Schedule 13 SWIP Permit Application

Burcott Road, Avonmouth
PyroCore

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Burcott Road SWIP
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Quality Management

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NON-TECHNICAL SUMMARY

PyroCore manufacture small waste incineration plants (SWIP), more specifically, co-incineration plants. Prior to shipping to Client's sites for operation, units may be installed and undergo factory acceptance tests and performance validation trials with the permitted wastes at a test site located at 203 Burcott Road, Avonmouth, Bristol, BS11 8AD.

Each SWIP to be tested will be of the same container sized footprint design (Phoenix model) and will be based on the processes of material pyrolysis and subsequent high temperature oxidation of the raw syngas. The Phoenix model has a capacity to process up to 500 - 600 kg/hr of waste, baselined on polyethylene terephthalate.

Incineration and co-incineration plant with a capacity to process less than 3 tonnes per hour of waste require a Schedule 13 SWIP permit to operate from the local authority, in this case Bristol City Council (BCC).

During factory acceptance testing the facility will initially be commissioned and tested using clean (virgin) biomass fuel before introducing other waste materials. Waste feed stocks will predominantly comprise plastic based wastes. The maximum annual throughput will be less than 200 tonnes of waste and 300 tonnes of biomass.

Waste will be delivered by road and will be offloaded within the waste storage building into one of three storage bunkers. Biomass will similarly be delivered by road and stored separate to the waste in one of the bunkers. All waste and biomass will have been pre-shredded prior to delivery to the site and no further pre-treatment will be carried out onsite.

Waste will be fed into the pyrolysis reactor which will generate a char residue, typically called "charcoal" or "biochar", and hot syngas. All commercial charcoal around the world is manufactured using pyrolysis. The hot syngas will be drawn into the thermal oxidiser where it will mix with excess air and either auto ignite or be ignited by the burner to give hot combusted gases. Under normal operation, heat from the hot gases released from the thermal oxidiser will be used to pre-heat the pyrolysis reactor. At start-up heat to the thermal oxidiser will be provided by burning liquified petroleum gas (LPG) up to a maximum output of 1 MW_{th}.

In an emergency it may be necessary to divert the syngas to a vent line. A single 10m vent stack will be installed for emergency syngas venting.

The SWIP will need to operate under the terms and conditions of a Schedule 13 permit which requires compliance with the ELVs for pollutants specified by the IED for small waste incineration plant.

Effective pollutant abatement will be achieved through the injection of a sodium bicarbonate reactant to achieve acid gas neutralisation and powdered activated carbon to abate potential dioxins, furans, volatile heavy metals and volatile organic compounds (VOCs). A ceramic filter will facilitate removal of particulate bound heavy metals and other particulates and the reactants of the sodium bicarbonate, namely NaCl (sodium chloride), Na_2SO_4 (sodium sulphate).

Continuous monitoring of emissions [CEMS] to air will confirm that levels are within IED emission limits. Where continuous monitoring is not proposed, independent periodic monitoring will be undertaken.

Abated emissions will be released from a separate 10m flue gas stack.

An air quality assessment has been completed and confirmed that the emissions to air from the facility at both human health and ecological receptors was not considered significant.

As above the pyrolysis stage will produce a solid char residue which will be collected and initially landfilled but with a longer-term view to securing alternative re-use/recovery. Interest has already been established for sale of the wood-derived char and PyroCore already has 2 firm offers for purchase of the charcoal for use as a biochar for carbon sequestration within the UK. A second residue is produced from the flue gas cleaning plant, this residue is separately collected and landfilled.

PyroCore will implement an Environmental Management System (EMS) to direct the operation of SWIP prior to the facility coming into operation.

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1 INTRODUCTION

1.1 Background

1.1.1 PyroCore manufacture portable small waste incineration plants (SWIP). Prior to shipping to Clients sites for operation units may be installed and undergo factory acceptance tests and performance validation trials using the permitted wastes (see Table 3-1) at a test site located at 203 Burcott Road, Avonmouth, Bristol BS11 8AD.

1.1.2 Each SWIP will be of the same container-sized footprint design (Phoenix unit) and will be based on the processes of pyrolysis and high temperature oxidation followed by gas cleaning to IED limits. The Phoenix unit has a capacity to process up to 500-600 kg per hour (kg/hr) of waste/fuel.

