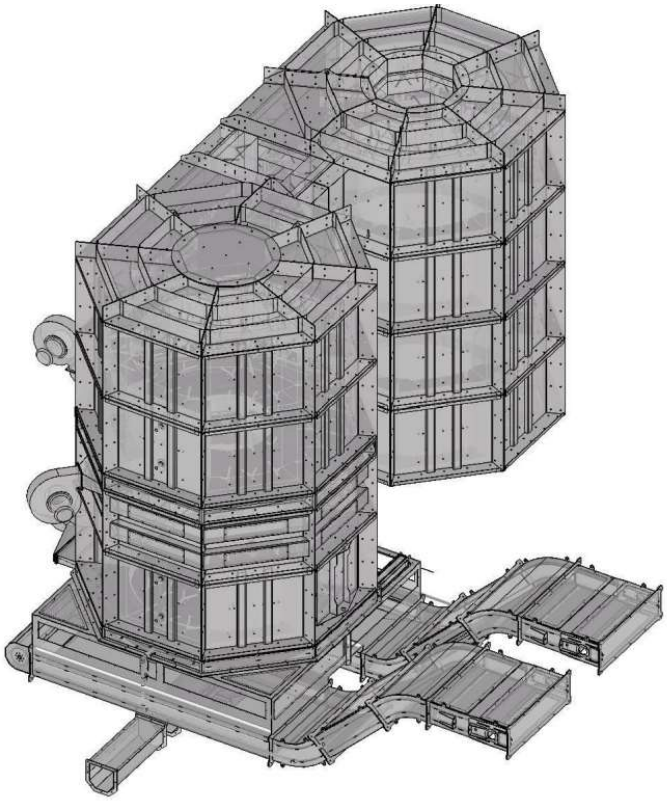
DETAILED TECHNICAL SPECIFICATIONS FOR THE PROPOSED MOVING GRATE ADVANCED THERMAL TREATMENT (ATTP)

BIO RENEWBALES MODEL: RDF PLANT

Reference: Brownhill Skips Ltd - UK

*** ENERGY RECOVERY BASED ON ORGANIC RANKIN CYCLE ENGINE**



BioRenewables
Technology that helps the environment

Engineering and Energy Recovery Process Design Report

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Contents

Introduction

Bio Renewables Ltd have been engaged by Brownhill Skip Hire Ltd to undertake works for a Design, Manufacture, Install and Service of an International Emissions Directive (IED) compliant Advanced Thermal Treatment Plant (ATTP) (with optional Energy Recovery via EBOX).

The plant is designed, and equipment selected in compliance with the UK Small Waste Incineration Permit (SWIP) directive and with UK and EU emissions regulations.

This document describes the technical & commercial section of this study.

1 Design case definition

1.1 ATTP main sizing criteria

The overall size of an ATTP is mainly driven by the thermal input to the combustion process. The thermal input can be expressed as throughput times the calorific value of the material to be treated.

The considered project shall be designed and operated within the limitations on throughput as defined in the Environmental Permitting Regulations of the UK, for Small Waste Incineration Plants (SWIP).

The material to be processed in this project is Refuse Derived Fuel (RDF). This RDF is a selected stream from the general wastes as produced by households and businesses in the UK; the RDF fraction typically consisting of relatively high calorific wastes, such as paper, plastics and other combustible materials.

The respective waste stream is regarded as non-hazardous.

The throughput as defined by the SWIP is restricted to maximum 3 tons per hour throughput on a 24-hour basis, and 72 tons per day maximum for treating non-hazardous wastes.

Annual throughput for this project has been defined as circa 4,000 tonnes.

1.2 Physical appearance of the waste and chemical analysis

The following pictures give a general impression of the RDF to be processed:

The material can be characterized as follows:

- solid waste,
- relative dry material,
- mainly combustible materials such as plastics, paper, textiles, cardboard etc
- non-shredded material, maximum of 0.5 meters.

1.3 RDF analysis

The calorific value of the RDF to be processed determines total thermal input to the ATTP process. The chemical composition will drive additive consumption as pollutants need to be neutralized in the flue gas treatment system to ensure that the flue gasses resulting from the combustion process are following the applicable emission regulations.

