Swadlincote Energy Recovery Facility (SERF)

Operating Techniques

on behalf of R&P Clean Power Limited

Application for Environmental Permit

May 2024

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1 Introduction

1.1 Application and Applicant Overview

The proposed Applicant is R&P Clean Power Limited. They have developed the Swadlincote Energy Recovery Facility (SERF) (the 'Facility') proposals in association with an EPC contractor. The operation of the Facility once commissioned will be contracted to a third-party operation and maintenance contractor.

The management of the Facility will reside with R&P Clean Power Limited including the following roles:

- Establishing the operation and management system of the Facility, including the day-to-day management, ensuring regulatory compliance and emergency procedures;
- Key staff appointments and management competence; and
- Financial decision-making.

1.2 The Site

The proposed SERF is located in South Derbyshire at Cadley Hill. Approximately 2km west of Swadlincote, Derbyshire. The Facility is centred at National Grid Reference SK 268 190, with the nearest postcode at DE11 9EN. The surrounding area is characterised by a mix of rural and residential land. Immediately adjacent land uses include; Willshee's Materials Recycling Facility (MRF); Stanton Sewage Works and the A444 (Burton Road) to the north and east respectively; residential properties to the north and south; and arable farmland to the west and south. See Figure 1 for the Site location.

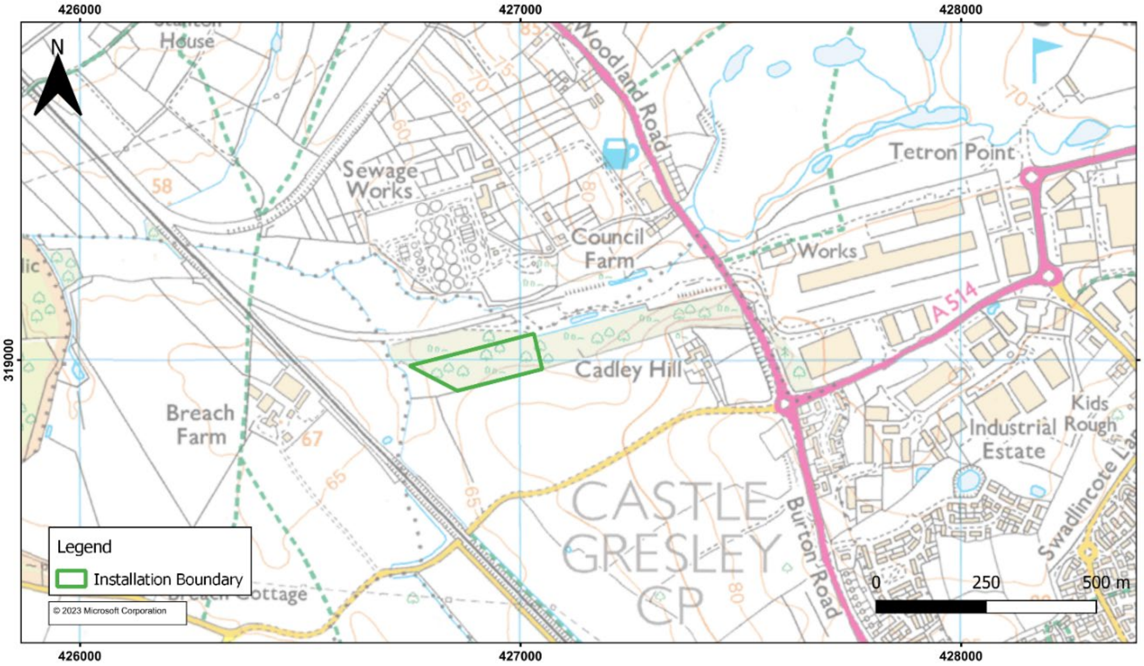


Figure 1: Site Location

1.3 Permitted Activities

1.3.1 Schedule 1 Activities

The Facility is defined as an Installation in accordance with Schedule 1 Part 5.1 Part A (1) (b) of the Environmental Permitting Regulation 2016 (hereafter referred to as the 'Regulations').

This permitted activity is defined as "The Incineration of non-hazardous waste in an incineration plant or waste co-incineration plant with a capacity exceeding 3 tonnes per hour".

1.3.2 Directly Associated Activities (DAA)

The Facility includes a number of Directly Associated Activities (DAA) which are set out below:

1. Storage of waste pending combustion;
2. Process effluent treatment; and
3. Generation of electricity.

2 Process Description

2.1 Plant Overview

The Swadlincote Energy Recovery Facility (SERF) is an energy from waste plant producing electricity and heat. The accepted wastes are defined with European Waste Catalogue (EWC) waste codes from the List of Wastes (LoW), the wastes are listed below, hereafter referred to as the 'fuel':

- 19 12 10 - Combustible Waste (Refuse Derived Fuel)
- 19 12 12 - Other Wastes (Including Mixtures of Materials) from Mechanical Treatment of Wastes other than those mentioned in 19 12 11
- 20 03 01 - Mixed Municipal Waste
- Other wastes listed in Table 1b of Form B3

Fuel will be delivered to a reception hall by means of articulated vehicles with the following trailer types:

a. walking floor;

b. ejection; and

c. tipping.

The fuel will be deposited directly into the fuel bunker.

The Facility is equipped with:

- Fuel reception hall;
- Fuel storage bunker with the capacity to store 4 to 5 days (depending on fuel density and net calorific value) of residual waste;
- Approximately 8,500m^3 total of storage capacity.

The incineration grate will have the following functions:

- Transport of materials to be incinerated through the combustion chamber;
- Distribution of the materials to be incinerated; and
- Distribution of primary combustion.

The fuel will be dosed by an integrated hydraulic pusher on the inclined, air cooled, mobile grate inside the combustion chamber. Operation of the pusher, combined with the movement of the combustion grate, will be used to adjust the height and distribution of fuel on the grate. Electric air fans, equipped with variable frequency drives, provides the primary and secondary air in the various sections of the combustion grate and furnace.

The combustion chamber has been designed to achieve a good burnout of the combustion gases by ensuring that these are maintained at a minimum 850°C for a minimum residence time of 2 seconds at a minimum oxygen level of 6%. The correct design of the combustion chamber, combined with the control temperature and residence time, will be the primary technique for the control of NOx, dioxins and furans formation. This technique will also ensure the control of carbon monoxide formation.

At start-up, auxiliary diesel-oil fed burners will be used to heat up the combustion chamber to at least 850°C before any waste is introduced. During operation, the burners will start automatically if the temperature approaches to fall below this 850°C. During shutdown, the burners will be used to maintain this temperature until there is no more unburnt waste in the combustion chamber.

The primary technique to be used to limit the formation of thermal NO_x will be the regulation of temperatures in the upper part of the combustion chamber after the oxidation zone by optimal dosing of primary and secondary air. If deemed necessary by the technology supplier, recirculation of flue gas from the exhaust stack may also be used for this purpose.

Incinerator bottom ash (IBA) developed in the combustion chamber will primarily be extracted from the bottom of the grate and quenched with water. A suitable transport system will then remove the quenched bottom ash, which will be temporarily stored within the building before being collected for off-site disposal and/or recovery.