1.1.3 Incineration and co-incineration plant with a capacity to process less than 3 tonnes per hour require a Schedule 13 SWIP permit to operate from the local authority, in this case Bristol City Council (BCC).

1.2 Site Location

1.2.1 The proposed testing facility will be located at a site at Unit 203C Burcott Road, Avonmouth, BS11 8AD within the administrative area of BCC. A location plan for the SWIP is provided in Drawing 1.

1.2.2 The site is located approximately 2km to the north of the centre of Avonmouth and over 10km to the northwest of the centre of Bristol. The site is within an industrial area with the closest residential receptors being located on McLaren Road in Avonmouth approximately 2km south of the site.

1.2.3 The site comprises of a large end of terrace industrial unit measuring 2,077.3 m^2. The accommodation within the building comprises of a warehouse; ground floor offices and amenities; and first floor offices. The property also has a large yard, it is understood that the dimensions the yard are 60m x 23m. The site is accessed from Burcott Road through the access gates into the yard with the building being accessed from the yard through 3 sizeable roller shutter doors on the eastern elevation.

1.2.4 The site is bound to the east by Burcott Road, and to the north and south by industrial premises, the unit directly adjoins a property to the north. The western boundary is formed by a small area of open green space with a waterbody, Mere Bank Rhine, within it. In addition, Avonmouth Docks are located approximately 1km to the south-west of the site.

1.2.5 The Environmental Agency's flood map shows that there is a small area of the site adjacent to Burcott Road located within Flood Zone 2 with the remainder of the site being in flood zone 1.

1.2.6 The site is not located in a DEFRA Air Quality Management Area (AQMA).

1.3 Applicant

1.3.1 The applicant and operator of the SWIP is PyroCore Ltd.

2 REGULATORY CLASSIFICATION

2.1.1 The testing facility will pyrolyse biomass and predominantly plastic based wastes (see Table 3-1. In any one year the testing facility will treat up to ~200 tonnes of waste and ~300 tonnes of biomass.

2.1.2 The Industrial Emissions Directive (IED) provides an exemption for certain types of testing facility under Article 42 (2) (b) where they meet the requirements below:

(b) experimental plants used for research, development and testing in order to improve the incineration process and which treat less than 50 tonnes of waste per annum.

2.1.3 Whilst the facility is used for testing, the testing is for commercial factory acceptance purposes not in relation to testing the incineration process for the purpose of identifying improvements. On this basis the facility would not fall under the above exemption.

2.1.4 Part A(1) activities are regulated by the EA and include the following processes:

Part A(1)

(a) The incineration of hazardous waste in a waste incineration plant or waste co-incineration plant with a capacity exceeding 10 tonnes per day.

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

(c) The incineration, other than incidentally in the course of burning landfill gas or solid or liquid waste, of any gaseous compound containing halogens.

2.1.5 The waste will be non-hazardous, and with a maximum feed rate of 500-600 kg/hr it falls below the threshold for a Section 5.1 Part A(1)(b) waste incineration or waste co-incineration plant.

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

(a) The incineration in a small waste incineration plant with an aggregate capacity of 50 kilogrammes or more per hour of the following waste;

(i) vegetable waste from agriculture and forestry;

(ii) vegetable waste from the food processing industry, if the heat generated is recovered;

(iii) fibrous vegetable waste from virgin pulp production and from production of paper from pulp, if it is co-incinerated at the place of production and the heat generated is recovered;

(iv) cork waste;

(v) wood waste with the exception of wood waste which may contain halogenated organic compounds or heavy metals as a result of treatment with wood preservatives or coatings;

(vi) animal carcasses.

2.1.7 The waste to be processed is not included within the list of wastes that fall under the Part B scheduled activities. The biomass to be used is clean virgin wood chip and/or straw.

2.1.8 Schedule 13 of the Environmental Permitting Regulations (EPR) 2016 (as amended) sets out the criteria for inclusion under the Schedule.

(1) This Schedule applies in relation to -

(a) every small waste incineration plant, and

(b) every waste incineration plant or waste co-incineration plant,

to which Chapter IV of the Industrial Emissions Directive applies, except those which are operated as a domestic activity in connection with a private dwelling.