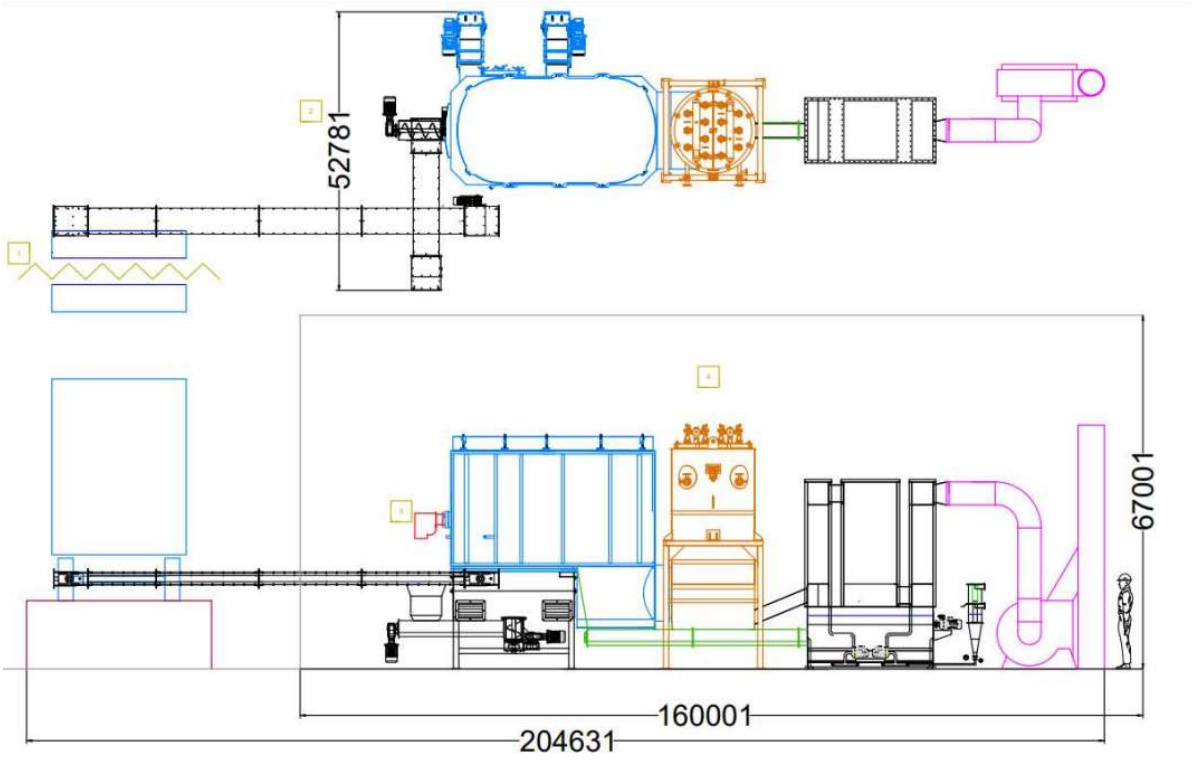
The density of the RDF is typically in a range of 200 to 300 kg/m3, with 250 kg/m3 taken as average design value.

Design RDF specification:
Moisture percentage range : 20-45* wt%
Moisture percentage design : 20 wt%
LHV design range (wet) : 8-15 MJ/kg
Ash content design (average) : 12 wt%
Nitrogen content max : 2 wt% (dry ash free)
Nitrogen content average : 1 wt% (dry ash free)
Chlorine content max : 1 wt% (dry ash free)
Chlorine content average : 0,5 wt% (dry ash free)
Sulphur content max : 0,5 wt% (dry ash free)
Sulphur content average : 0,3 wt% (dry ash free)
Fluor content max : 50 mg/kg (dry ash free)
Fluor content average : 20 mg/kg (dry ash free)
Size of RDF fed to chamber : <80mm
Non ferro max : 0.5 wt% (dry basis)
Non ferro Average : 0.3 wt% (dry basis)
Ferro : max 0.5 wt% (dry)
Sum non-fluidising particles : max 3 wt%(dry) sand, stone, glass, metal
Max particle size non-fluidising : max 50 mm. particles dirt, stone, glass, metal as received in storage bunker
Minimal (waste) wood fraction : 20 wt%**
Waste wood moisture content : <35 wt%

2. Conceptual Design

Moving Grate design is proposed as primary combustion technology for this application as this principle is capable to accept a wide range of wastes, varying in chemical, physical properties, and size, meanwhile ensuring a stable operation within the applicable operational permits.

This will also open the possibility to treat other waste streams in the future, to increase the profitability of the project, as the proposed project is technically capable to accept other waste streams, such as medical, clinical, liquids, hazardous, chemical etc.



Advanced Moving Grate concept:

- A Moving grate design is proposed, which can be operated within a range of +/- 20% of the thermal design capacity of the process, in full compliance with applicable emission standards and other required operational conditions.
- A waste feeding system will be included, to enable the supply of waste streams in addition to RDF, such as medical wastes, hazardous wastes, and other non-hazardous wastes, depending upon future permit approval. A container-based feeding system will be installed for this purpose. In this instance ONLY NON HAZOURDOUS Waste in the form of RDF will be processed.
- Considering the materials as specified in *Section 1*, it is a requirement that the materials need further processing/ size reduction before they can be supplied to the ATTP. This system design requires the RDF to be pre-shredded to 80mm particle size, before discharging in to the ATTP.