In order to further abate the NOx content in the exhaust, the Facility is equipped with a Selective Non- Catalytic Reduction (SNCR) process, which removes nitrogen oxides (a combination of nitrogen oxide and nitrogen dioxide) by injecting the reducing agent (urea solution) into the combustion chamber directly into the hot flue gases above the flame. Injection of the urea solution will be performed through a bank of nozzles installed at different levels in the furnace to provide flexibility of dosing. The reactions occur at temperatures between 850°C and 1,050°C.

The SNCR system will be controlled through the Distributed Control System (DCS). During detailed design of the Facility, the location of SNCR dosing points will be optimised using CFD modelling to ensure that emissions of NO2 and NH3 are maintained within the proposed emission limits. After heat recovery and NOx abatement, the flue gas will pass to the flue gas treatment (FGT) system. The flue gas treatment process will consist of: 1. hydrated lime and activated carbon injection; and 2. a fabric filter. Hydrated lime and powdered activated carbon (PAC) will be injected into the flue gases upstream of the fabric filter to abate acidic gases, heavy metals and any remaining dioxins and furans. The hydrated lime will abate the emission of acidic gases, including hydrogen fluoride, hydrogen chloride and sulphur dioxide. A dry FGT method using hydrated lime will be used, with the benefit that no liquid effluent is produced, and energy efficiency is increased. The activated carbon will abate emissions of volatiles within the flue gases, including mercury, organic compounds, and dioxins. Hydrated lime and activated carbon will be stored in separate silos, transported pneumatically, introduced to the flue gas stream through injection points installed at appropriate locations. Following the injection of lime and activated carbon, the flue gas will then pass through the fabric filter, which will remove the particulates and reaction products, collectively known as Air Pollution Control (APC) residues. The residues cake the outside of the filter bags, with the units periodically cleaned by a reverse jet of air. This displaces the filtered solids into chutes beneath, which are then stored in silos. The dosing rate for the acid gas reagent will be controlled by the upstream acid gas pollutant concentration measurements and proportioned to the volumetric flow rate of the flue.

The super-heated steam coming from the boiler at a temperature in excess of 400°C and pressure of ca. 50-60 bara is delivered at the steam turbine for electrical power production. The steam turbine has one sliding pressure bleed feeding the deaerator and combustion air pre-heater. The exhaust steam is sent from the turbine to an air-cooled condenser for final condensation in order to optimise power production.

The process condensate is returned to the deaerator to be recycled to the steam boiler for a new cycle.

In the deaerator the process condensate is heated using a steam turbine bleed in order to strip the dissolved gases before the boiler feed at approximately 60 bar. A demineralised water production plant is also installed to make-up the small amount of water lost in the steam cycle.

The electricity generated, net of the parasitic consumption of the plant, is dispatched to the national grid through an electrical substation.

A single diesel generator will be provided for emergency situations to supply the electrical power to enable a safe shut-down of the plant.

A compressed air system is installed to supply instrument and service air to all the necessary equipment. The supervision and control system to operate the plant is a DCS type and it assures the best flexibility.

2.2 Waste Acceptance

2.2.1 Fuel Specification

The fuel to be used in the system will be limited to the following:

- 19 12 10 - Combustible Waste (Refuse Derived Fuel)
- 19 12 12 - Other Wastes (Including Mixtures of Materials) from Mechanical Treatment of Wastes other than those mentioned in 19 12 11
- 20 03 01 - Mixed Municipal Waste
- Other wastes listed in Table 1b of Form B3

The fuel will be delivered to the Facility by third party sources under fuel supply contracts. The Facility will only accept fuel with European Waste Codes (EWCs) permitted under the Environmental Permit.

The relationship between the calorific value of the fuel, the system throughput and energy output are illustrated in the combustion diagram. This is provided in Appendix 1.

2.3 Fuel Acceptance Procedures

Fuel supply contracts will be held with suppliers that will deliver fuel directly to the SERF. The contracts will stipulate that fuel is delivered in accordance with the fuel specifications agreed with the suppliers and the Environmental Permit. Pre-acceptance and acceptance checks may include audits of waste producers and/or suppliers to review their operations and confirm that the waste which they are transferring to the SERF is in accordance with the correct waste descriptions, specifications and EWC codes.

A conceptual flow diagram outlining the fuel acceptance procedures is included as Appendix 2 to this report.

Fuel will be brought to the Facility by trucks. The fuel will be unloaded directly in the storage bunker. All fuel used in the process will be non-hazardous in nature. The fuel is a Controlled Waste and will be accepted in accordance with procedures set out in Sector Guidance note (SGN 5.06).

Vehicles will enter the Facility and pass over the weighbridge. Following completion of first waste acceptance checks at the weighbridge, they will travel to the Waste Reception Hall and will be directed to the designated fuel unloading point.

Once the vehicle has discharged its load and has been cleared to leave the Waste Reception Hall by the Mobile Plant Operator or Operations Technician, the driver will be directed to exit by Facility signage through an available reception door to return to the weighbridge.

Detailed procedures outlining the pre-acceptance, acceptance, and rejection procedures will be developed prior to the commencement of operations. See the Waste Management Plan for further detail of fuel acceptance.

2.4 Fuel Storage

The bunker will have a capacity of approximately 8,500m^3 and the maximum storage time of fuel under normal operating conditions will be ca. 4 to 5 days depending on fuel density and net calorific value (NCV). The annual throughput of fuel to the plant is estimated to be up to 230,000 tonnes per year.

2.5 Fuel Loading Procedures

The fuel in the bunker will be handled by an overhead crane that automatically spreads out and mixes the fuel, optimising the space for pit replenishment and to ensure fuel homogeneity. The overhead crane and grab are also used to load the boiler hopper. The operation of the overhead crane is fully automated via a PLC system, though it may be manually controlled if required.

From the hopper the fuel will be fed to a reciprocating combustion grate by a hydraulic pusher.

The fuel throughput at the fuel’s design NCV of 10.5 MJ/kg will be 23.2 tonnes per hour.

2.6 Combustion Process

Once within the grate, waste is combusted in the combustion chamber with excess air supplied by the primary and secondary air fans.

The combustion chamber will be designed and operated to achieve a good burnout of the combustion gases by ensuring that the combustion gases are maintained at a minimum 850°C for a minimum residence time of 2 seconds at a minimum oxygen level of 6%. The correct design of the combustion chamber combined with the control of the temperature and the residence time will be the primary technique for the control of NOx, dioxins, furans, and other VOCs. These techniques will also ensure the control of carbon dioxide.

For this reason, the secondary air injection in the combustion chamber will be carried out in order to supply a sufficient quantity of oxygen to complete the oxidation process of the fuel and be sure to have an oxygen excess than 6%.

Oil-fired auxiliary burners are installed for start-up and shut down of the plant and to maintain the combustion space temperatures at 850°C as required for compliance with the Industrial Emissions Directive on the rare occasions when it becomes necessary to use auxiliary fuel to do so. The rated power of these burners is expected to be 15-20 MW each.

The hot gases from combustion pass through a boiler where the heat is transferred to the water circuit and where steam is raised.