2.1.9 A small waste incineration plant is defined within the EPR as follows:

“small waste incineration plant means a waste incineration plant or waste co-incineration plant with a capacity less than or equal to 10 tonnes per day for hazardous waste or 3 tonnes per hour for non-hazardous waste.

2.1.10 The proposed testing facility will fall within this definition and therefore is subject to the permit requirements applicable to SWIPs.

2.1.11 Schedule 13 SWIP facilities are generally regulated by the LA. The regulator for this permit will be BCC.

2.1.12 SWIPs are subject to the requirements of Chapter IV of the IED, as identified in Schedule 13 of the EPR. Information in the subsequent sections of this report set out how the proposed SWIPs comply with these requirements.

3 OPERATION

3.1 Overview

3.1.1 The SWIP testing facility will only operate to undertake factory acceptance testing (FAT) of new containerised SWIP units (Phoenix model) prior to shipping to the purchaser's site. Each unit to be tested will be brought to the test site, installed and operated for testing.

3.1.2 FAT of a unit at the Avonmouth site will only be conducted where there are significant design modifications versus the previously tested unit. Some elements of the design will be retained across units; for example, the location, dimensions and release point elevation of the flue gas stack will remain the same. Although units being tested will have been modified, this will not necessarily include changes to the thermal oxidiser design.

3.1.3 Each new unit is expected to be on the site for typically up to 12 weeks, albeit during this time waste processing will only happen for a limited duration. Testing of the units will typically take 2-3 weeks duration with circa 3-9 days operation using virgin biomass and circa 2-6 days using PET/mixed plastic waste to establish performance criteria. Whilst this is the typical duration of testing, it is expected that the first unit will require longer testing for virgin wood chip and/or straw and PET/mixed plastics and on occasion there may be other reasons why a unit might need to be tested for a longer period. In any event the total number of weeks when testing is carried out will be no more than 18 weeks in any year.

3.1.4 During testing the unit would typically be operated on weekdays (Monday-Friday). Run times when burning waste and biomass during testing will vary, as will the feedrate into the process. Test feed rates at 25% or 50% of the capacity are likely for some tests, albeit at least one test at full capacity would be carried out. Test durations of 4, 8, 12, 24 and 48 hours running time for biomass and 6 and 12 for waste are expected. As a consequence, the maximum tonnage of waste and biomass as stated in this application will not be exceeded, despite the plant being capable of processing much higher amounts should it be operated at full capacity, 24 hours per day for 18 weeks. Waste acceptance records and records of deliveries of biomass will be available to demonstrate that the maximum tonnages of materials accepted remain at or below the tonnages being applied for.

3.1.5 In addition, during testing it is possible that the unit may be left in idle mode (no waste feed) over night to maintain a minimum temperature.

3.1.6 The principal activities proposed are as follows:

- Waste reception and storage;
- Waste transfer and charging;
  - Pyrolyser (skid mounted unit);
  - Thermal oxidiser;
- Char recovery and storage ;
- Exhaust gas cleaning and stack;
- Emergency syngas vent.

3.1.7 A process flow diagram (PFD) of the proposed SWIP testing facility is provided in Drawing 4.

3.1.8 Operational responsibility for the SWIP testing facility will sit with PyroCore Ltd.

3.2 Waste Reception, Storage and Handling

3.2.1 Waste and biomass will be delivered by road. On arrival at the site the waste transfer paperwork will be checked and assuming the waste complies with the waste types expected and included on the permit the delivery will be directed to the waste storage building.

3.2.2 The weight of the waste will be recorded based on the weight provided on delivery notes.

3.2.3 The wastes to be accepted and used for testing of the SWIPs will be PET and mixed plastics under the following EWC codes:

Table 3-1: EWC Codes to be Accepted at the SWIP Testing Facility

EWC	Waste Description
020104	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing
040209	Wastes from composite materials (impregnated textile, elastomer, plastomer)
070213	Wastes from the MFSU of plastics, synthetic rubber and man-made fibres
101103	Waste glass-bound fibrous materials
120105	Wastes from shaping and physical and mechanical surface treatment of metals and plastics
150102	Packaging (including separately collected municipal packaging waste)
160119	End-of-life vehicles from different means of transport (including off-road machinery) and wastes from dismantling of end-of-life vehicles and vehicle maintenance (except 13, 14, 16 06 and 16 08)
170203	Construction and demolition wastes (including excavated soil from contaminated sites)
170904	Mixed construction and demolition waste
191204	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
200139	Municipal Wastes (Household Waste and similar Commercial, Industrial and Institutional Wastes) Including separately collected fractions

3.2.4 Virgin biomass in the form of wood chip and/or straw will also be accepted and used for testing the SWIP units.

3.2.5 The composition of the waste and biomass will be provided by the supplier. This would be checked against the feed specification for the SWIP.

