RPS

Atlantic Recycling Ltd ï Boiler Installation

Schedule 13 Application ï Operating Techniques

Date: January 2019

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1	March 2017	Change of regulator	FB
2	January 2019	Change to request of NRW under Schedule 5 request for further information	AH

Executive Summary

Atlantic Recycling Ltd (Atlantic) propose to install a new biomass boiler and associated facilities at its site at Atlantic Ecopark, Newton Rd, Cardiff, CF3 2EJ.

The installation will incorporate a biomass boiler, supplying thermal energy in the form of 85 ºC hot water for use in an associated waste water treatment plant. The biomass boiler will be located within a new building to be erected on the site.

The biomass boiler will burn either Grade A, Grade B or Grade C recycled wood chip fuel, or mixtures thereof, at a rate of ~330 kg/hr, depending upon the moisture content of the fuel. The recycled wood chip will be sourced from the waste wood activity currently within the environmental permit EPR/PP3993VS.

An air quality assessment has been carried out to accompany the application and concludes that the development does not, in air quality terms, conflict with national or local policies. There are no constraints to the development in the context of air quality.

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1 Introduction

1.1 Background

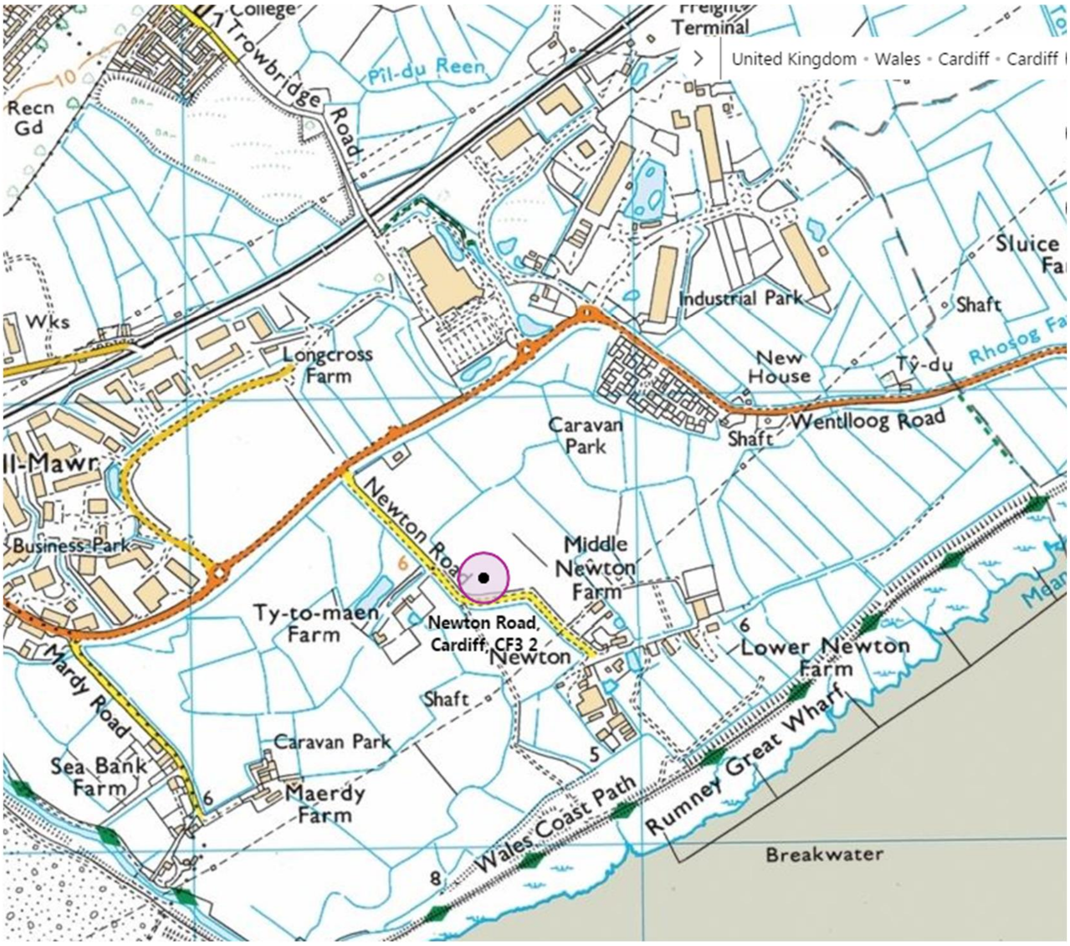
1.1.1 Atlantic Recycling Ltd (Atlantic) propose to install a new biomass boiler and associated facilities at its site at Atlantic Ecopark, Newton Rd, Cardiff, CF3 2EJ.

1.1.2 The installation will incorporate a biomass boiler, supplying thermal energy in the form of 85 ºC hot water for use in an associated waste water treatment plant. The biomass boiler will be located within an new building to be erected in the location shown on Drawing 1.

1.1.3 The biomass boiler will burn either Grade A, Grade B or Grade C recycled wood chip fuel, or mixtures thereof, at a feed rate of ~330 kg/hr, depending upon the moisture content of the fuel. The recycled wood chip will be sourced from the waste wood activity currently within the environmental permit EPR/PP3993VS. If sufficient fuel is not available from on-site operations it will be sourced from other local recycling operations.

1.1.4 The approximate location of the biomass boiler installation is highlighted on the map below.

Figure 1-1 - Site Location



1.1.5 Aerial photography shows the location of the Atlantic site where the biomass boiler and associated water treatment plant will be installed. The development site is situated within a predominantly rural and industrial landscape. The nearest residential area is approximately 500 metres to the north east of the proposed boiler location.

1.1.6 The approximate location of the biomass boiler installation is indicated on the following photograph. The biomass boiler will sit within the existing installation boundary for the Atlantic Ecopark site.

Figure 1-2 - Aerial Photograph

2 Regulatory Classification

2.1.1 The biomass boiler will burn Grade A, Grade B or Grade C recycled wood chip fuel, or mixtures thereof, sourced from other on-site recycling activities. Accordingly, as the recycled wood chip fuel is a waste the biomass boiler will be subject to the Environmental Permitting (England and Wales) Regulations 2016 (EPR 2016), as a Schedule 1, Part 2, Section 5.1 waste incineration activity.

2.1.2 Part A(1) activities are regulated by Natural Resources Wales and include the following processes:

Part A(1)
(a) The incineration of hazardous waste in a waste incineration plant or waste co-incineration plant with a capacity exceeding 10 tonnes per day.
(b) The incineration of non-hazardous waste in a waste incineration plant or waste co-incineration plant with a capacity exceeding 3 tonnes per hour.
(c) The incineration, other than incidentally in the course of burning landfill gas or solid or liquid waste, of any gaseous compound containing halogens.