The following process steps are proposed, based on one ATTP.

1. The proposed system is able to treat waste based on full continuous operation (24/7).

2. The ATTP is designed in such a way that each shut down period will never exceed 14 consecutive days. Annual availability of the overall process is set at 95% minimum.

3. The waste will be collected by Brownhill Skip Hire and unloaded at waste unloading bays.

4. The unloading bays for RDF Storage, which should be sufficient to store waste for at least 5 days at the maximum waste treatment throughput (maximum 500kg/hr).

5. Telehandlers will be used to maneuver the RDF from the Storage Bays to the Infeed Housing.

6. The waste Infeed Housing acts as an intermediate storage and dosing hopper to supply the RDF in a controlled way to the waste conveying system to the ATTP. Screw conveyors are installed at the bottom of the hopper to transport and dose the waste to the waste feeding system of the ATTP, being a proven technology for general (non-hazardous) waste supply and dosing.

7. The RDF will be loaded into a Moving Grate Primary Combustion Chamber by an Automatic Waste Feeder. Waste supply is fully automated, based on process parameters in the process with the waste feeding system automatically supplying waste to maintain stable operating conditions in the process.

8. The Moving Grate design is selected as this technology is specifically suitable to treat wastes with variable moisture content and variable calorific heat, as the flue gasses leaving the chamber tend to directly preheat the new waste as supplied to the chamber.

9. Bottom ash is fully contained and automatically discharged using dedicated integrated conveyors to enclosed ash storage containers.

10. Flue gasses generated in the Primary Combustion are supplied to a vertical Secondary Combustion Chamber. This vertical Post Combustion Chamber has a residence time of more than 2 seconds at the given process design conditions in compliance with the applicable environmental and operational regulations.

    The hot flue gas will flow from the post combustion chamber to the energy recovery section.

11. Energy recovery section is based on the production of Electricity. The flue gasses are cooled down in a boiler section, transferring thermal energy to ORC process loops.

12. Total electricity production will be higher than the internal electricity production of the process, so electrical energy is available for export to the National Grid.

13. The Flue Gas Treatment is based on Wet Flue Gas Treatment System (WFGT) using hydrated lime to neutralize the acids as present in the flue gas.

14. The limestone is supplied to the WFGT system using large capacity bags and a dedicated dosing system. In this case a pre-grinded limestone quality will be used to achieve optimum removal efficiency. Additionally, there is a manual dosing capability, utilizing hydrated lime, providing redundancy and rapid pH adjustment. pH is constantly monitored automatically.

15. A speed controlled Induced Draft fan is used to transport the flue gasses throughout the process. The speed of the ID fan is controlled in such a way that the pressure in the Primary Combustion chamber is maintained at an accurate under pressure relative to atmosphere, preventing any flue gas discharge from the overall combustion process.

16. The emitted flue gas via the stack will be continuously analyzed and recorded to control the concentration of CO, NOx, SO2, HF, HCl, O2, TOC, Particulate Matter in accordance with the applicable local regulations. Nominal outlet temperature will be

in a range of 80 - 90 ºC; no plume will be visible on the stack as this will not cross the water dew point under all atmospheric conditions.

3. Main components of the proposed ATTP system

The main components of the ATTP resulting from the plant design are as follows and are part of the scope of supply by Bio Renewables:

a) RDF Storage container installed for the ATTP line
b) RDF conveyor system with weighing conveyor to accurately control and monitor ATTP throughput,
c) Primary Combustion section consisting of a Moving Grate Furnace, Stationary Part, Ash Evacuation Chamber and Oil fired start-up Burner. Automatic Ash Evacuation, discharge of ashes into ash containers via automated screw conveyors for bottom ashes,
d) Post Combustion section (Retention time of minimum 2 seconds) and a oil fired back-up burner,
e) Primary cooling based on energy recovery, using a heat exchanger/ boiler
f) Wet Flue Gas Treatment (WFGT option) dosing and mixing section, including storage and dosing system for limestone and venturi mixer,
g) Induced Draft (ID) Fan, VFD controlled, direct drive,
h) Stack with platform to give access to the Continuous Emission Monitoring System (CEMS) sample ports,
i) CEMS system in full compliance with local regulations of an EU/UK based brand,
j) Process water buffer, supply and control systems,
k) Compressed air supply and control systems, including compressor package covering total #waste facility compressed air demand,
l) Connecting ducting between all equipment,
m) Electronic instruments consisting of Power cables, PLC cables, Electrical cables, communication cables and related instrumentation,
n) Plant automation system with remote access capabilities.

The following components are excluded from the scope of supply by Bio Renewables and will be provided by others:

o) All civil works, including waste receiving hall and pit construction, civil foundations,
p) Electrical power supply up to the main electrical connection terminals of the electrical panels of the ATTP process,
q) General plant electrical systems (lighting, utility power supply, lightning protection),
r) Firefighting systems,
s) Electrical distribution connections to external clients, if applicable.