3.2.6 PyroCore will not accept any wastes requiring ammonia (or urea) dosing for NOx abatement. This will be managed by ensuring all waste contracts have a clear specification including limits on the nitrogen content of waste.

3.2.7 Waste and biomass will be offloaded within the waste acceptance building. Biomass and waste will be separately stored in one of three bunkers within the building.

3.2.8 Material will be visually checked during offloading (e.g. for particle size, moisture content, tramp materials). A moisture meter will be used to check moisture content. Bulk density will be checked by filling a container of known volume with a sample of the load and weighing it.

3.2.9 A telehandler with bucket will be used to transfer the waste or biomass to the feed hopper. The feed hopper will discharge onto a covered belt conveyor which transfers the biomass or waste to the pyrolysis feed system.

3.2.10 The pyrolysis feed system comprises two interlocked knife gate valves, an intermediate feed hopper and a receiving feed screw. The knife gate valves operate semi continuously with only one in operation and an interlock to prevent concurrent opening and thereby minimising air entrainment into the pyrolysis reactor. In addition, nitrogen supplied from a small nitrogen generator will also be added into the feed hopper to protect against minor ingress of air into the process.

3.2.11 A shafted, rotating screw feeder will transfer the waste/biomass from the feed trough into the pyrolysis reactor.

3.3 Thermal Treatment

3.3.1 The thermal treatment process comprises the pyrolysis reactor (including the insulated annulus around it), the char cyclone and the thermal oxidiser.

3.3.2 The pyrolysis reactor will operate at a temperature between 700-900°C (within the kiln annulus), subject to the feedstock and testing requirements and at a slightly sub-atmospheric pressure. Hot combustion gases from the thermal oxidiser provide the heat to the pyrolysis reactor. The hot combustion gases are fed from the thermal oxidiser into the refractory lined and insulated annulus around the pyrolysis reactor. The waste or biomass feedstock rapidly thermally degrades in the reactor producing syngas and a residual char.

3.3.3 The syngas and coarse char generated in the pyrolysis reactor are first separated in the char separator. The syngas and residual fine char are then separated in the trace heated high efficiency cyclone. The char cyclone is designed to discharge char continuously into the collection drum, but also has the ability to hold a limited amount of char to facilitate exchange of the collection drum, if required during operation (see further detail in the section 3.66 below).

3.3.4 Syngas separated from the char will be transferred from the cyclone to the thermal oxidiser. The thermal oxidiser combusts the syngas with air at high temperature, nominally in the range of 900-1,100°C. Air is introduced via a damper control and forced draft fan to optimise temperature control. The excess oxygen concentration in the thermal oxidiser is also continuously monitored.

3.3.5 The thermal oxidiser is designed to achieve a minimum temperature of 850°C for at least 2 seconds, as required by Article 50 (2) of the IED. A 'hot combustion chamber volume' of circa $21m^3$ is provided to allow this to be achieved. The manufacturer has guaranteed this will be achieved. Additional residence time is also available within the hot duct to the pyrolysis reactor

3.3.6 The maximum flowrate through the thermal oxidiser when processing PET have been established based on a theoretical heat and material balance. The maximum flowrate on this basis is 34,691 Am^3/hr ($9.63Am^3/s$). On this basis the residence time in the thermal oxidiser is calculated at $21m^3$ / $9.63Am^3/s$ = 2.18s i.e. in excess of 2 seconds residence time.

3.3.7 The theoretical residence time calculation will be validated during 'hot' unit FAT for the first unit via measurement of system temperatures and the flue gas flowrate. All units subject to FAT testing at the site will utilise the same thermal oxidiser design.