Flue gases exiting the boiler are cleaned and discharged to atmosphere.

Other end products include the bottom ash and the Air Pollution Control (APC) residues from the bag filters:

- Exhaust gases from the combustion process are normal products of gas combustion and closely controlled and monitored for pollutant content;
- The incinerator bottom ash is discharged via a wet conveyor system to a dedicated storage area, from which it is transferred into appropriate covered bulk vehicles for transport to reprocessing into secondary products and/or disposal;
- APC residues from the bag filter are conveyed to an enclosed silo. This material is subsequently discharged into tankers through enclosed unloading systems (screw conveyor and flexible hose to tanker ports) for onward transport to reprocessing and/or disposal.

2.7 *Control and Abatement of Pollutants in Flue Gas*

2.7.1 Control and abatement of acidic gases

Acidic gases on the exhausts (typically HCl, SO2 and HF) will be neutralised by adding alkaline reagent (hydrated lime) into the flue gas stream between the boiler and the baghouse filter.

Reacted residues will be collected in the baghouse filters collection hoppers, temporarily stored in an enclosed silo and sent to off-site facilities for proper disposal.

2.7.2 Control and abatement of oxides of nitrogen

Nitrogen oxides may be mainly formed through the following mechanisms:

- Thermal NOx: During combustion, a part of the nitrogen in air is oxidised to form nitrogen oxides. This reaction only takes place significantly at higher temperatures. The reaction rate depends exponentially on the temperature and is directly proportional to the oxygen content; and
- fuel NOx: During combustion, a part of the nitrogen contained in the fuel is oxidised to nitrogen oxides.

The primary technique to reduce the formation of NO_x that will be implemented in the Facility are:

- Prevention of air oversupply (preventing the supply of additional nitrogen);
- Optimising the combustion with well distributed primary and secondary air in order to avoid unnecessary high temperatures in the combustion chamber; and
- If deemed necessary by the technology supplier, flue gas recirculation to control the temperature and oxygen content in the upper stage of the combustion chamber.

Further NO_x abatement will be carried out in the facility with secondary techniques.

The plant will be equipped with a SNCR system.

The reducing agent that will be used in the Facility will be a 40% urea water solution. The urea solution will be dosed directly into the combustion chamber as part of the SNCR system.

The selection, as a secondary technique, of the combination of the SNCR allows a reduction of NO_x in compliance with the upper limit of the new BREF indications.

2.7.3 Control and abatement of mercury emissions

The Facility will use, as a primary technique for the control of mercury emissions, the use of fuel with a low content of mercury. As a secondary technique, activated carbons are injected into the gas flow. The activated carbon adsorbs, with high efficiency, the volatile mercury compounds. The carbon is filtered in the bag filter.

2.7.4 Control and abatement of metals (other than mercury)

Differently from mercury, other metals will be mainly converted by the incineration process into non-volatile oxides.

The primary technique of abatement of metals from flue gases is the same used for dust removal. The Facility will be equipped with a boiler ash collecting hoppers and with a bag filter to trap metal compound particles.

As a secondary technique, the Facility will be equipped with an activated carbon dosing system where the metal compound can be adsorbed.

2.7.5 Control and abatement of dioxins, furans, and other organic carbon compounds

The primary techniques to control the formation of dioxins, VOCs, furans, and other organic compounds that will be implemented are:

- Design and operation of the combustion chamber to achieve a good burnout of the combustion gases by ensuring that the combustion gases are maintained at a minimum 850°C for a minimum residence time of two seconds at a minimum oxygen level of 6%;
- Installation of auxiliary burners to always avoid the temperature of the combustion chamber from falling below 850°C;
- Design of the boiler in order to limit the residence time of the fumes within the temperature range of 200 - 400°C; and
- Boiler bundles will be equipped with on-line cleaning systems to reduce the dust residence time and accumulation in the boiler. Off-line boiler bundles cleaning activities will be carried out during the maintenance periods.

The Facility will be equipped with the following secondary techniques:

- Activated carbon injection where dioxins, furans and other VOCs may be adsorbed.

2.7.6 Control of carbon oxide

The primary techniques to control the formation of carbon monoxide that will be implemented at the Facility are:

- Design and operation of the combustion chamber to achieve a good burnout of the combustion gases by ensuring that the combustion gases are maintained at a minimum of 850°C for a minimum residence time of 2 seconds at a minimum oxygen level of 6%.

2.7.7 Abatement of dust

The boiler flue gas path is designed in a way that boiler ash coming from conductive and radiant surfaces of the boiler will deposit in the lower hoppers where they will be collected before being transported to the IBA handling system by enclosed conveyors.

APC residues and other flying dust in the flue gases will be trapped by the bag filter and conveyed to an enclosed silo. This material is subsequently discharged into tankers through enclosed unloading systems (screw conveyor and flexible hose to tanker ports) for onward transport to reprocessing and/or disposal.

2.8 *Energy Recovery*

2.8.1 Electricity Generation

The combustion gases will flow from combustion chamber through the boiler, where they will transfer the heat to the boiler pipes where the water evaporates. The steam is then “superheated” via the boiler superheater to a temperature in excess of 400°C. The superheated steam is then delivered to the steam turbine for electrical power production.

Steam enters the turbine through a hydraulic emergency stop valve, and the rate of flow into the turbine is controlled via a hydraulic throttle valve.

The expected gross electricity generation is 20.5 MW, with a gross electrical efficiency is 30.3%. The actual gross electricity efficiency will be ratified during the commissioning of the plant. The net electricity generation (taking into account the parasitic load of the plant, other auxiliary consumptions and electrical losses) is 18.5 MWe, an equivalent net electrical efficiency of 27.3%.

The electricity produced at 33kV is connected to the electricity substation, as per the Connection Agreement with National Grid Electricity Distribution. A back-up diesel generator will be provided, to provide power to shut-down the plant in safety operation mode in an emergency scenario. This will be switched on once a week to run for approximately 5-10 minutes, as part of routine maintenance procedures.

2.8.2 Condensing System

Steam from the steam turbine exhaust, flows into the main steam duct to the air-cooled condenser. The steam is condensed inside a heat exchanger using air as the cooling medium. The cooling air is forced through the heat exchanger by axial fans, driven by electric motors and speed reducing gearboxes. Condensate is collected by gravity into the condensate tank, from where it is pumped to the deaerator to be recycled to the steam boiler for a new cycle.

2.9 *Emissions to Air*

Exhaust gases are discharged through a stack, with a height of 60m. The plant is designed to meet the exhaust emissions limit values (ELVs) shown below.

Table 1: Proposed emission limit values (ELVs)

Parameter	Half Hour Average (mg/Nm^3)	Daily Average (mg/Nm^3)	Periodic Limit
Continuously monitored pollutants			
Particulate matter	30	5	-
VOCs as Total Organic Carbon (TOC)	20	10	-
Hydrogen chloride	60	6	-
Carbon monoxide	100	50	-
Sulphur dioxide	200	30	-
Oxides of nitrogen (NO and NO_2 expressed as NO_2)	400	120	-
Ammonia	-	10	-
Periodically monitored pollutants			
Hydrogen fluoride*	-	-	1
Cadmium & thallium and their compounds (total)	-	-	0.02
Mercury and its compounds**	-	-	0.02
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V and their compounds (total)	-	-	0.3
PCDD/F***	-	-	0.04
PCDD/F + dioxin-like PCBs***	-	-	0.06
All expressed at 11% oxygen in dry flue gas at standard temperature and pressure.			