4. Technical Specification of the ATTP

RDF storage system

RDF (fuel) will be stored in a 40ft Walking floor Container system. Telehandler can drive from the shredding bay, and tip the buckets of RDF into the container, via its open top.

The RDF storage system includes:

- A RDF storage container, sufficient for RDF storage to allow throughput of 10 tonnes of RDF (500kgs/hr or approximately)

RDF feeding buffer

One RDF feeding buffer, one hopper for each waste line, with screw conveyor will be used for intermediate storage, dosing and supply of RDF to the process.

The feed buffer will be installed on load cells to monitor filling rates of the buffer, this process is integrated with the plant automation to monitor throughput and as a level indication of the hopper (or alternatively with a reliable level measurement system).

The RDF feeding buffer includes:

- Container RDF storage capacity, sufficient for 24 hours of storage capacity at full ATTP throughput,
- One RDF feeding buffer installed per ATTP, with space available in the layout to install the second buffer for future expansion,
- VFD (Variable Frequency Drive) controlled feeding screws, to feed RDF in a controlled way to the subsequent RDF conveying system

RDF conveying system

The RDF conveying system includes:

- A total of 2 Scraper Conveyors transferring the RDF from the RDF feeding buffer to the primary chamber
- RDF is transferred from the scraper conveyor into a trough, where the waste is then constantly dosed in to the furnace using a Auger Screw.
- Fully airtight and emission free feed system,

The solid waste feeding hopper is equipped with a spraying system to automatically suppress fire in the feed hopper.

Primary Combustion

The overall Primary Combustion system includes several different processes and related equipment.

Moving Grate Furnace

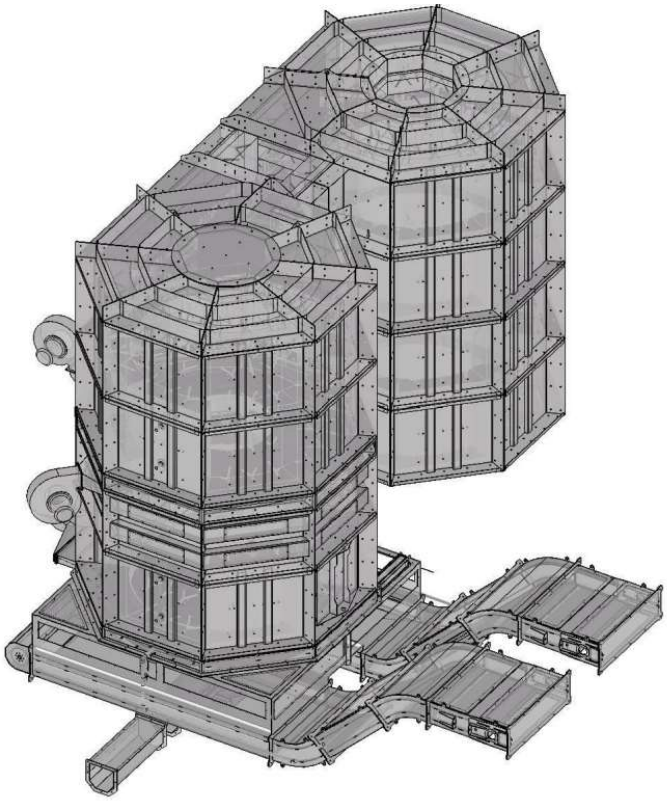
In the Moving Grate a nominal temperature is maintained around 900 to 1100 °C by influencing:

- the Auger feeding frequency,
- the control of the furnace burner.

The furnace has a nominal thermal capacity of 2.5MWth +/- 20% and is designed to treat waste with a calorific value of nominal 15MJ/kg.

Ash chamber

Ashes fall by gravity into an wet ash discharge conveyor situated underneath the ash chamber. This eliminates all possibilities of dust contamination on site.