3.3.8 During start-up and shutdown (or in the event of low syngas production) the thermal oxidiser will be operated on liquid petroleum gas (LPG). The thermal oxidiser temperature control will maintain the exit temperature at or above 850°C during normal waste processing, LPG will also be automatically used if the temperature of the combustion gases in the 'hot volume' falls below 850°C, in compliance with Art 50(3) IED for wastes.

3.3.9 The waste feed will be automatically prevented using software interlocks in the following circumstance (in accordance with Art 50(4) IED):

- at start-up, until the temperature in paragraph 3.3.5 is met;
- whenever temperature of 850°C is not maintained while running on wastes; and
- whenever the continuous measurements show that any emission limit value is exceeded due to disturbances or failures of the waste gas cleaning devices.

3.3.10 Under certain emergency (abnormal) conditions, it may be necessary to immediately shutoff the supply of syngas from the thermal oxidiser, to prevent generation of further heat. Under these emergency circumstances, syngas will be diverted to a nitrogen purged vent taken from the top of the char separator. Twin venting valves (normally closed) have been installed in parallel to increase the reliability of a venting route being made available for the syngas upon demand. The syngas venting system will also provide over-pressure protection of the pyrolysis equipment.

3.3.11 The emergency syngas vent will be continuously nitrogen purged and have a release point 10m above ground level. Dispersion analysis of a representative syngas emission has been conducted to demonstrate that toxicity and flammability effects are not significant.

3.4 Flue Gas Cooling

3.4.1 To enable heat removal from the combusted gases during testing, a closed recirculating cooling fluid system with blast air cooler for heat rejection will be installed. Cooling fluids will either be a glycol water mixture or a thermal oil.

3.4.2 Hot flue gases leaving the insulated annulus around the pyrolyser unit will be cooled by the flue gas cooling system to 200-300°C prior to undergoing flue gas cleaning.

3.4.3 The operation of this package will be automated, with facility to switch on or off as required from the main plant PLC.

3.5 Flue Gas Cleaning

3.5.1 Flue gas cleaning will be provided to ensure emissions to air will meet IED limits. The flue gas cleaning system will comprise the injection of a mixture of sodium bicarbonate and powdered activated carbon followed by a ceramic filtration system to recover all dust, reactants and products.

3.5.2 The sodium bicarbonate [$NaHCO_{3(s)}$] is used to neutralise acid gases (SOx, HCl, etc.) which may be produced by certain wastes, whilst activated carbon removes dioxins, furans, volatile heavy metals and volatile organic compounds. The fine powder mixture is injected dry into the gases after the heat exchanger and prior to the ceramic filter system.

3.5.3 The ceramic filter is used to remove any dust entrained in the flue gases as well as any residual flue gas treatment reagent (sodium bicarbonate/activated carbon mixture) and the resultant products, i.e., Na_2SO_4, NaCl, NaF and other inert salts.

3.5.4 Cleaned gases will be drawn through an ID fan and discharged to atmosphere via single 10m stack.

3.6 Solid Residues Management

3.6.1 The solid residues are generated by the SWIP testing facility comprise char from the pyrolysis reactor, fine char dust from the cyclone and a gas cleaning residue from the flue gas cleaning plant.

3.6.2 Char will be discharged off the end of the pyrolysis reactor screw into the char separator. A cooled screw conveyor will transfer the char to the removable storage container and discharge via a telescopic chute which can be raised and lowered in and out of the container. The cooling system is designed to cool the char to a temperature of <60°C.

3.6.3 A slide valve will be installed in the chute above the char collection container to isolate the discharge to facilitate change-over of the collection container. A level probe will be in place to detect when the bin is full.

3.6.4 Proximity switches will be installed to indicate the position of the telescopic chute and to confirm the bin is in place. The proximity switches will be interlocked with the slide valve to prevent opening of the valve in the event that either the chute is not lowered or a receiving bin is not in place.

3.6.5 The fine dust removed from the cyclone drops out from the bottom and will be collected in a metal drum. A similar configuration of cooling screw, slide valve, telescopic chute and associated interlocks will be provided as per the main char residue described above.

3.6.6 Air Pollution Control (APC) residues will be collected in sealed 1 tonne dumpy bags and stored within the building. Under normal conditions, both char and APC residues will be stored inside. However, on occasions there may be the need to store externally. Any char stored externally will be stored in sealed drums. APC will be stored in sealed dumpy bags.

