as watercourses, adjacent industrial premises etc;
- drainage facilities; and
- utilities supplies (water, gas, electric) including stop taps, isolating valves, routes etc.

5.1.2.5 Waste storage plan

Upon completion of detailed design of the site, a waste storage plan will be incorporated into the EMS, in accordance with the requirements of EA guidance '*Develop a management system: environmental permits*'. Preliminary information in relation to waste storage at the site is set out as follows:

- At the fuel preparation facility, baled waste will be stored within dedicated waste storage bays located within the main building. Furthermore, a tipping area will store rejected material from the ERF. It is proposed to provide further details of storage arrangements at the fuel preparation facility via a pre-operational condition or similar.
- Non-hazardous waste at the ERF will be stored within a dedicated waste bunker (within the main building). Allowing for stacking within the bunker, the waste storage capacity of the bunker will be equal to approximately 5 days of waste processing capacity, equivalent to around 18,000 m3 or 6,300 tonnes. However, allowing for extended periods of shutdown, the maximum amount of time that waste will be stored in the bunker is 4 weeks. APCr will be stored in 2 dedicated silos, with a total storage capacity of around 620 m^3.
- At the facility, unprocessed IBA would be stored within a bottom ash reception bunker of around 40,000 tonnes capacity. An external storage yard will provide storage for around 20,000

tonnes of processed IBAA, 1,000 tonnes of recycled metals, and 5,000 tonnes of aggregates for blending.

- Comprehensive waste acceptance procedures will identify the types of waste to be stored and processed at the site. Paperwork accompanying waste deliveries to the site will identify waste by EWC code(s).
- 'Incompatible' waste types will not be accepted or mixed at the site. Therefore, different wastes will not need to be separated from each other.

5.1.2.6 Site and equipment maintenance plan

Upon completion of detailed design of the site, a site equipment and maintenance plan will be incorporated into the EMS, in accordance with the requirements of EA guidance '*Develop a management system: environmental permits*'. Preliminary information in relation to this plan is set out as follows:

- Plant and machinery (including any mobile plant) will be maintained in accordance with the manufacturer's or supplier's recommendations. A preventative maintenance regime will be in place at the site.
- Records will be kept of any maintenance carried out on plant and machinery.

5.1.2.7 Personnel

Redcar Ltd will ensure that sufficient numbers of staff, in various grades, are provided to manage, operate and maintain the site on a continuous basis, seven days per week throughout the year.

It is anticipated that the key environmental management responsibilities will be allocated as described below:

- The 'Plant' or 'General' Manager for each component at the site will have overall responsibility for management of the facility and compliance with the EP. The Plant Manager will have extensive experience relevant to their responsibilities.
- The 'Operations' Manager(s) will have day-to-day responsibility for the operation of each component, to ensure that the facility is operated in accordance with the EP and that the environmental impact of operations is minimised. In this context, they will be responsible for designing and implementing operating procedures which incorporate environmental aspects.
- The 'Engineering' or 'Maintenance' Manager will be responsible for the management of maintenance activities, for maintenance planning and for ensuring that the facility continues to operate in accordance with its design.
- The Environment, Health and Safety (EHS) manager will be responsible for environmental and health and safety at the site, including compliance with the EP.

The majority of employees would be skilled operatives (electricians/fitters/crane operatives) or technical engineers (control and plant). In addition to the above, roles could include site fitters, security officers, engineers, technicians, administrators, weighbridge operatives, shift leaders, crane operatives, site operatives etc.

5.1.2.8 Competence, training and awareness

Redcar Ltd aims to ensure that any persons performing tasks for it, or on its behalf, which have the potential to cause significant environmental impact, are competent on the basis of appropriate education and training or experience.

Systems to assess competence and provide training for relevant staff will be provided. These may cover, but not be limited to, the following:

- awareness and importance of regulatory implications of the EP for the activities and operations undertaken at the site;
- awareness of potential environmental effects from operation under normal and abnormal circumstances (e.g., periods of shutdown);
- awareness of the need to report any significant deviations from the EP;
- prevention of accidental emissions and action to be taken when accidental emissions occur; and
- roles and responsibilities in achieving conformity with the requirements of the EMS.