All values in the table above are at reference conditions of 173 K temperature, 1.013 bar pressure and 11% oxygen, dry.

The following parameters are expected to be monitored and recorded continuously at the stack using a Continuous Emissions Monitoring System (CEMS):

- oxygen;
- carbon monoxide;
- hydrogen chloride;
- sulphur dioxide;
- nitrogen oxides;
- ammonia;
- VOCs (volatile organic compounds); and
- particulates.

In addition, the 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 IED.

The continuously monitored emissions concentrations will also be checked by an independent testing company at frequencies agreed with the EA.

The BREF states that continuous monitoring of hydrogen fluoride (HF) is required but can be replaced with periodic monitoring, with a frequency of once every six months, if hydrogen chloride (HCl) levels are proven to be sufficiently stable.

The BREF also states that monitoring of mercury should be continuous, but notes that "for plants incinerating wastes with a proven low and stable mercury content (e.g. mono-streams of waste of a controlled composition), the continuous monitoring of emissions may be replaced by long-term sampling or periodic measurements with a minimum frequency of once every six months".

The EA has produced a protocol for use by new plants to determine whether continuous mercury monitoring is required, which involves carrying out two tests per month until six results are obtained. Typically, UK plants are able to prove that continuous monitoring is not required and we would expect this will also be the case for the Facility.

The following parameters are therefore expected to be monitored by means of spot sampling at frequencies agreed with the EA:

- mercury;
- hydrogen fluoride;
- heavy metals; and
- dioxins and furans.

The methods and standards used for emissions monitoring will be in compliance with the EA guidance and the IED. In particular, the CEMS equipment will be certified to the Monitoring Certification for Environmental Permit Holders (MCERTS) standard and will have certified ranges which are no greater than 1.5 times the relevant daily average emission limit.

There will be a duty CEMS and one hot stand-by CEMS. This will ensure that there is continuous monitoring data available even if there is a problem with the duty CEMS.

2.10 Water Use Management

2.10.1 Water Supply

Process water for the Facility will be supplied by the mains potable water system, the water treatment plant, or the recirculation of used water dependent on usage.

The main use of water at the Facility will be to make up the water for the boilers (referred to as boiler feedwater). Other water consuming processes include the ash quench and the SNCR system injection nozzles in the Facility.

The Facility will consume approximately 5 tonnes per hour of water. However, the plant has been designed with the aim to reduce the water consumption as far as is feasible through the following operating techniques:

1. Utilisation of dry-Flue Gas Cleaning (FGC) techniques;
2. Utilisation of air-cooled steam condenser; and
3. Maximisation, as far as is possible, of water reuse in the process.

With regards to point 3 above, where practicable, waste waters generated from the Facility process will be reused/recycled within the process. Effluents from boiler blowdown, demineralisation unit and the cleaning/draining of equipment will be collected in the on-site wastewater collection pit to be re-used in the Facility's ash quenching system. Any excess process effluents will be collected for removal from the Facility under a suitable waste collection contract.

2.10.2 Water Treatment Plant

A demineralised water production plant will be installed to make up the small amount of water lost in the steam cycle. The process requires a potable water supply of approx. 5 m^3 per hour on average, with a peak demand of 25m^3 per hour (only during Start-up).

Raw water supply will be collected in a tank and transferred into the treatment plant, as required. The water treatment system will utilise either reverse osmosis, ion exchange technology or a combination of the two. Demineralised water will then be collected in a tank ready for use in the boiler.

2.10.3 Process Effluent

Excess process waters arising from boiler blowdown, the demineralisation unit and the cleaning/draining of equipment will pass through the on-site wastewater treatment plant to be re-used in the Facility. Any excess process effluents will be tankered off-site under a suitable waste collection contract. No process effluent will be discharged to surface water or sewer.

2.10.4 Surface Water

The Facility is to be served by a new stormwater network which includes use of Sustainable Drainage Systems (SuDS).

Surface water runoff from the proposed buildings and infrastructure will be collected and transferred via private storm networks towards a series of attenuation features. Prior to release into any attenuation features, runoff will first drain through a series of pollution control measures (i.e., trapped gullies, manholes with catch pits etc). The attenuation features will include a combination of belowground tank storage, together with above-ground Sustainable Drainage Systems (SuDS), each sized to accommodate up to the 100-year return period storm, including 40% allowance for climate change.

The proposed SuDS will include freeboard allowances to assist in the mitigation of exceedance rainfall events. The proposed SuDS will be designed in accordance with CIRIA C753 *The SuDS Manual* to maximise treatment potential and to ensure the cumulative 'SuDS Mitigation Indices' exceed the 'Pollution Hazard Index' for residential developments, so that adequate treatment is being provided. Attenuated runoff from the Facility will utilise a new stormwater outfall to the downstream watercourse which naturally receives flows from the catchment.

2.10.5 Foul Water

Foul waters arising from domestic water use will drain to a new private package treatment plant. Treated flows will discharge to the proposed swale and wetland area which can provide further polishing ahead of outfall to the downstream watercourse. The final discharge of treated foul waters will be in accordance with the general binding rules for small sewage discharges with effect from 2 October 2023. The following outlines the general binding rules and the associated measures to be in place at the Facility, as required for compliance.

General binding rules	Operating Techniques
The discharge must be 5 cubic metres or less per day in volume.	The discharge will not exceed this limit. If the limit is exceeding an environmental permit will be required for the discharge.
The sewage must only be domestic.	There will be no trade effluent discharges from the site.
The discharge must not cause pollution of surface water or groundwater.	The treatment plant will be a domestic grade plant, perhaps a Klargester BioDisc or similar. Oil separator(s) will be provided prior to entering the open SuDS attenuation. A flap valve will be installed downstream of the separator/s to prevent surcharge. Spill prevention and response procedures will be provided, to include secondary containment measures associated with the storage of materials. The SuDS will include a penstock at the outlet to enable discharges to be shut off, so that any pollution risk could be isolated.
The sewage must receive treatment from a sewage treatment plant.	The treatment plant will be a domestic grade plant, perhaps a Klargester BioDisc or similar.
All works and equipment used for the treatment of sewage effluent and its discharge must comply with the relevant design and manufacturing standards i.e., the British Standard that was in force at the time of the installation, and guidance issued by the appropriate authority on the capacity and installation of the equipment.	The treatment plant will be a domestic grade plant, perhaps a Klargester BioDisc or similar. All works and equipment used for the treatment of sewage effluent and its discharge will comply with the relevant design and manufacturing standards i.e., the British Standard that was in force at the time of the installation, and guidance issued by the appropriate authority on the capacity and installation of the equipment.

The system must be installed and operated in accordance with the manufacturer's specification.	The treatment plant will be installed and operated in accordance with the manufacturer's specification.
Maintenance must be undertaken by someone who is competent.	Maintenance will be undertaken under a service and inspection agreement with the manufacturer.
Waste sludge from the system must be safely disposed of by an authorised person.	Waste sludge from the system will be safely disposed of by an authorised person, either through a service agreement with the manufacturer or through a suitable waste disposal contract.
If a property is sold, the operator must give the new operator a written notice stating that a small sewage discharge is being carried out and giving a description of the waste water system and its maintenance requirements.	This arrangement would be put in place, as required.
The operator must ensure the system is appropriately decommissioned where it ceases to be in operation so that there is no risk of pollutants or polluting matter entering groundwater, inland fresh waters, or coastal waters.	The system will be appropriately decommissioned where it ceases to be in operation so that there is no risk of pollutants or polluting matter entering groundwater, inland fresh waters, or coastal waters.
New discharges must not be within 30 metres of a public foul sewer.	The discharge is not within 30m of an existing adopted foul sewer.
For new discharges, the operator must ensure that the necessary planning and building control approvals for the treatment system are in place.	All required applications
New discharges must not be in or within: 500 metres of a Special Area of Conservation (SAC), Special Protection Area (SPA), Ramsar site, biological Site of Special Scientific Interest (SSSI), freshwater pearl mussel population, designated bathing water, or protected shellfish water; 200 metres of an aquatic local nature reserve; 50 metres of a chalk river or aquatic local wildlife site.	Confirmed as not within stated distances of designated sites.
New discharges must be made to a watercourse that normally has flow throughout the year.	The watercourse is permanently running. It serves a large catchment >5km2.
For new discharges, any partial drainage field must be installed within 10 metres of the bank side of the watercourse.	As the watercourse is permanently wet, a partial drainage field is not required. A partial drainage field would only be required where the watercourse is not permanently wet.
New discharges must not be made to an enclosed lake or pond.	Treated effluent drains through a small water feature within the proposed installation boundary but this is positively drained to the watercourse downstream of the existing culvert. Flows are not discharging to an enclosed waterbody.

2.11 *Waste Management*

The waste associated with the operation are described below:

1. Incinerator Bottom Ash (IBA);
2. Air Pollution Control Residue; and
3. Utility waste (general).

Waste recovery and disposal techniques are subject to the indicative BAT requirements. A full list of waste streams and their anticipated annual tonnages is provided in the Waste Management

Plan.

2.12.1 Incinerator Bottom Ash

Incinerator bottom ash will be collected by a third-party contractor and taken off-site for recycling. Loss on ignition (LOI) tests will be carried out to monitor unburnt materials in the IBA.

2.12.2 Air Pollution Control (APC) Residues

APC residues and other flying dust in the flue gases will be trapped by the bag filter and conveyed to an enclosed silo. This material is subsequently discharged into tankers through enclosed unloading systems (screw conveyor and flexible hose to tanker ports) for onward transport to reprocessing and/or disposal.

2.12 System Control

The plant will be equipped with a fully redundant microprocessor-based distributed control system (DCS) which will manage and supervise the complete operation of the plant. For the purpose of optimizing environmental parameters, the control system will act on:

- Fuel supply;
- Supply and balancing of primary, secondary air and recirculation fumes;
- Temperature control in the combustion chamber;
- Feeding of reagents to optimize the reduction of acid gases;
- Feeding of activated carbons; and
- Urea supply for SNCR.

The plant will be equipped with pressure, temperature, flow, and analysis sensors directly connected to the control system which will act on the final acting elements with feedback and feedforward algorithms.

The plant Operators will have man-machine interfaces in which it will be possible to display of all the operating parameters of the plant and act on real time basis to adjust the behaviour of the plant. The various parameters will be recorded continuously, and it will be possible to view current and historical trends. An alarm system will be implemented with recording of events.

Finally, the DCS system will also manage the plant automatic shutdowns. Automatic plant shutdown cannot be overridden by Operators.

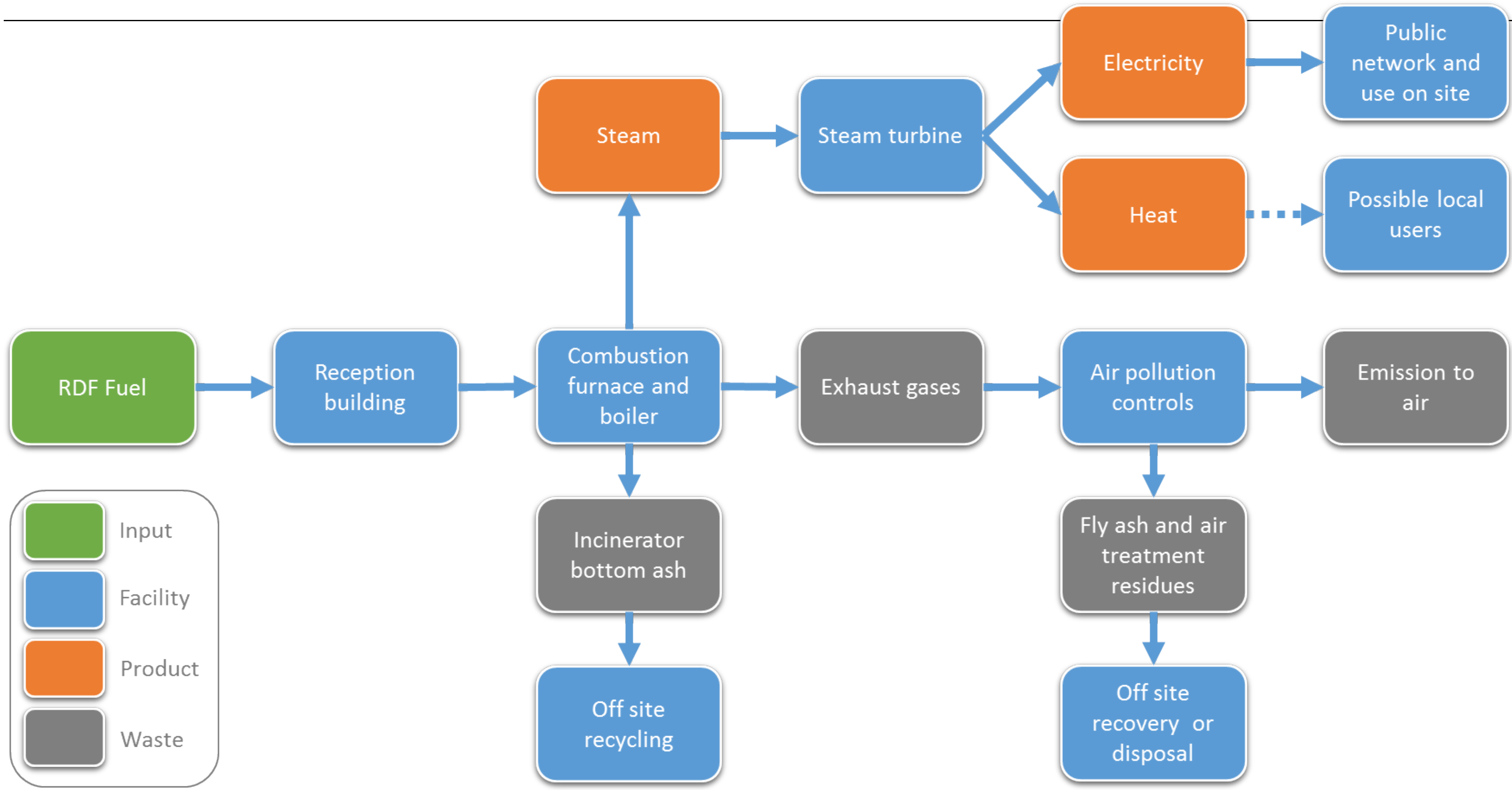


Figure 2: Process Flow

3 Raw Materials

3.1 Raw Materials Inventory

A full list of the raw materials that will be stored on-site is included within the Environmental Permit application in the Raw Material Inventory.