Table 3-2: Typical Amounts of Recovered Materials and Residual Wastes from the SWIP

Product Description	Expected Tonnes per Annum	Material End Use
Char	50 tonnes when processing waste and 75 tonnes when processing biomass	Initially sold when using wood, but with a longer term view to securing alternative re-use/ recovery subject to the client's requirements. Other waste char sent for disposal offsite.
Air pollution control residues	20 – 60 tonnes	Landfill as a recognised hazardous waste

3.7 Instrumentation

3.7.1 The SWIP will be equipped with a range of process instrumentation to monitor key parameters to ensure that the thermal treatment plant is operating as designed. Instruments are installed to provide continuous information to the PLC system, which monitors and adjusts key operational parameters to ensure efficient combustion of the waste at all times. The instruments will supply data to the PLC-based process control system overseen by SCADA supervisory control. This will control the combustion process and associated pollution control systems and derive key metrics for optimisation and monitoring of the combustion process by shift personnel.

3.7.2 Out of hours in the event that the SWIP is left in idle mode the plant will be remotely monitored by a trained site operative. The plant will be fully capable of being controlled remotely, including the ability to shut down the SWIP and/or respond to plant alarms. Where required the site operative would attend the SWIP out of hours.

3.8 Emissions to Air

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

Table 3-3: IED Compliance Limits

Pollutant	Scenario 1 Short-Term Emission Limits ($mg.Nm^{-3}$)	Scenario 2 Daily-Mean Emission Limits ($mg.Nm^{-3}$)
Particles	30	10
TOC	20	10
HCl	60	10
HF	4	1
SO_2	200	50
NO_x	400	200
CO	100	50
Group 1 metals (a)	-	0.05 (d)
Group 2 metals (b)	-	0.05 (d)
Group 3 metals (c)	-	0.5 (d)
Dioxins and furans	-	0.0000001 (e)

Notes: All concentrations referenced to temperature 273 K, pressure 101.3 kPa, 11% oxygen, dry gas.
(a) Cadmium (Cd) and thallium (Tl).
(b) Mercury (Hg).
(c) Antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), and vanadium (V).

(d) All average values over a sample period of a minimum of 30 minutes and a maximum of 8 hours.

(e) Average values over a sample period of a minimum of 6 hours and a maximum of 8 hours. The emission limit value refers to the total concentration of dioxins and furans calculated using the concept of toxic equivalence (TEQ).

3.8.2 Effective control of emissions to air will be achieved via the thermal oxidiser and flue gas treatment plant as detailed within Section 3.3 and 3.4.

3.8.3 An assessment of impacts on air quality from the operation of the SWIPs is included in Appendix B. The assessment included consideration of stack height and concluded that a 10 m stack was appropriate for this site. Modelling was therefore carried out on the basis of a 10m stack.

3.8.4 The assessment considered impacts at both human health and ecological receptors. Modelling was based on a number of conservative assumptions and overall concluded that the effects from operation of the SWIP are not considered significant.

3.9 Emissions to Water and Sewer

3.9.1 There will be no emissions to surface water, groundwater or sewer from the SWIPs.

3.9.2 Any condensate collecting in the main stack or emergency vent will be intermittently drained into a container and disposed of. Similar aqueous arisings from the heat exchanger coolant loop, chilled water package for char cooling or from the air compressor unit would be separately collected and disposed of.

3.9.3 In the event of a fire, contaminated fire water from firefighting would be contained on the site (see details in section 4.4).

3.10 Monitoring

3.10.1 To enable demonstration of compliance with the IED emission limit values, an IED compatible, MCERTS Continuous Emissions Monitoring System (CEMS) will be installed in the exhaust stack to enable continuous monitoring and recording of emissions concentrations for the following pollutants:

- Oxides of nitrogen (NO_X);
- Sulphur dioxide (SO_2);
- Carbon Monoxide (CO);
- Particulates;
- Hydrogen chloride (HCl);
- Total organic carbon (TOC); in addition to,
- Water vapour (H_2O) (unless measured dry);
- Oxygen;
- Temperature; and,
- Pressure.

