standard gas

Application Support Document

Scottow Enterprise Park

1st May 2025

Project No.: SOL_24_P090_STA

...consulting sustainability

sol environment

Document details	
Document title	Application Support Document
Document subtitle	Scottow Enterprise Park
Project No.	SOL_24_P090_STA
Date	1st May 2025
Version	QMS_7.5.38_TEM – Template – Report Long Form – New Style (Perm) v1
Author	Sol Environment Ltd
Client Name	Standard Gas SG No.1 Limited

Document history					
Version	Revision	Author	Reviewed by	Date	Comments
I1	First Issue to the EA	Jessica Easterbrook	Steve Butler	1st May 2025	First Issue to the EA

Signature Page

1st May 2025

Application Support Document

Scottow Enterprise Park

Name: Jessica Easterbrook
Job title: Senior Environment Consultant

Name: Steve Butler
Job title: Director

This report has been prepared by Sol Environment with all reasonable skill, care, and diligence, and taking account of the Services and the Terms agreed between Sol Environment Ltd and the Client. This report is confidential to the client, and Sol Environment accepts no responsibility whatsoever to third parties to whom this report, or any part thereof, is made known, unless formally agreed by Sol Environment Ltd beforehand. Any such party relies upon the report at their own risk.

Sol Environment disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the Services

CONTENTS

NON-TECHNICAL SUMMARY III

1. INTRODUCTION 1

2. SITE DESCRIPTION 7

2.1 Site Setting 7
2.2 Site History 7

3. PROPOSED ACTIVITIES 8

3.1 Type of Permit 8
3.2 Installation Boundary 9
3.3 Infrastructure and Design 9
3.3.1 Site Drainage Arrangements 9
3.3.2 Tanks and Bunds 10
3.3.3 Roadways and External Areas 10
3.4 Raw Materials 11
3.5 Description of the Process 15
3.6 Controls and Environmental Management System 29
3.7 Operator Competence 29
3.8 Site Security 30
3.9 Accidents and Emergencies 30

4. EMISSIONS AND THEIR ABATEMENT 32

4.1 Emissions to Air 32
4.2 Emissions to Controlled Waters 33
4.3 Emissions to Sewer 34
4.4 Emissions to Land 34
4.5 Fugitive Emissions 34
4.5.1 Odour 34
4.5.2 Noise 35
4.6 Waste / By-Product Generation and Management 35

5. ENVIRONMENTAL MONITORING 37

5.1 Emissions to Air 37
5.2 Emissions to Controlled Waters 38
5.3 Emissions to Sewer 38
5.4 Emissions to Land 39

6. BEST AVAILABLE TECHNIQUES AND APPROPRIATE MEASURES APPRAISAL 40

7. IMPACT TO THE ENVIRONMENT 49

7.1 Impacts to Air 49
7.1.2 Sensitive Human Health Receptors 49
7.1.3 Sensitive Habitat Sites 50
7.2 Impacts to Controlled Waters 51
7.3 Impacts to Sewer 51
7.4 Impacts to Land 51
7.5 Fugitive Emissions, Noise and Odour 51

List of Tables

Table 2.1 Existing Planning 7
Table 3.1 Listed Activities 8
Table 3.2 Incoming Waste Feedstock Specification 11
Table 3.3 Proposed Feedstock EWC Codes and Types 11
Table 3.4 Raw Materials Summary 14
Table 3.5 Syngas End of Waste Specification 24
Table 4.1 Stack Emission Parameters for A1 (Pyrolyser) and A2 (CHP Engines Combined) 32
Table 4.2 IED Emission Limits – Abnormal Operating Conditions 33
Table 4.3 Waste / By-Product Summary 36
Table 5.1 Monitoring Frequency 38
Table 6.1 Non-Hazardous and Inert Waste: Appropriate Measures for Permitted Facilities 40
Table 6.2 Waste Incineration BREF BAT Conclusions 45
Table 7.1 Human Health Receptors 49
Table 7.2 Sensitive Habitat Receptors 50

List of Figures

Figure 1.1 Site Location 3
Figure 1.2 Proposed Site Installation Boundary 4
Figure 1.3 Proposed Internal Site Layout 5
Figure 1.4 Proposed External Waste Storage Yard Layout 6
Figure 3.1 Process Flow Diagram 16

Acronyms and Abbreviations

Name	Description
CHP	Combined Heat and Power
SRF	Solid Recovered Fuel
RDF	Refuse Derived Fuel
ATT	Advances thermal treatment
SG	Specified Generator
MCP	Medium Combustion Plant
EA	Environment Agency
EMS	Environmental Management System
IED	Industrial Emissions Directive
EPR	Environmental Permitting Regulations
ELV	Emission Limit Values

NON-TECHNICAL SUMMARY

Standard Gas SG No.1 Limited (Standard Gas) is making a New Bespoke Installation Permit Application for the proposed operation of a synthesis gas fired CHP facility that incorporates Advanced Thermal Treatment (ATT, pyrolysis) at their Hangar 2 site, Scottow Enterprise Park, Norfolk.