3.2 Raw Material Storage

All raw materials will be stored within appropriate primary and secondary containment. Materials will be labelled with the appropriate Code of Substances Hazardous to Health (COSHH) sheets.

4 Energy Efficiency

4.1 General

The plant will utilise a waste fired steam boiler. The generated steam will supply a steam turbine generator to generate electricity. The Facility will supply electricity to the local 33kV electricity grid.

In the case of failure of electricity supply to the facility, an emergency supply will be provided from the diesel-fired backup generator to safely shut down the plant.

In considering the energy efficiency of the Facility, the Applicant has followed the guidance on energy efficiency standards for industrial plants.

4.2 Basic Energy Requirements

The ERF will be capable of generating 20.5 MWe with no steam (heat) export. Thermal input (based on averaged calorific value of fuel of 10.5MJ/kg and a consumption rate of 23.2 tonnes per hour) is 67.7MWth.

The electrical conversion has an expected gross efficiency of approximately 30.3%. Parasitic loads and other auxiliary consumption are expected to be ca. 2 MWe.

The net electrical output is 18.5 MWe (net efficiency of 27.3%). Parasitic energy usage will include the following:

- Fuel handling system (overhead cranes)
- Combustion air fans;
- Induced draft fans;
- Air Cooled Condenser (ACC);
- Boiler feeding system;
- Bottom Ash removal system;
- Pumps;
- Motor reverse jetting of bag filters;
- Turbine Auxiliaries; and
- Boiler Auxiliaries.

Parasitic / auxiliary consumption does not include any of the following:

- Consumption due to utilities;
- Firefighting and suppression systems; and
- Any additional equipment.

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

- The boiler will be equipped with economisers and super-heaters to optimise thermal cycle efficiency;

- Unnecessary releases of steam and hot water will be avoided ensure maximum recycling of heat, and also to avoid loss of any chemical used in the treatment of boiler water;
- Heat recovery systems also include the reuse of low grade extracted from the turbine and used to preheat combustion air and strip oxygen from boiler feedwater in order to improve the efficiency of the thermal cycle;
- Steady operation will be maintained where necessary by using auxiliary fuel firing (diesel oil);
- Boiler heat exchange surfaces will be cleaned on a regular basis to ensure efficient heat recovery; and
- An economiser will recover heat downstream of the main boiler to heat up the feedwater and increase the thermodynamic efficiency of the whole cycle.

4.3 R1 Status

A calculation has been undertaken in accordance with the R1 methodology using the “Proforma for determining energy efficiency using R1”. Details are submitted with this application to demonstrate the 65% efficiency threshold will be met.

4.4 Waste Incineration Best Available Techniques

The Waste Incineration BREF requires that both gross electrical efficiency and gross energy efficiency are calculated and that the BAT Associated Energy Efficiency Levels (BAT-AEELs are met) for the incineration of waste.

Full details are included in the CHP Readiness Assessment and Best Available Techniques Assessment submitted as part of the Environmental Permit application.

5 Environmental Management System

Prior to commencement of the permitted activities on-site, a full Environmental Management System (EMS) will be put in place. This will cover all operations described above, and its implementation will be the responsibility of the Applicant. The EMS will include the following information:

- Management Structure;
- Environmental Policy;
- Working Procedures;
- Health and Safety Procedures;
- Operation and Maintenance; and
- Accident Management.

5.1 Management Structure

R&P Clean Power will develop a documented Environmental Management System that defines the Facility's management structure, as well as setting out the roles and responsibilities of staff.

5.2 Environmental Policy

The Environmental Policy will include the following:

1. A commitment to continual improvement and prevention of pollution;
2. A commitment to comply with the relevant legislation and other requirements to which the organisation subscribes; and
3. Identification, setting, monitoring, and reviewing environmental objectives and key performance indicators of the Environmental Permit.

The Environmental Policy will be incorporated into the decision-making process, and procurement of equipment.

5.3 Working Procedures

To ensure the appropriate operation of the Facility, the Operator shall develop documented management procedures and written work instructions which incorporate environmental consideration into the following areas:

1. The control of process and engineering change on the Facility;
2. Design, construction, and review of new facilities and other capital projects (including provisions for their decommissioning);
3. Capital approval; and
4. Purchasing Policy.

The Facility will develop a clear a logical system for keeping records including records of:

- Policies;
- Roles and responsibilities;
- Environmental objectives;
- Procedures;
- Environmental audits; and
- Review of audits and any subsequent actions undertaken.

5.4 Operation and Maintenance

The Operation and Maintenance (O&M) procedures will include the following aspects:

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

An energy efficiency plan will be incorporated into the operation and maintenance procedures of the plant ensuring maximum, practical, sustainable, safe, and controllable electricity generation.

During normal operation, procedures will be reviewed and amended as required, 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.

6 Technology Selection

6.1 Cost Benefit Analysis for Co-Generation

Article 23 of the EPR on the Issue of Permits states that "it shall be a condition of any permit covering incineration or co-incineration with energy recovery that the recovery of energy take place with a high level of energy efficiency." The consideration for high level of energy efficiency should include the use of Combined Heat and Power (CHP) Technology which utilises the heat generated through the combustion and steam generation, as well as the generation of electrical power.

6.2 Best Available Techniques (BAT)

A full BAT Assessment is submitted as a standalone document to this report. Indicative BAT Standard are taken from the following documents:

- EPR 5.01 – How to comply with your environmental permit. Additional guidance for the incineration of waste[1]
- CHP Ready Guidance[2]
- Best Available Techniques (BAT) Reference Document for Waste Incineration[3]

[1] Incineration of Waste (EPR 5.01): Additional Guidance

[2] CHP Ready Guidance for Combustion and Energy from Waste Power Plants

[3] https://eippcb.jrc.ec.europa.eu/reference/BREF/WI/WI_BREF_FD_Black_Watermark.pdf