Combustible Air

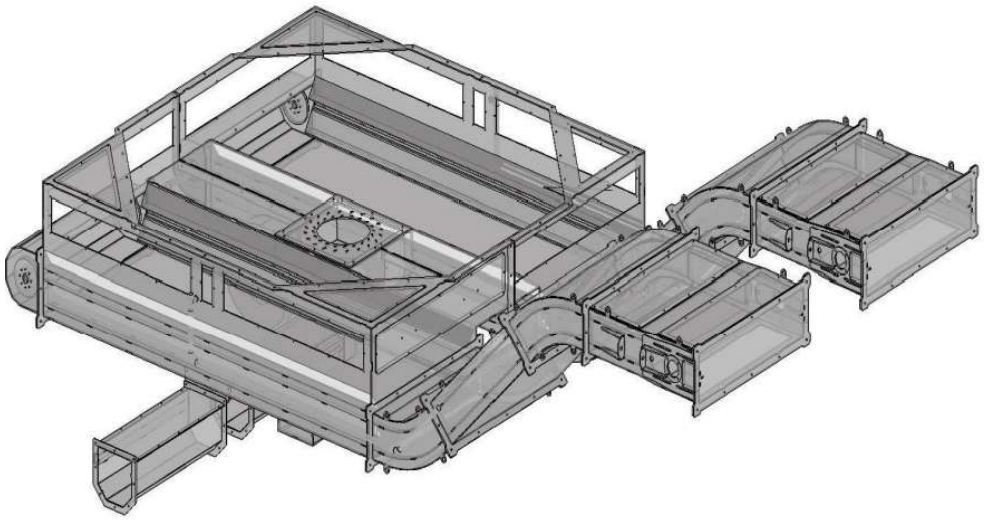
The ID fan maintains a specific and constant (but adaptable) under pressure in the primary combustion section via the ID fan speed control (VFD) and an under-pressure measurement with corresponding setpoint in the plant automation system.

The overall quantity of combustion air supplied to the primary combustion stands in direct relationship to the amount of thermal energy generated in the combustion process, as the operating temperatures in the furnace are controlled within a small range via the plant automation system. If temperatures go down, waste supply is started, to maintain these operating temperatures automatically within this narrow band (typically within 850 – 1100 ºC).

ATTP bottom ash discharge

As total ash content of the waste is only a small fraction of waste input (nominal 20 mass % of total waste supply, but less than 5 volume %), it is possible to recycle the ashes discharged by the furnace and collected at the ash chamber.

The system operates fully automated and includes in total 2 Scraper Conveyors for automated and dust emission free discharge of the plants bottom ashes to the ash collection container.



ATTP Start-up burner

An Oil fired burner installed beneath the Primary chamber starts automatically when the temperature in the plant drops below a certain threshold temperature, normally minimum 600 °C. This can happen when there is a deficiency in the feeding system or when the waste does not contain sufficient combustion energy to maintain the temperature at the desired 850 to 1100 °C in the primary combustion. Under normal operating conditions the burner is not activated as the combustion process is controlled in such a way that the combustion energy as available in the waste is sufficient to maintain stable operating conditions.

The combustible gases produced by the combustion of the waste in the primary combustion section are mixed with secondary air introduced at the front of the ATTP and burn out completely in the post combustion chambers. The achieved temperature is in a range of 850 to 1100 °C, during minimum 2 seconds residence time of the flue gasses at this temperature range.

Post Combustion Support Burner

A diesel fired Post Combustion burner is installed to ensure that the post combustion temperature is maintained above the minimum defined temperature of 850 ºC, even if the energy supply from the primary combustion is inadequate. This Post Combustion burner is then automatically activated.

Primary flue gas primary cooling / energy recovery section

The flue gas will flow from the post combustion chamber to the primary cooling stage at nominal 850 °C, maximum 1100°C. The flue gasses are primarily cooled down in the boiler

section, transferring energy to produce Hot water/ Electricity, cooling the flue gasses to required design parameters.

The heat exchange/ boiler section is based on the water tube principle, with the flue gasses flowing through the tubes to facilitate fast and easy servicing.

Wet Flue Gas Treatment system (WFGT option)

A wet flue gas treatment system is proposed for the ATTP as this completely eliminates any visual emissions from the plant. As a result, no water vapor plume or “white smoke” (extreme fine aerosols) are visible. As the WFGT is integrated to the primary combustor Wet ash system, there is no waste water is generated. At the given waste composition, WFGT emission reduction efficiency will be sufficient to produce flue gasses safely within the emission limits of UK and EU emission regulations.

The Wet Gas Scrubber utilizes 2 absorption media:

- Limestone: to effectively absorb acid components in the flue gas, such as HCl, SO2, HF, due to the high reactivity of Limestone,
- Activated Carbon: to absorb dioxins, heavy metals.

The Limestone dosing rate is controlled via the actual emission levels of HCl and SO2 in the flue gas discharged via the stack, as measured via the CEMS. Via a feedback PID controller the dosing rate is adapted and corrected based on the actual input of contaminants via the waste, thus minimizing limestone consumption.

Induced Draft fan

The ID fan draws the flue gases through the whole ATTP, connected to the discharge side of the WFGT system.

The fan is speed–controlled based on the negative pressure in the furnace which will thus be maintained to a fixed (but adjustable) set point regardless of a variable pressure drop throughout the system or changes in throughput or combustion properties.

The ID fan in combination with the under-pressure control influences total primary and secondary combustion air supply to the process, influencing total throughput as a result, as combustion air supply is directly related with waste ATTP capacity at a defined temperature.