The proposed Installation is located at Hangar 2, Lamas Road, Badersfield, Scottow, Norfolk, NR10 5FB (National Grid Reference: TG 26104 23008).

Standard Gas's pyrolysis technology is a proven Advanced Thermal Treatment plant which thermochemically produces cracked and cleaned syngas from pre-processed non-hazardous solid wastes, principally Refuse Derived Fuel (RDF) and other similar combustible material to operate a series of gas fired CHP engines to generate power and provide heat to the wider Scottow Enterprise Park.

The Installation has been designed to process approximately 50,000 tonnes of pre-processed non-hazardous waste per annum (energy mass balance of the plant assumes an average of 6 tonnes per hour with a typical GCV of 11 – 15MJ/kg) to generate approximately 5MWe of renewable electricity and approximately 2.5MWth of heat.

The Standard Gas pyrolysis technology will produce a clean '*End of Waste'* synthesis gas and therefore meets the definition of an Installation as defined by Section 1.2 '*Gasification, liquefaction and refining activities*' paragraph A(1)(f)(iv) namely:

'Activities involving the pyrolysis, carbonisation, distillation, partial oxidation or other heat treatment of other carbonaceous materials.'

On the basis that all gas combusted by the process meets the *'End of Waste'* criteria, the CHP engines will be regulated as Medium Combustion Plant (MCP) and Specified Generators (SG) and operated in accordance with the Environmental Permitting (England and Wales) Regulations 2018 (As Amended).

A commissioning and validation process is currently underway which has been agreed by the Environment Agency (EA) under the conditions of a Local Enforcement Position (LEP) and in accordance with Regulatory Position Statement 182 '*Carrying out research or trials with waste at sites without an Environmental Per*mit'.

The LEP agreement allows Standard Gas to carry out a controlled and time limited commissioning test of their syngas production module (SG100). The test will confirm overall energy mass balance of the process in addition to demonstrating the cleanliness of the syngas produced by the plant will be comparable to natural gas and therefore meeting '*End of Waste'* criteria. All evidence from the R&D trial will be available to the EA during the determination of the permit.

General Overview

Standard Gas have developed a facility that will produce clean gas for the purposes of generating renewable heat and power from pre-processed non-hazardous wastes. The Installation has been designed to process approximately 6 tonnes per hour of pre-prepared non-hazardous wastes, which will be thermally treated / pyrolysed at elevated temperatures to produce a cracked and clean synthetic gas that satisfies the EU Industrial Emissions Directive Article 42(1) requirements.

Accordingly, the resultant syngas will be purified to the extent that it will no longer be classed as a waste, and its combustion will result in emissions no higher than those resulting from the combustion of natural gas.

The relevant listed activity for the Installation is defined by Section 1.2 Part A(1)(f)(iv). All emissions from the combustion activities shall be in accordance with the MCP Directive, noting that Chapter IV of the Industrial Emissions Directive (IED) does not apply where Article 42 (1) is achieved – deeming syngas as no longer a waste and causing emissions no higher than combustion of natural gas.

Under Abnormal Operating Conditions it is anticipated that the Installation will be required to mirror the Emission Limit Values (ELV) prescribed by Chapter IV of the IED.

The CHP facility is an anchor development for the regeneration of the wider Scottow Enterprise Park and will be the source all of all heat and power for the proposed new developments.

All feedstock will either be delivered to site loose or in pre-prepared sealed bales. Bales will either be stored externally within a designated sealed storage area or internally within the main processing building. All loose waste will be stored internally within a dedicated bay within the main processing building. All feedstock will be inspected via a dedicated quality assurance site operative. When ready for processing, the feedstock will be loaded into a sealed and contained hopper, de-baled if required, and pre-processed via screening equipment. Once processed, the feedstock will be transferred into the primary pyrolysis retort where it undergoes thermal conversion and processed into syngas. In order to ensure that there is no secondary formation / reformation of tars and oils within the syngas, the syngas is then passed through multiple heat exchangers to elevate and thermally crack and to ensure the effective thermal decomposition of all long chain hydrocarbons. Once cracked, the syngas is quenched and rapidly cooled to remove any residual carbon and solids in the gas stream.

Any residual contamination in the syngas such as acid gases, halides and particulates are fully scrubbed from the gas using conventional ