EPR PERMIT APPLICATION SUPPORT DOCUMENT

Biomass UK No.2 Ltd

Energy Production Facility

Prepared by:
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Date:
July 2017

Project Issue Number:
SOL1605BUK201

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VERSION CONTROL RECORD			
Contract/Proposal Number:		SOL1605BUK201	
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Signature:			
Issue	**Description of Status**	**Date**	**Reviewer Initials**
1	First Submission to Natural Resources Wales	October 2016	SP
2	Second Submission to Natural Resources Wales	July 2017	SP

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Glossary of Terms

Term	Definition
Advanced Conversion Technology	A suite of technologies which have the capacity to convert solid waste materials into gas for the generation of renewable energy. Technologies include Pyrolysis, Gasification and Anaerobic Digestion. The technologies used to utilise renewable fuels or waste include: - Direct firing open cycle steam turbine systems, - Integrated gasification combined cycle turbine systems, - Integrated pyrolysis combined cycle turbine systems, - Anaerobically generated biogas fuel in reciprocating engine or gas turbine systems.
Air quality objective	Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedances within a specific timescale (see also air quality standard).
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive sub groups (see also air quality objective).
Ambient air	Outdoor air in the troposphere, excluding workplace air.
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year. Usually this is for a calendar year, but some species are reported for the period April to March, known as a pollution year. This period avoids splitting winter season between 2 years, which is useful for pollutants that have higher concentrations during the winter months.
AQMA	Air Quality Management Area.
BTEX	BTEX is an acronym that stands for benzene, toluene, ethylbenzene, and xylenes.[1] These compounds are some of the volatile organic compounds (VOCs) found in petroleum derivatives such as petrol (gasoline). Toluene, ethylbenzene, and xylenes have harmful effects on the central nervous system.
By-product	A by-product is a secondary product derived from a manufacturing process or chemical reaction. It is not the primary product or service being produced.
CHP	Combined Heat and Power Plant (CHP) integrates the production of usable heat and power (electricity), in one single, highly efficient process.
CHPQA	The CHPQA (Quality Assurance for Combined Heat and Power) programme is carried out on behalf of the Department of Energy and Climate Change, in consultation with the Scottish Executive, the National Assembly for Wales, and the Northern Ireland Department of Enterprise, Trade and Investment.

DEFRA	Department for Environment, Food and Rural Affairs.
Dioxin	Dioxins and dioxin-like compounds, a diverse range of chemical compounds which are known to exhibit "dioxin-like" toxicity. In chemistry, a dioxin is a heterocyclic 6-membered ring, where 2 carbon atoms have been replaced by oxygen atoms.
Eutrophication	Eutrophication or more precisely hypertrophication, is the ecosystem response to the addition of artificial or natural substances, such as nitrates and phosphates, through fertilisers or sewage, to an aquatic system
Exceedance	A period of time where the concentrations of a pollutant is greater than, or equal to, the appropriate air quality standard.
Fugitive emissions	Emissions arising from the passage of vehicles that do not arise from the exhaust system.
Gasification	Gasification is a process that converts organic or fossil based carbonaceous materials into carbon monoxide, hydrogen and carbon dioxide. This is achieved by reacting the material at high temperatures (>700°C), without combustion, with a controlled amount of oxygen and/or steam.
HVAC	HVAC (heating, ventilation, and air conditioning) is the technology of indoor and vehicular environmental comfort.
ISO14001	ISO 14000 is a family of standards related to environmental management that exists to help organizations (a) minimize how their operations (processes etc.) negatively affect the environment (i.e. cause adverse changes to air, water, or land); (b) comply with applicable laws, regulations, and other environmentally oriented requirements, and (c) continually improve in the above.
LAQM	Local Air Quality Management.
NO	Nitrogen monoxide, a.k.a. nitric oxide.
NO_2	Nitrogen dioxide.
NOx	Nitrogen oxides.
O_3	Ozone.
PAH	Polycyclic aromatic hydrocarbons (PAHs), also known as poly-aromatic hydrocarbons or polynuclear aromatic hydrocarbons, are potent atmospheric pollutants that consist of fused aromatic rings and do not contain heteroatoms or carry substituents. Naphthalene is the simplest example of a PAH. PAHs occur in oil, coal, and tar deposits, and are produced as by-products of fuel burning (whether fossil fuel or biomass). As a pollutant, they are of concern because some compounds have been identified as carcinogenic, mutagenic, and teratogenic.
Percentile	The percentage of results below a given value.

PLC	A Programmable Logic Controller, PLC or Programmable Controller is a digital computer used for automation of electromechanical processes, such as control of machinery.
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 micrometres.
PPB parts per billion	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppb means that for every billion (10^9) units of air, there is one unit of pollutant present.
PPM parts per million	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppm means that for every billion (10^6) units of air, there is one unit of pollutant present.
Pyrolysis	Pyrolysis is a thermochemical decomposition of organic material at elevated temperatures in the absence of oxygen.
Ratification (Monitoring)	Involves a critical review of all information relating to a data set, in order to amend or reject the data. When the data have been ratified they represent the final data to be used (see also validation).
RDF	Refuse-derived fuel (RDF) or solid recovered fuel/ specified recovered fuel (SRF) is a fuel produced by shredding and dehydrating solid waste (MSW) with a Waste converter technology. RDF consists largely of combustible components of municipal waste such as plastics and biodegradable waste.
Renewable Energy	Renewable energy is generally defined as energy that comes from resources which are continually replenished on a human timescale such as sunlight, wind, rain, tides, waves and geothermal heat. Renewable energy is also defined under the Renewable Energy Directive as comprising energy from the biomass fraction of waste.
ROC	Renewable Obligation Certificates
SCADA	SCADA (supervisory control and data acquisition) is a type of industrial control system (ICS). Industrial control systems are computer controlled systems that monitor and control industrial processes.
SCR	Selective catalytic reduction (SCR) is a means of converting nitrogen oxides, also referred to as NOx with the aid of a catalyst into diatomic nitrogen, N_2, and water, H_2O. A gaseous reductant, typically anhydrous ammonia, aqueous ammonia or urea, is added to a stream of flue or exhaust gas and is adsorbed onto a catalyst.
SRF	SRF can be distinguished from RDF in the fact that it is produced to reach a standard such as CEN/343 ANAS.
Synthesis Gas (Syngas)	Syngas, or synthesis gas, is a fuel gas mixture consisting primarily of hydrogen, carbon monoxide, and very often some carbon dioxide. The name comes from its use as intermediates in creating synthetic natural gas (SNG) and for producing ammonia or methanol.

µg/m^3 micrograms per cubic metre	A measure of concentration in terms of mass per unit volume. A concentration of 1ug/m^3 means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.
UKAS	United Kingdom Accreditation Service.
Uncertainty	A measure, associated with the result of a measurement, which characterizes the range of values within which the true value is expected to lie. Uncertainty is usually expressed as the range within which the true value is expected to lie with a 95% probability, where standard statistical and other procedures have been used to evaluate this figure. Uncertainty is more clearly defined than the closely related parameter 'accuracy', and has replaced it on recent European legislation.
USA	Updating and Screening Assessment.
Validation (modelling)	Refers to the general comparison of modelled results against monitoring data carried out by model developers.
Validation (monitoring)	Screening monitoring data by visual examination to check for spurious and unusual measurements (see also ratification).
VSD	Adjustable speed drive (ASD) or variable-speed drive (VSD) describes equipment used to control the speed of machinery. Many industrial processes such as assembly lines must operate at different speeds for different products. Where process conditions demand adjustment of flow from a pump or fan, varying the speed of the drive may save energy compared with other techniques for flow control.

NON TECHNICAL SUMMARY

Biomass UK No.2 Ltd (the *'Applicant'* or the *'Operator'*) is making a New Bespoke Installation Permit Application for the proposed operation of a renewable energy generation facility that incorporates Advanced Thermal Treatment (ATT, gasification) at their site on Woodham Road, Barry.

The proposed Installation is located on land at Woodham Road, Barry, CF63 4JE (Grid Reference ST 12610 67683).

The proposed development is a renewable energy generation facility which has been designed to recover energy from pre-prepared mixed waste wood feedstocks using gasification. The gasification facility is an Advanced Thermal Treatment (ATT) process that will produce a combustible synthesis gas, which is then used to raise steam and generate electricity, through steam cycle turbine generation.

The Advanced Thermal Treatment (ATT) plant is designed to process shredded mixed waste wood feedstocks to produce heat to raise steam in a conventional tube boiler for utilisation in a steam turbine for the production of renewable electricity with an export capacity up to 10MWe.

The Installation has been designed to process approximately 86,400 tonnes of pre-processed non-hazardous mixed waste wood per annum.

The treatment process will be permitted by Natural Resources Wales as a Waste Incineration Activity and will be operated in accordance with the Environmental Permitting (England and Wales) Regulations 2014 and Chapter IV of the Industrial Emissions Directive (IED).

The proposed process meets the definition of an Installation as defined by Section 5.1 *'Incineration and Co-Incineration of Waste'* paragraph A(1)(b) namely:

'The incineration of non-hazardous waste in a waste incineration plant or waste co-incineration plant with a capacity exceeding 3 tonnes per hour.'

General Overview

Shredded mixed waste wood will be delivered directly into the Fuel Storage [fuel bunker] Building via electrically operated fast roller shutter doors. When required, the shredded wood will be discharged onto the feedstock conveyor system, which will deliver the waste into the gasification building.

The gasification plant will be coupled to a single steam turbine and generator. The steam turbine has been designed to recover all available thermal energy from the steam and subsequently generate 10MWe.

The gasifier is independently fed with the fuel feedstocks from the Fuel Storage Building via a feedstock feed system. The feeding system comprises a material screen and metal separator to remove any

oversize materials and metals from the feedstock. A chain conveyor will transport the waste wood into the gasifier metering bins.

Detailed Computational Fluid Dynamic modelling (CFD) of the gasification/combustion process has been carried out to ensure complete combustion of the fuels under varying conditions, and also guarantees the 2 seconds minimum combustion gas retention time above 850ºC stipulated by the Industrial Emissions Directive (IED) Chapter IV.

Flue gas cleaning and pollution control consists of Selective NOx Catalytic Reduction (SNCR) through urea injection, Selective Catalytic Reduction (SCR), anhydrous lime injection for acid gas neutralisation and activated carbon powder injection for absorption and removal of heavy metals, dioxins, VOC and other harmful substances.

The gasification line will have a dedicated baghouse designed with sufficient capacity to remove all submicron dust particles.

The steam turbine is fed with the superheated steam from the gasifier and used to generate electricity. With the exception of a small portion of the steam which is extracted at the high-pressure exit stage of the turbine and the boiler drum for the supply of heat to the 'deaerator' and the feedwater preheater respectively, all steam is used for the generation of power.

An air cooled condenser circuit is employed to cool the exhaust steam from the turbine exit back to liquid state (condensate) to be re-used by the boiler.

Emissions to Air

The gasifier has a flue (A1) combined within a single wind shield to form a single chimney for the discharge of cleaned flue-gas to atmosphere.

All combustion products / flue gases are passed through multiple gas clean up stages and abatement stages resulting in all emissions to atmosphere being comfortably within the stipulated Emission Limit Values (ELVs) for Chapter IV IED activities.

Odour

Due to the design of the building structure, the fully enclosed processing activities and the nature of the waste feedstock materials stored and processed on site, there is very little potential for offsite odour emissions and impacts to arise from the site.

The Fuel Storage Building is sealed (nominally air tight) and fitted with roller shutter doors. Air is extracted from the building via the push floor area to mitigate and extract dust via a dedicated extraction and filtration system.

Emissions to Controlled Water

There will be no direct process emissions to controlled water arising from the Installation.

All effluent and blow down arising from the plant will be treated through an integral waste water treatment system (comprising pH correction / reverse osmosis) and discharged to sewer.

Foul drainage from the office / administration area from the process will be discharged into a small packaged treatment plant and then discharged to sewer.

Ultimately, all foul drain emissions discharge to the lower estuarine potion of Sully Brook via the Barry Sewerage Treatment Works.

The only discharges to controlled waters will be uncontaminated clean surface water runoff captured from roof drainage and external roadways / car parking areas.

Emissions to Land

There will be no emissions to land arising from the Installation.

Waste Management

The gasification process will not inherently produce significant quantities of waste.

There are two principle types of solid by-products produced from the operation of the gasification facility. These are:

- Bottom Ash; and
- APC Ash (Air Pollution Control (APC) residues).

Bottom Ash will be recirculated as bed material before ultimately being rejected from the bed as particulate within the combustion gases. Periodic (every 4 years) bed replacement will be required.

All combustion gases arising from the combustion of the syngas are cleaned by a dedicated flue gas cleaning system (FGCS) comprising;

- Urea injection for the chemical reduction of NOx;
- Screening for the removal of large particles prior to entrance to the boiler;
- Lime injection for the chemical reduction of acid gases;
- Carbon injection for the removal of volatiles and dioxins; and
- Filtration for the removal of all fly ash and adsorbents.

All air pollution control residues will be stored within dedicated hoppers and exported off site to a re-processor for use as a gypsum replacement, aggregate recycler or disposal. All ash collection and transfer will be via dedicated covered vehicles

Impact

The air emissions from the proposed development have been modelled using ADMS 4.2 and AERMOD atmospheric dispersion modelling software.

The air quality impact assessment considered the air impact to all identified residential, sensitive habitat and ecological receptors.

It is the conclusion of the modelling that the Installation is unlikely to have a significant impact at any of the receptor locations examined and is unlikely to have a significant impact on the environment.

All of the air emissions from the Installation have been risk assessed against their potential impact on human health. The results of the assessment are that the proposed installation will not present any risk to human health.

Impacts associated with the foul water drainage have been screened using the EA H1 tool. All emissions are screened as insignificant.

1. INTRODUCTION

This document has been prepared on behalf Biomass UK No.2 Ltd (Biomass UK or the Applicant hereafter) by Sol Environment Ltd and provides supporting evidence as required by Environmental Permit Application Forms B2 and B3 issued by Natural Resources Wales (NRW).

The Applicant is making this application for a Bespoke Part A(1) Installation Permit Application under The Environmental Permitting (England and Wales) Regulation 2013 (as amended) for the proposed operation of a renewable energy generation facility incorporating Advanced Thermal Treatment (ATT, gasification) on Woodham Road, Barry.

The proposed Installation is located on land at Woodham Road, Barry, CF63 4JE (Grid Reference ST 12610 67683).

The proposed Installation will comprise of the construction and operation of an Advanced Thermal Treatment (ATT) gasification line which will typically process 86,400 tonnes of shredded mixed waste wood[1] feedstocks per annum.

The main features of the proposed Installation, as described in this document are as follows:

- *Fuel Storage Building:* For the delivery and reception of mixed waste wood feedstocks;
- *Waste Processing:* For the screening and sampling of the fuel feedstocks before being delivered to the gasification unit;
- *Fluidised Bed Gasification System:* Comprising a gasification line for the thermal conversion and combustion of syngas from the fuel feedstocks;
- *Steam Turbine Generator:* Comprising a steam turbine and generator for the conversion of steam into electricity within a steam turbine; and
- *Gas Cleaning and Pollution Abatement Plant:* Consisting of selective non-catalytic reduction (SNCR) and selective catalytic reduction (SCR) for the reduction of Nitrogen Oxides (NOx), sorbent injection for acid gas neutralisation and activated carbon powder injection for absorption and removal of heavy metals, dioxins, VOC and other harmful substances.

The Installation will make an important contribution to regional waste management and local renewable energy generation and will provide a single treatment facility for mixed waste wood materials that would otherwise be destined for landfill, incineration or foreign export.

1 All waste wood feedstocks will be prepared to meet the requirements of Waste Wood Grade B and Grade C (Fuel Grade) materials as defined by BSI PAS 111 Processing Waste Wood.

The gasification process meets the definition of a listed activity as defined by Schedule 2 of the Environmental Permitting Regulations 2014.

Therefore, the proposed facility meets the definition of an Installation as defined by Section 5.1 *'Incineration and Co-Incineration of Waste'* paragraph A(1)(b) namely:

'The incineration of non-hazardous waste in a waste incineration plant or waste co-incineration plant with a capacity exceeding 3 tonnes per hour.'

The remainder off this application support document is structured accordingly:

- Section 2: Provides a detailed planning history of the site and associated activities;
- Section 3: Provides specific details associated with the New Bespoke Installation Permit Application;
- Section 4: Provides specific nature and detailed description of the emissions to air, water emissions and waste associated with the Installation;
- Section 5: Provides details of all environmental monitoring associated with the Installation;
- Section 6: Provides a BAT description of the proposed technology and provides a comparison against the applicable guidance and emission limit values for the Installation; and
- Section 7: Provides an Environmental Impact and Assessment of the Installation against the requirements of the Habitats Directive.

All technical appendices associated with the Installation are included within SOL1605BUK201 – Volume 2 and comprise the following:

- Volume 2 – Annex A: Figures;
- Volume 2 – Annex B1: Energy Balance;
- Volume 2 – Annex B2: Technical Drawings;
- Volume 2 – Annex B3: Global Warming Potential (GWP);
- Volume 2 – Annex C1: H1 Assessment and Air Quality Assessment;
- Volume 2 – Annex C2: H5 Assessment - Site Condition Report;

- Volume 2 – Annex C3: Environmental Noise Assessment;
- Volume 2 – Annex D1: Draft Site Working Plan;
- Volume 2 – Annex D2: Accident Management Plan;
- Volume 2 – Annex D3: Fire Prevention Plan;
- Volume 2 – Annex D4: Certificates of Technical Competence;
- Volume 2 – Annex E: Planning Permissions.

The location of the Installation is provided overleaf in Figure 1.1.

The site layout and Installation Boundary is provided in Figure 1.2.

Figure 1.1: Site Location

Figure 1.2: Site Plan Showing the Installation Boundary and Key Process Locations

2. PLANNING STATUS

The principle of establishing a wood fuelled power plant at the site was established by planning permission reference 2008/01203/FUL, as approved by appeal reference APP/Z6950/A/09/2114605 on 2nd July 2010.

Due to finalising the technology and design layouts for the projects, an amendment to the 2010 permission was made on 12th January 2015. The planning application was successfully granted on 31st of July 2015.

The outline application Planning Permission has been included within *SOL1605BUK201 Volume 2: Annex E – Planning Permission* and the details pertaining to all known planning permissions are provided in Table 2.1 below.

Table 2.1: Planning History

Reference	Description	Status	Date Granted
2016/00187/RES	Approval of the landscaping of the development condition 1 of the outline 2015/00031/OUT	Granted	29/04/2016
2015/00031/OUT	Outline application for a wood fired renewable energy plant	Granted	31/07/2015
2008/01203/FUL	Erection of new industrial building and installation of 9MW fuelled renewable energy plant.	Granted Through Appeal	02/07/2010

3. PROPOSED ACTIVITIES

3.1 Type of Permit

The Applicant are making an application for a Bespoke Installation Permit for the proposed operation of a waste to energy plant utilising Advanced Thermal Treatment (gasification) in Barry.

The Installation will typically accept approximately 86,400 tonnes of mixed waste wood per annum[2], for the purpose of the generation of a synthetic gas which will be utilised in a steam turbine to produce renewable electricity with a continuous export capacity up to 10MWe.

The use of Advanced Thermal Treatment and the generation of heat and power meets the definition of an '*Incineration Plant*' as defined by Chapter 5 *'Waste Management'* of Schedule 1 of the Environmental Permit Regulations.

The Installation has been designed to accept non-hazardous mixed waste wood in accordance with stringent site waste acceptance procedures and agreed specification. All waste will be obliged to meet the specification provided in Table 3.2.

The applicant is making an application for an Environmental Permit to carry out the following listed activities:

Table 3.1: IED Activities

Activity listed in EP Regulations 2013	Description of Specified Activity	Limits of Specified Activity	Specified Waste Management Operation
Section 5.1 'Incineration and Co-incineration of Waste' paragraph A(1)(b)	The incineration and co-incineration of non-hazardous waste using Advanced Thermal Treatment (gasification).	The reception, storage and gasification of non-hazardous mixed waste wood feedstocks to produce steam for the generation of renewable electricity. Installation includes all ancillary activities including water treatment, emissions abatement and electrical generation.	R1: Use principally as a fuel or other means to generate electricity. R13: Storage of waste pending the operations numbered R1

2 Note that this figure will vary depending on the GCV and moisture content of the material. The 86,400 TPA relates to an average (mean) GCV of 14.3MJ/kg.

The technical guidance notes used in the preparation of this application document are:

- EPR – The Incineration of Waste (reference EPR 5.01);
- EPR – The Treatment and Disposal of Non-Hazardous Waste (reference EPR 5.06); and
- EPR – How to Comply with your Environmental Permit (reference EPR 1.00).

The main issues identified within these guidance documents and the relevant Best Available Techniques have been built into the site operation procedures that will form the management systems and working plans for the site.

3.2 Installation Boundary

All proposed operations will be contained within the site ownership boundary. A figure showing the proposed building configuration and Installation boundary has been provided in Section 1, Figure 1.2.

A Site Condition Report that provides a baseline conceptual model for the site has been completed and included within *SOL1605BUK201 Volume 2: Annex C2 – H5 Assessment – Site Condition Report* of this document.

The Site Condition Report does not indicate that the existing site presents either a significant contamination risk, or does it identify any aspect of the new Installation that presents a potential risk to the environment.

All aspects of the new Installation have been designed in accordance to Natural Resources Wales Pollution Prevention Guidance and Horizontal Guidance Notes.

3.3 Infrastructure and Design

The facility is to be constructed in its entirety including all drainage, foundation works, steel structure and structural slabs, intermediate floors, stairs, external clad walls, roof system, glazing and external doors.

The facility will consist of the following:

- Wood Storage and Feed Building (52.4 x 21.6 x 13.7m high) – providing fuel reception, storage and an enclosed transfer system;
- Turbine, Welfare & Ancillaries Building (29.1 x 17.9 x 11m high) – incorporates the electrical switchgear, the main control room and a turbine room to house the steam turbine;
- Main Processing Building (41.4 x 20.4 x 23m high) – this building will house the fluidised bed gasification equipment;
- An Air Cooled Condenser Unit (32 x 14.5 x 20m high);
- Ash silos – ash residue from the combustion process will be stored in two externally located silos (18.4m high x 6.7 diameter. Flue Gas Treatment (FGT);

- A boiler feed system including a deaerator incorporated in a feed tank, feed pumps and a water treatment facility;
- A water distribution storage and waste water pH correction system incorporating a drainage system;
- A control system to provide automated operation of the plant;
- A syngas monitoring and measurement system;
- A flue gas cleaning system incorporating SNCR including dry mixing urea system, SCR, flue gas treatment (removal of contaminants and dust), flue gas fan and flue gas recirculation;
- Continuous Emission Monitoring System; and
- A 44m high exhaust stack.

Site Drainage

There will be no direct process effluents discharged to controlled waters from site. All process effluents are discharged to Welsh Water sewer which discharges to Barry Sewage Treatment Works. All emissions from the Sewage Treatment Works ultimately discharge to Lower Estuarine region of Sully Brook.

The buildings on site are all provided with both secondary and tertiary containment. Any spillages, leaks or incidents arising within the process areas will be effectively contained and captured within the footprint of the main building.

Roof drainage will be collected through a Syphonic rainwater collection system. Any uncontaminated rainwater runoff and surface water runoff will be discharged to surface water drain via the sites attenuation tank (design to be confirmed). All discharges are via oil separators to discharge to the Welsh Water drainage system.

Foul drainage from the office / administration area will be discharged into a packaged treatment plant before being discharged to sewer.

Any effluent and blow down from the process will be discharged to the sites attenuation tank.

Above ground drainage shall be designed in accordance with BS EN 12056.

All of the site drains have the ability to be isolated in the event of an emergency for the purposes of preventing any off site release of fire water or contamination.

The following has been designed in the event of a fire:

- An actuated penstock to isolate the surface water drainage system in the event of a fire;
- All fire water will enter the drainage system and overflow into the attenuation tank;
- The fire water will be tested to allow discharge to the surface water connection point;
- If not suitable, all fire water is to be pumped and tankered away to a suitable water treatment facility.

All site surface water drainage systems are ultimately connected to the surface water drainage system and equipped with shut off valves to ensure the site can be isolated in the event of a major fire / incident.

Tanks and Bunds
All storage tanks will be installed with secondary containment and be designed to comply with the following standards and guidance requirements;

- Gov.uk: Oil Storage Regulations for Businesses;
- CIRIA C958: Chemical Storage Tank Systems – Good Practice; and
- CIRIA 164: Design of Containment Systems for the Prevention of Water Pollution from Industrial Sites.

All storage tanks associated with the process are detailed within Table 3.4 in Section 3.5 *'Raw Materials'.*

Roadways and External Areas
An internal roadway system has been designed to give safe access to the external plant, wood storage building, ash collection bays and power generation area.

Separate segregated pedestrian walkways and car parking areas have been provided to allow for safe access and egress of all personnel at site.

3.4 Description of the Process

The Applicant has designed a high efficiency energy generation plant that utilises advanced thermal technology, namely gasification, as a cost effective means of processing mixed waste wood feedstock's to produce a synthesis gas which will be used to raise steam and generate energy.

The principle components of the process comprise the following:

- *Waste Acceptance and Reception*: All waste wood will be delivered directly into the fuel storage building via electrically operated roller shutter doors. When required, the waste will be discharged onto the feedstock feed system, which will deliver the waste into the gasification building. All waste will be accepted in accordance to the sites waste acceptance procedures.

- *Gasification*: The feedstock feed system will deliver the waste into the fluidised bed gasification system where the waste will be combusted to produce a synthetic gas (syngas). The syngas is then combusted to produce a high temperature flue-gas. A steam boiler then recovers the heat from the combustion gases through the conversion into superheated steam.

- *Electricity Generation*: The superheated steam then passes to a Steam Turbine and Generator, which will export 10MWe (net) of renewable electricity onto the Local Distribution Network.

- *Flue-Gas Cleaning*: Flue gas cleaning and pollution control consists of urea injection for De-NOx, lime injection for acid gas neutralisation and activated carbon powder injection for absorption and removal of heavy metals, dioxins, VOCs and other harmful substances. The stream will have a baghouse system, which is designed to have the capacity to remove submicron dust particles within anticipated emission limit values (ELV's) stipulated by Chapter IV of the Industrial Emissions Directive (IED).

More detailed equipment specifications have been included within Section 3. A simplified process layout is provided in Figure 3.1 below.

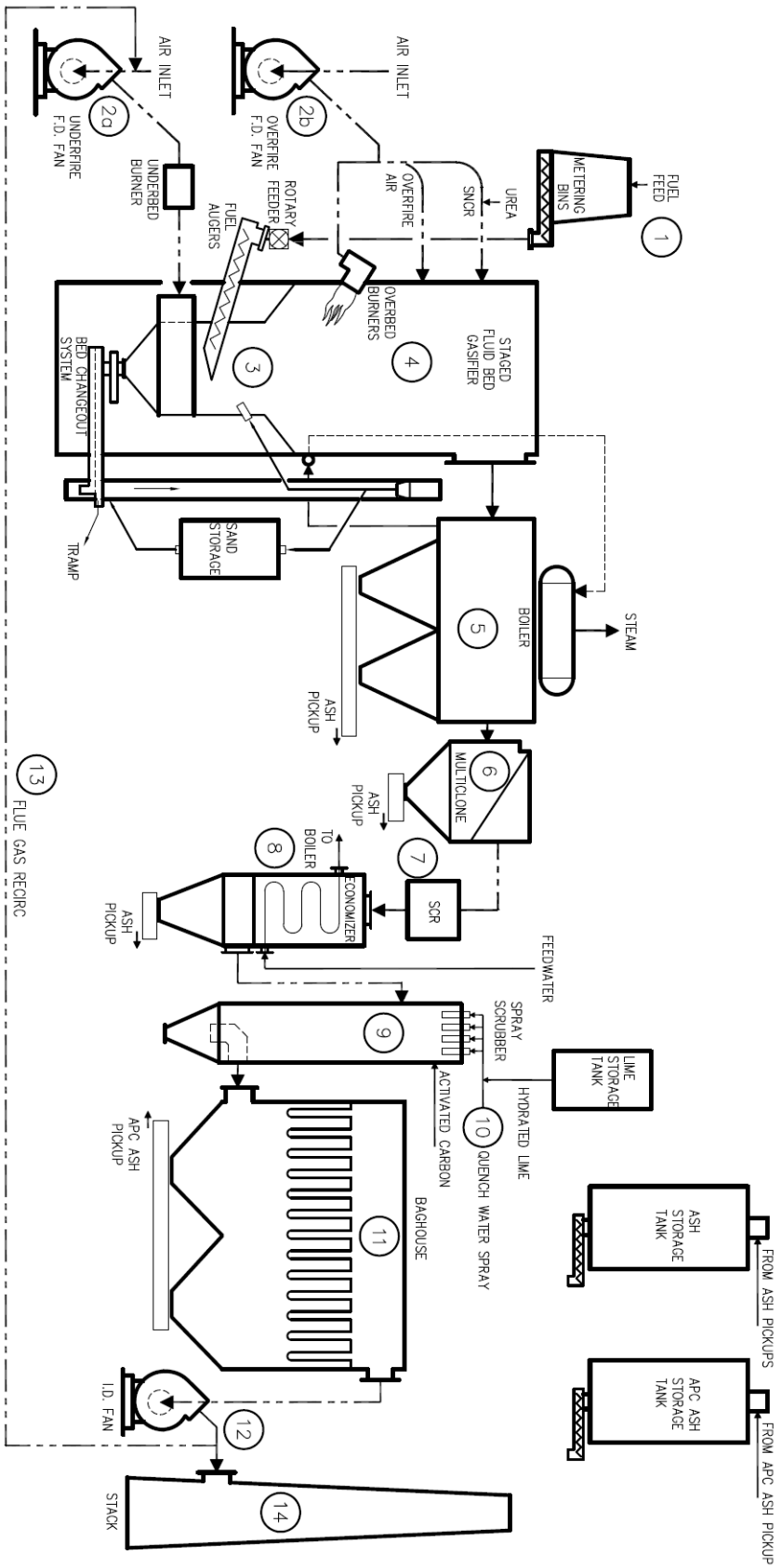

Figure 3.1: Simplified Process Schematic

3.5 Raw Materials

Waste Feedstocks

The Installation will typically accept approximately 86,400 tonnes of mixed waste wood per annum. The incoming waste will consist of 'fuel grade' mixed waste wood as defined by BS PAS 111: Waste Wood Processing[3].

Prior to processing, all wastes accepted on site will be subjected to stringent waste acceptance criteria in accordance with the site environmental management plan and associated procedures:

- BUK-E01 Waste Pre-Acceptance;
- BUK-E02 Waste Acceptance; and
- BUK-E03 Waste Rejection.

Table 3.2 below describes the feedstock specification as well as the maximum range.

Table 3.2: Waste Wood Specification

		Acceptance Range		
Parameter	Unit	Minimum	Maximum	Design Value
Higher Heating Value (HHV), dry	MJ/kg	18.6	-	19.599
Lower Heating Value (LHV), a.r.	MJ/kg	11	16	14.275
Moisture Content	wt-%	5.00%	30.00%	20.00%
Carbon	wt-%DS	44.00%	52.00%	48.00%
Hydrogen	wt-%DS	5.00%	6.50%	5.40%
Sulphur	wt-%DS	0.00%	0.25% but not to exceed 0.13kg/GJ	0.25%
Oxygen	wt-%DS	-	-	40.29%
Nitrogen	wt-%DS	0.00%	3.00% but not to exceed 1.53kg/GJ	2.00%
Chlorine	wt-%DS	0.00%	0.12% but not to exceed 0.06kg/GJ	0.06%
Total Alkaline Elements	wt-%DS	-	0.10%	0.10%
Ash	wt-%DS	0.00%	5.00%	4.00%
Bulk Density	kg/m^3	200	400	304.35
Energy Density (LHV)	MJ/m^3	3,500	4,500	4,282
100% Particles: Maximum Size	Mm	6	101.6	101.6
90% Particles: Maximum Size	Mm	6	76.2	76.2

3 All waste wood will meet Grade C (Fuel Grade) or better

Fines Amount	wt-%	0	10	-
Oversized Amount (75-100mm)	wt-%	0	10	-
Dust <3.15mm	%	0%	5%	-
Ash Deformation Temperature	ºC	1,065	1,093	1,093
Maximum Tramp Content	%	-	2%	-
Ferrous and non-ferrous metals	%	-	0.10%	-
Maximum Dimension (100%)	Inches	-	4"	-
Maximum Dimension (90%)	Inches	-	3"	-

A detailed list of European Waste Catalogue (EWC) codes of wastes that will be accepted by the Installation is provided in Table 3.3 below.

Table 3.3: Proposed Feedstock EWC Codes and Types

Waste Code	Description
03	**WASTES FROM WOOD PROCESSING AND THE PRODUCTION OF PANELS AND FURITURE, PULP, PAPER AND CARDBOARD**
03 01	**wastes from wood processing and the production of panels and furniture**
03 01 01	waste bark and cork
03 01 05	sawdust, shavings, cuttings, wood, particle board and veneer other than those mentioned in 03 01 04
03 03	**wastes from pulp, paper and cardboard production and processing**
03 03 01	waste bark and wood; would be typically used for any non hazardous waste wood packaging (pallets, packing timbers etc);
15	**WASTE PACKAGING; ABSORBENTS; WIPING CLOTHS, FILTER MATERIALS AND PROTECTIVE CLOTHING NOT OTHERWISE SPECIFIED**
15 01	**packaging (including separately collected municipal packaging waste)**
15 01 03	wooden packaging
17	**CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES)**
17 02	**wood, glass and plastics**
17 02 01	paper and cardboard; would be typically used for any general non hazardous wood emanating from building/construction sites;
19	**WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE**
19 12	**wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified**
19 12 07	wood other than that mentioned in 19 02 06

Notwithstanding the EWC's codes stipulated in Table 3.3 above, waste shall not be accepted at the site which has any of the following characteristics:

- Consisting solely or mainly of dusts, powders, loose fibres or liquids;
- Defined as Infectious;
- Drummed waste; or
- Malodourous wastes.

Waste deliveries will take place during the following hours:

- Monday – Friday: 08:00 – 17:30.

In addition to the above core hours, the facility will also need to be available to receive waste in emergencies and in the event of unforeseen delays.

Process Consumables

Table 3.4: Raw Materials Summary			
Material	**Nature of storage**	**Location**	**Fate**
Mixed Waste Wood	Fuel used to generate synthesis gas Maximum 86,400 tonnes per annum	Stored within the Wood Storage Building	Thermally converted to ash
Diesel	Diesel Used for the start-up burners and for the mechanical loading shovel Stored in a 15m^3 tank	Internal	Used to fuel the mechanical loaders
Lubrication, Hydraulic and Turbine Oils	Internal Bunded oil tanks approx. 5m^3 All tanks will be installed with secondary containment and be designed to comply with the following standards and guidance requirements; - PPG2: Above Ground Oil Tanks. - CIRIA C958: Chemical Storage Tank Systems – Good Practice; - CIRIA R164: Design of Containment Systems for the Prevention of Water Pollution from Industrial Sites.	Internal	Used within turbines and hydraulic plant. All oils reprocessed off site
Urea	40% urea Solution Approx. 2,400 tonnes per annum	Internal	Reacts with flue gas and discharged to atmosphere
Limestone	Approx. 140 tonnes per annum	Internal	Reacts with acid gases and discharged as APC residue from bag filter. All APC residue will be transferred off site and reprocessed.

Table 3.4: Raw Materials Summary			
Material	Nature of storage	Location	Fate
Hydrated Lime	Approx. 540 tonnes per annum	Internal	Reacts with acid gases and discharged as APC residue from bag filter. All APC residue will be transferred off site and reprocessed.
Activated carbon	Stored in FIBC Bulk bags Approx. 30 tonnes per annum	Internal	Discharged from bag filter. All APC residue will be transferred off site and reprocessed.
Water Treatment Chemicals	Internal bunded storage tanks <5m^3. Proprietary item	Internal	Used within water treatment system and ultimately discharged to foul sewer.

3.6 Waste Reception

All vehicles will enter the site and report to the weighbridge at the site entrance to weigh and record the delivered waste in accordance to the sites working plan procedures (BUK-E02 – Waste Acceptance).

All incoming and outgoing delivery vehicles will be recorded via the weighbridge, located at the site entrance.

All vehicles will be directed from the weighbridge to the fuel storage building via electrically operated roller shutter doors. Waste will then be deposited directly into the reception area of the building.

Site operators will move the fuel around using a mechanical loading shovel and will load it onto a fuel transfer system for automatic feeding into the gasification system.

The wood storage building is of sealed construction, fitted with roller shutter doors. Air is extracted from the building in order to maintain dusts at below occupational exposure levels.

The wood storage area has an approximate storage volume of 2,000m^3.

3.7 Fuel Reclaim System / Waste Feeding System / Material Handling System

The fuel storage building will be equipped with a push floor which will provide intermediate storage and transport of the mixed waste wood. It will consist of several metal conveyors, which are driven by hydraulic actuators, sliding over a metal frame.

The hydraulic actuators will pull the fuel to the end of the conveyors where the fuel will drop on to a transport system and onto conveyors.

Table 3.5: Push Floor Design Parameters	
Width	8.5m
Depth	12.8m
Floor space waste wood bay	105m^2
Stackable height	4m

The conveyor system is equipped with a ferrous and non-ferrous metal separator to remove any metals contained within the feedstock materials. Metals will be separated using an overband magnet and segregated into a dedicated container.

Downstream of the metal separator, the wood chips will travel over a police screen. Oversize feedstock parts will be too large to fall through the screen and will be collected in a separate container. Smaller feedstock parts will be dropped onto a chain conveyor, which will transport the waste wood towards the gasifier metering bins and onwards into the gasifier.

3.8 Fluidised Bed Advanced Staged Gasification System

The gasification system is made up of the following major plant items:

- Advanced Fluidised Bed Staged Gasification Cell;
- Underbed Air Distribution System;
- Overfire Air; and
- Bed Material.

Each of these plant items are discussed in turn within the sections below.

Advanced Fluidised Bed Staged Gasification (FBSG) Cell

The waste wood fuel feedstocks will enter the metering bins from a chain conveyor. The fuel is then discharged through isolation side gates into the fuel augers which are mounted on the FBSG sidewall. The augers will distribute the fuel across the active fluidised bed to enhance the heat release.

The advanced fluidised bed staged gasification (FBSG) cell is rectangular in shape and includes a sealed carbon steel shell. The unit is approximately 1.8m wide by 4.3m long in the gasification area and expands to 7.62m wide by 6.1m long in the secondary chamber. The overall height is approximately 16m.

The FBSG is designed to withstand internal pressures of ±35 inches water column (WC) in accordance with the UK / EU Pressure Equipment Directive. The bottom support structure is designed to meet International Building Code (IBC) seismic zone and wind loadings.

Within the secondary chamber, the gas temperature is maintained above 900ºC (i.e. greater than the 850^{o}C minimum requirements), with residence time well above the 2 seconds minimum required by Chapter IV IED Requirements.

Underbed Air Distribution System

Fluidisation and gasification air enters the fluidised bed vessel through the fluidising air plenum. The air is distributed from the plenum through individual air manifolds that extend across the base width.

The manifolds are sized to allow sufficient air flow and pressure to the fluidising nozzles. The air manifolds are fitted with slip sleeve expansion mechanisms and cleanout ports on the end opposite the air plenum and are spaced to allow bed and tramp material to flow between them. The manifolds have cooling air ports to reduce the temperature of the bed and tramp material being drawn out of the system. This proprietary feature allows the use of low temperature bed cleaning and recycling equipment.

Air is distributed across the fluidised bed from the air manifolds through proprietary air distribution nozzles. These nozzles are spaced to provide a uniform flow of air through the bed material.

Overfire Air

Overfire air is delivered through multiple elevations of nozzles in the walls of the FBSG above the active bed. Each elevation of nozzle is supplied with air from a dedicated header and damper assembly. Individual control of the overfire air at each elevation is used to optimise the thermal oxidation and temperature profile. Overfire air is key to the control of primary NOx emissions from the plant.

Bed Material

The bed material is a fired refractory clay. The refractory bed material is selected for its resistance to thermal shock and abrasion. Bottom ash material that is collected within the gasifier is recycled through the bed and discharged as particulate with in the syngas.

3.9 Forced Draft and Preheat System

The forced draft (FD) / preheat system includes the necessary equipment to preheat the fluidised bed energy system and supply the air required for normal operation.

Underfire Air Fan (UFA)

Fluidising air will be supplied by the UFA fan. The UFA fan delivers air through the underbed preheat burner, fluidising nozzles and bed material. The UFA fan includes fan wheel (radial tip or backward incline type), casing, bearings, drive motor, inlet silencer with screen, access door, housing drain, isolation boot, inlet vane damper and inlet and outlet flanges.

Overfire Air Fan (OFA)

The OFA fan will deliver air to the overfire air system, the startup burners and the SNCR system. The OFA fan includes a fan wheel (radial tip or backward incline type), casing, bearings, drive motor, inlet silencer with screen, access door, housing drain, isolation boot, inlet vane damper and inlet and outlet flanges.

Underbed Preheat Burner System

The fuel oil fired underbed preheat burner is rated at 15.8 GJ/hr. The system, in conjunction with the overbed burner system, provides energy to heat the bed material and vapour space for start-up.

The underbed burner system consists of a refractory lined duct with an excess air burner installed in the branch section, out of the normal flow path of the fluidising air. In addition, combustion air ducting, dampers, and a fuel oil valve train are also installed. The valve train is complete with input metering valve, air flow safety switch, ignition system and flame supervision system. Burner firing rate can be adjusted for temperature control. Combustion air is supplied from the UFA fan.

In order to comply with the 850ºC / 2 second IED requirements, the plant has been design in accordance to the following:

- Start-up to create an environment of 850ºC within the refractory material prior to fuel start; and

- To maintain a minimum of 850ºC during normal operating conditions should the temperature fall because of loss of energy from the fuel supply.

Detailed Computational-Fluid-Dynamic modelling (CFD) of the gasification/combustion process has been carried out to ensure complete combustion of the fuels under varying conditions, and also ensures the 2 seconds minimum dwell time above 850°C. This information is commercial in confidence and has not been included within the application.

Overbed Burner System
A fuel oil fired overbed burner, rated at a minimum of 52.8 GJ/hr is located in the upper vessel region of the fluidised bed. During startup, the unit complements the underbed burner to heat the bed and vapour regions for reduced emission startups. The system can also provide supplemental energy output during operation.

The burner firing rate can be adjusted for temperature control utilising an input metering valve. The overbed burner system is complete with the combustion air ducting from the OFA fan, dampers, valve train, ignition system and flame supervision system. The system is supplied with all necessary gas train components and safety devices in accordance with International and EU requirements.

Ducting and Dampers
Carbon steel ducting is provided from the UFA and OFA fan outlets to the fluidising air plenum at the fluidised bed cell, to the overfire air ports and the preheat burner. An inlet damper is provided at the UFA and OFA fan inlets to control the outlet pressure of the fans. A fluidising air damper and overfire air dampers are downstream of the air preheater. Overfire air dampers are provided to regulate the flow of overfire air to the upper vessel.

3.10 Bed Recycle System

The Outotec bed recycle system permits continuous operation of the fluidised bed process while removing inert material from the bed. This proprietary "on-line" cleaning capability enables bed material along with the accumulated tramp and clinkers, to flow downward between the fluidising nozzles and air distribution manifolds and be removed from the active region of the bed.

Recirculated cooling air from the FD fan is distributed through the manifolds to cool the bed material allowing the use of low temperature bed recycle equipment.

Bed Recycle Drawdown Cone
The proprietary bed drawdown cones consist of an outer sealed cone and an inner grid mass flow control cone. The cone is designed to create an even drawdown across the entire active bed region.

Bed Recycle Slide Gates

Each drawdown cone is equipped with a slide gate valve at the bottom discharge. The slide gate valves are horizontal-slide, roller-mounted, low-profile and are powered by a double acting air cylinder. The open/close action is electrically controlled through a four-way solenoid valve.

Bed Recycle Vibrating Screen Conveyor

The bed and tramp material metered from the automatic slide gate valve is discharged onto a common vibrating screen conveyor. The vibrating screen incorporates a specially designed perforated plate to separate tramp material from the reusable bed material. The screen discharges the bed material into the bucket elevator that returns it to the vessel. The tramp material is discharged into a hopper for disposal.

Ferrous Metal Removal System

A belt magnet is suspended above the vibrating conveyor up stream of the vibrating screen section. The magnet removes ferrous metals from the discharged bed media and deposits them into a bin.

Bed Recycle Bucket Elevator

A bucket elevator lifts the clean bed material above the active bed for reinjection, thereby maintaining a constant inventory of bed material in the vessel. A hopper is attached to the bucket elevator near ground level to facilitate manual makeup of the bed material.

Bed Recycle Sand Reinjection Piping Train

Bed material, which is elevated by the bucket elevator, is gravity fed through the sand reinjection piping train. The train consists of a wye branch sand reservoir, an isolation slide-gate, a wye branch cleanout, reinjection piping, and miscellaneous interconnecting piping, fittings, etc.

Bed Material Storage System

A bed material storage tank will be provided to store and automated bed material handling for the fluidised bed energy system.

Bed material is diverted from the bucket elevator discharge to the storage tank by a pneumatically operated valve. This allows the vessel to be emptied for inspection or maintenance purposes and also permits automated refill and makeup to maintain the proper vessel bed material inventory during operation.

The tank is designed to hold the full vessel inventory of bed material, plus approximately 25%. Bed material refill and makeup operation is achieved by discharging from the bottom of the tank into the bucket elevator and then back into the vessel.

3.11 Bed Additive System

A bed additive system will be provided to introduce limestone into the fluidised bed energy system. This is carried out for two reasons:

- Firstly, fuels containing high levels of alkaline elements typically contain ash with low softening temperatures. Lime will help reduce the effects of ash softening by coating the ash particles with the additive.
- Secondly, sulphur and other acid gas constituents are abated by introducing lime into the fluidised bed.

Bed Additive Storage

The bed additive storage bin has a storage capacity of approximately 4.25m^3. The bin is cylindrical with a conical base, sloped top and support structure. The conical base is provided with pneumatic fluidising nozzles to aid the material flow.

The storage bin is filled using an automated loading system from a bulk hopper. A quick disconnect fill connection is near ground level. Pneumatic transport air is exhausted through a bin vent filter, positioned on top of the storage bin that collects fugitive emissions during filling operations.

The bin vent filter is supplied with an induced draft fan providing additional vacuum for dust abatement throughout the system.

Bed Additive Metering and Conveyance

Additives are metered from the storage bin to a discharge line that gravity feeds into the bed media bucket elevator through the common injection piping to the FBSG.

3.12 "A" Type Steam Generating System with Superheat

This "A" type superheated steam generating system uniquely combines heat transfer surfaces in the vapour-space area with evaporative surface areas in the "A" type boiler.

A dual-stage superheater with a mid-stage, water-spray attemporator raises and controls the steam to its final superheated temperature. A lightly finned tube economiser heats the feedwater to near steaming conditions before entering the steam drum.

Several significant advantages result from this proven innovative design. Vapour-space steam generating tubes sparsely spaced near refractory walls reduce excess air required while the wide spacing and refractory backing guards against incomplete oxidation caused by a cold zone (such as exists with solid water walls).

A screen evaporative boiler module is positioned in front of the superheater module to reduce the tendency of ash fouling the hot superheat tubes.

All pressure components comply with the applicable ASME Boiler and Pressure Vessel Code and Power Piping Code and EU /EN PED requirements. Piping systems are analysed, as required, for stress and routing by finite element analysis/modelling software.

Vapour-Space Tubes and Circulation Water System

Vapour-space tubes are positioned near the refractory walls in the vapour-space zone. The outlet header is complete with factory installed tube stubs for field attachment to the vapour-space tubes.

Boiler water from the steam drum is naturally circulated through the invessel tubes and returned to the steam drum for separation of the steam.

Heat Recovery Steam Generating System

Flue gas from the fluidised bed enters the heat recovery steam generator through a vertical tube, natural circulation, evaporative screen section. Wide tube spacing and relatively cool saturated temperatures reduce the potential for ash bridging and provide initial flue gas cooling.

Lower flue gas temperatures reduce fouling of the downstream superheater tubes. The superheater is split into sections with a mid-stage spray type attemporator to control the outlet steam temperature.

Motorised retractable sootblowers and rotary type sootblowers are provided to maintain tube surface cleanliness. Ash cleaned from the tubes falls into the ash hoppers and is continuously removed.

Access doors are provided for maintenance and inspection purposes. The steam generator casing is gas tight and factory lined with insulation and refractory where necessary.

Economiser

The economiser is a single pass, lightly finned tube design and includes non-insulated casing and supports. Flue gas flows downward so that ash is entrained at the bottom of the unit.

Feedwater will flow counter-current or upward to prevent steam bubbles from being trapped. The modular unit is fitted with electrically driven rotary sootblowers, operable locally or from the control room.

Ash cleaned from the tubes falls into the ash hoppers and is constantly removed.

Ash Handling and Disposal

A mechanical ash system is provided for continuous collection and transport from each discharge point of the process to a multi-day storage tank. A rapid unloading and conditioning system is included to empty the ash storage tank into sealed articulated vehicles for removal from site.

Ash Pick-up and Conveyance (to Storage)

The Installation will have two ash systems.

- The first system handles the ash from the boiler, multiclone and the economiser; and
- The second system will remove and store the ash from the air pollution control devices.

The boiler / multiclone / economiser system starts from the discharge flange of a manual isolation valve and powered seal valve on each ash collection hopper.

Ash from the boiler hopper seal valves discharge to a water cooled mechanical conveyor transporting the high temperature ash to downstream collection conveyors.

A series of mechanical collection conveyors pick up ash from the multiclone and economiser hoppers and transports it to the boiler / multiclone / economiser lift elevator for discharge into the ash silo for storage.

The air pollution control ash system is a mechanical system that includes the required components to collect and transport ash from each ash hopper on the pollution control system to a second ash storage tank dedicated to store ash from these components.

Ash Storage and Conditioning System

The storage tank for the boiler / multiclone / economiser system provides approximately 212m^3 of storage.

The storage tank for the air pollution control equipment provides approximately 141m^3 of storage. Each tank is equipped with a fabric filter bin vent that filters the air of particulate prior to venting to atmosphere. The storage system is complete with supports, fluidising nozzles to enhance mass flow and an isolation slide gate valve in the lower cone section. The discharge is elevated to facilitate unloading into trucks.

An ash wetting system is included to condition the fly ash and suppress fugitive dust during the normal unloading operation from the storage bin.

A pneumatic knife gate and rotary feeder seals the ash tank and discharges ash into the conditioning mixer. The conditioning mixer is equipped with an automated water spray system that wets the ash during the mixing process to reduce fugitive emissions during discharge into truck containers.

Table 3:6: Indicative BAT Requirements for the Combustion Systems and Boilers	
Minimise dioxin production by boiler design and operation	
Avoidance of slow rates of combustion gas cooling between 450 and 200°C.	• The boiler has been designed to ensure that flue gas is rapidly cooled through the critical de novo synthesis temperature (around 170°C); • CFD has been used to confirm that there are no pockets of stagnant or low velocity gas; • Boiler passes are progressively decreased in volume so that the gas velocity increases through the boiler; and • The design of the boiler ensures that boundary layers of slow moving gas are prevented.
Prevention of boiler fouling	The boiler has been designed with the following control methods to prevent fouling: • Uniform surface temperatures to avoid adhesion of dusts and fouling; • Uniform waste feeding and combustion rates; • Supply of uniform and homogeneous waste feedstocks; • High degree of control over combustion air; and • On-line cleaning (steam or compressed air soot blowing) and off-line cleaning.
NOx reduction techniques may also help to minimise dioxin emissions.	NOx reduction is achieved through the use of SNCR, SCR and flue gas recirculation. All NOx limits within BAT ELV's.
Minimising releases to water from boilers	
Reducing boiler blow down	• All boiler blowdown is discharged to the waste water treatment system and treated for reuse; and • The waste water system blowdown is then used for the ash treatment, thus preventing the use of main water.
Reduction in water treatment and de-ionisation plant effluent.	• Streams are mixed together and pH adjusted and treated by RO; and • The waste water system blowdown is then used for the ash treatment, thus preventing the use of main water.
Treatment of wash water and cleaning solutions.	• All wash water and cleaning liquors will be discharged to the water treatment system and treated reused.

3.13 Steam Turbine

The superheated steam flow from the gasifier will then pass to the steam turbine. A generator will be connected to the steam turbine via a gearbox which will convert the mechanical energy into electricity. The generator will be water-cooled and connected to a closed dry cooling system.

Table 3.7 overleaf provides the steam turbine technical information.

Table 3.7: Turbine Technical Data	
Steam Turbine	TGM Kanis CT32
Steam Inlet Flow	47.619 tonne/hr
Steam Inlet Temperature	398ºC
Steam Inlet Pressure	43 bar(a)
Turbine Outlet Flow	39.7 tonne/hr
Turbine Outlet Temperature	41.5ºC
Turbine Outlet Pressure	0.08 bar(a)
Generator Rating (pf 0.8)	>11MWe

Air Cooled Condenser

An air cooled condenser (ACC) condenses the steam exiting the turbine. The low pressure steam from the turbine exhaust will flow towards the ACC through an exhaust duct. The duct includes a hot well to prevent any condensate flowing back into the turbine. The condensate will be pumped to the condensate tank.

The steam will be distributed to a steam distribution header located on top of the ACC.

Figure 3.2 Air Cooled Condenser

Table 3.8: Air Cooled Condenser Technical Data	
Steam Inlet Flow	40 tonne/hr
Steam Inlet Temperature	41.5ºC
Steam Inlet Pressure	0.08 bar(a)
Ambient Temperature	15ºC
Minimum Flow Requirement	17.2 tonnes/hr

Electrical Generation

The electricity produced by the steam turbine generator will be transferred onto the Local Distribution Network using a 33kV connection.

3.14 Water Treatment System

The installation will include a water treatment system which is designed to provide high quality water to the boiler.

Make up water will be provided from a multi-stage de-mineralisation plant treating mains water, consisting of the following elements:

- Activated carbon filter for the removal of free chlorine and any other organic impurities;
- Duplex base exchange softeners for the conversion of calcium and magnesium salts to the equivalent sodium salts;
- Reverse osmosis for removal of the majority of dissolved solids; and
- Electro-deionisation unit for final polishing.

The feed water will contain less than 0.1 ppm dissolved solids and less than 0.02 ppm silica. Due to the high quality make-up water combined with condensate with the same chemical analysis it is proposed that the boiler is operated on an all volatile treatment (AVT) regime.

No chemicals are added directly into the drum via a high pressure dosing pump. The HP pump is only necessary for hydraulic testing purposes. All necessary chemicals are dosed directly into the feed line.

Under AVT control no solid chemicals are added to the water, therefore solid deposit formations are avoided.

The pH of the feed-water will be maintained between 8.5 and 9.2 in order to minimise corrosion in the feed system. The pH of the feed water will be controlled by dosing a blend of amines (ethanolamine and methoxypropylamine).

These low volatile amines will not only control the feed pH but will afford protection to the water and steam wetted surfaces of the boiler thus minimising corrosion. They are dosed directly via a dedicated

dosing pump. Oxygen removal from the feed water is accomplished using Carbohydrazide is used which will also be dosed directly via the dedicated dosing pump.

All dosing systems will be fully contained and operated by means of an adjustable, microprocessor controlled, diaphragm dosing pump which will be specifically designed for this purpose.

The dosing unit will consist of a PE tank, chemical dosing pump with motor, mixer, level monitoring unit, injection connection and nozzle, shut off and check valve, stainless steel piping and flexible hoses.

Table 3.9: Water Systems Technical Data	
Main Condensate Flow	40 tonne/hr
Main Condensate Temperature	41.5ºC
Feedwater Preheater Condensate Flow	2.9 tonne/hr
Feedwater Preheater Condensate Temperature	116ºC
Steam Inlet Flow	4.5 tonne/hr
Steam Inlet Pressure	1.4 bar(a)
Outlet O_2 Concentration	<20 ppb

Feedwater Preheater

A feedwater preheater will be installed in the system to deliver the feedwater at the required 138°C. Bleed steam will be extracted from the turbine and fed to a steam water heat exchanger. In this heat exchanger the feedwater from the feedwater pumps will be heated up from approximately 105°C to 138°C. The steam condensate used for heating up the feedwater will be returned to the deaerator.

Table 3.10: Feedwater Preheater Technical Data	
Normal Feedwater Flow	50.4 m^3/h
Feedwater Temperature Inlet	105ºC
Feedwater Temperature Outlet	138ºC
Steam Bleed Turbine Flow	2.9 tonne/hr
Steam Bleed Turbine Temperature	~168ºC
Energy transferred to Feedwater	~1.8 MW_{th}

Make-up Water

Water and steam will be continuously used and discharged from the steam cycle for blowdown purposes, soot blowing and sampling.

The water systems will be supplemented with treated make-up water to prevent low water levels in the system. Insufficient treatment will increase blowdown losses and could reduce the lifetime of the boiler and the turbine.

The water treatment system will include water quality instruments for the local control system (hardness, conductivity), flow meters for permeate and concentrate, frequency controlled booster pumps, pressure transmitters and temperature transmitters. The control will be mounted on the skid and integrated in the overall plant control system.

Table 3.11: Make-Up Water Technical Data	
Normal Make-Up Water Flow	0.5 m^3/h
Maximum Design Flow	1.2 m^3/h
Output Conductivity	<0.2 µS/cm
Output SiO_2	<0.02 mg/l
Output Fe	<0.05 mg/l
Output Hardness	<0.1 ºDH
Demi-water Storage Tank	20 m^3

Blowdown System

Proper boiler water quality will be maintained by continuously blowing water from the steam drum to the blowdown tank. Flashed steam will be recovered and the remaining condensate will be drained to the blowdown tank. The flashed water vapour will be vented to atmosphere.

The various drains from the economiser, superheaters, feedwater tank, soot blowing, feedwater preheater and main steam line will be piped to common drainage collection headers located at various locations in the boiler house. From here the drain water will be piped to the blowdown tank.

3.15 Flue Gas Cleaning

The flue gas generated by the gasification process enters a cleaning system. Fly ash and absorbents are removed from the flue ash as it passes through the bag house filter leaving them behind as Air Pollution Control (APC) ash.

In turn, this ash is recovered from the bottom of the filter and transported to the APC ash tank, where it is then transported from the site to an identified re-processor and is used as gypsum replacement.

A brief summary of the flue gas cleaning system is provided below:

- Lime stone and Urea injection into the combustion chamber;
- Lime and Powdered Activated Carbon (PAC) injection into the scrubber;
- Bag house filter, complete with APC ash tank;
- Induced draft (ID) fan with speed-controlled electric motor driver;
- 44m high chimney; and
- Continuous Flue Gas Monitoring system to monitor all dust and gas emissions.

The plant has been designed to ensure compliance with the Industrial Emissions Directive (IED) Chapter IV Emission Limit Values (ELVs).

Selective NOx Catalytic Reduction (SNCR) and Selective Catalytic Reduction (SCR)
As the fluidised bed combustion system maintains a uniform and relatively low combustion temperature, very little NOx is formed from the nitrogen in the combustion air.

The NOx that is formed during the combustion process is abated using a Selective Non Catalytic Reaction (SNCR) system. SNCR utilises a urea based reagent to reduce NOx by way of chemical reaction. Urea solution is injected through multiple injection nozzles into the vapour space of the combustion vessel where temperatures are controlled within the range of 871 – 982°C.

The aqueous urea solution is drawn from the bottom of the storage tank and is metered with a variable speed pump. The pump is controlled from the NOx analyser supplied separately as part of the continuous emissions monitoring system (CEMS) to supply the required amount of reagent for NOx abatement and to minimise ammonia slip. Urea solution is further mixed with plant water to maintain a base flow then injected into the vapour space of the combustion vessel.

Compressed air is supplied to the injection nozzles for atomising of the urea solution in the combustion chamber. Air from the FD fan is provided as additional cooling around the injection nozzles. The number and location of the injection nozzles are designed to optimise injection velocities and distribution of the ammonia reagent into the reaction zone of the furnace.

The urea reacts selectively in the presence of oxygen and primarily reduces the nitrogen oxides (NOx) to molecular nitrogen (N_2) and water vapour (H_20) and thus inhibits the formation of NOx. The process is a chemical reaction and will not be impeded by a change in fuel chemistry or influenced by increased un-combusted materials and fly ash particles.

In addition to the SNCR system, a Selective Catalytic Reduction (SCR) system will also be used. This is located downstream of the multiclone and ahead of the economiser and is provided for final NOx control and to reduce ammonia slip. Operating at a flue gas temperature window of approximately 371°C, the system will incorporate a series of honeycomb ceramic catalyst modules located in housing incorporates into the flue gas ductwork.

The SNCR and SCR system includes:

- A dry urea to liquid mixing system;
- A 8000L liquid storage tank;
- Variable speed metering pump;
- Atmospheric vent valve;
- Drain valve;
- Process liquid connection;

- Liquid level gauge;
- Flow control valve;
- Flow indicator;
- Pressure gauge;
- Access manway; and
- Urea solution.

Dry Scrubber System

Hot flue gas is ducted from the outlet of the economiser to the reaction tower where it is cooled by direct contact with a water spray injected co-current with the gas. Final gas outlet temperature will be determined by the inlet conditions and the overall scrubbing efficiency required of the scrubber.

In addition, scrubber reagent (anhydrous lime) is injected into the flue gas at the entrance of the reaction zone. Quenched and cleaned flue gas containing reacted solids, exhausts into a distribution plenum at the inlet to the fabric filter. The fabric filter (baghouse) removes particulate from the gas stream prior to discharge and provides additional reaction surface with the filter cake deposit to complete acid gas adsorption.

The dry scrubber system includes the reaction tower, water delivery and spray system including redundant pump station and associated control, bypass and isolation valving, spray valves, dry reagent storage silo, reagent mixing and metering system, vessel supports and access. Filling of the reagent silo will be accomplished via pneumatic unloading of bulk truck.

An activated carbon injection system is included with the dry scrubber. Activated carbon is delivered in bulk storage sacks and discharged via the included bulk sack unloading station.

Baghouse System

Particulate in the gas stream is captured in a pulse-jet baghouse system. The air passes through the filter media, depositing dust on the outside of the bag. The cleaned air passes inside the bag to the clean air chamber at the top of the unit.

Treated filter ash is retained within the filter unit and is collected directly in a bagging unit located underneath the filter.

Induced Draft Fan

The induced draft (ID) fan is located immediately upstream of the stack to create a draft through the gas path of the system.

Stack

The flue gas duct system consists of all ducts required for transporting flue gas from the boiler to economiser, from the economiser to the scrubber, from the scrubber to the baghouse, from the

baghouse to the ID-fan and from the ID-fan to the stack. There will be a single stack comprising of one flue (A1) associated with the site.

All emissions the flue (release points A1) will be monitored using a fully compliant MCERTS accredited Continuous Emissions Monitoring System (CEMS) on the exhaust stack.

The CEMS will be 'WID' complaint and monitor HF, HCl, NO, NO_2, N_2O, NOx, NH_3, O_2, SO_2, VOC, particulates, H_2O, temperature, pressure and flow. TOC will be analysed by a Flame Ionisation Detector.

3.16 Controls and Environmental Management System

The site shall be operated in accordance with corporate standards and procedures as part of a wider Environmental Management System. The system will be designed to meet the requirements of ISO14001:2004.

All aspects of the operation will be managed in accordance with a formal Environmental Management and Working Plan. The plan will define all activities throughout the lifecycle of the treatment process (i.e. pre-acceptance, acceptance, reception).

The Environmental Management and Working Plan will be structured to meet the requirements of the Environmental Permitting Regulations and associated pollution prevention guidance.

The EMS will be designed to ensure:

- The identification of all foreseeable environmental impacts and risk that the Operators activities pose to the environment.
- Prevention or minimisation of any identified risks to practical minimum.
- Legal Compliance assurance.
- Identification of risks of pollution including those arising from operations, maintenance, accidents, incidents, non-conformances and complaints, and how these will be minimised.
- Activities at the site will be managed in accordance with the management system, which will be subject to continuous review, audit and improvement. Specific detailed management system reviews will take place if there is a significant change to the activities, following an accident or if a non-compliance is found.
- Furthermore, the whole management system will be subject to annual external audit by competent third parties.
- The key aspects of the EMS for the site will include:
  - Preventative maintenance;
  - Operator requirements;
  - Training and Competence;
  - Emergency response and incident management; and
  - Monitoring, measurement and reporting.

The environment management system and procedures will be written to ensure that the environmental risk and impact of the normal running of the site activities are documented and minimised.

The EMS will be fully developed, implemented and in operation at the time of plant commissioning and permit issue and a copy of the management system will be kept at a convenient location on site

Working Plan

The Applicant have developed a draft working plan for the operation of the site. This working plan defines the management of the site and provides the management controls for all aspects of the site. The basic structure of the operational procedures has been designed around the best practise requirements of the EPR S5.01 and S5.06 Guidance notes.

The company will operate a suite of procedures for each of the key activities on site. Draft versions of these procedures are included in *SOL1605BUK201 Volume 2: Annex D1 – Draft Site Working Plan* and includes the following:

Table 3.12: Working Plan		
Ref No:	Title	Purpose
BUK-E01	Waste Pre-Acceptance	This procedure defines the upstream screening, checking and pre-acceptance of all incoming fuel feedstocks prior to its arrival on site.
BUK-E02	Waste Acceptance	This procedure outlines the onsite controls and considerations that need to be applied when fuel feedstock materials arrive on site for processing.
BUK-E03	Waste Rejection	This procedure outlines the waste rejection process for all non-conforming feedstocks that cannot be processed on site. Acceptance of non-conforming wastes will be a direct breach of the permitted conditions of the sites Environmental Permit.
BUK-E04	Off Site Waste Transfers	This procedure provides the necessary information to enable the assessment and off site transfer of non-conforming or untreatable waste streams.
BUK-E05	Waste Reception and Storage	This procedure outlines the fuel reception and storage processes for all incoming waste.
BUK-E06	Environmental Records	This procedure defines the necessary Environmental Permit and Waste Records that are required to be managed by the site to ensure compliance.
BUK-E07	Environmental Management and Monitoring Programme	This procedure provides an overview of all of the necessary environmental monitoring procedures and controls to ensure compliance with the Permit.
BUK-E08	Infrastructure Management and Monitoring Programme	This procedure provides an outline of the inspection and cleaning requirements for the site.
BUK-E09	Accident Management Plan	This procedure refers to the sites emergency plans and response requirements.
BUK-E10	Fire Prevention Plan	This procedure refers to the sites fire prevention measures.

It is acknowledged that at this stage neither the EMS nor the working plan are fully developed.

A completed Working Plan and Environmental Management System designed in accordance to ISO 14001, will be fully developed prior to operations commencing on site.

Suggested Pre-Operation Condition 1

The operator shall submit a detailed site working plan that incorporates all aspects of the proposed installation to the satisfaction of NRW, prior to the commencement of operations of the new facility.

This working plan shall form part of a wider formal Environmental Management System that meets with recognised best practice for the sector.

Site Maintenance

All maintenance activities on site will be carried out in accordance to the manufacturers' recommendations and will be integrated within the company's environmental management system.

The key aspects of the maintenance management programme will include:

- A programme of Planned Preventative Maintenance (PPM) is undertaken to ensure ongoing management and replacement of key plant and equipment rather than waiting for the equipment to fail and the maintenance of any critical environmental equipment.
- The inspection and maintenance schedules that the manufacturer recommends are adhered to, including any period of recommended shut-down.
- Predictive maintenance (e.g. assessment of vibration from bearings in motors) is carried out to prevent any catastrophic breakdown.
- Real time data collection and plant condition monitoring.

The detailed management system operated by the site will include procedures for ensuring that adequate maintenance is undertaken at the site.

The maintenance programme will ensure that all equipment or infrastructure that is deemed essential in the prevention of pollution to the environment (e.g. hard-standing, bunds, abatement plant etc.) or the prevention of local nuisance impacts (e.g. noise abatement equipment etc.) is maintained and kept in good operating condition.

All maintenance activities for critical pollution control equipment (engines, abatement etc.) will form a key part of the certified EMS that will be established prior to the commencement of operations at site.

During planned periods of maintenance, if any of the following situations arise, waste will cease to be charged until normal operations can be restored:

- Continuous monitoring shows that emissions are exceeding any ELVs due to failure of the abatement systems or CEMS are out of service for a total of 4 hours;
- The cumulative duration of the periods of abnormal operation over 1 calendar year has reached 60 hours; or
- The continuous emission monitors are unavailable.

The planned period of abnormal operation will end at the earliest of the following:

- When the failed equipment is repaired and brought back into normal operation;
- When the operator initiates a shutdown of the combustion activity;
- When a period of four hours has elapsed from the start of the period of abnormal operation; or
- When, in any calendar year, an aggregate of 60 hours has been reached for planned periods of abnormal operation.

3.17 Operator Competence

The facility will be fully automated to the point that all process activities will be PLC controlled and SCADA monitored. The installation will have on-line monitoring which can be administered remotely to ensure the process is optimised and operating correctly.

Notwithstanding the above, the site will be staffed at all times by the Operations team. The primary role of day staff is to ensure and oversee plant loading operations, fuel transfers and management.

Additional activities will include general site housekeeping and administration activities. Additional staff attending the site will be visiting engineers from the equipment manufacturers who are adequately trained to perform their duties at site. Biomass UK will maintain written operation instructions for all plant and monitoring equipment present on site.

All personnel working at the facility will be trained in the necessary sections of the EMS and Working Plan and any associated Procedures. All staff working for and on the behalf of the site will be suitably trained and competent (e.g. professional maintenance engineers, electricians, equipment operators etc.).

The Operations Team will employ on a full time basis a site manager / technically competent person who holds the necessary WAMITAB CoTC Level 4 qualifications as required by the WAMITAB / EA Operator Competency Scheme. Additional COTC personnel will be available through contracted third parties where necessary.

Details of CoTC personnel are included within Annex *SOL1605BUK201 Volume 2: Annex D4 – Certificates of Technical Competence*.

No operations (pre-conditional or otherwise) that involve the acceptance, handling or processing of any wastes will take place without a technically competent person being employed by the Operator.

Operational Times
The site will be operated on a continuous 24/7 basis with deliveries, loading and unloading operations generally (but not restricted to) being carried out in accordance to the schedule below:

- Monday – Friday: 07:00 – 19:00.

The side gates will be closed to vehicular access outside these hours with only authorised personnel on site to open the gates for emergency and regulatory access.

In addition to the above core hours, the facility will also need to be available to receive waste in emergencies and in the event of unforeseen delays.

Additional activities will include general site housekeeping and administration activities. The site will maintain written operation instructions for all plant and monitoring equipment present on site.

All personnel working at the facility will be trained in the necessary sections of the Working Plan and associated Procedures.

3.18 Site Security

The site will consist of the relevant security measures including:

- A perimeter fence which will be inspected periodically to ensure that the site security has not been compromised;
- CCTV monitoring of the external and internal areas of the Installation;
- External on-line monitoring and administration of the waste-to-energy process from a remote location;
- All personnel and vehicles entering the site are strictly controlled and managed; and
- No vehicles or personnel will be allowed access to the facility without prior authorisation.

3.19 Accidents and Emergencies

Fire Protection Strategy

The specification of the plant includes the inclusion of a fire detection and alarm system that has been designed in accordance with the requirements of Category P1/L1 of BS 5839, Fire and Service Rescue Act.

The fire protection strategy for the Installation includes the following fire mitigation and suppression measures:

- Internal fire barriers separating fire areas on site will be a minimum of 2 hour fire resisting rating, including fire rating any sealing of penetrations;
- An automatic fire detection and alarm system will be installed;
- An automatic sprinkler system will be installed;
- An automatic suppression system will be installed;
- A suitable number of manual break-glass call points will be installed;
- Appropriate first aid fire-fighting equipment will be provided throughout the site;
- Planning inspection, maintenance and testing procedures will be established and used to ensure that all fire protection systems can be operated effectively. A component person will regularly test and inspect all fire safety equipment, installations and systems; and
- Fire extinguishers throughout the plant and in the control and electrical room areas.

All escape routes will be designed as per the building regulations and fire and Service Rescue Acts.

The Applicant will be carrying out a DSEAR study as part of the detailed design stage of the project. Any ATEX requirement as a result of this study shall be implemented into the design and control of the Installation.

The design of the plant will also be the subject of a HAZOP study. Again, any additional plant requirements that arise from this assessment will be fully implemented as part of the detailed design process.

Fire Prevention Plan

The site has developed a Fire Prevention Plan that complies with the TGN7.01 'The Storage of Combustible Materials'.

The Fire Prevention Plan relates to the internal storage of all fuel product and provides the necessary information on site infrastructure, storage locations, storage practices, monitoring equipment and emergency response procedures.

The Fire Prevention Plan is included as part of *SOL1605BUK201 Volume 2: Annex D3 – Fire Prevention Plan.*

Accident Management Plan

The Applicant has developed a draft Accident Management Plan based around the specific risks associated with the site operations.

The key aspects of the Sites Accident Management Plan are:

- Reviewed by the Site Management annually and as soon as practicable after an accident.
- Considers hazards presented by:
  - Emergency shut-down procedures;
  - Actions in case of fire/explosion;
  - Actions in case of fire/emergencies;
  - Contaminated firewater;
  - Failure of any equipment;
  - Failure of abatement plant;
  - Spillages and uncontrolled release;
  - Plant or equipment failure (e.g. over-pressure of vessels and pipework, blocked drains);
  - Vandalism; and
  - Flooding.
- Identify events or failures that could damage the environment;
- Assesses the likelihood and the potential environmental consequences from accidents at the site.
- Proposes action to minimise the potential causes and consequences of accidents.

In the event of an accident, the EA will be immediately informed and necessary measures to limit the environmental impact of the accident will be carried out, as well as measures to prevent further possible accidents.

The draft Accident Management Plan has been included in *SOL1605BUK201 Volume 2: Annex D2 – Accident Management Plan.*

Specific emergency response procedures will be developed by the Operator in conjunction with the plant manufacturer. These procedures will be completed prior to operations commencing at the site.

Suggested Pre-Operation Condition 2

The operator shall submit a detailed emergency plan to the satisfaction of the Agency, prior to the commencement of operations of the new facility.

Incident Reporting

The reporting of incidents and non-conformities will form a key component of the companies Environmental Management System. Identified non-conformities under the system include, but are not limited to the following:

- Uncontrolled leaks and spillages of any materials with the potential to cause pollution to the environment (hydraulic fluid/oils, unabated dust emission to atmosphere);
- Non-compliance to any permitted condition or consent limit (emissions excursions, missing of reporting deadlines, breach of any permitted consent limits);
- Internal Audit findings (legal non-compliances, EMS procedural breaches, system non-compliances);
- External and Internal Complaints; and
- Whenever a plant malfunction, breakdown or failure, or any near miss occurs.

The company's EMS will undergo periodic external audit and review to ensure that both compliance and continuous improvement is achieved. The EMS requires that all identified incidents and non-conformities will be investigated and closed out. The EMS will be certified to ISO14001.

All plant and equipment will be PLC controlled, monitored and alarmed using a 'SCADA' system, thus ensuring that continuous plant diagnostics can be facilitated.

Furthermore, the site management system will have documented procedures and registers to:

- Ensure that any members of the public/residents are alerted and informed if a significant plant issue arises (fire, explosion etc);
- Record, report and investigate any internal or external complaints to ensure that any necessary measures are taken to prevent, or where that is not possible to minimise, the causes; and
- Inform any members of the public about the nature of the site, key contacts and sources of further information.

4. EMISSIONS & THEIR ABATEMENT

4.1 Emissions to Air

Point-source Emissions to Air

All point source emissions from the plant are detailed in the table below. This table provides details of the predicted emissions parameters, concentrations and source.

All concentrations from the plant will be in line with those ELV's specified in the Industrial Emissions Directive (IED) as shown in Table 4.1 below.

Table 4.1: Stack Technical Data

Source ID	ATT Stack	
Stack Height (m)	43	
Stack diameter (m)	1.6	
Temperature of release (K)	419	
Actual flow rate (Am^3/s)	35.7 (a)	
Emission velocity at stack exit (m/s)	17.8	
Normalised flow rate (Nm^3/s)	21.6 (b)	
Emission Concentration (mg/Nm^3)	**Long-Term**	**Short-Term**
PM_{10}	10	30
TOC	10	20
HCl	10	60
HF	1	4
CO	50	100
SO_2	50	200
NOx	200	400
Group I (Cd, Tl)	0.05	
Group II (Hg)	0.05	
Group III (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	0.50	
Dioxins and Furans	1.0×10^{-7}	
PAHs (as B[a]P)	0.001	
PCBs	0.005	
NH_3 (d)	5	
Emission Rate (g/s)	**Long-Term**	**Short-Term**
PM_{10}	0.22	0.65
TOC	0.22	0.43
HCl	0.22	1.3
HF	0.022	0.086

CO	1.1	2.2
SO_2	1.1	4.3
NOx	4.3	8.6
Group I (Cd, Tl)	0.0011	
Group II (Hg)	0.0011	
Group III (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	0.011	
Dioxins and Furans	2.2×10^{-9}	
PAHs (as B[a]P)	2.2×10^{-5}	
PCBs	1.1×10^{-4}	
NH_3	0.11	

(a) Actual flow rate at 419 K and 10.1% O2, 101.3 kPa, 15% H2O

(b) Reference conditions: 273 K and 11% O2, 101.3 kPa, dry gas

Detailed emission modelling to full IED requirements have been carried out as part of this Application.

All details are provided within the *SOL1605BUK201 Volume 2: Annex C1 – H1 Assessment and Air Quality Assessment.*

A full commissioning and acceptance programme will be carried out by the operator and the technology supplier as part of the plant installation and handover.

The exact nature of the commissioning programme is currently unknown; however, it will be structured around the needs of the permit.

This programme will be devised by the installation contractor in conjunction with the operator and agreed with the Agency as part of a pre-operation condition.

The following table summarises the BAT justifications regarding the emissions from site.

Table 4.2 BAT Justification for Emissions to Air

Indicative BAT	Justification
Emissions identification and benchmark comparison	The emissions benchmarks in the Sector Guidance Note can be met.
Vent & chimney height dispersion capacity and assessment of emitted substances fate in the environment	An impact assessment has been carried out and is referenced in Section 7 of this document.
Visible particulate plumes	Controlled by the particulate abatement system (baghouse system).
Visible condensed water plumes	There will be no visible plume from the facility and hence this is not considered to be an issue.

Particulate matter	Controlled by the particulate abatement system (baghouse system).
NOx - Primary Measures	
Fuel selection	Light fuel oil No2 used for start-up burners.
Combustion chamber design	This is compliant with IED and represents BAT.
Air control – primary and secondary	Automated air control at the point of final combustion – dilution air valve
Temperature control	Temperature control is a key aspect of the control system, as is a uniform temperature gradient.
NOx – Secondary measures	
Flue gas recirculation	This will be used and is considered BAT.
SNCR	Urea injection will also be used and is considered BAT
SCR	SCR will also be used and is considered BAT
Acid gases and halogens	
Primary acid gas measures	The waste feed will exclude hazardous waste and will not contain significantly chlorinated or halogenated components. Each supplier is governed by the fuel specification and supply contract.
Secondary acid gas measures	Lime and PAC injection will be used in order to control acid gases.
Alkaline reagent selection	Lime has been chosen because it is readily available, has a very good removal rate, significantly less material is required than traditional systems, it can be directly injected into the combustion chamber and is highly efficient.
Acid gas control: cost/benefit study	As this installation is a newly built facility, all measures employed are BAT, for this reason a cost benefit study on the merits of primary and secondary measures is not required. Careful consideration has been made during the design stage of this project to ensure that releases of acid gases and halogens are well managed by appropriate primary and secondary measures.
Carbon Dioxide	All measures to increase energy efficiency will also reduce CO_2 emissions.
Carbon monoxide and VOCs	CO is not significantly influenced by the conventionally employed abatement techniques. Reduction of both CO and VOCs is achieved by control of conditions in the combustor.
Dioxins and Furans	The primary method of reducing the emissions of dioxins is by careful control of the conditions in the combustor.

	Boiler residence time is controlled to minimise de novo formation. PAC injection will remove dioxins and furans from the gas phase, followed by bag filters which will provide efficient particulate abatement.
Metals	PAC gives reliable and effective heavy metal (e.g. mercury) reductions, and for the majority of metals particulate abatement is the main means of ensuring that releases are minimised.

4.2 Emissions to Controlled Water

There will be no direct process emissions to controlled water arising from the Installation.

Any uncontaminated rainwater runoff arising from the roof drainage will be collected through a Syphonic rainwater collection system and discharged to surface water drain via an attenuation tank.

Rainwater which falls onto the roads and hardstanding will be captured via the surface water drainage system and also be discharged to surface water drain via the attenuation tank.

The Site Drainage System is shown in *SOL1605BUK201 Volume 2: Annex A – Figures*.

4.3 Emissions to Sewer

Process effluents from the installation are limited to the water treatment system discharges and boiler blowdown. All liquid effluent emissions from the plant are processed via the water treatment system and released directly to sewer.

All other discharges relate to sanitary effluents, internal plant (floors etc.) wash water and maintenance activities (periodic cooling plant discharges etc).