2.1.3 The wood chip to be burned as fuel in the biomass boiler is non-hazardous, but with a maximum burning rate of ~330 kg/hr it falls below the threshold for a Section 5.1 Part A(1)(b) waste incineration or waste co-incineration plant.

2.1.4 The corresponding Part B scheduled activities, that are subject to local authority regulations include the following:

(a) The incineration in a small waste incineration plant with an aggregate capacity of 50 kilogrammes or more per hour of the following waste;
(i) vegetable waste from agriculture and forestry;
(ii) vegetable waste from the food processing industry, if the heat generated is recovered;
(iii) fibrous vegetable waste from virgin pulp production and from production of paper from pulp, if it is co-incinerated at the place of production and the heat generated is recovered;
(iv) cork waste;
(v) wood waste with the exception of wood waste which may contain halogenated organic compounds or heavy metals as a result of treatment with wood preservatives or coatings;
(vi) animal carcasses.

2.1.5 The Grade A and Grade B wood chip to be burned as fuel in the biomass boiler will not contain halogenated organic compounds or heavy metals as a result of treatment with wood preservatives or coatings. Accordingly, if only Grade A or Grade B wood chip was to be burned as fuel then the biomass boiler could be classified as a combustion plant and would fall below permitting thresholds. However, there is the possibility that the Grade C recycled wood chip may contain low levels of contamination and in this instance the biomass boiler would be classified as a Schedule 13 small waste incineration plant (SWIP). For the purpose of this application and to maximise flexibility of operation it is assumed that up to 100% of the feed could be Grade C waste wood and therefore the emission limits for incineration plant have been applied to the SWIP.

(1) This Schedule applies in relation to -
(a) every small waste incineration plant, and
(b) every waste incineration plant or waste co-incineration plant,
to which Chapter IV of the Industrial Emissions Directive applies, except those which are operated as a domestic activity in connection with a private dwelling.

2.1.6 Schedule 13 SWIP facilities are generally regulated by the local authority. The EPR 2016 define a Part A(1) installation as:

"an installation where a Part A(1) activity is carried on either alone or in combination with any or all of the following—
(a) a Part A(2) activity;
(b) a Part B activity;
(c) the operation of a small waste incineration plant;
(d) a solvent emission activity"

2.1.7 Atlantic is simultaneously applying to vary its Environmental Permit. The SRF activity included in the variation will be a Part A(1) installation. The boiler will be used to heat water in a waste water treatment plant (also subject to the variation). The waste water treatment plant receives surface water run-off from the entire site. As such it is considered to be a directly associated activity. The boiler is an integral part of the waste water treatment plant and as such it is a part of the directly associated activity.

2.1.8 Therefore, in these particular circumstances it is considered that NRW is the appropriate regulator for the boiler rather than the local authority. This position has been agreed with NRW permitting team.

2.1.9 The site is currently permitted to process waste wood under activity A3. This includes the storage and treatment of waste wood. Treatment consists of:

- Separation
- Cutting
- Pulverising
- Shredding
- Chipping
- Screening

of wood waste for recovery only.

2.1.10 The waste types and quantities allowed for wood processing are set out in Table S2.3 of the environmental permit.

2.1.11 It is therefore not necessary to include any pre-treatment activities within this application. The SWIP activities will commence once fuel is delivered to the fuel storage area inside the building containing the boiler.

2.1.12 SWIPs are subject to the requirements of Chapter IV of the Industrial Emissions Directive (IED). Information in the subsequent sections of this report set out how the proposed biomass boiler complies with these requirements. The boiler is designed to be able to use Grade A, Grade B or Grade C wood, however the proportion of each grade will depend on the waste arriving at the site and will be changeable. Therefore for the purposes of this assessment and the IED requirements it is assumed that the boiler will only burn Grade C wood as this is the ñworst caseò scenario. For this reason, in terms of the IED requirements, the boiler has been assessed against thresholds set out for incineration rather than co-incineration.

3 Operation

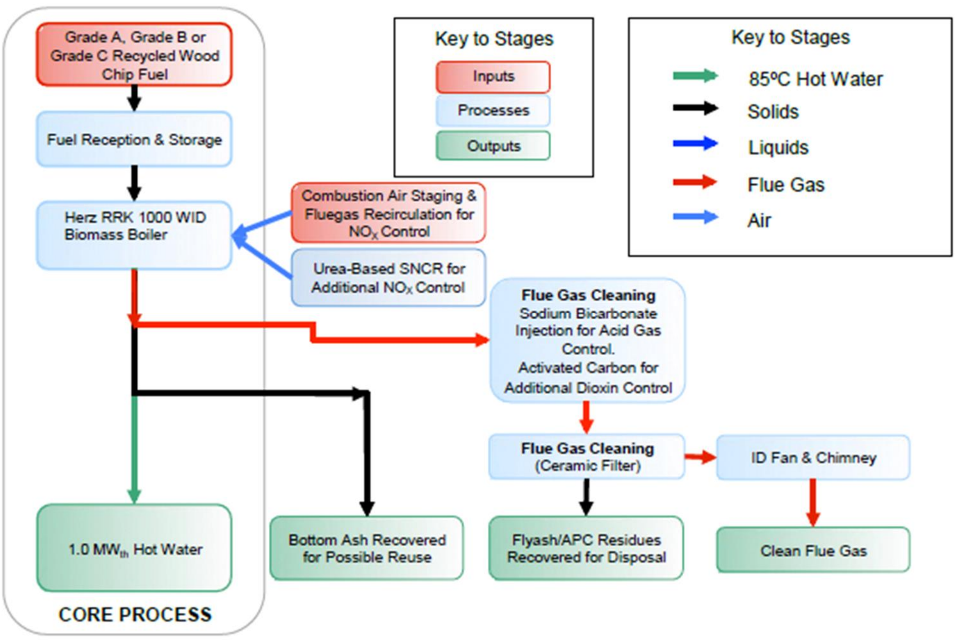
3.1 Activities Associated with the Operation of the Biomass Boiler

3.1.1 The principal activities carried out within the Installation are as follows:

- Fuel reception, storage and handling;
- Combustion of biomass fuel with associated recovery of heat via a boiler in the form of hot water for distribution to the associated waste water treatment plant;
- High efficiency ceramic filter to remove particulates;
- NO_x control measures including staged supply of combustion air, flue gas recirculation (FGR) and a urea based selective non-catalytic reduction (SNCR) abatement system;
- Injection of sodium bicarbonate to control acid gases (SO_2, HCl, and HF);
- Effective boiler design and injection of activated carbon to minimise emissions of dioxins and furans, and volatile heavy metals (mercury);
- Final discharge if treated exhaust gases to atmosphere via an 11 metres high chimney;
- Collection of bottom ash and air pollution control (APC) residues for subsequent utilisation or disposal.

3.1.2 The main activities associated with the operation of the biomass boiler are summarised in the following process flow diagram (PFD).