Skills, competencies and training requirements for staff will be documented and recorded as part of the internal management systems at the site. Redcar Ltd will comply with industry standards or codes of practice for training, where they exist. The EMS will contain an archiving procedure to ensure all training is recorded and all associated records are retained.

Competence

Redcar Ltd will identify the minimum competencies required for each role. These will then be applied to the recruitment process to ensure that key roles and responsibilities are satisfied. Particular attention will be paid to potential candidate's experience, qualifications, knowledge and skills.

Induction and awareness

Staff induction programmes are location and job role specific and will include, as a minimum, the induction of:

- the Environmental Policy;
- the requirements of the EP;
- the Health and Safety Policy and Procedures; and
- the EMS Awareness Training.

Staff will have access to the EMS via internal computer systems and will be required to understand any sections of the EMS relevant to the activities they carry out.

Training

Redcar Ltd will be required to train staff during the commissioning of the site and prior to the site becoming operational. Line Managers will be required to identify and monitor staff training needs as part of the appraisal system. The training needs of employees will be addressed using on-the-job training, mentoring, internal training and external training courses/events. As stated above, records of training will be documented and recorded, with industry standards or codes of practice for training complied with where relevant. Training records will be maintained onsite. The operation of the site will comply with industry standards or codes of practice for training where they exist.

For any contractors working on-site, potential environmental risks will be identified where relevant and instructions provided to the contractors.

5.1.2.9 Accident management

As indicated within section 5.1.2.1, the scope of the EMS will include for an 'accident prevention and management plan' or similar in accordance with the requirements of EA guidance '*Develop a management system: environmental permits*', which will identify the likelihood and consequences of any accidents and identify actions or measures to prevent accidents and mitigate any consequences (such as environmental pollution). The accident plan will include for written procedures and forms for recording, handling, investigating, communicating and reporting actual or potential non-compliance (e.g. complaints) with operating procedures/emission limits. Any incidents will be investigated thoroughly and documented, with the regulatory authorities informed if the incident is significant. Near misses will be reported and suitable corrective action/mitigation measures implemented and followed up.

For each potential accident or incident, the following will be identified:

- the likelihood of the accident happening;
- the consequences of the accident happening;
- proposed measures to be taken to avoid the accident happening; and
- proposed measures to be taken to minimise the impact if the accident does happen.

A list of substances stored at the site, and storage facilities, will also be incorporated into the accident management plan (either linked to part of the wider EMS or listed specifically within the accident management plan itself).

The accident plan will be regularly reviewed, no less than once per year, with records kept of the dates that reviews have occurred and planned future review dates. Furthermore, a list of emergency contacts will be included within the accident plan (such as the local fire service, EA etc.)

5.1.2.10 Climate change and flood risk

The potential impacts of climate change (including flood risk) have been and will continue to be considered in the context of the design and operation of the site. The proposed accident management and contingency plans presented within the sections above will include for relevant climate change impacts.

A climate change risk assessment is presented with the Application Forms submitted with the EP application. The risk assessment will be incorporated into the scope of the EMS for the site and will continue to be monitored and updated regularly throughout the lifetime of the site.

5.1.2.11 Keeping records

Any records required by the EP will be kept in accordance with the relevant timescales indicated within the EP. Should the EP not identify timescales for certain records, these will be defined within the EMS. Records will be kept as part of the EMS for the site.

The records that will be kept will include, but not be limited to, the following:

- the EP for the site;
- other legal requirements for the site;
- environmental risk assessments;
- environmental management plans;
- EMS plans;
- operating procedures;
- staff competence and training (such as qualifications, courses attended);
- emissions and any monitoring undertaken as required by the EP;
- compliance checks, findings of investigation and actions taken;
- complaints made, findings of investigation and actions taken;

- audits of management system, findings (reports) and actions taken;
- management reviews and changes made to the management system;
- where applicable, certification audit reports and any actions carried out;
- records of pre-acceptance and acceptance checks on waste delivered to the site (including quantity, EWC codes, origin, producer, date of arrival, any unacceptable wastes);
- records to show that the duty of care requirements are being met.

Copies of any approved plans (such as the fire prevention plan and dust management plan) will be kept with the EMS and records will be maintained of any updates to these plans. Furthermore, the Site Condition Report will be kept with the EMS and records will be maintained of any updates to the Site Condition Report.