The plant has been designed to release approximately 3,921 l/h of waste water to sewer.

Table 4.3 Emissions to Sewer S1

Parameter	Conc
Biochemical Oxygen Demand (BOD_5 at 20°C without nitrification)	< 2000mg/l
Chemical Oxygen Demand (COD)	< 2000mg/l
Suspended Solids	< 500mg/l
Sulphates (as SO_4)	< 1000mg/l
Sulphides, hydrosulphides and polysulphides	1mg/l
Metals	As below
Zinc	Shall not exceed 5mg/l of effluent

Copper	Shall not exceed 3mg/l of effluent
Nickel	Shall not exceed 2mg/l of effluent
Chromium	Shall not exceed 2mg/l of effluent
Lead	Shall not exceed 2mg/l of effluent
Arsenic	Shall not exceed 2mg/l of effluent
Maximum Daily Volume	< 36.6m^3
pH	6-10
Temperature	< 43.3°C
No oils or greases	-

A separate effluent discharge consent application is being made in conjunction with this permit application by the applicant to Welsh Water. A site drainage plan for the site is provided in *SOL1605BUK201 Volume 2: Annex A – Figures.*

Impacts associated with the effluent discharge to sewer have been calculated using H1. All impacts have been screened out as insignificant. Results of the H1 assessment to sewer have been provided in Section 7.4 – Impacts (Emissions to Sewer).

All foul water (toilet, shower, kitchen etc.), water from the water treatment system and boiler blowdown will be discharged to the public sewer at the site boundary.

Impacts associated with the effluent discharge to surface water have been calculated using H1. All impacts have been screened out as insignificant. Results of the H1 assessment to sewer have been provided in Section 7.4 – Impacts (Emissions to Controlled Water).

Table 4.4 below summarised the BAT justification for emissions to water and emissions to groundwater.

Table 4.4 BAT Justification for Emissions to Water	
Indicative BAT	**Justification**
Water use	Water use will be minimised and recycled where possible.
Contamination identification and fate analysis	Sampling, monitoring and analysis will be carried out, once the installation is operational, in agreement with the Agency.
Filtration	No further filtration necessary.
Off-site treatment	No off-site treatment,
Benchmark comparison - Control of emissions to meet EQS and WID requirements	IED Chapter IV requirements do not apply.
BAT Justification for Emissions to Groundwater	
Identification of List I substances	n/a

Table 4.4 BAT Justification for Emissions to Water	
Indicative BAT	Justification
Identification of List II substances	n/a
Prior Investigation	Discussed in the Site Condition Report
Surveillance	n/a

4.4 Emissions to Land

There will be no emissions to land arising from the Installation.

4.5 Odour

The wastes that are proposed to be processed through the gasification plant are by their nature stable and non-reactive and do not have significant potential for odour generation. Furthermore, the fundamental design of the facility has a hierarchy of odour control and abatement measures to ensure that the potential for odour impacts are eliminated.

The ATT process itself has no significant potential for odours as the combustion effectively destroys any odorous compounds.

No odorous wastes will be accepted onto site and therefore the potential for offsite odour impacts is considered negligible.

Table 4.5: Odour Management Summary		
Tier	Reference	Description
1	Inventory Control	The Installation will process a maximum of 86,400 tonnes per annum of mixed waste wood. Mixed waste wood is not considered to be odorous. The site will be operated such that there is never more than 3 days' inventory awaiting processing and will be managed in a manner that prevents wastes being accepted into the site in the vent that the site in inoperable. All wastes accepted on site will be required to be pre-declared and be deemed acceptable by the site manager prior to the transportation and delivery to site. All waste accepted on site will be inspected on arrival to ensure compliance with the agreed *'Waste Declaration Form'* and do not have any malodourous properties. Waste Acceptance and inventory controls are covered within the site working plan documents Procedures BUK-E02 to BUK-E05. The delivery and reception of waste will not produce any odour emissions.
2	Sealed Building	All buildings have been designed to be air tight and sealed.

		Entry to the building is via electrically controlled roller shutter doors so that no air will escape.
3	Controlled Extraction System	The Reception building has been fitted with an air and dust extraction system. No odours are generated by this system.

Notwithstanding the above measures, due to the nature of the materials being processes at the site, the potential for odour emissions is consider low and therefore no Odour Management Plan is considered necessary.

Although no odour from the plant is anticipated, odour shall be monitored daily at points around the site boundary and observations shall be noted in the site diary and/or on a daily monitoring document.

In the unlikely event that there is any discernible odour detected at the site boundary and the odour is judged to be 'moderate' (i.e. odour Intensity Rank 3), then the Site Manager will be notified immediately and the olfactory survey will continue to attempt to determine the source and extent of the odour plume, as follows:

- A suitable location downwind of the site and potentially sensitive receptor at which the odour plume is unlikely to extend will be selected for assessment;
- Survey will continue toward the facility until a site-related odour is perceived; and
- Assessment points perpendicular to the plume axis and equidistant from the site will then be monitored, subject to access requirements.

The main aim of monitoring will be to test if any odours emitted from the site will be causing the nearest receptors nuisance. In scenarios where nuisance is being caused then operations will be suspended until the conditions improve. The Site Manager may deem it necessary to find the precise source of the odour and attempt to eliminate it or neutralise it immediately.

The following table shows the BAT justification for odour prevention on site.

Table 4.6: BAT Justification for Odour

Indicative BAT	Justification
Containment. The Operator should maintain the containment and manage the operations to prevent its release at all times.	All fuel movements will take place within a fully enclosed system. The doors will be closed at all times except during direct deliveries. Doors are rapid rise roller shutter doors.
Assessment and Management	
For existing installations, the releases should be modelled to demonstrate the odour impact at sensitive receptors. The target should be to minimise the frequency of exposure to ground level concentrations that are likely to cause annoyance.	N/A Not an existing installation.

Table 4.6: BAT Justification for Odour	
Indicative BAT	Justification
For new installations, or for significant changes, the releases should be modelled and it is expected that the Operator will achieve the highest level of protection that is achievable with BAT from the outset.	Dispersion modelling has been undertaken for combustion gases and also an assessment of the likelihood of fugitive emissions (dust and odour) from the facility. This concluded that the potential for emissions of dust and odour from the facility is considered to be unlikely. The design and operational controls will prevent odour being an issue.
Where there is no history of odour problems then modelling may not be required although it should be remembered that there can still be an underlying level of annoyance without complaints being made.	N/A.
Where, despite all reasonable steps in the design of the plant, extreme weather or other incidents are liable, in the view of the Regulator, to increase the odour impact at receptors, the Operator should take appropriate and timely action, as agreed with the Regulator, to prevent further annoyance (these agreed actions will be defined either in the Permit or in an odour management statement).	N/A.
Where odour generating activities take place in the open, (or potentially odorous materials are stored outside) a high level of management control and use of best practice will be expected.	N/A No odour generating activities are taking place outside.
Where an installation releases odours but has a low environmental impact by virtue of its remoteness from sensitive receptors, it is expected that the Operator will work towards achieving the standards described in this Note, but the timescales allowed to achieve this might be adjusted according to the perceived risk.	N/A.
Specific Odour control techniques:	
Enclosing odorous areas (applicable to all).	All appropriate areas will be enclosed.
Enclosing odorous waste all the way to the furnace (ACI, CWI).	As above though the use of mixed waste wood limits odour potential.
Confining waste to designated areas (all).	Designated areas designed into the layout.
Ensuring that putrescible waste is incinerated within an appropriate timescale (MWI, CWI, ACI, SSI).	Only mixed waste wood is used. Storage times in the storage building are minimised. No putrescible wastes will be processed on site.
Refrigeration of such waste which is to be stored for longer than an appropriate timescale (CWI, ACI).	N/A.
Regular cleaning and (for putrescible wastes) disinfection of waste handling areas (all).	All areas will be regularly cleaned.

Table 4.6: BAT Justification for Odour	
Indicative BAT	Justification
Design of areas to facilitate cleaning (all).	Facility is new and designed to ease cleaning.
Ensuring that the transport of waste and ash is in covered vehicles, where appropriate (all).	All vehicles will be covered.
Ensuring good dispersion at all times from any release points (all).	Release points have been designed aided by modelling to ensure adequate dispersion. The location and height have been optimised.
Preventing anaerobic conditions by aeration, turning of waste and short timescales (SSI, MWI).	Storage times are minimal hence this is not anticipated to be an issue.
Chlorination of waters being returned to STW or in storage (SSI) drawing air from odorous areas at a rate which will ensure that odour is captured (all), and treating such extracted air prior to release to destroy the odours - see below.	N/A.
The use of these techniques should obviate the need for odour masking or counteractants.	No masking agents or counteractants have been specified at the plant.
Treatment of Odour	
The use of odorous air e.g. air from the waste handling area or air displaced from tanks, as furnace air is an ideal way of treating odours. The quantity of contaminated air that can be handled this way is obviously limited by the needs of the furnace. A disadvantage is the need to consider provision for odour control when the incinerator is not operating.	Odorous air is not anticipated to be a problem. Plant combustion air will be drawn from within the building.
Biofilters.	Biofilters will neither be used nor required.
Scrubbing for odour control.	Scrubbing for odour control will not required.
Carbon filters.	Carbon filters will not be required for odour control.
For a new plant it would normally be the case that the imposition of conditions achieving BAT also secures that no significant pollution (including odour) is caused.	The proposed plant has no potential for significant odour pollution.

4.6 Noise Impacts

The design of the Installation has taken into account the potential impacts on the environmental and neighbouring receptors in regards to noise.

The plant and main processing building have been designed to abate and control noise, odour and fugitive emissions. The boiler hall as well as the dteam turbine hall will be fully enclosed. Other plant such as the air cooled condensers, an economiser, ID fans, baghouse filter etc will be located externally.

The processing plant and associated equipment has been designed in accordance with best practice and to ensure that internal noise does not present an issue to the employees at the site under the Control of Noise at Work Regulations and to ensure that noise breakout does not lead to noise nuisance at the identified sensitive receptors.

A noise assessment in accordance with statutory noise guidance has been carried out, including detailed modelling shown in *SOL1605BUK201 Volume 2: Annex C3 – Environmental Noise Assessment.* The report concludes that the noise impacts will have an insignificant effect on existing residential receptors due to the appropriate design, mitigation and intervening distances to the nearest residential receptors.

Noise Abatement Measures

All key components identified in the table below have been specified to meet a noise specification such that the occupational noise exposure limits as defined by the EC Physical Agents Directives and their regulations (Control of Noise at Work Regulations) are met.

As required by the above regulations the site has specified an occupational noise climate (i.e. internal noise levels) to be below the first action level of 80dB $L_{epd.}$ This will be achieved by the equipment manufacturers through the use of acoustic enclosures around all internal noise generation equipment.

Due to the level of noise control engineering that has been designed into the plant and the sound insulation that will be provided by the building fabric, there is limited potential for the internal installed equipment to create a noise nuisance at any neighbouring receptors.

All associated external ancillary plant (i.e air cooled condensers, an economiser, ID fans, baghouse filter etc) will all be screened by the process buildings as far as possible. The air cooled condenser fans will be acoustically treated and the ID outlet will have a silencer within the stack.

The identified noise generating plant and equipment associated with the Installation have been identified in the table overleaf.

Table 4.7 Identified Noise Sources and Abatement						
Equipment	Description	Location of Source	Nature of Noise	Duration of Noise	Abatement Fitted	Significant Impact at Receptor
Reception and feedstock	Internal and external vehicle noise, hydraulic and fan plant noise	External to wood storage building	Intermittent vehicle engine noise	Intermittent	The wood storage building is double skinned and sealed. The building is accessed via rapid rise roller shutter doors. These will be kept closed at all times unless a direct delivery of fuel is taking place. Vehicle deliveries will only take place during daytime only.	No, all reception activities will be carried out internally, resulting in no noise emissions during the delivery and reception of waste Buildings are treated to prevent noise break out. No deliveries will be carried out during night time periods.
Gasifier	Fan and burner noise	Internal	Continuous tonal plant noise.	Continuous	All gasification plant is fitted with acoustic treatment and draws the combustion air from internal sources.	No, the gasifier is acoustically treated.
Steam Turbine	Plant noise	Internal	Continuous tonal plant noise.	Continuous	Fully enclosed inside steam turbine hall.	No, the steam turbine hall is treated and sealed to prevent noise outbreak.
Air Cooled Condensers	Fan noise	External	Continuous tonal plant noise.	Continuous	Acoustically treated (large, slow moving with lagging)	No, the air cooled condenser fans are acoustically treated.
Stack	Tonal exhaust noise from stack	Elevated	Continuous tonal noise – fitted with attenuation	Continuous	ID outlet will have a silencer within the stack in order to be inaudible at the Installation Boundary.	No, the stack will be acoustically treated.

Table 4.8 below shows the BAT justification for noise prevention on site.

Table 4.8: BAT Justification for Noise	
Indicative BAT	**Justification**
Maintenance • Plant • Equipment • Fans • Bearings • Vents • Building Fabric • Other	Appropriate preventative maintenance will be provided for the various elements of the installation. This will ensure no deterioration of plant or equipment that would give rise to increases in noise.
Control Techniques and comparison with BAT indicative thresholds	Control techniques will be in line with BAT. The noisiest equipment is housed in acoustic enclosures.
Reasonable Cause for Annoyance – Sensitive Receptors/Complaints?	The facility will not give rise to reasonable cause for annoyance. In the unlikely event that complaints are received measures described in the integrated management system will be put in place.
Noise Survey	A noise assessment in accordance with statutory noise guidance has been carried out, including detailed modelling shown in *SOL1605BUK201 Volume 2: Annex C3 – Environmental Noise Assessment.*

4.7 Fugitive Emissions

The waste storage building and plant have been designed to ensure that all odour, vapour and fugitive emissions are contained.

An air extraction system will be in place for odour and dust control within the wood storage building. Air shall be extracted from the reception building via the push floor area by connecting the under fire air fan and the building. Air extraction flow will be up to 20,000kg/h.

This extraction system is provided from ventilation purposes only as there is no odour potential associated with the fuel feedstock. The main purpose of the fan is to future proof the building should any potential odour issues occur.

There are no separate or additional release points associated with this system as all air is ultimately drawn into the intakes of the combustion fans.

Table 4.9 shows the BAT justification for preventing fugitive emissions from the proposed development.

Table 4.9: BAT Justification for Fugitive Emissions

Indicative BAT	Justification
Dust controls	
Covering of skips and vessels	There will be no open skips or vessels at the facility which could give rise to fugitive emissions.
Avoidance of outdoor or uncovered stockpiles (where possible)	There will be no outdoor or uncovered stockpiles which could give rise to fugitive emissions.
Where dust creation is unavoidable, use of sprays, binders, stockpile management techniques, windbreaks and so on	N/A.
Regular wheel and road cleaning (avoiding transfer of pollution to water and wind blow)	Due to the nature of the operations, problems with wheel contamination are not expected to be significant. All areas of the site will have hardstanding.
Closed conveyors, pneumatic or screw conveying (noting the higher energy needs), minimising drops. Filters on the conveyors to clean the transport air prior to release	Feed systems are simple and enclosed. A baghouse system will be used to prevent dust emissions.
Regular housekeeping	The site staff will be fully trained and regularly audited through the EMS to ensure that housekeeping measures are appropriate to the nature and scale of the activities and that there is minimum possibility of uncontrolled emissions.
The recycling of by-products	All waste will be removed from site by a covered tanker.
Enclosed containers or sealed bags used for smaller quantities of fine materials	No materials will be stored outside. Small volumes of materials for maintenance etc. shall be stored in

Table 4.9: BAT Justification for Fugitive Emissions	
Indicative BAT	Justification
	appropriate containers, sealed so as to prevent fugitive emissions.
Mobile and stationary vacuum cleaning	Mobile and stationary vacuum cleaning will be used if necessary.
Closed storage with automatic handling system	All storage is closed and transferred using an automated handling system.
Sealed charging system	The charging system is fully enclosed.
VOC control measures	N/A.

4.8 Waste Generation and Management

Types and Amounts of Waste

The gasification process will not inherently produce significant quantities of waste. The main solid by-products produced from the operation of the gasification facility will be:

- Bottom Ash – which is recycled through the gasification bed; and
- APC Ash (Air Pollution Control (APC) residues).

The Bottom Ash will be recycled through the gasification bed and rejected from the gasifier as a fine particulate along with the flue ash.

Flue ash is removed from the process within the gas cleaning bag house filter. All flue ash is contained and retained as Air Pollution Control (APC) residues. The residue will be exported off site to a re-processor where it will be used as a gypsum replacement.

Table 4.10 below shows a tabular summary of site wastes.

Table 4.10: Waste Summary					
Waste	EWC Code	Approx. Quant (tonnes/yr)	Source	R / D Code	Environmental Fate
Mixed General Waste (office and general wastes) – Non Hazardous	19 12 12	<5	Office and General Waste	R5 (Off site recycling)	Transferred off site for recycling
Waste Oils and Greases	13 02 05	10	Turbine	R5 (Off site recycling)	Transferred off site for recycling
Bottom Ash	10 01 15	3,944	Gasifier	R5 (Off site recycling)	Aggregate
Fly Ash (Air Pollution Control (APC) residues)	19 01 05*	2,072	Gas Scrubber	R5 (Off site recycling)	Reclaimed and reused
Oversized Particles	20 03 01	88	Fuel Screening	R5 (Off site recycling)	Reclaimed and reused
Metals	02 01 10	88	Fuel Screening	R5 (Off site recycling)	Reclaimed and reused
Used Bed Material	10 01 15	Not known but assumed to be 400 T PA	Gasifier	R5 (Offsite recycling)	Aggregate

All waste produced at the site will be sampled and analysed. Additional samples will be taken if the disposal or recovery route changes or it is suspected that the nature or composition of the waste has changed such that it may no longer be appropriate for its environmental fate.

Throughput of Waste

The facility principally utilises non-reactive non-hazardous solid waste as a means to generate a synthetic gas which is combusted to recover energy.

All wastes will be sourced from commercial and industrial sources and will be mixed waste wood that can be processed to form a gasification fuel that meets with the plants specification.

The Installation has been designed to process approximately 86,400 tonnes per annum of non-hazardous mixed waste wood.

Under 11B of the Waste Framework Directive, the Installation activities fall under the generic description D1.

Waste Storage

The design of the installation has taken into account the potential impacts on the environmental and neighbouring receptors.

All incoming fuel feedstocks will be stored within the reception area of the Fuel Storage Building. All other waste materials, will be clearly identified, sealed and stored internally within a secured area protected by secondary containment.

Table 4.11 summarises the BAT justification for the proposed storage on site.

Table 4.11: BAT Justification for Storage on Site

Indicative BAT	Justification
Subsurface structures	N/A.
Appropriate surfacing and containment or drainage facilities for all operational areas, taking into consideration collection capacities, surface thicknesses, strength/reinforcement; falls, materials of construction, permeability, resistance to chemical attack, and inspection and maintenance procedures; • have an inspection and maintenance programme for impervious surfaces and containment facilities; • unless the risk is negligible, have improvement plans in place where operational areas have not been equipped with: – an impervious surface – spill containment kerbs – sealed construction joints – connection to a sealed drainage system Above-ground tanks	• Surfacing has been designed in accordance with the design standards for similar installations. There is no open ground in the process area. All joints are sealed. • The surfacing is designed to ensure that it is of the appropriate strength, reinforcement and thickness to withstand the heavy traffic which will pass over it during operations. • The installation will have an extensive maintenance programme in place which will include provision for the inspection of all appropriate plant and structures. • The detailed inspection of the impervious surfaces and containment will be in line with the construction engineer's recommendations. • Routine inspections will be undertaken on a daily basis by site personnel as part of the daily site checks. Since this is a new installation BAT will be demonstrated from commencement of operations. • Above ground bulk storage tanks containing liquids will be appropriately constructed to ensure they are impermeable. • Supervised deliveries will ensure that the risk of contamination of surface water is negligible. All tanks and facilities will be installed with secondary containment and be designed to comply with the following standards and guidance requirements; . • Pollution Prevention Guideline Note 2: Above ground Oil Tanks (PPG2).

Table 4.11: BAT Justification for Storage on Site	
Indicative BAT	Justification
	• Pollution Prevention Guideline Note 11: Preventing Pollution on Industrial Sites (PPG11). • Pollution Prevention Guideline Note 26: Pollution Prevention in the Storage and Handling Drums and Intermediate Bulk Containers (IBC's) • CIRIA C958: Chemical Storage Tank Systems – Good Practice; • CIRIA R164: Design of Containment Systems for the Prevention of Water Pollution from Industrial Sites.
Storage areas (IBCs, drums, bags etc.) Storage areas should be located away from watercourses and sensitive boundaries, (e.g. those with public access) and should be protected against vandalism. Storage areas should have appropriate signs and notices and be clearly marked-out, and all containers and packages should be clearly labelled. Where spillage of any stored substance could be harmful to the environment, the area should be appropriately kerbed or bunded. The maximum storage capacity of storage areas should be stated and not exceeded, and the maximum storage period for containers should be specified and adhered to. • Appropriate storage facilities should be provided for substances with special requirements (e.g. flammable, sensitive to heat or light) and formal arrangements should be in hand to keep separate packages containing incompatible substances (both "pure" and waste). • Containers should be stored with lids, caps and valves secured and in place - and this also applies to emptied containers. • All stocks of containers, drums and small packages should be regularly inspected (at least weekly). • Procedures should be in place to deal with damaged or leaking containers.	All non-bulk storage (IBCs etc.), where used, shall be stored within the fully contained building. In the event of a release it is not possible for the materials to enter the surface water drainage system.

5. ENVIRONMENTAL MONITORING

5.1 Emissions to Air

All emissions to atmosphere (as identified within Table 4.1) will arise from the main gasification plant stack.

The plant will have continuous emissions monitors (CEMS) located on the exhaust flues of the gasification plant (Emission Point A1).

The CEMS system will monitor the stack emissions and provide data reporting. The system features a single-point extraction and includes monitors for CO, O_2, NOx, SO_2, ammonia slip and opacity.

The CEMS will be IED/WID compliant and continuously monitor HF[4], HCl, NO, NO_2, N_2O, NOx, NH_3, O_2, SO_2, VOC, particulates, H_2O, temperature, pressure and flow. TOC will be analysed by a Flame Ionisation Detector.

The dust monitor provides added flow, stack pressure and temperature. All analysers are provided with remote control, calibration & maintenance.

The continuous monitoring equipment will operate on a 24-hour basis and will include the facility for on-line monitoring of the gas concentrations and provide for any out-of-tolerance indications to be monitored by remote staff.

All CEMS equipment and associated platforms and sampling ports installed on site will meet the requirements of the NRW Technical Guidance Note M2. All CEMS equipment shall be MCERTS approved.

Procedures will be created for monitoring undertaken at the site. These procedures will conform to M1 and M2 guidance and those required by the operator monitoring and assessment scheme and are incorporated into the sites EMS system.

The CEMS will be used such that:

- The values of the 96% confidence intervals of a single measured result at the daily ELV shall not exceed the following percentages:
  - Carbon Monoxide – 10%
  - Sulphur Dioxide – 20%
  - Oxides of Nitrogen (NO and NO_2) – 20%
  - Particulate Matter – 30%

4 Note that HF will be monitored through the surrogate monitoring of HCl.

  - Total Organic Carbon – 30%
  - Hydrogen Chloride – 40%
- Valid half-hourly average values or 10-minute averages shall be determined within the effective operating time from the measured values;
- Where is it necessary to calibrate or maintain the monitor resulting in data not being available for a complete half hour period, the half-hourly average or 10-minute average shall in any case be considered valid if measurements are available for a minimum of 20 minutes or 7 minutes during the half-hour or 10-minute period respectively;
- Daily average values shall be determined as the average of all valid half-hourly average or 10-minute average values within a calendar day; and
- No more than ten daily average values per year shall be determined not to be valid.

5.2 Emissions to Controlled Water

There are no process emissions to controlled water.

Any uncontaminated rainwater runoff arising from the roof drainage will be collected through a Syphonic rainwater collection system and discharged to surface water drain via an attenuation tank. Rainwater which falls onto the roads and hardstanding will also be discharged to surface water drain via attenuation tank.

The Applicant will carry out periodic visual and check compliance monitoring to ensure that the discharges are free from contaminants.

5.3 Emissions to Sewer

The process effluent emissions will be monitored and sampled in accordance to the requirements stipulated by the effluent discharge consent.

All effluent discharges will be monitored using online equipment and backed up with periodic third party extractive sampling. The online monitoring equipment will allow the constant monitoring of the water emissions while the periodic measurement will detect any problem with the waste to energy process.

It is proposed that continuous monitoring will be carried out to monitor the following parameters, prior to discharge from site;

- Flow Rate;
- Conductivity;
- COD; and
- pH.

In addition to the Continuous Emissions Monitoring, third party extractive sampling will take place on a bi-annual (six monthly) basis;

- pH;

- BOD;
- COD;
- Suspended Solids;
- Sulphate and Sulphides;
- Metals;
- PAH's; and
- Oil and Grease

All releases from the site are via Welsh Water sewer.

5.4 Emissions to Land

There are no process emissions to land arising from the process. No monitoring is required.

5.5 Monitoring Frequency

The process will be subject to a range of process monitoring which has been designed to comply with the requirements of the EA M1, M2 and IED Guidance.

Table 5.1 Monitoring Frequency

Emission Point	Parameter	Monitoring Frequency	Methodology
A1	• Oxides of Nitrogen • Carbon Monoxide • Particulate Matter • Hydrogen Chloride • Hydrogen Fluoride • Carbon Monoxide • Sulphur Dioxide • Ammonia • Total Organic Carbon • Temperature • Oxygen Concentration • Water	• Continuous daily & ½ hour average for all parameters	MCERTS certified CEMS equipment
A1	• Particulate Matter • Total Organic Carbon • Hydrogen Chloride • Hydrogen Fluoride • Carbon Monoxide • Sulphur Dioxide • Oxides of Nitrogen • Toxic Metals • Dioxin & Furans • Dioxin like PCB's	• Periodic (6 monthly) all parameters	EA Monitoring Guidance M1/M2 compliant extractive sampling

	• VOCs • Specific Individual PAH's • Ammonia		
W1	• BOD • Total Suspended Solids • pH • Oil and Grease • Metals	• Six Monthly Check monitoring	In accordance with EA Monitoring Guidance M18
S1	• COD* • BOD • Sulphates and Sulphides • Conductivity* • Total Suspended Solids • pH* • PAHs • Metals • Oil and Grease* • Volume*	• *Continuous As stipulated by Welsh Water	As stipulated by Welsh Water
NA	Gasifier Syngas Quality	Continuous Gas sampling • Calorific value • Wobbe Index • Specific gravity • Air/Fuel ratio	As per Ofgem requirements

Records will be kept of all monitoring carried out at site. The records will be made as soon as practicable and will be retained for at least 6 years from the date the records were made. More information regarding the environmental monitoring and record keeping is shown in *SOL1605BUK201 Volume 2: Annex D1 – Draft Site Working Plan*.

Process Monitoring

The Applicant will (as a requirement of Ofgem) be carrying out an ongoing fuel measurement and sampling procedure (FMS), as part of their routine process monitoring programme.

This programme includes the following:

- Syngas GCV measurement and flow rate determination;
- Fossil fuel consumption;
- Bottom ash GCV; and
- Electrical output.

In collating the above information, the following will be continuously monitored throughout the duration of the operation of the plant:

- Feedstock throughput (weigh belt feeder) – Determination of the mass feedstock used per month;
- Feedstock sampling – Determination of the qualifying percentage and GCV of the feedstock per month;
- Syngas sampling – GCV determination continuously during gasification operations;
- Bottom ash – Determination of the mass and GCV of char produced per month;
- Natural gas consumption – Based on monthly billings;
- Gas Meters – One natural gas meter per primary combustion chamber shall be installed; and
- Gross Electrical power output

6. BAT APPRAISAL

6.1 Technology Appraisal

There is a number of potentially suitable Energy from Waste (EfW) technologies which have been considered for the application Site. Although all of the technologies reviewed are capable of treating waste wood, a majority have been rejected on ground of environmental impact, operational cost or efficiency.

Advanced Thermal Treatment (ATT) has a number of advantages over traditional incineration processes, due to many factors.

- It is viable at smaller unit sizes, enabling the development of facilities ancillary to existing waste management operations;
- There is much less visual impact, as ATT processes tend to be smaller and require shorter exhaust stacks (44m compared to 60-100m for conventional incinerators);
- ATT is also modular and therefore more flexible to changes in quantity or quality of feedstock. This modularity also provides insurance against single point of failure problems; and
- ATT is more suited to pre-sorted or processed wastes. Hence material is more homogenous and will contain less recyclable [predominantly hard plastic] materials.

As a consequence of this, less flue gas treatment is required. Hence, fewer raw materials are used resulting in the production of fewer residues.

A summary of the advantages and disadvantages of the available combustion technologies is included in Table 6.1.

The processes proposed for this facility have been selected against detailed criteria which are based on the application of BAT, both to the particular process operation and to the combined process as a whole.

The objectives for the process were established as follows:

- To provide an advanced thermal treatment facility (ATT) that can produce energy from waste using gasification;
- To achieve significantly lower levels of emissions when compared with conventional energy from waste (EfW) technologies;
- To achieve a high degree of plant availability and reliability;
- To offer a cost effective and financially low risk solution for the generation of renewable power; and
- To utilise conventional unit operation techniques and technologies which meet the above aims and are established as BAT.

The design principles for the process were therefore defined as follows:

- To provide equipment with a suitable level of robustness and redundancy for the process duty and the inherent risk associated with that duty;
- To utilise conventional technologies to avoid the business and reliability risks associated with syngas clean up techniques for gas engine (compression or spark ignition) and gas turbine appliances which are not yet commercially proven or widely available;
- To utilise primary NOx control (low NOx combustion) combined with flue gas recirculation and SNCR Urea Injections; and
- To achieve excellent acid gas removal utilising dry injection (high acid gas removal efficiency).

Table 6.1: BAT Comparison for Combustion Technologies				
BAT Criteria	Moving Grate (MG) Combustion	Fluidised Bed Combustion	ATT	
			Gasification	Pyrolysis
Emissions	Abated emissions meet IED, lower levels are achieved by many plants.	Lower temperature leads to low NOx levels, but abatement will still be required to guarantee IED.	Abated emissions meet IED, and lower levels are achievable.	Abated emissions meet IED, and lower levels are achievable.
Waste	Municipal Waste is main application.	Only suitable for reasonably homogenous material. May be used for waste that has been sufficiently treated.	Homogenous feedstock required. Opportunity to link to waste management facility and allow increased recycling.	Homogenous feedstock required. Opportunity to link to waste management facility and allow increased recycling.
Residue Generation	Produces bottom ash (<3% carbon) and air pollution control (APC) residues.	Produces larger volumes of residues for disposal.	Raw material consumption is lower than conventional incineration options and hence residue production is lower. Produces bottom ash (<5% TOC/3% LOI) and APC residues.	Raw material consumption is lower than conventional incineration options and hence residue production is lower. Produces carbon char and APC residues. Char can then be gasified or directly combusted to create process heat.
Odour	Odour management typically avoids nuisance.	Odour management typically avoids nuisance.	Odour management typically avoids nuisance. Due to pre-treatment feedstock less likely to be odour producing than untreated municipal waste.	Odour management typically avoids nuisance. Due to pre-treatment feedstock less likely to be odour producing than untreated municipal waste.
Raw Materials	Depends on flue gas treatment option selected.	Higher due to fluidisation sand requirements.	Selection of appropriate flue gas treatment minimises raw material consumption. Typically less than conventional incineration options.	Selection of appropriate flue gas treatment minimises raw material consumption. Typically less than conventional incineration options.

Table 6.1: BAT Comparison for Combustion Technologies				
BAT Criteria	Moving Grate (MG) Combustion	Fluidised Bed Combustion	ATT	
			Gasification	Pyrolysis
Noise	With appropriate abatement noise can successfully be controlled.	Similar to MG, although pre-treatment plant may cause additional noise requiring abatement.	With appropriate abatement noise can successfully be controlled.	With appropriate abatement noise can successfully be controlled.
Accidents	Proven technology with a large number of operational facilities. Similar accident potential as for other incineration options, mainly related to loss of storage of FGT reagents, supplementary fuel and residues.	Some operational experience, with mixed performance. Similar accident potential as for other incineration options, mainly related to loss of storage of FGT reagents, supplementary fuel and residues.	Operated on a smaller scale to conventional incineration options. Increased accident potential from storage of oxygen and pressurised oxygen delivery systems*.	Operated on a smaller scale to conventional incineration options. Not considered to have any greater accident potential as other incineration options. Gas containment and storage issues (similar to AD) associated with storage of pyro gas.

Gasifier

The type of gasifier that is being selected at site is an updraft fluidised bed type.

Updraft fluidised bed gasification is advantageous over a fixed bed gasifier. Fixed bed gasifiers are usually limited to a small capacity (<3MWth) because of their operating principle. Also, a good fuel distribution is necessary and this is more difficult for larger plants. A fluidised bed gasifier can be used for a large range of capacities, the technology is very well suited to be scaled up from around 5MWth to 300MWth. Because of the fluidised bed the temperature distribution is very good and the system can deal with a large variety of fuel types.

Updraft fluidised bed gasification is considered BAT for the gasification of waste wood.

Table 6.2 shows a BAT comparison for the different types of gasifiers.

Table 6.2: BAT Comparison for Gasification Technologies

BAT Criteria	Updraft	Downdraft	Crossdraft	Fluidised bed	Circulating fluidised bed
Efficiency	High thermal efficiency – low gas exit temperature	Good efficiency but higher temperatures on exit	Lower efficiency - high exit temperature	Turndown gives lower efficiency – lower bed temperatures overall	Enhanced heat and mass transfer over FB
Reliability	Simple robust design	Reliable with prepared fuel	Not as reliable as up or down draft due to slagging	Lower temperatures and fast throughput give good reliability	Not so proven as other solutions
Feedstock preparation	No drying required – wide variety of feed materials	Drying – moisture reduces efficiency	Low ash fuels only	High moisture and ash can be handled	As per FB
Particle size	Not so sensitive to small particle size	Sensitive to small particle size	Smaller particles preferred	Fast process so not so sensitive to large particles	As per FB
Tar, oil & particulates	High sensitivity to dust and tars – keeps tars/oils within gas for improved CV	Low sensitivity to dust and tars – removes majority from gas	Vulnerable to slag blockage	Not sensitive to tars and oils as per down draft	Good bed filtration
Flexibility	Excellent flexibility for moisture content and	Less flexible than updraft systems – fast to reach	Flexible gas production, low CO_2 reduction but fast	Low flexibility, as bed temp must remain constant	As per fluidised bed

Table 6.2: BAT Comparison for Gasification Technologies					
BAT Criteria	Updraft	Downdraft	Crossdraft	Fluidised bed	Circulating fluidised bed
	feedstock variability.	regulation temperature	response time with high exit velocity		

The gasifier chosen is a hybrid design which combines the advantages of the fluidised bed (high reliability and low sensitivity), with the advantages of an updraft gasification plant (highly flexible, tolerant and efficient).

Combustion Plant and Prime Mover

An external combustion system such as a steam cycle can operate with a relatively dirty combustion gas (tars and oils in vapour phase) and does not require significant syngas clean up to operate.

Internal combustion systems, such as a gas turbine or a spark ignition gas engine, provide higher levels of thermal efficiency, but require highly cleaned, conditioned and stable syngas in order for them to operate reliably.

Such gas conditioning requires the removal of condensable tars and oils as well as the removal of water vapour and particulate. These residues are typically hazardous and require further treatment and processing for final disposal.

Table 6.3 shows a BAT comparison for three different combustion options for the plant.

Table 6.3: BAT Comparison for Electrical Generation			
BAT Criteria	Steam Cycle	Gas Turbine	Spark Ignition Gas Engine
Efficiency	Up to 29% process efficiency – the addition of low grade heat recovery can improve this	Can be 40% but requires fuel preparation – combined cycle (i.e. heat recovery to a steam turbine) will improve this efficiency further.	Gas engine typically operate in the region of 37-40% electrical generation efficiency. Gas engines produce a reliable and consistent low and medium grade heat that can be used for process heating and/or export.
Feedstock	Less preparation required – steam cycle plant can reliably operate on low quality, low CV gas.	Much higher CV and stable gas required, indicating that higher quality feedstock and gas processing is required. All tars, moisture and particulate will be removed, indicating that higher degrees of fuel preparation required	As per Gas turbine
Flexibility	Highly flexible: Steam can be raised by many gas combinations and or auxiliary firing if required	The flexibility is contingent with level of gas clean up and conditioning. A high level of fuel feedstock preparation is required to ensure stable gas formation and reliable clean up.	Less flexible with feedstock
Design	Well proven	Proven in a number of cases, however no plant has operated a long term commercial basis using RDF/SRF from MSW	As gas turbine, but not commercially proven on SRF from MSW
Reliability	Excellent with maintenance	Reliable but very sensitive to gas composition	Reliable but sensitive to gas composition

Flue Gas Clean-up Technologies

The syngas cleanup requirements for combustion systems are relatively minimal due to the combustion of the syngas at relatively high temperatures. Tars and oils remain in the vapour phase and add to the gas energy content which is recovered in the staged combustion and steam cycle phases.

Acid gas removal is achieved by the use of a dry scrubbing system, utilising a lime based reagent.

Dry scrubbing techniques compare favourably with wet scrubbers or semi-dry scrubbers, and generally achieve the best acid gas removal efficiencies. It also eliminates any water effluent treatment requirements and allows for use with other reagents such as activated carbon for the absorption and removal of heavy metals, dioxins, VOC and other harmful substances.

Dry Flue Gas Treatment (FGT) has become the predominant solution for modern flue gas facilities. The basic FGT consists of a filtration unit combined with an injection of dry sorbent. The actual acid gas neutralisation takes place in the duct and on the surface of the filter bags.

Benefits of the dry FGT over wet scrubbing systems include;

- Low Investment Cost;
- Simplicity of design and operation;
- Proven ability to meet stringent emission limits;
- Small physical footprint;
- Lower parasitic loads;
- Flexible operation with regards to temperature and capacity; and
- Easy stabilisation of dry residues.

Other options such as sodium bicarbonate could also be used in the process in a similar manner, however it is higher in purchase cost and has a limited supply base.

The Installation will have a baghouse system which is designed to have the capacity to remove submicron dust particles within anticipated emission limit values of the Industrial Emission Directive.

6.2 The Industrial Emissions Directive (IED) and Best Available Technology (BAT) Compliance

Chapter VI of the IED describes all aspects of management and operation of a process as well as the environmental impact but allows for the Member State to vary the requirements of the IED where there is good reason. The following tables outline the IED technical requirements that apply and a justification of how they have been met.

The gases evolved from gasification are fully oxidised in the combustor at temperatures above 850°C for a period of over 2 seconds.

The flue gas treatment equipment scrubs out the acid gases, NOx, particulates and dioxins and furans to ensure that the emission levels do not exceed the ELVs detailed in Annex VI of the IED.

The ash discharged from the gasifier base also experiences temperatures in excess of 850°C for approximately 30 minutes. A level of gasification will be achieved such that the requirements of the IED

will be met. The gasifier operates above 850°C by necessity since the water gas reactions do not occur fast enough at temperatures below this temperature.

Table 6.4: Chapter IV Compliance - SPECIAL PROVISIONS FOR WASTE INCINERATION PLANTSAND WASTE CO-INCINERATION PLANTS	
IED technical requirement	Justification
Article 41 – 45	NA
Article 46 Control Of Emissions (1) Waste gases from waste incineration plants and waste co-incineration plants shall be discharged in a controlled way by means of a stack the height of which is calculated in such a way as to safeguard human health and the environment.	Significant ground level pollution will not arise as a result of this installation. Section 4 and 7 of this application discuss this in detail. Atmospheric Dispersion Modelling and Human Health Risk Assessment have been completed by the applicant.
(2) Emissions into air from waste incineration plants and waste co-incineration plants shall not exceed the emission limit values set out in parts 3 and 4 of Annex VI or determined in accordance with Part 4 of that Annex. If in a waste co-incineration plant more than 40 % of the resulting heat release comes from hazardous waste, or the plant co-incinerates untreated mixed municipal waste, the emission limit values set out in Part 3 of Annex VI shall apply.	All Chapter VI IED Emission Limit Values will be met by the Installation.
(3) Discharges to the aquatic environment of waste water resulting from the cleaning of waste gases shall be limited as far as practicable and the concentrations of polluting substances shall not exceed the emission limit values set out in Part 5 of Annex VI.	There are no waste water discharges resulting from the gas cleaning process. The exhaust gases will be cleaned using dry processes, namely flue gas recirculation; lime/activated carbon injection and bag filters. There will be no aqueous gas cleaning effluents.
(4) The Emission Limit Values shall apply at the point where waste waters from the cleaning of waste gases are discharged from the waste incineration plant or waste co-incineration plant. When waste waters from the cleaning of waste gases are treated outside the waste incineration plant or waste co-incineration plant at a treatment plant intended only for the treatment of this sort of waste water, the emission limit values set out in Part 5 of Annex VI shall be applied at the point where the waste waters leave the treatment plant. Where the waste water from the cleaning of waste gases is treated collectively with other sources of waste water, either on site or off site, the operator shall make the appropriate mass balance calculations,	N/A There are no waste water discharges resulting from the gas cleaning process. The exhaust gases will be cleaned using dry processes, namely flue gas recirculation; lime/activated carbon injection and bag filters. There will be no aqueous gas cleaning effluents.