Figure 3-1 - Process Flow Diagram



3.1.3 The key features of the biomass boiler are summarised below:

- Stepped grate, stoker-fired combustion system to ensure even combustion throughout the combustor for improved efficiency;

- Computer control to ensure stable combustion at low and high output levels, and to facilitate automatic turndown to as little as 30% of design capacity;
- Self-cleaning heat exchanger to ensure that the biomass boilers work at optimum efficiency at all times;
- Flue gas recirculation system to control combustion temperatures and minimise the formation of oxides of nitrogen;
- Urea-based SNCR system to control emissions of NO_X ;
- Sodium bicarbonate injection to control emissions of acid gases (SO_2, HCl and HF) if required;
- Activated carbon injection to control emissions of dioxins and furans, and volatile heavy metals;
- Independently verified thermal efficiency in excess of 90%;
- Provision of both FD and ID fans to ensure stable, efficient combustion conditions;
- Supply of 85ºC hot water to the associated waste water treatment plant.

3.1.4 An indicative schematic representation of the biomass boiler is provided in Drawing 2.

3.1.5 The biomass boiler has been designed to comply with the principles of Best Available Techniques (BAT) for the combustion of biomass fuels, and incorporates a range of monitoring and control features to optimise combustion and the associated recovery of thermal energy from the wood chip fuel, while at the same time minimising pollutant emissions and the generation of solid residues.

3.2 Fuel Reception, Storage and Handling

3.2.1 The Grade A, Grade B and Grade C wood chip fuel will be sourced from the on-site waste recycling operation. Waste coming into the site is segregated in the waste transfer station in accordance with the current environmental permit. Any observed contamination is removed during this process as per the current operating techniques. The current operating techniques are compliant with Art 52(1) and (2) IED. Hazardous waste is not permitted for wood processing under the current permit and will not be accepted. Art 52(3) and (4) IED are therefore n t relevant to this SWIP.

3.2.2 Wood segregated from the waste will be shredded to an appropriate size on the waste transfer station under the existing environmental permit[1]. It is then moved to the fuel storage area inside the SWIP building by a front loader truck. The building is fitted with roller shutter doors to minimise the potential for fugitive dust emissions from the fuel store, and to mitigate external noise levels associated with the operation of the biomass boiler and its associated process equipment.

3.2.3 The whole area within the fuel storage building will be laid to concrete to provide an impermeable base which prevents the ingress of moisture into the base of the fuel stockpile. The fuel storage area also incorporates a drainage system to collect water that may be

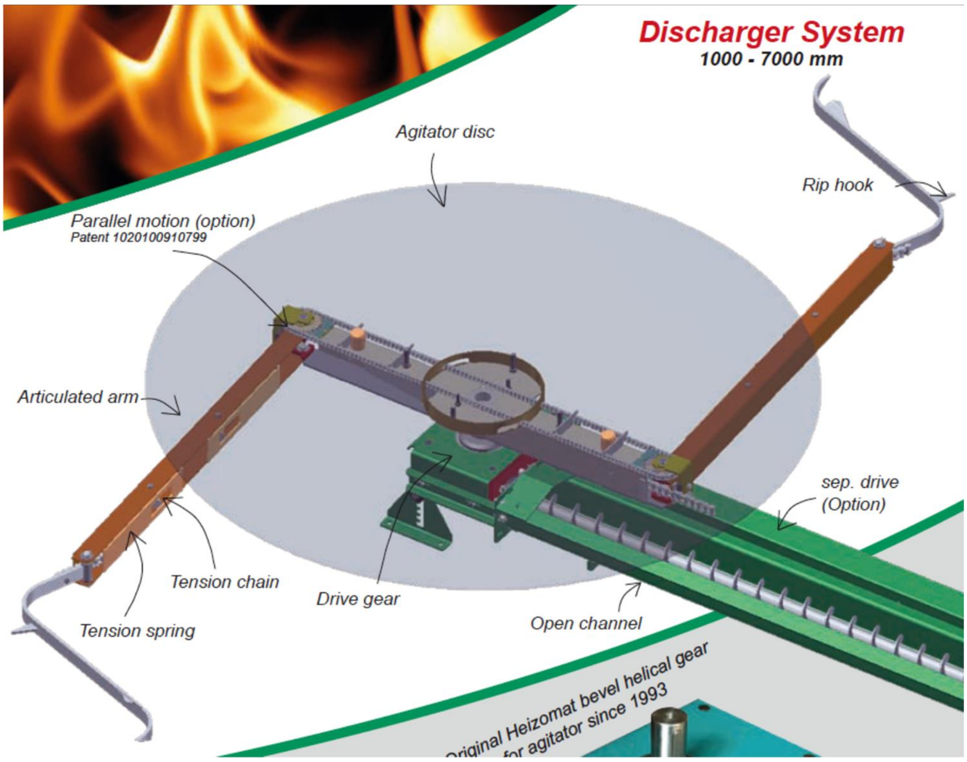
[1] It is anticipated that around 40% of waste wood accepted at the WTS will be utilised within the biomass boiler based on figures from 2015.

associated with wet fuel, which is then transferred to the on-site wastewater treatment plant that operates in accordance with section 2.4 of the main variation application document. Samples are routinely collected in order to measure the moisture content of the fuel. The concrete flooring and drainage collection also prevent the unauthorised or accidental release of polluting substances into soil, surface water and groundwater in accordance with Art 46(5) IED.

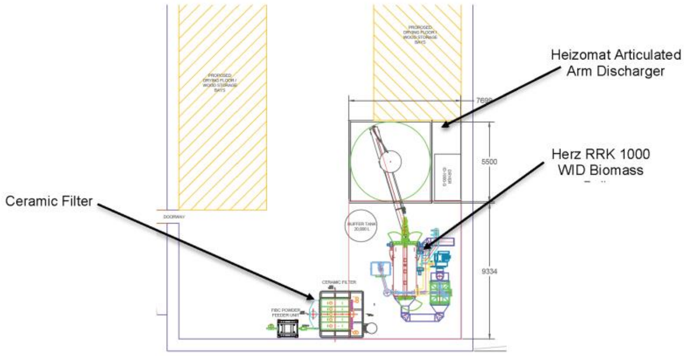
3.2.4 The fuel storage area will have sufficient capacity to store enough fuel for a three day period, assuming continuous 24 hour operation of the biomass boiler at full output. The self-contained fuel bunker has a max capacity of approximately 20 tonnes. It is usual practice to only keep one daysôworth of fuel in the bunker at a time (approximately 7 tonnes) and only fill it to capacity on a Friday night and holidays to see it through the period.

3.2.5 Fuel will be extracted from the storage area using a circular ñAgitatorò or ñArticulated Arm Dischargerò as illustrated in the following figure.

Figure 3-2 - Articulated Arm Discharger



3.2.6 The collecting arms fold underneath the pressure plate at a height of approximately 0.5 metres and above, and the screw auger transfers the fuel from the bunker. The collecting arms push the fuel into the screw auger and also prevent bridging. As fuel is removed from the bunker the collector arms fold out further. The layout of the biomass boiler and the associated agitator feeder is shown in the following figure.



3.2.7 At the end of the screw auger is a pre-cutting claw to reduce the size of any long shards that may be drawn through. A safety switch is automatically activated if there is mechanical overloading or a blockage.

3.2.8 Wood chip fuel then falls into an airtight rotary valve, which acts as a fire break and also cuts down long shards to reduce the chance of a blockage in the inclined auger feeder. These augers are pulsed according to the power requirement and boiler sensor feedback, in order to deliver the correct quantity of fuel to maintain the heat output. A temperature sensor after the rotary value provides burnback protection measures such that if a temperature reaches 70°C water will automatically be released to cool the area. This ensures that the fuel store and transport system are protected from the combustion within the boiler under all conditions (including power failure). Rainwater from the roof of the boiler building will be collected and stored for this purpose.

3.3 Fuel Combustion

3.3.1 The fuel feed system and the combustion process within the boiler is controlled by a programmable logic controller (PLC) in accordance with measured and calculated values from a number of sensors, via control and safety logic.

3.3.2 Primary combustion air is delivered via the forced draft (FD) fan beneath the grate. The under-grate section of the boiler is divided into two compartments to enable the excess air levels to be controlled to match the requirements of the initial devolatilisation of the wood chip at the front end of the stepped grate, and the slower burn out of the residual char which requires higher excess air levels. The primary combustion air flowrates into the two under grate sections are controlled by dampers, whose position is controlled by the boilers PLC control system. Secondary combustion air is introduced above the grate via a series of channels in the refractory lining, to obtain the correct air-to-fuel ratio for combustion of the volatile gases released by the burning wood chip fuel, and tertiary air is added above the refractory arch, prior to entry into the water-cooled heat exchange section of the boiler. The various combustion air flowrates are adjusted, as required, by a residual oxygen (lambda) sensor located in the boiler exhaust. The combustion air system is designed to ensure good mixing and to avoid hot spots within the boiler.

3.3.3 Once combustion of the fuel is established, it is self-sustaining. The biomass boiler is fully modulating, both in terms of fuel and air feed rates, and can operate down to 30% of maximum continuous rating (MCR) without any significant loss in efficiency. It should be noted that the planned usage for the biomass boiler is expected to be at 100% of MCR when in use.

3.3.4 The auxiliary burner (used for ignition) will be switched on automatically when the temperature of the combustion gases after the last injection of combustion air falls below 850°C in compliance with Art 50(3) IED.

3.3.5 The waste feed will be automatically prevented in the following circumstance (in accordance with Art 50(4) IED (see also paragraph 3.5.2):

- whenever temperature of 850°C is not maintained
- whenever the continuous measurements show that any emission limit value is exceeded due to disturbances or failures of the waste gas cleaning devices.

3.3.6 The biomass boiler utilises a stepped grate, stoker-fired combustion system to transfer the fuel along the length of the primary combustion zone of the boiler. Wood chip fuel is introduced to the front end of the boiler where moisture is initially driven off and the temperature increases to ~350ºC where devolatilisation of the wood chip fuel begins to occur.

3.3.7 The emission abatement systems will be bypassed during initial start-up from cold to avoid potential blinding by condensation of moisture in the ceramic filter generated by the initial drying of the wood chip fuel. As soon as the flue gas temperature is above 150ºC, the bypass damper will be closed and emissions will pass through the ceramic filter prior to release to atmosphere. This initial start-up period, bypassing the ceramic filter, normally lasts for no more than about 15 minutes. During this initial start-up procedure only virgin wood chip will be used to fuel the boiler.

3.3.8 The burning fuel continues to travel down the grate and the volatiles that are released burn above the bed of fuel and pass into the secondary and tertiary combustion zones of the boiler, while the resulting ash passes on down the grate where it is exposed to higher concentrations of oxygen (higher air:fuel ratio) to promote complete combustion (burnout) of the less reactive char. At the end of the grate the bottom ash residue falls into an ash cooling zone, with an ash auger, which extracts the ash from the boiler and deposits it into an enclosed metal receiver for disposal.

3.4 Secondary Combustion Zone and Residence Time

3.4.1 The tertiary combustion zones of the biomass boiler provide a residence time of about 2.2 seconds following the final injection of combustion air, based upon the volumetric flowrate of the flue gas generated by the combustion of the wood chip fuel, which exits the combustion chamber at a temperature in between 950 and 1,000ºC. A copy of the technical data sheet for the biomass boiler is at appendix 4 and provides information on flue gas volumetric flowrates and the dimensions of the combustion chamber, and the derivation of the 2.2 seconds residence time.

3.5 Boiler Start-up Procedures

3.5.1 At start-up, the fuel is ignited using a 750 kW_{th} burner, utilising red diesel fuel, which is used to raise the temperature of the combustion chamber to the operational temperature of >850ºC prior to the introduction of the recycled wood chip fuel. A refractory arch positioned above the stepped grate provides radiative heat to assist with the wood chip ignition process. The red diesel fuel complies with Art 50(3) IED.

3.5.2 An automatic system will prevent waste feed until the temperature of 850°C has been reached.

3.6 Boiler Shutdown Procedures

3.6.1 Shutdown procedures are controlled automatically by the boiler's PLC controller. During shutdown of the boiler, flue gas will continue to be discharged via the ceramic filter until the wood chip fuel is completely burned out, or the temperature falls below the dewpoint temperature where condensation of water vapour may occur. The urea injection and sodium bicarbonate injection systems will continue to operate if required, as determined by the CEMS measurement of the NO_X and SO_2 emissions concentrations. Activated carbon injection for mercury and dioxins/furan control will continue to operate until shutdown is complete.

3.6.2 During a controlled shutdown, the fuel feed is stopped, but the boiler continues to operate the induced draft and combustion air fans to fully burn out the fuel while the boiler is still at operational temperatures. During shutdown, the wood chip fuel will have completed the devolatilisation stage while the combustion chamber refractory temperatures are significantly elevated, which will ensure the complete combustion of any material evolved from the grate. While the combustion chamber temperatures are elevated, virtually no visible smoke emissions will be present. There should be little to no fuel remaining in the boiler by the time the combustion chamber temperatures reduce to levels where visible smoke would be produced.

3.6.3 The operation of the biomass boilers is fully automated. In the event of any faults occurring with the boiler or associated equipment, or other abnormal operating condition, the boiler will automatically shut down to a safe condition and await attendance by a trained operator to restore the boiler into service. Various safety circuits and fail-safe devices continuously monitor the boiler state, and provide control and safety response to any developing issues. The boiler is controlled via a PC interface linked to the process instrumentation and the PLC controller, providing the operator with detailed current and historic information on operating conditions.

3.7 Breakdown

3.7.1 In the case of a breakdown, the operator shall reduce or close down operations as soon as practicable until normal operations can be restored.

3.8 Heat Recovery Mechanism for supply to the effluent treatment plant

3.8.1 Hot combustion gases pass to the heat exchange section of the biomass boiler where heat in the gases is used to generate hot water. . The hot water then enters waste water treatment plant as described in section 2.4 of the main Operating Techniques document.

3.9 Emissions to Air

3.9.1 The boiler will operate under the terms and conditions of a Schedule 13 permit which requires compliance with the following pollutants specified by the IED for small waste incineration plant.

Table 1 - IED Compliance Limits

Pollutant	Scenario 1 Short-Term Emission Limits (mg.Nm-3)	Scenario 2 Daily-Mean Emission Limits (mg.Nm-3)
Particles	30	10
TOC	20	10
HCl	60	10
HF	4	1
SO2	200	50
NOx	400	200
CO	-	50
Group 1 metals (a)	-	0.05 (d)
Group 2 metals (b)	-	0.05 (d)
Group 3 metals (c)	-	0.5 (d)
Dioxins and furans	-	0.0000001 (e)

Notes: All concentrations referenced to temperature 273 K, pressure 101.3 kPa, 11% oxygen, dry gas.
(a) Cadmium (Cd) and thallium (Tl).
(b) Mercury (Hg).
(c) Antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), and vanadium (V).
(d) All average values over a sample period of a minimum of 30 minutes and a maximum of 8 hours.
(e) Average values over a sample period of a minimum of 6 hours and a maximum of 8 hours. The emission limit value refers to the total concentration of dioxins and furans calculated using the concept of toxic equivalence (TEQ).

3.9.2 The combustion of the recycled wood chip fuel will give rise to the conventional pollutants that are associated with all combustion processes, namely, oxides of nitrogen (NO_X), sulphur dioxide (SO_2), particulates, carbon monoxide (CO) and volatile organic compounds (VOCs). The latter two are enhanced when conditions of incomplete combustion occur, however, control systems incorporated into biomass boiler will ensure that combustion efficiency is maximised at all times, and the formation of CO and VOCs is minimised. Sulphur dioxide is created by the combustion of sulphur-containing compounds in the fuel, and as the sulphur content of the wood chip fuel will be low the resulting concentrations of SO_2 in the flue gas will be comparatively low, albeit acid gas abatement will also be provided to guarantee emissions below IED limits.

3.9.3 The principal pollutant emissions associated with the combustion of the recycled wood chip fuels are expected to be NO_X and particulates. The control system within the boiler is also designed to minimise emissions of heavy metals, dioxins and furans as described below.

3.10 Emissions to Water and Sewer

3.10.1 There will be no emissions to either: surface water, groundwater or sewer from the SWIP.

3.11 Pollution Control System

3.11.1 The biomass boiler is equipped with control systems to minimise the formation and subsequent IED, as applied to waste incineration processes.

3.11.2 A staged combustion air system will be employed. The injection system for the combustion air has been designed to provide effective distribution of combustion air to avoid hot zones and minimise the amount of inorganic material volatised.

3.11.3 Primary air, extracted from above the waste fuel bunker will be injected beneath the combustion grate. Primary air is preheated using steam. The primary air injection is controlled to minimise NOx production and avoid excessive entrainment of particles.

3.11.4 Secondary air is extracted from the roof area of the boiler house. Extracting the air from this point in the building provides pre-heating of the secondary air.

3.11.5 Turbulence within the combustion chamber is achieved via the injection of the secondary air which utilises a battery of nozzles on each side of the boiler to provide an even distribution of combustion air. The injection points for the secondary air have been selected to ensure that the flue gas mixture and secondary air injection achieve good distribution of the oxygen.

3.11.6 The furnace is designed to ensure the combustion chamber is as air tight as practicable. In addition the furnace is maintained under negative pressure to prevent the release of gases during charging.

NOx Control

3.11.7 There are three recognised mechanisms for the formation of NOx:

- Fuel NOx
- Thermal NOx; and
- Prompt NOx.

3.11.8 Fuel NOx relates to the conversion of fuel bound nitrogen into nitrogen oxides and therefore is partly a function of the incoming waste material. Fuel NOx is affected by the level of oxygen in the vicinity of the flame and therefore reducing oxygen levels can influence NOx emissions. However, there is a balance between minimising NOx emissions and ensuring effective combustion and compliance with WID requirements for providing good burn out of waste material and minimising carbon in ash levels to <5% LOI or <3% TOC. The proposed air supply regime has been selected to ensure that effective combustion and burnout is achieved whilst controlling oxygen levels to a minimum to limit oxidation of the fuel bound nitrogen to NOx.

3.11.9 Thermal NOx requires high temperatures and there is a direct relationship between increasing temperature and unabated NOx levels in the flue gases. WID requires that any process burning waste material comprising or containing non-hazardous waste must maintain a minimum temperature of 850ºC.

3.11.10 Prompt NOx is formed by the relatively fast reaction between nitrogen, oxygen, and hydrocarbon radicals.

3.11.11 In reality, this very complicated process consists of hundreds of reactions and dozens of species. Prompt NOx is an important mechanism in lower- temperature combustion processes, but is generally much less important compared to thermal NOx formation at the higher temperatures found in combustion processes.

3.11.12 The primary NOx controls will comprise the following:

- optimisation of the primary and secondary air feeds, providing turbulence within the combustion chamber;
- design of the system to ensure it is as air tight as possible;
- control of the combustion stage to ensure that optimum combustion conditions are maintained; and
- use of low NOx burners for auxiliary fuel firing.

3.11.13 A SNCR for NOx abatement using dry urea prills as a reducing agent is used. Solid urea will be supplied from a storage tank. The rate of injections will be optimised during commissioning and controlled during operation to avoid over dosing. Dosing will be linked to the continuous NOx monitoring.

3.11.14 Due to high temperature in the furnace, urea is decomposed into ammonia and carbon dioxide:

$CO\ (NH_2)_2 + H2O \rightarrow\ 2\ NH_3 + CO_2$

3.11.15 The produced ammonia reduces NOx in the exhaust gas producing nitrogen and water

$4NO + 4NH_3 + O_2 \rightarrow 4 N_2 + 6 H_2O$

$2NO_2 + 4NH_3 + O_2 \rightarrow 3 N_2 + 6 H_2O$

Acid Gases

3.11.16 Sulphur dioxide is created by the combustion of sulphur-containing compounds in the fuel, and as the sulphur content of the wood chip fuel will be low the resulting concentrations of SO_2 in the flue gas will be comparatively low.

3.11.17 The biomass boiler is equipped with a sodium bicarbonate injection system to provide control of emissions of acid gases (SO_2, HCl and HF) to ensure that the emissions concentrations are at all times within relevant emission limit values specified by the IED for waste incineration plant. Powdered sodium bicarbonate will be injected into a reaction chamber upstream of the ceramic filter (after the cyclone filter), with the injection rate controlled by the central PLC unit, linked to the SO_2 emissions concentration data provided by the online CEMS. Both HCl and HF are much more reactive gases than SO_2, therefore, control of the SO_2 emissions concentration will ensure compliance with the emissions limit values for both HCl and HF.

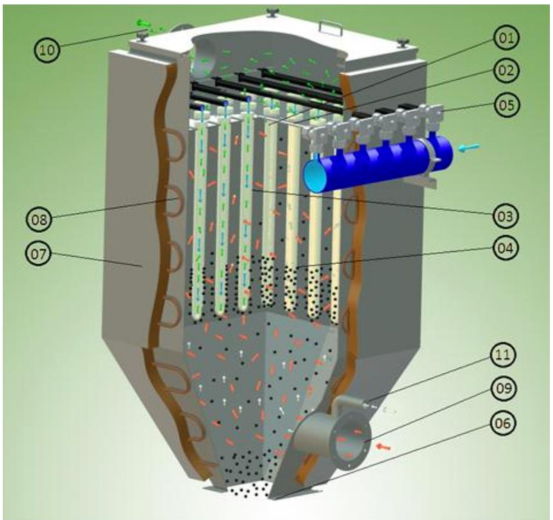
3.11.18 A sodium bicarbonate injector is located next to the flue which mixes sodium bicarbonate with activated carbon prior to it being injected into the flue. This provides additional control of emissions of dioxins & furans, and volatile heavy metals such as mercury, which may be present in the flue gas generated by the combustion of the recycled wood chip fuel. APC residues generated by the pollution control systems of the biomass boiler will be collected by the ceramic filter and stored in an enclosed container while awaiting despatch from site for disposal to landfill as described in section 3.12 below.

Particulate matter control

3.11.19 Heavier particulates will be deposited and removed within the boiler sections and a cyclone filter. Any finer particulates carried over from the boiler will pass through the heat exchange section and into the flue gas treatment plant.

3.11.20 Flue gas exits the flue gas treatment section at a much reduced temperature (~165ºC). The flue gases then pass through a high efficiency ceramic filter where the fine particulate matter is removed. The ceramic filter is illustrated schematically below.

Figure 3-3 - Ceramic Filter



- The ceramic filter element (1) hangs vertically from header plate (2) within the filter vessel. The header plate separates the filter's clean and dirty compartments.
- Hot gas is drawn through the filter medium (3) from outside to inside.
- Particulates and dry scrubbing sorbents are collected on the outer surface (4) of each filter element. These consist of the PM_{10}, $PM_{2.5}$ size ranges; these agglomerate.
- The particles are removed from the element by reverse jet cleaning (5). This reversal causes the accumulated solids to be detached from the outer surface of the ceramic filter elements.
- The particulates and spent dry-scrubbing sorbents are discharged through the hopper outlet (6) for collection and disposal.
- The filter body can be protected with insulation (7) and trace heated (8) to prevent the formation of the condensation when the equipment is not in use.
- Incoming gas stream (9) and sorbent (if required).
- Outgoing cleansed gas stream (10)
- Injection point for activated carbon and/or sodium bicarbonate.

3.11.21 The ceramic filter is capable of reducing incoming particulate emissions (including particulate phase heavy metals) by as much as 99.9%, ensuring that emissions will be at all times compliant with the 10 mg/Nm^3 particulate emission limit value specified by the IED for waste incineration plant. The filter will be equipped with a differential pressure sensor that will detect blockages and damage to the filtration media, which will trigger a visual and audible alarm on the control panel if the pressure deviates outside of pre-set control parameters that will be defined at the commissioning stage. If the pressure monitoring detects a fault with the filter, either blockage or failure of a filtration element, then the PLC initiates a "Critical Alarm", requiring the immediate attention of an operator. In the event that the operator does not respond then the boiler will be shut down automatically, and will lock-out the boiler preventing restart. The operator will be advised by an appropriate alarm text on the control panel, and must take appropriate action and then positively confirm this alarm before the boiler can be placed back into service.

3.11.22 A copy of the performance guarantee will be available for inspection once the contract has been signed with the technology provider.

Exhaust Stack

3.11.23 Flue gas exiting the ceramic is discharged via a twin-wall insulated chimney. The induced draft fan achieves an efflux velocity of $7.4 m.s^{-1}$ when the boiler is in operation.

3.11.24 The height of the chimney has been designed to provide effective dispersion of pollutants generated by the combustion of the recycled wood chip fuel. The results of the stack height assessment indicated that a height of 11 metres would provide effective dispersion of emissions from the chimney of the biomass boiler. This is discussed in detail in appendix 1.

3.12 Solid Residues

3.12.1 The biomass boiler has an automatic cleaning system which cleans the heat exchangers by means of the rotation of horizontal turbulators, to mechanically scrape ash deposits from the heat exchange surfaces, with the scrapings falling into the bottom ash system. The bottom ash and heat exchanger scrapings will be combined with the bottom ash residues.

3.12.2 APC residue is separately collected from the hopper beneath the ceramic filter.

3.12.3 The intention would be to sample and test the bottom ash and APC residue to assess their hazard levels. It is expected that the bottom ash will be deemed non-hazardous and may be recycled, with possible applications for land spreading or for use as a component in the manufacture of construction materials such as breeze blocks. The APC residue is expected to be classified as a hazardous waste (as will the bottom ash initially until demonstrated otherwise) and will be removed from the site in sealed containers by a contractor specialising in the treatment, partial recycling and disposal of APC residues. The quantity of solid waste generated by the biomass boiler depends upon the ash content and moisture content of the wood chip fuel, and on the boiler output, i.e. on the amount of fuel supplied.

3.13 Instrumentation

3.13.1 The biomass boiler is equipped with a range of process instrumentation to monitor temperature and flue gas oxygen concentration at strategic locations throughout the boiler. Instruments are installed to provide continuous information to the boilerọs PLC (Programmable Logic Controller) which monitors and adjusts key operational parameters to ensure efficient combustion of the recycled wood chip fuel at all times. The instruments supply data to the PLC-based process control system overseen by SCADA supervisory control. This controls the combustion process and associated pollution control systems, and derives key metrics for optimisation and monitoring of the combustion process by shift personnel.