A hard copy of the EMS will be kept at the gatehouse, with electronic copies of the EMS and supporting documents (including records) accessible to staff via internal computer systems.

5.1.2.12 Review of management systems

The EMS will be reviewed and updated regularly in response to changing internal and external factors, with records kept on any checks carried out and updates made. Updates may be made, for example, when changes are made to operations and activities carried out at the site, if new equipment is installed, if the EP is varied, following any accidents or complaints, or if a new environmental risk is identified. As a minimum, the EMS will be reviewed once per year.

5.1.2.13 Contingency

A contingency plan will be developed as part of the EMS following completion of detailed design. This will incorporate measures and procedures for the following scenarios in order to minimise environmental risk:

- breakdown scenarios;
- enforced shutdowns;
- planned shutdowns;
- any other abnormal operation (e.g. due to flooding or extreme weather).

The EA will be provided with a copy of the EMS (or relevant parts thereof) for the site if requested.

5.1.2.14 Contact information for the public

A notice board will be displaced at (or near) the gatehouse which tells the public key information about the site. This will include, but not be limited to, the following:

- the EP holder's name;
- an emergency contact name and telephone number;
- a statement that the site is permitted by the Environment Agency;
- the EP number;
- the Environment Agency telephone number 03708 506506 and the incident hotline 0800 807060.

5.1.2.15 Complaints

A complaints procedure will be in place and will form part of the EMS to record any complaints received in relation to activities covered by the EP. The procedure will include details on how complaints will be investigated, and any actions to be taken following complaints.

5.1.3 Operating and maintenance procedures

In addition to the EMS described above, an operating and maintenance (O&M) manual(s) or similar will be developed for the site. The O&M procedures will include, but not be limited to the following aspects:

- comprehensive description of each component at the site including operating hours and design details;
- as-built drawings of the site;
- maintenance and service plans;
- staffing and staff responsibilities;
- waste acceptance and pre-acceptance procedures;
- waste storage and handling procedures;
- copies of any guaranties/warranties/certificates; and
- health and safety procedures.

5.2 Closure

5.2.1 Introduction

The site is designed for an operational life of approximately 25 – 30 years. However, the operational lifetime of these type of facilities can be (and often is) extended. The actual operational lifetime is dependent on a number of factors including:

- the level of planned and lifecycle maintenance;
- the continued supply of waste; and
- the development of alternative methods competing for the same waste fuels.

When the site has reached the end of its operational life, it could be adapted for an alternative use or demolished as part of a redevelopment scheme and cleared and left in a fit-for-use condition. It is possible that each component of the site may have different lifetimes respectively.

5.2.2 Site Closure Plan

At the end of the economic life of the site, the development site and buildings may be redeveloped for extended use or returned to an alternative status. The responsibility for this may well rest with other parties if the site is sold. However, Redcar Ltd recognise the need to ensure that the design, the operation and the maintenance procedures facilitate decommissioning in a safe manner without risk of pollution, contamination or excessive disturbance to noise, dust, odour, groundwater and surface watercourses. Therefore, the site will be designed with consideration for eventual site decommissioning and demolition. The operation of REC will be undertaken in a manner as not to lead to deterioration of the site.

To achieve this a Site Closure Plan will be prepared. The following is a summary of the measures to be considered within the closure plan to ensure the objective of safe and clean decommissioning.

5.2.2.1 General requirements

The general requirements associated with the implementation of the Site Closure Plan will include, but not be limited to, the following:

- underground pipework to be avoided except for supply and discharge utilities such as towns water, sewerage lines and gas supply;
- safe removal of all chemical and hazardous materials;
- adequate provision for drainage, vessel cleaning and dismantling of pipework;
- disassembly and containment procedures for insulation, materials handling equipment, material extraction equipment, fabric filters and other filtration equipment without significant leakage, spillage, release of dust or other hazardous substance;
- where practicable, the use of construction material which can be recovered (such as metals);
- methodology for the removal/decommissioning of components and structures to minimise the exposure of noise, disturbance, dust and odours and for the protection of surface and groundwater; and
- soil and groundwater sampling and testing of sensitive areas to ensure the minimum disturbance (sensitive areas to be selected with reference to the initial site report and any ongoing monitoring undertaken during operation of the installation).