Stack

The stack is equipped with the necessary sampling ports and an access platform to access the CEMS sample points as described under the previous section. This also enables easy access for 3rd party emission monitoring.

With a nominal outlet temperature of 80 – 90 ºC for the flue gasses discharged by the stack, there is no plume of water vapor visible under all atmospheric conditions.

CEMS (Continuous Emission Monitoring System)

A CEMS systems will be installed to monitor the flue gasses leaving the stack:

- Gaseous compounds sampling: a sampling lance mounted at the stack wall is used to take continuous samples from the flue gas. Via a heated sample line these samples are transported to the CEMS analyzer to analyze the chemical composition of the flue gas.
- Dust measurement: a dust analyzer is installed on the stack platform to measure the dust concentration, based on an optical measurement principle.

Both units will be manufactured by a premium brand European / UK supplier. The CEMS will continuously send information to the plant automation PLC and PC based HMI's (Human Interface) for operator supervision and data logging. The emissions data are accessible for external parties such as authorities as a dedicated PC as Data Acquisition System (DAS) is installed for direct reporting to authorities. The plant automation PC's can be made accessible for supervision via the internet for remote monitoring.

The following parameters will be monitored continuously and send to the Central Control Room and as such shown on PC-based HMI for operator supervision: CO, NOx, SO2, Dust (Particulate Matter), HCl, HF, O2, TOC, H2O. Other parameters can be added, upon client request.

Excellent performance for multigas measurements in dry sampling, including HCL, HF, NO, NO_2, N_20, SO_2, CO_2, TOC, CH_2, CO, O_2.

Designed to operate under IED.

Electrical Installation, Automation Control Equipment

The entire plant is automatically controlled by a PLC (Programmable Logic Controller). All required instrumentation for the system, the waste feed system, the furnace, the post

combustion chamber, the flue gas treatment and scrubbing system and the fan controls are included. The automation system includes temperature controls and pressure controls, excess air controls, all burner safeties and the necessary alarms/alert and data retention systems. The PLC is digitally linked with a PC- based HMI's serving as a process data monitor and logger.

The PC serves as both a gateway to remote access and as a remote supervising PC (e.g. in plant manager's office). Both PCs will have a pre-installed full user version of our plant control software. The gateway computer will be modem linked to our technical services (if requested by the client) to monitor all parameters during the guarantee period and enabling online, real-time diagnosis and intervention.

Peripherals

Air compressor package

As many functions in the plant are compressed air operated, the compressed air system is an essential item and is as such integrated with the overall design package of the plant. The compressor package is sized to cover all normal compressed air consumption by the whole process. The plant compressed air piping system is included in the scope of supply.

Process water system

The process water system consists of a 5000lts water storage tank, with automated float type level control, two process water supply pumps (one running, one on standby) and related instrumentation and plant water distribution piping.

Diesel system

The diesel system supplies diesel to the furnace start up and post combustion burner. The diesel system consists of a 2000ltr bunded wall diesel storage tank, with integrated level monitoring and related instrumentation and diesel distribution piping.

The pumps will only be activated once a burner is effectively started by the plant automation system for safety reasons; most of the time the pumps will be switched off as the burners are normally not required during normal operations (continuous waste supply with sufficient calorific value).

5. System performance

5.1 Performance guarantee of ATTP System

Based on the fuel (RDF) meeting specifications as defined within this document and a consistent supply of fuel at the rate of 400-500kg/hr the plant will perform as specified below:

- Plant throughput 400-500kg/hr RDF or 12 tons per day maximum,
- Throughputs can be varied from the nominal 0.5tons per hour throughput as long as the total thermal input is maintained within the above range of 1.5 MW +/- 20%
- Emission Standard: in compliance with the current UK and EU and local regulations
- Post Combustion Temperature will be operated at minimum 850 to maximum 1100 ºC flue gas temperature; the system is designed for a continuous maximum operation temperature of maximum 1100 °C, which gives the flexibility to treat all types of wastes (theoretically medical and hazardous waste also with high plastic content) complying with any world-wide emission standard.

- The minimum residence time in the Post Combustion chamber will be 2 seconds at the specified operating conditions, in accordance with the applicable regulations
- Unburnt carbon in bottom ash 3% max, TOC, maximum loss of Ignition 5% maximum on dry sample weight.
- Subject to fuel quality, operational availability at full capacity under normal operation: minimum 95 % of 365 days, typically 97 – 98% uptime is achieved. Maximum shut down time is 14 consecutive days. Our maintenance cycles are 1 per quarter, with circa 5 days downtime.

*Performance Guarantees will be subject to contract negotiation, whereby, all parties agree to unencumbered operation for a minimum of 8000 hours per year. The format of the performance guarantee will be specified and agreed with both parties.