3.14 Monitoring

3.14.1 To enable demonstration of compliance with the IED emission limit values, an IED/WID compatible Continuous Emissions Monitoring System (CEMS) will be installed in the chimney of the biomass boiler to enable continuous monitoring and recording of emissions concentrations for the following pollutants:

- Oxides of nitrogen (NO_X);
- Sulphur dioxide (SO_2);
- Carbon Monoxide (CO);
- Particulates;
- Hydrogen chloride (HCl);
- Volatile organic compounds (VOCs); in addition to,
- Water vapour (H_2O);
- Temperature; and,
- Pressure.

3.14.2 In accordance with Annex VI part 6 IED, HF is not monitored continuously as treatment stages for HCl are used, as described in section 3.9 above, which ensure that the emission limit value for HCl is not being exceeded. Emissions of HF will be subject to periodic measurements.

3.14.3 In order to comply with Art 45(1) IED any technically unavoidable stoppages, disturbances, or failures of the purification devices or the measurement devices, during which the emissions into the air and the discharges of waste water may exceed the prescribed emission limit values will be monitored and recorded to ensure that the maximum permissible period set out in the permit is not exceeded.

3.14.4 In order to comply with Art 46(6) IED any period where emission limit values are exceeded will be recorded to ensure that the plant does not continue to incinerate waste for a period of more than 4 hours and that the cumulative duration of operation in such conditions over 1 year does not exceed 60 hours.

3.14.5 The proposed CEMS is capable of measuring all of the above gaseous species, and is MCERTS-accredited. A copy of the expected unit technical brochures and the MCERTS certificate is at appendix 2. This confirms that the monitoring equipment has been certified to EN15267-3 as required by TGN M2 ï Monitoring of stack emissions to air. Monitoring will be carried out in accordance with this TGN[2].

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[2] Environment Agency Technical Guidance Note (Monitoring) M2, Monitoringof stack emissions to air, Version 11,November 2015: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/483866/LIT_6405.pdf

3.14.6 All monitoring equipment will be calibrated in accordance with the relevant standard in accordance with Art 48(2) IED.

3.14.7 To enable periodic compliance check monitoring to be undertaken, the chimney of the biomass boiler will be equipped with sample ports comprising two 5ò BSP sockets complete with screw caps, and installed at 90 degrees to each other. The sample ports will be installed at a location in the chimneys that is 5 x the flue diameter downstream of the nearest bend, and more than 2 diameters from the exit of the chimney. This is in accordance with the requirements of Environment Agency Technical Guidance Note M1 and British Standard BSEN15259.

3.14.8 The location of the sample ports will ensure that a full traverse on both sampling planes can be achieved during the annual compliance monitoring programme that will be a condition of the Schedule 13 permit. Temporary sampling platforms will be erected to enable full and unfettered access to the sample ports by the specialist contractors appointed to undertake the compliance monitoring programme.

3.14.9 All monitoring results will be recorded, processed and presented in such a way as to enable NRW to verify compliance with the operating conditions and emission limit values which are included in the permit.

3.14.10 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 IED are fulfilled.

4 Energy Usage

4.1 Energy Efficiency

4.1.1 It is recognised that there are both environmental and financial benefits associated with the reduction and minimisation of energy usage. Even small percentage savings in energy consumption can represent considerable financial savings and environmental benefits through emission reductions.

4.2 Energy Recovery

4.2.1 The biomass boiler is intended specifically to recover energy, via combustion, from recycled wood chip fuel. Energy is recovered from the hot combustion flue gas in a boiler that generates 85ºC hot water for use in a directly associated waste water treatment plant. The biomass boiler will generate ~8,000 MWhr per annum of renewable thermal energy that will be utilised by the waste water treatment plant on an annual basis, depending on the variability of the moisture content and calorific value of the recycled wood chip fuel.

4.2.2 The biomass boiler provides a dedicated hot water supply to the waste water treatment plant, which uses all of the available heat that the boiler can generate.

4.3 Energy Consumption

4.3.1 The boiler will utilise approximately 2,500 tpa of recycled wood chip fuel. With average moisture content of 25% the heat produced from each tonne of this fuel would be expected to be 3,200kWh.

4.3.2 The auxiliary burner is described above and will only be used under abnormal operating conditions in accordance with the IED.

4.4 Basic Energy Efficient Physical Measures

4.4.1 The basic, low cost physical techniques include the following:

- Insulation ï hot water pipe-work, vessels, boiler, combustion plant (high efficiency refractory insulation);
- High-efficiency electric motors for all drives;
- Thyristor control of motors for the ID fan and FD fan.

4.4.2 It is important to ensure that all connecting joints and flanges within the biomass boiler are sealed effectively to prevent the egress of combustion gases that may pose a risk to the health of the workforce. In so doing, the gas-tight containment of the process equipment minimises the escape of hot flue gas that would otherwise reduce the overall thermal efficiency of the boiler, which could require additional supplementary fuel firing to maintain operating temperatures.

4.5 Building Services Energy Efficiency Measures

4.5.1 The energy use directly associated with the building services is of minor impact and is expected to account for <1% of the total energy use.

4.5.2 The biomass boiler will be housed within a new building to be erected on the site. The building will be designed to incorporate skylights to allow natural lighting and therefore minimal additional lighting will be required. There will be no need for heating within the building as the only requirement for anyone to be inside the building other than twice a day for monitoring purposes.

4.6 Further Energy Efficiency Requirements

4.6.1 Energy management techniques will be incorporated into the EMS that will direct the operation of the biomass boiler, however, the following provides a concise overview of the techniques and measures that Atlantic may employ:

- **Continuous basis**: Use of Critical Control Points and Standard Operating Procedures to ensure operators are able to identify, monitor and maintain optimum process operating conditions;
- **Shift basis**: Hourly recording of key process conditions (the biomass boiler will have a computerised system to record trends and data);
- **Daily**: review of key energy production figures and environmental performance;
- **Monthly**: production of energy report covering energy consumption, based on data generated on Site and utility bills/statements. Cross checked against Site targets and performance for thermal energy.

4.6.2 Combustion efficiency within the biomass boiler will be optimised by employing the following measures:

- Minimising combustor excess air levels (whilst maximising the combustion of volatile gases released by the burning fuel on the grate). This will be achieved by careful control of air flows and combustion zone temperatures;
- Minimising boiler flue gas exit temperatures (whilst maintaining sufficient temperature to avoid acid dew-point corrosion and excessive visible plume). This will be achieved by design of the combustion and heat recovery sections of the boiler and, in operation, regular cleaning of the boiler smoke tubes to remove insulating deposits.

4.6.3 It is recognised that even with the above factors incorporated into the design of the biomass boiler, the energy recovery efficiency of the facility may vary throughout the year. The principal reason for this is the seasonal variability in the moisture content of the recycled wood chip fuel that will be received on site.

4.6.4 The parasitic electrical load used by the biomass boiler will be minimised by employing the following techniques:

- The use of variable speed drives for all motors operating at less than full load for significant periods, including the combustion forced draft and induced draft fans;
- The use of high efficiency motors for all drives.