5.2.2.2 Specific details

The specific details associated with implementation of the Site Closure Plan will include, but not be limited to, the following:

- a list of recyclable materials/components and current potential outlet sources;
- a list of materials/components not suitable for recycle and potential outlet sources;
- a list of materials to go to landfill with current recognised analysis, where appropriate;
- a list of all chemicals and hazardous materials, location and current containment methods; and
- A Bill of Materials detailing total known quantities of items throughout the site such as:
  - steelwork;
  - plastics;
  - cables;
  - concrete and civils materials;
  - oils;
  - chemicals;
  - consumables;
  - contained water and effluents; and
  - residues/wastes including IBA and APCr.

5.2.2.3 Disposal routes

Each of the items listed within the Bill of Materials will have a recognised or special route for disposal identified; e.g., landfill by a licensed contractor, disposal by high sided, fully sheeted road vehicle or for sale to a scrap metal dealer, disposal by skip/fully enclosed container, dealer to collect and disposal by container.

5.3 Improvement programme

Redcar Ltd is committed to continual environmental improvement of its operations, and is therefore proposing that a small number of improvement conditions be incorporated into the final EP. These have been set out below. It is understood that the proposed conditions are consistent with EPs which the EA has granted for waste incineration facilities in England.

5.3.1 Prior to commissioning

Prior to commencement of commissioning of the ERF, Redcar Ltd will comply with the typical Pre-Operational Conditions which will be included for this type of installation, as follows:

- Submit a written report to the EA, on the details of the computational fluid dynamic (CFD) modelling used in the design of the boilers. The report will demonstrate whether the BAT design stage requirements, stated in EPR5.01, have been completed. In particular, the report will demonstrate whether the residence time and temperature requirements will be met.
- Submit to the EA for approval a protocol for the sampling and testing of bottom ash for the purposes of assessing its hazard status. Sampling and testing shall be carried out in accordance with the protocol as approved.
- Provide a written commissioning plan, including timelines for completion, for approval by the EA. The commissioning plan shall include the expected emissions to the environment during the different stages of commissioning, the expected durations of commissioning activities and the actions to be taken to protect the environment and report to the EA in the event that actual emissions exceed expected emissions. Commissioning shall be carried out in accordance with the commissioning plan as approved.
- Provide the EA with a summary of the site EMS and also a copy of the proposed OTNOC management plan in accordance with the BREF.

In addition to the above, as stated within section 1.4.1.3, it is proposed to provide the EA with a full summary of the storage arrangements (including capacities) for the fuel preparation facility via a pre-operational condition. Furthermore, it is requested that a pre-operational condition is included within the EP to allow details of the NOx abatement system (including the NOx abatement reagent to be used) to be confirmed during detailed design of the ERF.

5.3.2 Post commissioning

Following commissioning of the ERF, Redcar Ltd will comply with the typical Post-Commissioning Conditions which will be included for this type of installation, as follows:

- Submit a written report to the Environment Agency describing the performance and optimisation of the Selective Non-Catalytic Reduction (SNCR) system and combustion settings to minimise oxides of nitrogen (NOx) emissions.
- Carry out checks to verify the residence time, minimum temperature and oxygen content of the exhaust gases in the furnaces whilst operating under the anticipated most unfavourable operating conditions. Results will be submitted to the EA.
- Provide a written proposal to the EA, for carrying out tests to determine the size distribution of the particulate matter in the exhaust gas emissions to air, identifying the fractions in the PM_{10}

and $PM_{2.5}$ ranges from the ERF. The report will detail a timetable for undertaking the tests and producing a report on the results.

- Submit a written summary report to the EA to confirm by the results of calibration and verification testing that the performance of Continuous Emission Monitors for parameters as specified in Table EPR3.1 and Table EPR3.1(a) complies with the requirements of BS EN 14181, specifically the requirements of QAL1, QAL2 and QAL3.
- Submit a written report to the EA on the commissioning of the ERF. The report will summarise the environmental performance of the ERF as installed against the design parameters set out in the Application.

Appendices

A Plans and drawings

B Site condition report

C Noise assessment

D Environmental risk assessment

E Air quality assessment

F BAT assessment

G CHP assessment

H Fire prevention plan

I Planning application

J Odour Management Plan (fuel preparation facility)

K Dust Management Plan (IBA facility)

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