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

3.10.3 PyroCore will not accept any wastes requiring ammonia (or urea) dosing for NOx abatement at site. So there is no requirement for ammonia monitoring.

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

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

3.10.6 The proposed CEMS is capable of measuring all of the above gaseous species and is MCERTS-accredited. The monitoring equipment will be certified to EN15267-3 as required by EA Guidance 'Monitoring stack emissions: technical guidance for selecting a monitoring approach'[1]. Periodic monitoring will be carried out in accordance with EA Guidance 'Monitoring stack emissions: techniques and standards for periodic monitoring' [2]. The monitoring frequencies and methods are provided in Table 3-4 below.

Table 3-4. Monitoring Frequency

Emission Point	Parameter	Monitoring Frequency	Method
A1	Particulates; Total organic carbon; Oxides of nitrogen; Sulphur dioxide; Hydrogen chloride; Carbon monoxide; Oxygen; Pressure; Temperature; Water vapour content (unless measured dry).	Continuous daily and half hourly average for all parameters	MCERTS certified CEMS equipment (BS EN 14181, BS EN 15267-3)
A1	Hydrogen fluoride (HF); Polycyclic aromatic hydrocarbons (PAHs); Trace metals; Dioxins and furans.	Bi-annually (periodic)	In accordance with EA guidance 'Monitoring stack emissions: techniques and standards for periodic monitoring'[2] • HF: BS ISO 15713 • PAHs: BS ISO 11338-1 and BS-ISO 11338-2. • Metals: BS EN 14385, BS EN 13211 (Hg) • Dioxins and furans: BS EN 1948 Parts 1, 2 and 3

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

3.10.8 To enable periodic compliance check monitoring to be undertaken, the exhaust stack is equipped with sample ports. The location of the sample ports will ensure that a full traverse on both sampling planes can be achieved during the annual compliance monitoring programme that will be a condition of the permit. A permanent sampling platform has been installed to enable full and unfettered access to the sample ports by the specialist contractors appointed to undertake the compliance monitoring programme.

[1] Environment Agency Guidance, Monitoring stack emissions: technical guidance for selecting a monitoring approach, December 2019. https://www.gov.uk/guidance/monitoring-stack-emissions-technical-guidance-for-selecting-a-monitoring-approach

[2] Environment Agency Guidance, Monitoring stack emissions: techniques and standards for periodic monitoring, December 2019 https://www.gov.uk/government/publications/monitoring-stack-emissions-techniques-and-standards-for-periodic-monitoring/monitoring-stack-emissions-techniques-and-standards-for-periodic-monitoring

3.10.9 All monitoring results will 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.

3.10.10 The emission limit values for air shall be regarded as being complied with if the conditions described in Part 8 of Annex VI IED are fulfilled.

3.10.11 During periods when waste and/or biomass is stored on the site, the PyroCore Site Manager will undertake a routine daily inspection of the site which includes visual monitoring for dust. Details of inspections are recorded in line with PyroCore's Environmental Management System (EMS).

4 ENVIRONMENTAL MANAGEMENT

4.1.1 PyroCore Ltd. will implement an Environmental Management System (EMS) to direct the operation of the SWIP.

4.2 Operations and Maintenance

4.2.1 Procedures will be put in place to ensure that those operations associated with the SWIP which have the potential to give rise to significant environmental effects are controlled. Procedures will cover testing activities including start-up and shutdown and will also address accidents and incidents.

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

- Waste and biomass reception, handling and storage within the waste storage building;
- Good housekeeping measures;
- Maintenance of key plant and equipment; and
- Handling of char, cyclone dust and flue gas treatment residues and removal of residues from the site.

4.2.3 Regular site inspections will be undertaken to check that the site remains in good working order.

4.2.4 Housekeeping measures that will be implemented on site include:

- The waste and biomass storage areas will be kept clean and tidy;
- Any spillages of materials and wastes will be immediately cleaned up;
- The Site Manager will undertake site inspections which will include checking for dust and litter across site and implementing corrective measures should any be identified. The site inspections will be recorded on the site inspection form; and
- As part of the factory acceptance test the SWIP units will be inspected daily during testing on biomass and waste.