4.6.5 The design of the biomass boiler will ensure that the efficiency of energy utilisation is optimised at all times. It is anticipated that the associated waste water treatment plant will take all of the available thermal energy generated by the biomass boiler. However if additional thermal energy is generated this will be utilised on site for heating water within buildings used by employees.

4.7 CO_2 Emissions Reductions via the Combustion of Recycled Wood Chip Fuel

4.7.1 The biomass boiler will generate 1 MW_{th} of 85ºC hot water for supply to the associated waste water treatment plant, which equates to ~8,000 MWhr $annum^{-1}$ of renewable energy generated by the boiler.

4.7.2 DEFRA provides Greenhouse Gas conversion factors for the purpose of company reporting. For scope 1 these factors consider emissions of carbon dioxide (CO_2), methane and nitrous oxide emitted during combustion. For renewable fuels (such as wood chips) the CO_2 associated with the biogenic content of the fuel is reported as zero since an analogous amount of CO_2 is absorbed in the growth of the wood to that released during combustion.

4.7.3 Using the conversion factors for 2016[3] it is estimated that if all of the thermal energy supplied to the waste water treatment plant was generated by an electrical heating system, then approximately 3,300 tonnes of CO_2 per annum would be released to the atmosphere:

8,000,000 (kWh) x 0.41205 ($kgCO_2e$/kWh) = 3,296,400 $kgCO_2e$[4]

4.7.4 Using the conversion factors provided for wood chip and assuming a 90% efficiency of the boiler the estimated amount of CO_2 that will be generated by the boiler will be approximately 110 tonnes per annum.

$$\frac{8{,}000{,}000\ (\text{kWh}) \times 0.01307\ (\text{kgCO}_2\text{e/kWh})}{0.9} = 116{,}177.77\ \text{kgCO}_2\text{e}$$

4.7.5 Over the twenty year operational lifetime of the biomass boiler, a saving of about 63,800 tonnes of CO_2 would be made by the site.

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[3] https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2016

[4] This assumes a 100% efficient recovery of electrical energy as heat, for lower efficiency boilers electrical input would increase and associated CO_2 releases would similarly increase.

5 Environmental Management System

5.1.1 Atlantic has an existing Environmental Management System (EMS) to direct the operation of currently permitted process operations carried out on site under the Permit. The EMS will be updated to include aspects associated with the operation of the biomass boiler.

5.2 Operation and Maintenance

5.2.1 Procedures will be put in place to ensure that those operations which have the potential to give rise to significant environmental effects are controlled. Procedures will not only cover normal operation but will also address abnormal operation, including start-up and shutdown.

5.2.2 In particular procedures will be developed in relation to the following:

- Waste reception and handling, including waste acceptance procedures;
- Good housekeeping measures;
- Maintenance of key plant and equipment;
- Management and maintenance of the settlement pit lagoon; and
- Storage, handling and removal of wastes (materials) from the site.
- Planned maintenance routines will be established to ensure all key plant components which have the potential to affect the environmental performance of the IBA Recycling Facility remain in good working order. Maintenance routines will draw on manufacturersô recommendations, unless operational experience during the lifetime of the IBA Recycling Facility would indicate the need for variance.

5.2.3 Inspections will include but not be limited to:

- Hoppers;
- Feeders;
- Auxiliary fuel tank;
- Fuel storage area.

5.3 Training and Competence

5.3.1 There are no specific technical competence qualifications for operators of biomass boilers, similar to those for other waste activity sites. Atlantic will ensure that all personnel employed to operate the biomass boiler have appropriate skills and technical capabilities to understand the operation of the process, and their obligations under the terms and conditions of the Permit. This will be managed via an update to the existing management systems

5.3.2 On-site operational staff will be trained for normal operation as well as routine interventions, response to alarm conditions, and start-up and shut down procedures by Herz and Ecotec

Services Ltd's commissioning engineers. This will involve checking the boiler operating status and alarm status. Training records of the personnel involved will be recorded and operator training certificates will be issued by Herz and Ecotec Services Ltd, who are the EPC contractors for the project. Only trained personnel will be permitted to operate the biomass plant. Following operation of the biomass plant any new operational staff will be trained under the supervision of experienced operational staff.

5.3.3 Any detailed interventions required either during commissioning or on an ongoing basis will either be conducted by Ecotec Services Ltd trained personnel, or a suitably trained third-party agent. If using a third party agent, this person will have received detailed training by Herz engineers, and will hold a certificate of competence. The boiler's PLC will be password-protected with different access according to the user level, such that untrained personnel will be unable to operate the boiler.

5.3.4 Training records will be prepared for all operational staff and training needs will be reviewed on a regular basis as part of Atlantic's EMS procedures. Copies of all training records will be available for inspection upon request.

5.4 Accidents and Incidents

5.4.1 The biomass boiler has been designed to be fully compliant with the operational requirements of the Industrial Emissions Directive, and is fully consistent with Environment Agency guidance for the operation of waste incineration plant[5], and with the principles of Best Available Techniques (BAT) in all aspects of the design of the biomass boiler.

5.4.2 An Accident Management Plan has been developed as part of the EMS for the activities currently permitted on site. This will be updated to include aspects associated with the operation of the biomass boiler.

5.4.3 A fire prevention plan has been produced in connection with the main permit variation application which includes consideration of the biomass boiler. This is at appendix 5 of the main application.

5.4.4 Atlantic will undertake frequent inspections of the biomass boiler installation to identify potential problems with the process equipment that may adversely affect performance. This will include a programme of preventative maintenance of major components of the installation, in addition to commissioning a boiler servicing agreement with Ecotec Services Ltd. A copy of the service agreement is at appendix 3.

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[5] How to comply with your environmental permit: The Incineration of Waste (EPR 5.01 Environment Agency) (adopted by Natural Resources Wales).

Glossary

APC	Air Pollution Control
Atlantic	Atlantic Recycling Limited
BAT	Best Available Techniques
CEMS	Continuous Emissions Monitoring System
EMS	Environmental Management System
EPR 2016	The Environmental Permitting (England & Wales) Regulations 2016
FD	Forced Draft
FGR	Flue Gas Recirculation
IED	The Industrial Emissions Directive
NRW	Natural Resources Wales
PFD	Process Flow Diagram
PLC	Programmable Logic Controller
SCADA	Supervisory Control and Data Acquisition
SNCR	Selective Non-catalytic Reduction
SRF	Solid Recovered Fuel
SWIP	Small Waste Incinerator Plant
WTS	Waste Transfer Station

Drawings

Appendices

Appendix 1

Air Quality Assessment

Appendix 2

CEMS technical brochures and MCERTS certificate

Appendix 3

Biomass Boiler Service Agreement

Appendix 4

Biomass Boiler Data Sheet