5.2 Emission standards

The planned waste treatment system is defined as a Small Waste Incineration Plant (SWIP) by the Environmental Permitting Regulations in the UK. Equipment installed is required to with EU Directive 2010/75/EU of November 2010 (and later approved revisions), Chapter IV (IED).

5.3 Utility consumption rates

5.3.1 Auxiliary fuel (Diesel)

Auxiliary fuel oil consumption will be nil to meet the above characteristics under normal operating conditions and provided the waste is properly mixed.

5.3.2 Process water

No water is required for direct cooling purposes of the process, however, process water will be used for the flue gas treatment system. The total energy recovery section, based on the water cycle is basically a closed loop system.

5.3.3 Limestone (additive)

The nominal consumption rate of limestone is directly related to the composition of the waste, as the dosing rate is controlled on the actual emission of HCl and SO2 via the stack. The actual consumption rate will therefore vary with the actual waste composition, specifically related to the chlorine and sulfur concentration in the waste.

5.4 Battery limits

The battery limits define the interconnecting scope of supply of “Contractor” (Bio Renewables Ltd and any of its Sub contractors) and “Employer” (Brownhill Skip Hire and sub-contractors).

Auxiliary fuel (diesel)

Contractor will supply and install the auxiliary fuel tank, with a connection for loading fuel into the tank. The complete auxiliary fuel system is installed by Contractor as part of the overall scope of supply, including pumps , piping, instrumentation, supports, etc.

Contractor to supply a suitable hose to this connection.

Process water

Contractor will supply and install the process water tank, with a filling line to supply water to the tank. A level controller and mechanical water meter will be installed in this supply line by Contractor.

Limestone (WFGT additive)

Contractor will install a dosing hopper with bottom discharge screw. Employer will supply Limestone to be added to the WFGT Process.

Furnace bottom ash

Contractor will install a Furnace bottom ash discharge system. This enables ash discharge without any under pressure influences from the process and the ash will be discharged freely. Contractor will supply containers / skip bins in mild steel with sufficient capacity with a closed top to limit dust emissions.

WFGT residue

The residue from the WFGT is within a closed loop system and therefore requires discharge to an IBC before entry for maintenance.

RDF Storage

Contractor will supply and install the RDF bunker.

Contractor will supply the whole assembly, including 2 rams to facilitate moving RDF through container and dropping on to Infeed Scraper conveyor system.

Employer will supply all civil works of the RDF Walking floor, including building to house the plant away from rainwater and the corresponding vertical and horizontal beams that act as supports for the building, as supplied by Employer.

Stack

Contractor will supply and install the stack, including platform, stair cases, insulation if required.

Employer will install lightning protection and aviation lighting, if required.

Electrical

Contractor will supply and install the complete electrical and instrumentation system for the overall thermal treatment process, including the corresponding electrical panels.

Employer will supply and install the main cable connecting to the input terminals of electrical panels of the process and connect them accordingly.

Employer will supply and install electrical utilities (such as local lighting, local power sockets), within the building and process plant. Employer will supply and install the related main distribution board between grid transformer and general utilities and process electrical panels.

6 References and Technical Data:

General note: all specifications and data are preliminary and subject to change during the detailed engineering phase.

6.1 RDF storage system

The overall design criteria of the RDF storage system are given in the following table:

6.2 RDF Conveyor

- Overall design criteria of the RDF infeed system are given below

Indicative specifications of the RDF feeding buffer:

- Type : Scraper conveyor
- Material of construction : Mild Steel
- Installed electrical power : 1.5 kW, VFD drive
- Level monitoring : Load cells, alt. level monitoring in bunker

6.3 RDF Auger Feed system

- Overall design criteria of the RDF infeed system are given below

Indicative specifications of the RDF feeding buffer:

- Type : Auger conveyor
- Diameter : 250 mm
- Material of construction : Mild Steel
- Installed electrical power : 1.5 kW, VFD drive
- Level monitoring : Load cells, alt. level

6.4 Primary Combustion system includes the following equipment:

Indicative specifications of the combustion zone:

Refractory lined with refractory brick with minimum 60 and maximum 85% alumina (Al2O3) with a maximum operating temperature of at least 1600 °C.

- General material of construction : EN 10025-2 S235JR or equivalent
- Equipped with air cooled inlet gutter
- Material of construction inlet gutter : AISI 310, AISI 304
- Installed electrical power stationary fan : 1.5 kW

Indicative specifications of the Primary Chamber:

- External length, main section : 3500 mm
- External Width : 3400 mm
- Thermal capacity : 2.5 MW (HCV) +/- 20%
- Design calorific value of waste : 15Mj/kg
- Kiln bottom ash quality : 3 % TOC / 5% LOI max.
- Operating temperature : 850 to 1100 □C.
- Rotary speed (intermittent). : 0.17 rev/min at 50 Hz

6.5 Wet Ash Removal System

The wet ash system uses a Carbon steel ash scraper system, which conveys the bottom ash generated from the combustion process, and safely discharges this waste in to ash collection bins.