Table 6.4: Chapter IV Compliance - SPECIAL PROVISIONS FOR WASTE INCINERATION PLANTSAND WASTE CO-INCINERATION PLANTS	
IED technical requirement	**Justification**
using the results of the measurements set out in point 2 of Part 6 of Annex VI in order to determine the emission levels in the final waste water discharge that can be attributed to the waste water arising from the cleaning of waste gases. Under no circumstances shall dilution of waste water take place for the purpose of complying with the emission limit values set out in Part 5 of Annex VI.	
(5) Waste incineration plant sites and waste co-incineration plant sites, including associated storage areas for waste, shall be designed and operated in such a way as to prevent the unauthorised and accidental release of any polluting substances into soil, surface water and groundwater. Storage capacity shall be provided for contaminated rainwater run-off from the waste incineration plant site or waste co-incineration plant site or for contaminated water arising from spillage or fire-fighting operations. The storage capacity shall be adequate to ensure that such waters can be tested and treated before discharge where necessary.	There will be an environmental management system (EMS) in place to include procedures to manage waste delivery and reception. Hazardous waste will not be accepted at the Installation. Feedstock will be delivered to the renewable energy facility within a fully enclosed conveyor system / docking system. Roadways, floor and store surfaces will be designed and constructed so as to prevent any emissions to groundwater, surface water and soil. All waste handling activities and the main process will take place inside the process building. All external process areas will be hardstanding served by appropriate drainage systems. All fire water will enter the drainage system and overflow into the attenuation tank. The fire water will be tested to allow discharge to the surface water connection point. If not suitable, all fire water is to be pumped and tankered away to a suitable water treatment facility. The site surface water drainage systems will pass through an oil separator prior to attenuation on site using swales.
(6) Without prejudice to Article 50(4)(c), the waste incineration plant or waste co-incineration plant or individual furnaces being part of a waste incineration plant or waste co-incineration plant shall under no circumstances continue to incinerate waste for a period of more than 4 hours uninterrupted where emission limit values are exceeded.	The plant will be operated with a single CEMS which will be linked into the controls system. In the unlikely event of CEMS failure on one of the streams, a full replacement CEMS will be available on site with 24 hours.

Table 6.4: Chapter IV Compliance - SPECIAL PROVISIONS FOR WASTE INCINERATION PLANTSAND WASTE CO-INCINERATION PLANTS	
IED technical requirement	**Justification**
The cumulative duration of operation in such conditions over 1year shall not exceed 60 hours. The time limit set out in the second subparagraph shall apply to those furnaces which are linked to one single waste gas cleaning device.	
Article 47 Breakdown In the case of a breakdown, the operator shall reduce or closedown operations as soon as practicable until normal operations can be restored.	The feed system for the process is automated and in the event of temperature loss or departure from operating conditions the process will automatically shut down in a controlled manner.
Article 48 Monitoring of Emissions (1) Member States shall ensure that the monitoring of emissions is carried out in accordance with Parts 6 and 7 of Annex VI.	Monitoring will meet all the requirements of Article 48. The plant is designed to have continuous emissions monitors (CEMS) located on the exhaust stack of the gasification plant (Emission Point A1). The CEMS will be IED/WID complaint and monitor HF, HCl, NO, NO_2, N_2O, NOx, NH_3, O_2, SO_2, VOC, particulates, H_2O, temperature, pressure and flow. TOC will be analysed by a Flame Ionisation Detector.
(2) The installation and functioning of the automated measuring systems shall be subject to control and to annual surveillance tests as set out in point 1 of Part 6 of Annex VI.	CEMS will be installed in the stack for continuous monitoring of emissions to air to comply with IED. Please see section 5.1 for more details. In the event of the failure of one of the CEMS, backup CEMS will be available.
(3) The competent authority shall determine the location of the sampling or measurement points to be used for monitoring of emissions.	The exact positions of all sampling points will be agreed with NRW prior to commencement of operation.
(4) All monitoring results shall be recorded, processed and presented in such a way as to enable the competent authority to verify compliance with the operating conditions and emission limit values which are included in the permit.	Reporting format will be agreed with NRW prior to commencement of operation and will reflect the requirements of the permit. CEMS will be backed up by non-continuous check monitoring to comply with the IED.
(5) As soon as appropriate measurement techniques are available within the Union, the Commission shall, by means of delegated acts in accordance with Article 76	Should such a technique become available, it will be adopted as required.

Table 6.4: Chapter IV Compliance - SPECIAL PROVISIONS FOR WASTE INCINERATION PLANTSAND WASTE CO-INCINERATION PLANTS	
IED technical requirement	**Justification**
and subject to the conditions laid down in Articles 77 and 78, set the date from which continuous measurements of emissions into the air of heavy metals and dioxins and furans are to be carried out.	
Article 49 Compliance with the Emission Limit Values The emission limit values for air and water shall be regarded as being complied with if the conditions described in Part 8 of Annex VI are fulfilled.	The plant has been designed to comply with the specific ELV's stipulated by Part 8 of Annex VI of the IED. The reference conditions in the exhaust gas will be Temperature 273 K; Pressure 101.3 kPa, 11% oxygen; Dry Gas
Article 50 Operating Conditions (1) Waste incineration plants shall be operated in such a way as to achieve a level of incineration such that the total organic carbon content of slag and bottom ashes is less than 3 % or their loss on ignition is less than 5 % of the dry weight of the material. If necessary, waste pre-treatment techniques shall be used.	The waste streams will be treated so the recoverable organic fraction will be removed by upstream processing. Ash will therefore comply with the 3% TOC/ 5% LOI limits. Testing will be undertaken quarterly for the first year and annually thereafter to demonstrate this. The design, which incorporates a combustion chamber, ensures that the minimum temperature of 850°C is met at the final point of combustion whenever waste is being fed, and the residence time of combustion gases at or above this temperature is >2s. This has been demonstrated by CFD modelling. The EMS includes procedures for the checking of waste composition and removal of contaminants.
(2). Waste incineration plants shall be designed, equipped, built and operated in such a way that the gas resulting from the incineration of waste is raised, after the last injection of combustion air, in a controlled and homogeneous fashion and even under the most unfavourable conditions, to a temperature of at least 850°C for at least two seconds.	This is an incinerator, not a co-incinerator.

Table 6.4: Chapter IV Compliance - SPECIAL PROVISIONS FOR WASTE INCINERATION PLANTSAND WASTE CO-INCINERATION PLANTS	
IED technical requirement	Justification
Waste co-incineration plants shall be designed, equipped, built and operated in such a way that the gas resulting from the co-incineration of waste is raised in a controlled and homogeneous fashion and even under the most unfavourable conditions, to a temperature of at least 850 °C for at least two seconds. If hazardous waste with a content of more than 1% of halogenated organic substances, expressed as chlorine, is incinerated or co-incinerated, the temperature required to comply with the first and second subparagraphs shall be at least 1100°C. In waste incineration plants, the temperatures set out in the first and third subparagraphs shall be measured near the inner wall of the combustion chamber. The competent authority may authorise the measurements at another representative point of the combustion chamber.	
(3) Each combustion chamber of a waste incineration plant shall be equipped with at least one auxiliary burner. This burner shall be switched on automatically when the temperature of the combustion gases after the last injection of combustion air falls below the temperatures set out in paragraph 2. It shall also be used during plant start-up and shut-down operations in order to ensure that those temperatures are maintained at all times during these operations and as long as unburned waste is in the combustion chamber. The auxiliary burner shall not be fed with fuels which can cause higher emissions than those resulting from the burning of gas oil as defined in Article 2(2) of Council Directive 1999/32/EC of 26 April 1999 relating to a reduction in the sulphur content of certain liquid fuels, liquefied gas or natural gas.	There is one incineration line fitted with auxiliary burners to ensure combustion temperature reaches 850°C prior to waste introduction. Note: this is 850°C at the final point of combustion of the syngas i.e. in the combustor. The auxiliary burners will be fuel oil burners, low NO_x.
(4). Waste incineration plants and waste co-incineration plants shall operate an automatic system to prevent waste feed in the following situations: (a) at start-up, until the temperature set out in paragraph 2 of this Article or the temperature specified in accordance with Article 51(1) has been reached;	Fuel is transferred from the fuel store to the conveyor system where it is introduced to the metering bin in batches. This is an automated system. The feed system will have automatic shutdown to prevent waste feed if the temperature in the combustor at the final point of combustion is <850°C, or if emission limit values, obtained via the CEMS, look to be breached.

Table 6.4: Chapter IV Compliance - SPECIAL PROVISIONS FOR WASTE INCINERATION PLANTSAND WASTE CO-INCINERATION PLANTS	
IED technical requirement	**Justification**
(b) whenever the temperature set out in paragraph 2 of this Article or the temperature specified in accordance with Article 51(1) is not maintained; (c) whenever the continuous measurements show that any emission limit value is exceeded due to disturbances or failures of the waste gas cleaning devices.	
Article 51 Authorisation to change operating conditions	No requests to change operating conditions will be required.
Article 52 Delivery and reception of waste (1) The operator of the waste incineration plant or waste co-incineration plant shall take all necessary precautions concerning the delivery and reception of waste in order to prevent or to limit as far as practicable the pollution of air, soil, surface water and groundwater as well as other negative effects on the environment, odours and noise, and direct risks to human health.	All waste will be received directly into a purpose designed enclosed reception building. All pollution abatement and prevention methodologies are detailed in main application document.
(2) The operator shall determine the mass of each type of waste, if possible according to the European Waste List established by Decision 2000/532/EC, prior to accepting the waste at the waste incineration plant or waste co-incineration plant.	The site will only receive non-hazardous waste wood. The range of waste codes from the List of Wastes (England) Regulations 2005 that will constitute this prepared fuel is included in Section 3.5 of the application. This will be weighed at the weighbridge. Unsuitable material and material that is hazardous, or contains unwanted materials, will not be accepted. All materials charged into the gasifier will be via a metered fuel hopper.
(3) Prior to accepting hazardous waste at the waste incineration plant or waste co-incineration plant, the operator shall collect available information about the waste for the purpose of verifying compliance with the permit requirements specified in Article 45(2).	No hazardous waste will be accepted into the plant. All wastes will be non-hazardous waste wood only.

Table 6.4: Chapter IV Compliance - SPECIAL PROVISIONS FOR WASTE INCINERATION PLANTSAND WASTE CO-INCINERATION PLANTS	
IED technical requirement	**Justification**
(4) Prior to accepting hazardous waste at the waste incineration plant or waste co-incineration plant, at least the following procedures shall be carried out by the operator:	No hazardous waste will be accepted into the plant. All wastes will be non-hazardous waste wood only.
Article 53 Residues (1) Residues shall be minimised in their amount and harmfulness. Residues shall be recycled, where appropriate, directly in the plant or outside.	The process has been designed around a specified electrical power generation capacity. It is a new installation so a waste minimisation audit is yet to be carried out. This will be done in compliance with the permit condition specified.
(2) Transport and intermediate storage of dry residues in the form of dust shall take place in such a way as to prevent dispersal of those residues in the environment.	Bottom ash will be damped down and transported to ash storage bags by an enclosed conveyor. It will be removed by road in covered vehicles on a regular basis. Chemical analysis will be undertaken on a regular basis. It is intended to send the bottom ash for reuse as secondary aggregates. Fly ash will be kept separately from bottom ash. It will be collected in sealed bags and removed by road to a re-processor.
(3) Prior to determining the routes for the disposal or recycling of the residues, appropriate tests shall be carried out to establish the physical and chemical characteristics and the polluting potential of the residues. Those tests shall concern the total soluble fraction and heavy metals soluble fraction.	Chemical analysis will be undertaken regularly.

Other requirements (former WID compliance requirement not specifically stated under the IED) **Technical Competence** **Former WID Article 6 (8)** The management of the incineration or the co-incineration plant shall be in the hands of a natural person who is competent to manage the plant.	The operator will employ on a full time basis a site manager / technically competent person who holds the necessary WAMITAB CoTC Level 4 qualifications as required by the WAMITAB / EA Operator Competency Scheme. The operator will also meet all the other requirements of operator competence as stipulated in the Environmental Permitting Regulations. There will be named individuals with the relevant qualifications to supervise the operation of this renewable energy facility.
Former WID Article 11 (3) The residence time as well as the minimum temperature and the oxygen content of the exhaust gases shall be subject to appropriate verification, at least once when the incineration or co-incineration plant is brought into service and under the most unfavourable operating conditions anticipated.	During the plant's first year of operation we would seek to discuss with the Agency the need for a validation study to measure residence times through the combustor at above 850°C. Oxygen, moisture and temperature measurements will be made via the CEMS as well as spot sampling and analysis.
Former WID Article 11 (4) The continuous measurement of HF may be omitted if treatment stages for HCl are used which ensure that the emission limit value for HCl is not being exceeded. In this case the emissions of HF shall be subject to periodic measurements as laid down in paragraph 2(c).	The CEMS specified for the plant will continuously monitor HF.
Former WID Article 11 (5) The continuous measurement of the water vapour content shall not be required if the sampled exhaust gas is dried before the emissions are analysed.	Water vapour is continuously monitored to correct emissions for dry gas conditions.
Former WID Article 11 (6) Periodic measurements as laid down in paragraph 2(c) of HCl, HF and SO2 instead of continuous measuring may be authorised in the permit by the competent authority in incineration or co-incineration plants, if the operator can prove that the emissions of those pollutants can under no circumstances be higher than the prescribed emission limit values.	CEMS will be provided for continuous HCl, HF and SO_2 measurement.
Former WID Article 11 (7) The reduction of the frequency of the periodic measurements for heavy metals from twice a year to once every two years and for dioxins and furans from twice a year to once every year may be authorised in the permit by the competent authority provided that the emissions resulting from co-incineration or incineration are below 50 % of the emission limit values determined	After one year of operation sampling and measurement of heavy metals will be reduced from twice a year to once every two years as well as sampling and measurement for dioxins and furans will be reduced from twice a year to once a year, once it is demonstrated that the emissions are shown to be 50% of those stated in Annex V.

according to Annex II or Annex V respectively and provided that criteria for the requirements to be met, developed in accordance with the procedure laid down in Article 17, are available. These criteria shall at least be based on the provisions of the second subparagraph, points (a) and (d). Until 1 January 2005 the reduction of the frequency may be authorised even if no such criteria are available provided that: L 332/100 EN Official Journal of the European Communities 28.12.2000 (a) the waste to be co-incinerated or incinerated consists only of certain sorted combustible fractions of non-hazardous waste not suitable for recycling and presenting certain characteristics, and which is further specified on the basis of the assessment referred to in subparagraph (d); (b) national quality criteria, which have been reported to the Commission, are available for these wastes; (c) co-incineration and incineration of these wastes is in line with the relevant waste management plans referred to in Article 7 of Directive 75/442/EEC; (d) the operator can prove to the competent authority that the emissions are under all circumstances significantly below the emission limit values set out in Annex II or Annex V for heavy metals, dioxins and furans; this assessment shall be based on information on the quality of the waste concerned and measurements of the emissions of the said pollutants; (e) the quality criteria and the new period for the periodic measurements are specified in the permit; and (f) all decisions on the frequency of measurements referred to in this paragraph, supplemented with information on the amount and quality of the waste concerned, shall be communicated on a yearly basis to the Commission.	
Former WID Article 13 (3) The incineration plant or co-incineration plant or incineration line shall under no circumstances continue to incinerate waste for a period of more than four hours uninterrupted where emission limit values are exceeded; moreover, the cumulative duration of operation in such conditions over one year shall be less than 60 hours. The 60-hour duration applies to those lines of the entire plant which are linked to one single flue gas cleaning device.	The plant will be operated with CEMS which will be linked into the controls system. In the unlikely event of CEMS failure, backup CEMS will be available on site with 24 hours.

Former WID Article 13 (4) The total dust content of the emissions into the air of an incineration plant shall under no circumstances exceed 150 mg/m^3 expressed as a half-hourly average; moreover, the air emission limit values for CO and TOC shall not be exceeded. All other conditions referred to in Article 6 shall be complied with.	The applicant does not request the abnormal emission limit value for particulates available under Article 13(4). In the unlikely event of CEMS failure on one of the streams, backup CEMS will be available. In the case of long term CEMS breakdowns, replacement units (temporary or permanent) will be provided.

BAT

The following BAT demonstration is based on the BREF document for incineration and the sector guidance. The BAT demonstration is summarised in the following tables. These detail all of the indicative BAT requirements insofar as they apply to this process.

It must be noted that this application relates only to the gasification of a fuel which has been prepared in another activity prior to transport to the site.

Table 6.5: BAT Justification

Indicative Requirement	BAT justification
Incoming waste and raw materials management	
Waste code	The proposed technology uses non-hazardous waste wood. The waste codes from the List of Wastes (England) Regulations 2005 are identified in Table 3.5.
Pre-treatment	Before entering the gasifier the feedstock will be transported to a feedstock oversize screening device, a metal separator and a police screen.
EMS	Biomass UK will operate to an environmental management system (ISO14001) which will ensure that procedures are in place for fuel input and raw material management. All necessary operating procedures will be in place and documented and stored within the company EMS. Biomass UK will aim for certification of the renewable energy facility to ISO 9001:2008, ISO 14001:2004 within the first year of operation.
Odour control – internal storage	The reception area is accessed via roller shutter doors. These will be kept closed at all times unless a direct delivery of fuel is taking place. During periods of planned shutdown, the feedstock within the storage system will be run down prior to the shutdown. All doors will remain closed as far as practicable. Fuel stores will only start to be increased again slightly in advance of the planned recommencement date. If there are extended periods of unplanned shutdowns deliveries will be diverted to other suitably permitted facilities. For longer unplanned shutdowns the feedstock will be removed from site.
Fire fighting	The feedstock is not volatile or easily combustible. An automatic fire detection and alarm system, an automatic sprinkler system and an automatic suppression system will be installed on site. All fire water will enter the drainage system and overflow into the attenuation tank. The fire water will be tested to allow discharge to the surface water connection point. If not suitable, all fire water is to be pumped and tankered away to a suitable water treatment facility. A Fire Prevention Plan is included in SOL1605BUK201 Volume 2: Annex D3 – Fire Prevention Plan. The Fire Prevention Plan relates to the internal storage of all fuel product and provides the necessary information on site infrastructure, storage locations, storage practices, monitoring equipment and emergency response procedures.

Table 6.5: BAT Justification	
Indicative Requirement	**BAT justification**
Storage of fuel and treatment chemicals	Treatment chemicals will be stored in drums or tanks or bags (whichever are required for the quantity needed to be held in storage). These will be stored in the building and/or on hardstanding, within bunded areas that can contain 110% of the largest drum or 25% of the total storage capacity, whichever is the greater.
Preventing rainwater contamination	All external process areas will have hardstanding. Surface water run-off from the site roads will enter the surface water drainage system.
Incoming waste covered	Incoming waste will be delivered in covered vehicles with walking floor trailers. It will be off-loaded from these vehicles within the fuel storage building.
Litter avoidance	It is not anticipated that litter will be a problem. If litter does arise a litter patrol will be initiated at the end of each working day.
Maximisation of homogeneity of feed	Homogeneity of the waste is achieved by pre-treatment. A fuel specification is in place which stipulates the parameters that must be achieved.
Inspection and removal	The waste acceptance procedures include the validation of a load against the pre-acceptance documentation. Loads may be inspected at the weighbridge, during unloading within the waste reception area and prior to transfer to the renewable energy facility. A waste rejection procedure is in place for unsuitable loads/part loads/items within a load.
Feed transfer	Waste is transferred by internal conveyor from the waste storage building to a metering bin to allow continuous feed into the gasifier. This is an automated system. The control system automatically controls the feed of feedstock to the gasifier. Due to the intermittent delivery of fuel to the installation (day time only) the fuel will be stockpiled in the waste storage building to provide a maximum of approximately 3 days of continuous operation during periods of no deliveries being received; i.e. night-time, periods of maintenance.
Control of dust emissions	The waste will neither be dry or friable (i.e. the moisture content will be sufficiently high so to avoid excessive dust) therefore dust generation is unlikely. The waste is also delivered and stored within a building / enclosed conveyors so dust generation is further minimised. Bag filters are also used to reduce dust emissions. Ash and bag filter residues will be stored in enclosed tanks and removed from the facility in enclosed wagons.
Odour prevention Storage time within the buffer store	The reception area is accessed via roller shutter doors. These will be kept closed at all times unless a direct delivery of fuel is taking place. The waste storage building will be complete with an air extraction system. During short-term shutdowns the waste storage building will be kept closed, the stocks of feedstock will be reduced and the buffer stores cleared. During long-term shutdowns in addition to the previous actions, no incoming waste will be accepted.