4.2.5 Key plant/infrastructure that will be subject to routine inspection will include:

- Routine inspection of the waste storage building fabric;
- Routine inspection and maintenance of the building doors to the waste storage building to ensure they remain in good working order; and
- Routine inspection of the SWIP will be undertaken during each trial to ensure that no significant air in-leakage points exist and that key systems are working effectively (ID fan, reagent injection systems).

4.2.6 Records of inspections and checks for each trial will be retained in the site office.

4.3 Training and Competence

4.3.1 The Operator will ensure that all personnel employed to operate the SWIP have appropriate skills and technical capabilities to understand the operation of the process, and their obligations under the terms and conditions of the Permit. The operators will therefore be suitably qualified and experienced personnel (SQEP). This will be managed via an update to the existing management systems.

4.3.2 On-site operational staff will be trained for normal operation as well as routine interventions, response to alarm conditions, and start-up and shut down procedures. Training records of the personnel involved will be recorded and copies kept on site. Only SQEPs will be permitted to operate the plant. Following commissioning of the plant any new operational staff will be trained under the supervision of experienced operational staff.

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

4.4 Accidents and Incidents

4.4.1 The SWIP has been designed to be fully compliant with the relevant operational requirements of the IED.

4.4.2 Site staff and visitors must complete the Site Induction Plan and training.

4.4.3 An Accident Management Plan (AMP) will be developed as part of the EMS. The AMP will detail management procedures for the prevention of accidents as well as the procedures in the event of an accident. Of note the AMP will set out procedures in the event of a fire including measures for containment of fire waters. It is proposed that fire waters would be contained using inflatable poly booms, see details in Appendix C. PyroCore has purchased poly booms of sufficient length to enclose the perimeter of the facility. Spent fire waters would be removed by a specialist third party contractor.

4.4.4 The Operator will undertake frequent inspections of the SWIP to mitigate against potential problems with the process equipment that may adversely affect performance. This will include a programme of preventative maintenance of major components of the installation.

4.5 Review and Record Keeping

4.5.1 The site inspections will be recorded in the Site Manager's Site Diary.

4.5.2 The site inspection will include:

- Compliance with the environmental permit and EMS;
- Waste and biomass storage;
- LPG storage;
- Sodium bicarbonate and activated carbon storage;
- Signage;
- Integrity of waste storage building fabric including floor surfaces;
- Dust and odour emissions as well as presence of litter and pests (should there be any); and
- Complaints received.

4.5.3 Records will be retained at least 6 years from the date the records were made, or in the case of the records pertaining to off-site environmental and health effects, until the permit is surrendered.

4.5.4 BCC may request copies of the site diary and site inspection records relating to SWIP operations at any time.

4.6 Energy Recovery

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

4.6.2 Given the SWIP testing facility will only be operated for short periods at a time to undertake acceptance tests of a unit the potential to secure uses for the energy generated is limited. However, as described in Section 3, the facility is designed to make use of heat from the hot combustion gases to sustain the pyrolysis stage.

4.6.3 Although further energy recovery is limited by the nature of the operations at the facility, each SWIP unit would be capable for providing heat either for direct use by an end user or to generate electricity at the end users' sites should this be feasible.

4.6.4 Basic energy efficiency measures will be in place at the site. The facility will only operate when needed, hot systems will be insulated to prevent gross heat losses and energy efficient lighting will be provided.

4.7 Raw Material Management

4.7.1 Other than waste and biomass the raw materials will be used at the SWIP testing facility are identified in Table 4-1. Expected usage, storage arrangements and capacities are also identified in this Table.

Table 4-1 – Raw Materials

Raw Material	Net storage capacity in m^3	Maximum storage capacity (tonnes)	Storage Arrangements	Annual Consumption
Sodium Bicarbonate and Powdered Activated Carbon	2.0	8.0	Sealed 1 tonne dumpy bags, waterproof and stored inside the building	20 - 60
LPG	11.7	5.81	3x4,600 litre tanks (max. 85% fill)	25-75

Drawings

Drawing 1 Site Location Plan

Drawing 2 SWIP Layout Plan Indicating the Boundary and Emission Points

Drawing 3 Drainage Plan

Drawing 4 Process Flow Diagram

Appendices

Appendix A

Application Form

Appendix B

Air Quality Assessment

Appendix C

Poly Boom Datasheet