6.6 Furnace Start Up Burner

Indicative specifications of the kiln start up burner:

- Brand : TBC
- Type : TBC
- Thermal output : max. 200kw
- Type of fuel : Light oil (diesel)
- Power supply : 3 x 400/50Hz + N
- Installed electrical power : 0.5 kW

6.7 Post Combustion

The over all Post Combustion system inclues the following Equipment :

Post Combustion Residence Time Chamber

Indicative specifications of Post Combustion Residence Time Chamber:

Refractory lined with refractory castable with minimum 60 and maximum 85% alumina (Al2O3) with a maximum operating temperature of at least 1600 °C.

Residence time of flue gasses at 900 ºC; this temperature defined as design case with sufficient safety margin relative to the minimum required 850 ºC:

The post combustion zone as specified therefore complies with the minimum required 2 seconds residence time for the combustion gases, under all design conditions.

Post Combustion Support Burner

Indicative specifications of the post combustion support burner:

- Brand : TBC
- Type : TBC
- Thermal output : max. 600kw
- Type of fuel : Light oil (diesel)
- Power supply : 3 x 400/50Hz + N
- Installed electrical power : 0.5 kW

6.8 Primary flue gas primary Heat Exchanger/ Energy Recovery

- Type : water tube type
- Design pressure : 15 bar(g) nominal
- Nominal flue gas inlet temperature : 850 ºC

6.9 Wet Flue Gas Treatment System

The over all Wet Flue Gas Treatment System includes the following equipment:

- Type : Stainless Steel construction, 3 Circulation Pumps, fully integrated control and instrumentation to PLC
- Design pressure : <3 bar(g) nominal
- Nominal flue gas inlet temperature : 850 ºC

6.10 Limestone Dosing System

Indicative specifications of the Limestone dosing system.

- Electrical power supply :3 x 400 V/ 50Hz + N
- Control range : 0-20m AMP
- Motor control type dosing screw : VFD
- Installed electrical power dosing screw : 1.5 kW

6.11 Induced Draft Fan

Indicative specifications of the Induced draft fan.

- Type : centrifugal
- Medium temperature : 216 °C
- Power supply : 3 x 400/50Hz + N
- Motor control type : VFD
- Installed electrical power : 7kW

6.12 Stack

Indicative specifications of the stack.

- Type : centrifugal
- Flue gas discharge temperature : 80-90 °C
- Stack diameter, inner flue gas duct : 500mm
- Stack height above ground level : TBA

Note: final stack dimensions will be based on an AQS-Dispersal study and might be adapted.

6.13 Continuous Emission Monitoring System

Indicative specifications of the CEMS, gas analyzer:

- Specifications electrical supply 3 x 400 VAC/50Hz + N
- Continuous measured components : CO, NOx, SO2, HCl, HF, O2,H2O, TOC (other components upon request)
- Measurement principle : FTIR
- Measurement concept : Extractive, heated sample line

Indicative specifications of the CEMS, dust analyzer:

- Specifications electrical supply : 3 x 400 VAC/50Hz + N
- Continuous measured components : Dust (PM)
- Measurement principle : Optical, absorption, single path
- Measurement concept : In-situ

6.14 Peripherals

Air Compressor package

Two compressed air systems are supplied. The plant compressed air package delivers general compressed air supply for the plant. The instrument air package delivers oil free compressed air to the CEMS unit.

Indicative specifications of the plant compressed air system:

- Max. working pressure : 7.5 bar(g)
- Capacity (approximate) : 10.2 m3/min FAD
- Power supply : 3 x 400/50Hz + N
- Motor control type compressor : DOL, internal motor

Process Water supply system

Indicative specifications of the process water system:

- Water storage capacity : 5000ltr
- Installed process water pump electrical power : 1.0 kW
- Power supply : 3 x 400/50Hz + N
- Motor control type compressor : DOL

Diesel system

Indicative specifications of the diesel system:

- Diesel storage capacity : 2000ltr, bunded

7. Commercial Return of Investment

TBC.

8. Abbreviations

SWIP	Small Waste Incineration Permit
RDF	Refuse Derived Fuel
CV	Calorific Value
N	Nitrogen
S	Sulphur
Cl	Chlorine
WFGT	Wet flue gas treatment
ID	Induced draft
CO	Cobalt
NOx	Nitrogen oxide
SO2	Sulphur dioxide
HF	Hydrogen fluoride
HCL	Hydrochloric acid
O2	Oxygen

TOC	Total organic compound
VFD	variable frequency drive
CEMS	Continuous emissions monitoring system
PLC	Programmable logic controllers
DAS	Data acquisition system