Table 6.5: BAT Justification	
Indicative Requirement	**BAT justification**
	The Applicant will operate to an environmental management system (EMS) that includes procedures relating to all reception and handling areas, including handling of fuel within the buffer stores.
Waste Charging	
Automatic waste feed prevention system	The installation is provided with a control system that automatically controls the feed of waste to the gasifier. At start-up waste cannot be fed to the gasifier until the combustor reaches the required operating conditions. The feed system for the gasifier process is automated and in the event of temperature loss or departure from operating conditions the process will automatically shut down in a controlled manner.
Furnace interlock	The waste feed system is interlocked with the gasifier vessel conditions to prevent feed taking place when synthesis gas combustion is inadequate or other parameters are not within limits.
Airtight charging design, with interlock for chute or hopper	The transfer of waste to the gasifier is controlled. The waste will be transferred via a conveyor system into the gasifiers metering bin. This is then continuously fed into the gasifier via a feed compactor that forms an air tight seal. In the event of the gasifier deviating from its normal operating conditions, the control system will automatically alter the waste feed rate to the gasifier to ensure optimum conditions are achieved.
Charging rate and firing diagram, throughput rate, optimised combustion, waste residence time	Firing diagrams are not relevant as conventional burning does not take place of solid fuel/waste in this process.
Pyrolysis and Gasification	The gasifier has been designed for purpose. The feedstock is non-hazardous waste wood. The fuel handling system is by conveyor and is designed with this material in mind. The fuel is continuously fed into the gasification plant via a feed compactor that prevents the ingress of air into the process.
Feed of Waste Wood	The pre-processing of the mixed waste wood prior to delivery to the site ensures that no further on site processing is required.
Furnace Requirements	The fuel is gasified at temperatures typically between 850 to 1,000°C. CFD modelling of the combustor has demonstrated that residence times above 850°C in excess of 2 seconds. Following commissioning of this installation, the results will be validated. No waste that contains a significant chlorinated or otherwise halogenated component is accepted. This is to ensure that halogen content cannot exceed 1% (as chlorine). The combustion process is controlled on temperature and remains above 6% O_2 at all times.
Validation of combustion conditions	CFD modelling of the combustor has demonstrated that residence times above 850°C in excess of 2 seconds. This has informed the design of the combustor.

Table 6.5: BAT Justification	
Indicative Requirement	BAT justification
Measuring oxygen levels	Measurement of oxygen is taken by extractive measurement in the stack as part of the emissions monitoring package to allow sample data to be converted to standard conditions.
Combustion Control	There are numerous temperature measuring positions throughout the thermal process which ensure correct combustion conditions at all times including at the point of final combustion.
Dump stacks and by-passes	There will not be any dump stacks or by-passes during normal operation at the installation.
Flue gas recirculation	Secondary NOx control will be employed using recirculated flue gas to minimise NOx formation.
Cooling systems	Cooling will be provided by air cooled condensers. The purpose of the condenser is to condense the steam by dissipating low grade heat to the atmosphere. The condensate recovered is returned to the boiler de-aerator and makes up the majority of the boiler feed water. There will be no cooling towers required; therefore, there will be no use of biocides in any cooling water systems and no release to land.
Boiler design	The boiler design has been chosen to prevent as far as possible the formation of dioxins and furans. The shell boiler, connecting duct work and economiser sections are designed to minimise the residence time of gases. This is in order to minimise the formation of dioxins and furans by de-Novo synthesis.
Environmental Performance Indicators	Key process performance indicators will be devised in discussion with the Agency prior to commencement of operation of the facility.

6.3 Resource Efficiency and Climate Change

Basic Energy Efficiency Measures

The plant and ancillaries have been designed to operate with a high level of energy efficiency. Key energy efficiency measures that have been included within the design of the plant are as follows:

- All plant and equipment will be individually monitored and controlled using a SCADA monitoring system and PLC controls, optimised for efficiency of operation;
- All heat generated by the gasification plant will be recovered and used for the generation of electricity;
- All aspects of the gasification plant are controlled in real time to ensure maximum thermal efficiency and operational control;
- All plant energy data will be monitored and recorded and targeted to ensure optimal plant performance; and
- As part of the company's environmental management system, targets will be set regarding the increased thermal efficiency of the plant and the potential export of heat to neighbouring facilities.

Development of KPI's

The Operator will establish Key Performance Indicators (KPIs) when site electricity generation figures are available. The composition of the waste materials in the process will not vary greatly over the life of the plant. Should any site equipment or technology be replaced, efforts will be made to replace the unit with one which is more energy efficient, if available.

The Operator will create KPIs based on monitoring data from how much energy is used to run the site and whether this can be reduced. Within six months of operating the Applicant will produce a report detailing the energy uses at the site and where energy use improvements, if any, can be made.

Basic Design Principles

The Installation has been designed to ensure that all potential electrical energy is generated and supplied to the grid. A summary of the basic measures has been provided below:

- Wherever possible the plant utilises the waste heat to generate steam, which is used to generate electricity;
- All parasitic loads of the plant will be provided by the generated electricity, and hence the net energy imports are required to power and operate the plant;
- All pipelines and thermal processes are lagged and insulated to ensure that heat loss is minimised and prevented;
- The steam turbine specified for the plant has a high electrical and thermal efficiency;
- All ancillary plant (fans and motors) have been specified with high efficiency electrical motors and variable speed drives;

- The plant is controlled by PLC and optimised to ensure maximum efficiency and minimal operation of ancillary components where required;
- The Installation uses high efficiency electrical generation technology (i.e. steam turbine). The proposed process will achieve 1.075 MWe per tonne of material processed;
- Waste heat will be used for internal uses where possible i.e. preheating combustion air etc;
- The overall energy efficiency of the plant, even when in open cycle when taking account of ancillary uses, has been designed around to achieve 27.1% efficiency, which compares well with the 25% efficiency target stipulated for incineration processes; and
- The plant will be maintained at steady capacity to avoid downtime.

Raw Materials and Water Usage

- The plant has been designed to ensure that all residues are reused or recycled; and
- The net water use meets the sector average (250 – 1100kg per tonne of material processed).

Avoidance, Recovery and Disposal of Waste

- All feedstock delivered to the site will be subject to an acceptance and pre-acceptance process that should ensure that the potential for inappropriate feedstock delivery is minimised;
- The site has a detailed inspection process to avoid unsuitable wastes to be introduced to the process; and
- The safe storage of rejected loads has been provided within and procedures will be in place for dealing with such loads to ensure that they are safely stored and dispatched for onward disposal. The storage times will be minimised.

An Energy Balance has been provided within *SOL1605BUK201 Volume 2: Annex B1 – Energy Balance.*

6.4 CHP-Ready Assessment

The plant has been configured to maximise power generation only and has not been configured for CHP mode operation at this time. The turbine has the capacity to be modified to operate in a CHP mode and stream could be diverted to heat exchangers if required (CHP-ready), however the likely operating mode will be power only.

At present there are no immediate high value heat neighbours which provide an economically viable heat export opportunity. Therefore, a CHP-R Assessment is not considered necessary.

This situation will be reviewed on a periodic basis and the feasibility re-appraised.

6.5 BAT Comparison

An assessment of the applicable indicative BAT requirements (as stated by EPR Guidance Note 5.01 Incineration) for the sector has been carried out. The following indicative BAT measures are considered to be met by the process.

Operations

- Very high levels of housekeeping will be employed throughout the site;
- All vehicles will be loaded and unloaded under cover and on sealed concrete hardstanding and engineered containment;
- All waste wood feedstocks will be stored under cover within a dedicated fuel storage facility;
- The main processing building will be maintained under negative pressure;
- Segregated water systems have been incorporated into the design of the plant to minimise the contamination of rainwater; and
- All building doors will be self-closing.

Waste Charging

- All feedstock into the gasifier will be on an automatic feed system to prevent waste feed at start-up:
  - Until the required temperature has been reached;
  - Whenever the required temperature is not maintained; and
  - Whenever the continuous monitors show that any emission limit value is exceeded due to disturbances or failures of the purification devices.
- Waste charging will be interlocked with gasifier conditions so that charging cannot take place when:
  - The temperatures and air-flows are inadequate;
  - Any flue gas cleaning bypasses are open;
  - Where the continuous monitors show that the emission limit values are being exceeds for a period of time in excess of the limits set within IED (formerly WID); or
  - Monitoring results required to demonstrate compliance with emission limit values are unavailable.
- The charging process has been designed to be sealed and all pressure controls have been designed to avoid escape of fumes or excess air flows; and
- The charging rates will be maintained at the optimum feedstock design rate of 10.798 tonnes per hour.

Legislative Requirements

- The gases resulting from the gasification process will be maintained at above 850ºC for at least 2 seconds;
- The combustion temperature and residence time and the oxygen content of the stack gases have been validated under the most unfavourable operational conditions;
- Ash produced by the plant will comply with the IED/WID 3% TOC requirements; and
- The installation will not give rise to significant ground level air pollution as demonstrated by Section 7 '*Environmental Impact'*.

Emissions to Air

- Bag filters will be used to provide reliable abatement of particulate matter to below 5mg/m^3;
- Filters with multiple compartments will be used, which can be individually isolated in case of individual bag failures. There will be sufficient of these to allow adequate performance to be

maintained when filter bags fail, i.e. design will incorporate capacity for meeting emission limits during online maintenance;

- The filtration systems will be equipped with bag burst detectors (e.g. differential pressure type) on each compartment to indicate the need for maintenance when a bag fails. This type of system provides better control of emissions than simple observation of emitted particulate levels;
- The plant is fitted with SNCR (Urea Injection) and Selective Catalytic Reductive (SCR Catalysts) to control and abate NOx formation;
- The gas is cooled quickly to avoid de novo synthesis of dioxin between 450ºC and 200ºC; and
- All indicative IED ELV's will be met.

Odour Emissions

Odour will be minimised through the following measures:

- Containing waste to designated areas;
- Ensuring that no putrescible waste is processed at the plant;
- Regular cleaning of waste handling areas;
- The design of all waste handling areas facilitates cleaning; and
- Drawing air from feedstock areas at a rate which will ensure that any odour present is captured.

7. IMPACT TO THE ENVIRONMENT

7.1 Impacts to Air

An assessment has been carried out to determine the potential air quality impacts associated with the proposed development in Barry.

Scope of the Assessment

The scope of the assessment has been determined in the following way:

- Consultation with Rebecca Athay Environmental Health Officer at Vale of Glamorgan Council (VGC);
- Review of air quality data for the area surrounding the site, including data from the DEFRA Air Quality Information Resource (UK-AIR);
- Desk study to confirm the location of nearby areas that may be sensitive to changes in local air quality; and
- Review of emission parameters for the proposed development and dispersion modelling using the Breeze AERMOD 7 dispersion model to predict ground-level concentrations of pollutants at sensitive human and habitat receptor locations.

The assessment for the proposed development comprises a review of emission parameters for the plant and dispersion modelling to predict ground-level concentrations of pollutants at sensitive human and habitat receptor locations.

Predicted ground level concentrations are compared with relevant air quality standards for the protection of health and critical level / loads for the protection of sensitive ecosystems and vegetation. This modelling presented within *SOL1605BUK201 Volume 2: Annex C1 – H1 Assessment and Air Quality Assessment.*

7.2 Sensitive Human Health Receptors

Specific receptors have been identified where people are likely to be regularly exposed for prolonged periods of time (e.g. residential areas). The location of the discrete sensitive receptors is presented in Table 7.1 below.

Table 7.1 Location of Sensitive Receptors				
ID	Receptor	Type	Easting	Northing
1	Vistamar House	Residential	312199	167543
2	Docks Office	Industrial	312243	167664
3	Phillipa Freeth Court	Residential	312162	167836
4	Barry Dock Station	Station	312359	167806
5	54 Dock View Road	Residential	312368	167918
6	89 Dock View Road	Residential	312528	168111
7	131 Dock View Road	Residential	312724	168359
8	Wimbourne Buildings	Industrial	313155	167691
9	Bendrick Road	Residential	313437	167606
10	Public Recycling Facility	Recycling Facility	313445	167271
11	Atlantic Crescent	Industrial	312983	167416
12	Port Office	Industrial	312659	167100
13	Queens Way	Industrial	312414	167253
14	Dyfrig Street	Residential	312037	166947

The report concludes that predicted maximum off-site process concentrations are well within the relevant air quality standards for all pollutants consisted. The significance of the impacts has been assessed as negligible, in accordance with the NRW risk assessment guidance. Please refer to *SOL1605BUK201 Volume 2: Annex C1 – H1 Assessment and Air Quality Assessment* for more information.

7.3 Impact on Sensitive Habitat Sites

The NRW H1 guidance states that the impact of emissions to air on vegetation and ecosystems should be assessed for the following habitat sites within 10 km of the source:

- Special Areas of Conservation (SACs) and candidate SACs (cSACs) designated under the EC Habitats Directive[5];
- Special Protection Areas (SPAs) and potential SPAs designated under the EC Birds Directive[6]; and
- Ramsar Sites designated under the Convention on Wetlands of International Importance[7].

Within 2km of the source:

- Sites of Special Scientific Interest (SSSI) established by the 1981 Wildlife and Countryside Act;
- National Nature Reserves (NNR);

5 Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.
6 Council Directive 79/409/EEC on the conservation of wild birds
7 Ramsar (1971), The Convention of Wetlands of International Importance especially as Waterfowl Habitat.

- Local Nature Reserves (LNR);
- Local wildlife sites (Sites of Interest for Nature Conservation, SINC and Sites of Local Interest for Nature Conservation, SLINC); and
- Ancient woodland.

Table 7.2: Location of Sensitive Habitat Receptors

ID	Receptor	Status
H1	Cadoxton River SINC	690m east
H2	Cadoxton Wetlands SINC	780m northeast
H3	Fields at Merthyr Dyfan SINC	1.9km northwest
H4	Friars Point SINC	1.98km southwest
H5	Gladstone Road Pond SINC	1.2km west-northwest
H6	Nells Point East SINC	1.1km northeast
H7	North of North Road SINC	1.98km northeast
H8	Cadoxton Ponds Wildlife Trust Reserve	780m northeast
H9	Severn Estuary Ramsar	3.9km east
H10	Severn Estuary SPA	6.2km east
H11	Ancient Woodland (Hayes Lane)	1.1km east

The Air Quality Assessment also concludes that the predicted process contributions are also negligible compared with the critical levels and critical loads for nutrient nitrogen deposition and acidification at nearby statutory sensitive habitat sites and locally designated sensitive habitat sites. Please refer to *SOL1605BUK201 Volume 2: Annex C1 – H1 Assessment and Air Quality Assessment* for more information.

7.4 Human Health Risk Assessment

A Human Health Risk Assessment has been carried out to determine the possible impacts on human health arising from dioxins and furans (PCDD/F) and dioxin-like PCBs emitted from the proposed facility. The impacts have been assessed under the very worst case scenario, namely that of an individual exposed for a lifetime to the effects of the highest airborne concentrations and consuming mostly locally grown food.

The assessment has identified and considered the most plausible pathways of exposure for the individuals conserved.

For the assessment, twelve residential receptors and three farm receptors per defined area. The locations of the resident and farmer receptors are presented in Table 7.3 below.

Table 7.3 Description of Resident and Farmer Receptors

Reference	Name	Type	Easting	Northing
FE1	Farmer East 1	Farmer	313700	167600
FE2	Farmer East 2	Farmer	313600	167500
FW1	Farmer West 1	Farmer	312300	170600
FW2	Farmer West 2	Farmer	310200	167700
FW3	Farmer West 3	Farmer	311900	170600
FW4	Farmer West 4	Farmer	311700	170500
RB1	Residential Barry 1	Residential	311000	168100
RB2	Residential Barry 2	Residential	311100	167000
RB3	Residential Barry 3	Residential	311300	167900
RBI1	Residential Barry Island 1	Residential	312100	166900
RBI2	Residential Barry Island 2	Residential	311400	167000
RDN1	Residential Docks North 1	Residential	312300	167900
RDN2	Residential Docks North 2	Residential	312500	168100
RDN3	Residential Docks North 3	Residential	312100	167600
RDS1	Residential Docks South 1	Residential	313400	167600
RDS2	Residential Docks South 2	Residential	313400	167500
RG1	Residential Gibbonsdown 1	Residential	311200	168700
RG2	Residential Gibbonsdown 2	Residential	312200	168900
RG3	Residential Gibbonsdown 3	Residential	312100	168900
RP1	Residential Palmerstown 1	Residential	313700	168800
RP2	Residential Palmerstown 2	Residential	313300	169000
RP3	Residential Palmerstown 2	Residential	313400	168900
RS1	Residential Sully 1	Residential	315200	168000
RS2	Residential Sully 2	Residential	315000	168300

The report concludes that the maximum contribution of the facility to the COT TDI is 0.08% for the farmer receptors and 0.04% for the residential receptors. However, for the farmer this assumes as a worst-case that these receptors are located at the closest framing area to the facility and all their food is reared and grown at this location. Therefore, the impact of emissions on local sensitive receptors is considered not to be significant.

The risk assessment methodology used in the assessment has been structured so as to create worst case estimates of risk. A number of features in the methodology give rise to this degree of conservatism.

It has been demonstrated that for the maximally exposed individual, exposure to dioxins, furans and dioxin-like PCBs is not significant.

Please refer to *SOL1605BUK201 Volume 2: Annex C1 – H1 Assessment and Air Quality Assessment* for more information.

7.5 Global Warming Potential

The global warming potential of the plant has been calculated using the EA H1 Annex H methodology and has been summarised and included in *SOL1605BUK201 Volume 2: Annex B3 – Global Warming Potential (GWP).*

The CO_2 emissions from the plant have been calculated assuming a biogenic content of 100%[8].

In accordance with the H1 methodology the Global Warming Potential (GWP) is -32,644 (tonnes CO_2 equivalent per annum).

7.6 Impacts to Land

There are no impacts to land relating to this permit application.

7.7 Impacts to Controlled Waters

There are no impacts to controlled waters relating to this permit application. All discharged water is clean surface water only

7.8 Impact to Sewer

All emissions to sewer will be released under consent to the sewerage undertaker [Welsh Water].

This application will be applied for by the applicant during the permit determination period as required.

The nearest sewage treatment works is Barry Sewage Treatment Plant, operated by Welsh Water. This Sewage Treatment Plant discharges to the low estuarine section of Sully Brook.

There is no relevant metering data associated with Sully Brook. All dilution factors have been assumed as H1 default values.

All impacts have been screened using the H1 Assessment Tool, using the maximum effluent ELV data stipulated in Table 7.4.

[8] The fuel feedstock contract assumes 100% waste wood content

Table 7.4 Water Impacts (H1)						
	Annual Avg EQ			MAC EQS		
	Release	EQS	Release Conc <4%	Release	EQS	Release Conc<10%
	ug/l	ug/l	Test 1	ug/l	ug/l	Test 1
Arsenic (Discharges to Barry Sewage Treatment Plant)	0.565	25	PASS	0.565	-	N/A
Chromium III (95%ile) (dissolved) (Discharges to Barry Sewage Treatment Plant)	0.0593	-	PASS	0.0593	-	N/A
Copper (0-50mg/l CaCO3) (dissolved) (Discharges to Barry Sewage Treatment Plant)	0.0875	5	PASS	0.0875	-	N/A
Lead and it's compounds (Discharges to Barry Sewage Treatment Plant)	0.103	7.2	PASS	0.103	-	N/A
Nickel and its compounds (Discharges to Barry Sewage Treatment Plant)	0.250	20.00	PASS	0.250	-	N/A
Zinc and its compounds (Discharges to Barry Sewage Treatment Plant)	0.194	40	PASS	0.194	-	N/A

All impacts to controlled water have been screened as insignificant.