7 Site Closure

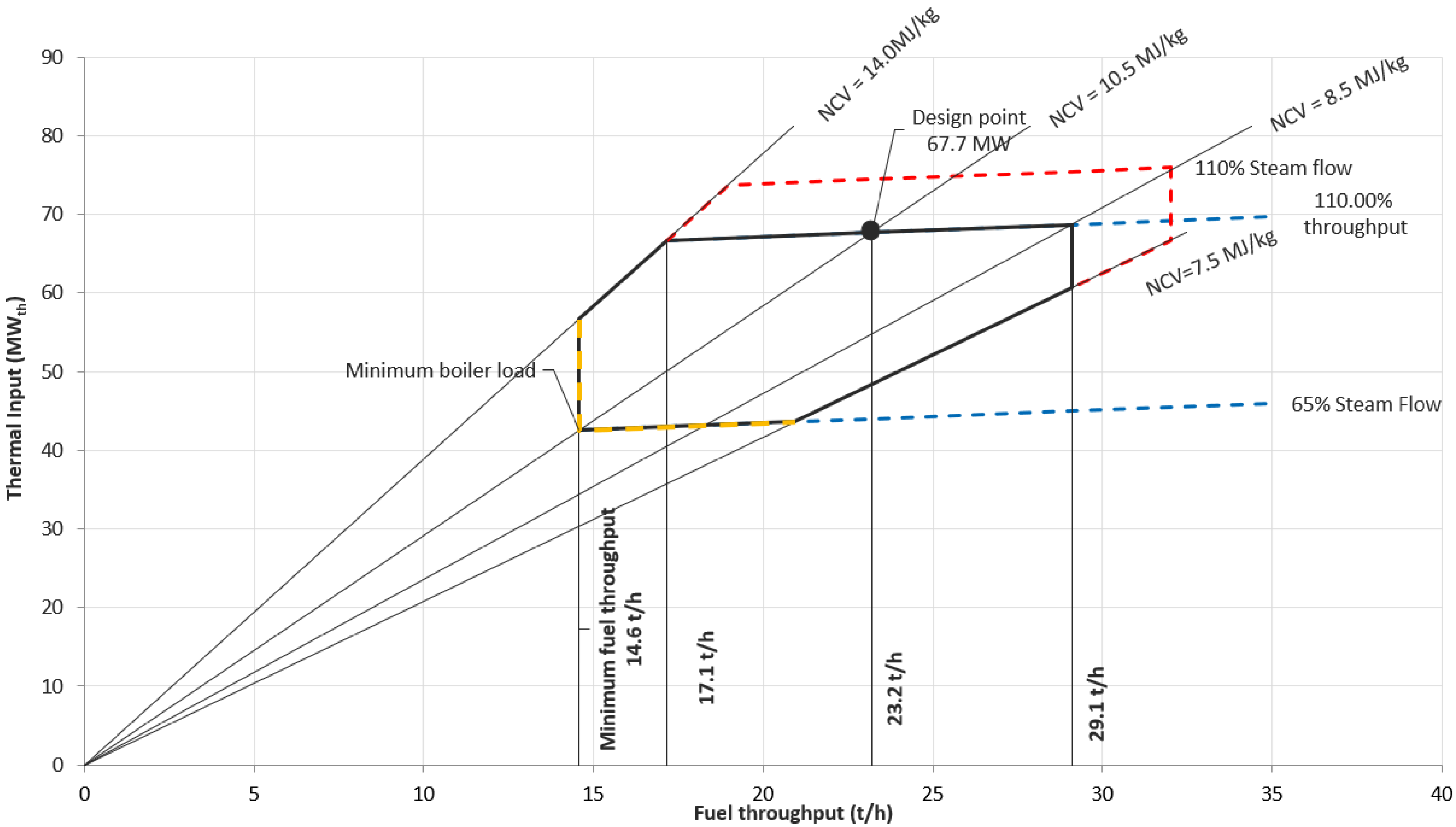
The Site Closure Plan will be prepared in advance of the permanent cessation of permitted operations at the Facility and surrender of the Environmental Permit to ensure that there is no residual pollution risk. The following general provisions will be incorporated within a Site Closure Plan.

This will include appropriate surveys to determine that the operation of the permitted activities has not had a detrimental impact upon the condition of the land within the permit boundary or receiving environments. This will include monitoring of the groundwater and soil, with comparative analysis of the condition of the Facility at the time of closure with the baseline conditions established prior to the commencement of activities.

During the operating lifetime of the Facility, the preventative measures undertaken and monitoring programme to be implemented are designed to ensure that requirements for remediation at the end of the operational lifetime should be minimised.

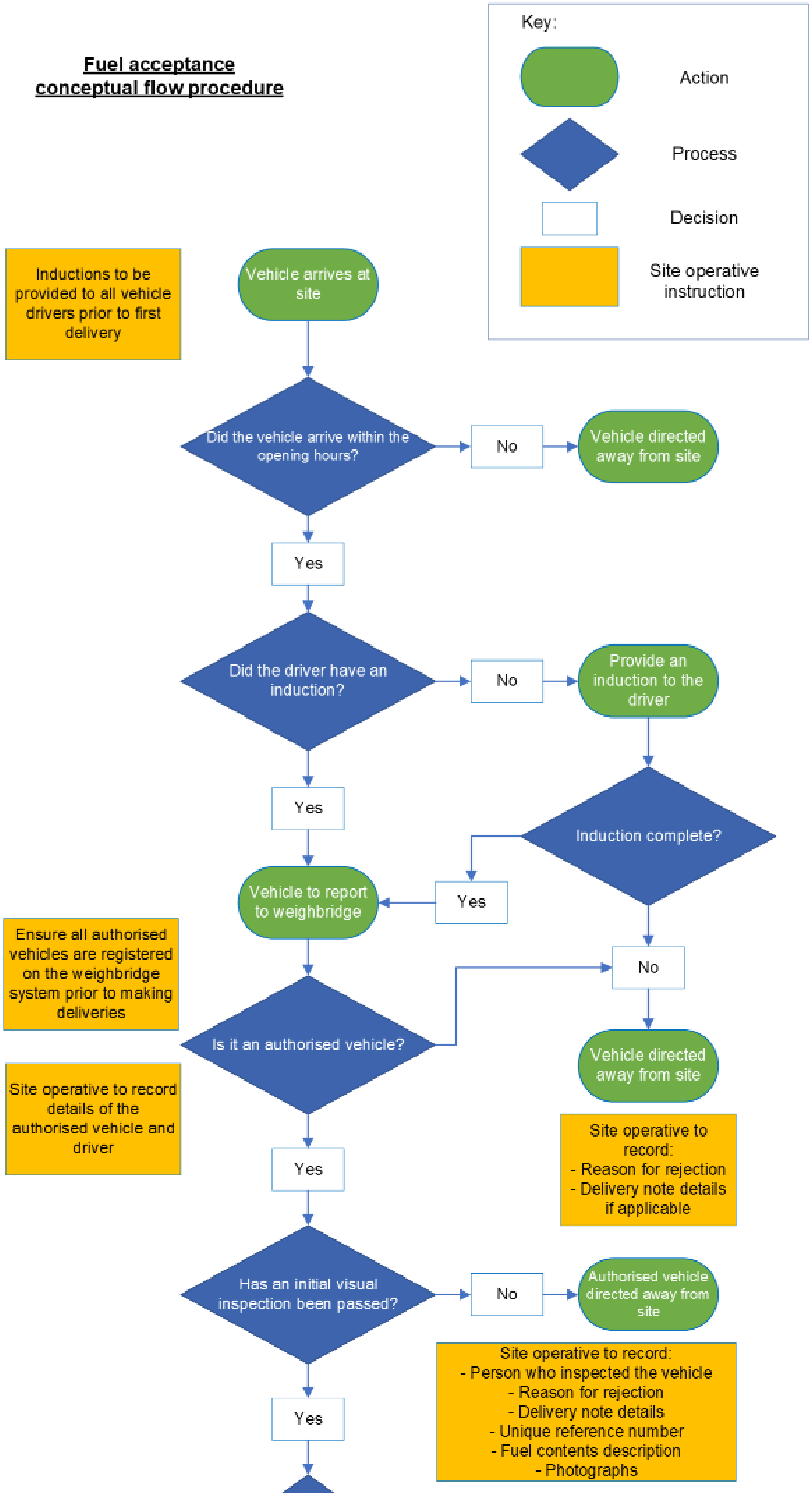
Appendices

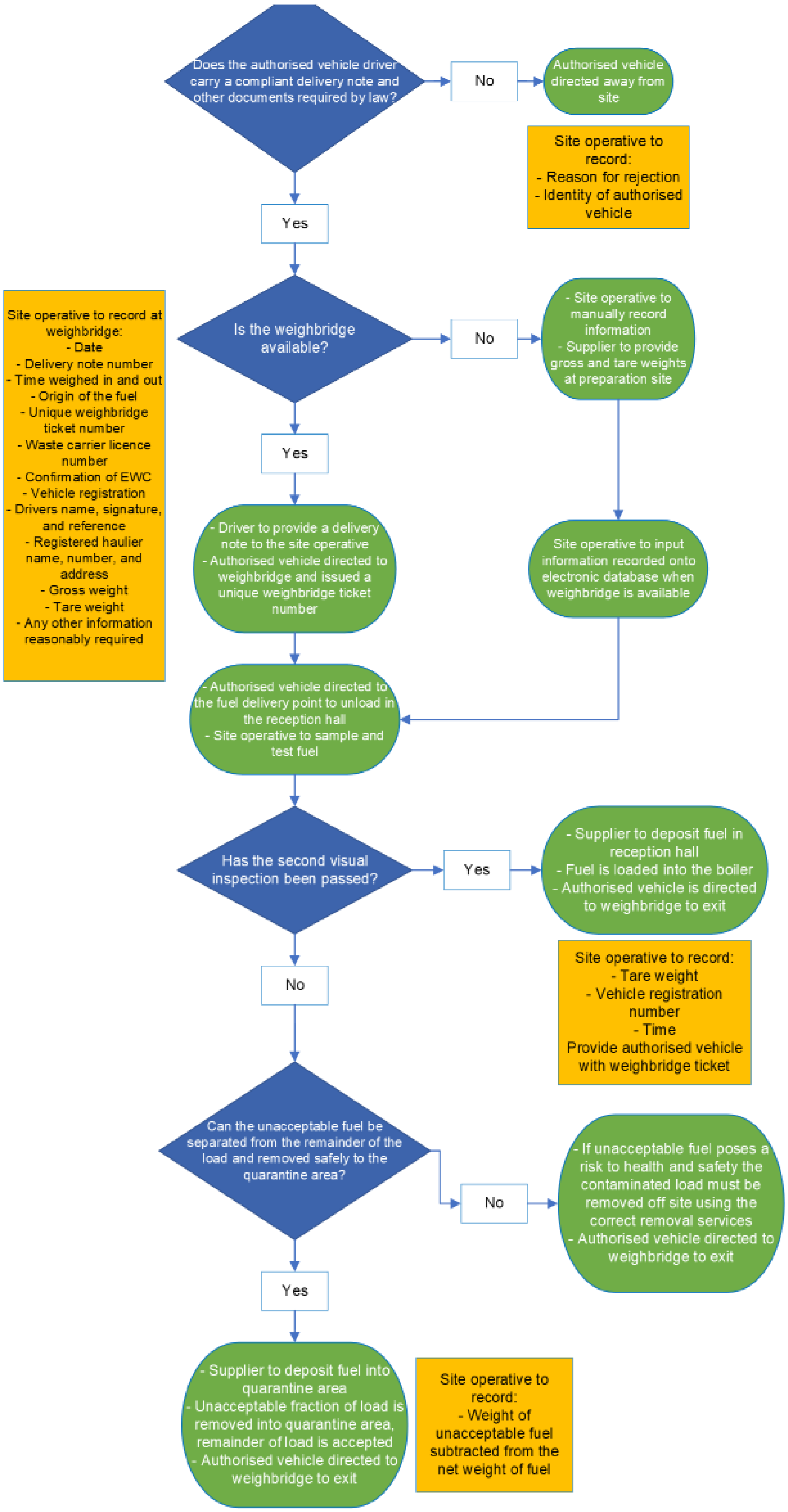
Appendix 1 – Combustion Diagram



NCV = 14.0MJ/kg
NCV = 10.5 MJ/kg
NCV = 8.5 MJ/kg
NCV=7.5 MJ/kg
Design point
67.7 MW
110% Steam flow
110.00%
throughput
65% Steam Flow
Minimum boiler load
Minimum fuel throughput
14.6 t/h
17.1 t/h
23.2 t/h
29.1 t/h
Thermal Input (MW$_{th}$)
Fuel throughput (t/h)
0
10
20
30
40
50
60
70
80
90
0
5
10
15
20
25
30
35
40

Appendix 2 – Fuel acceptance conceptual flow procedure




Does the authorised vehicle driver carry a compliant delivery note and other documents required by law?
No
Authorised vehicle directed away from site
Site operative to record:
- Reason for rejection
- Identity of authorised vehicle
Yes
Site operative to record at weighbridge:
- Date
- Delivery note number
- Time weighed in and out
- Origin of the fuel
- Unique weighbridge ticket number
- Waste carrier licence number
- Confirmation of EWC
- Vehicle registration
- Drivers name, signature, and reference
- Registered haulier name, number, and address
- Gross weight
- Tare weight
- Any other information reasonably required
Is the weighbridge available?
No
- Site operative to manually record information
- Supplier to provide gross and tare weights at preparation site
Yes
- Driver to provide a delivery note to the site operative
- Authorised vehicle directed to weighbridge and issued a unique weighbridge ticket number
Site operative to input information recorded onto electronic database when weighbridge is available
- Authorised vehicle directed to the fuel delivery point to unload in the reception hall
- Site operative to sample and test fuel
Has the second visual inspection been passed?
Yes
- Supplier to deposit fuel in reception hall
- Fuel is loaded into the boiler
- Authorised vehicle is directed to weighbridge to exit
Site operative to record:
- Tare weight
- Vehicle registration number
- Time
Provide authorised vehicle with weighbridge ticket
No
Can the unacceptable fuel be separated from the remainder of the load and removed safely to the quarantine area?
No
- If unacceptable fuel poses a risk to health and safety the contaminated load must be removed off site using the correct removal services
- Authorised vehicle directed to weighbridge to exit
Yes
- Supplier to deposit fuel into quarantine area
- Unacceptable fraction of load is removed into quarantine area, remainder of load is accepted
- Authorised vehicle directed to weighbridge to exit
Site operative to record:
- Weight of unacceptable fuel subtracted from the net weight of fuel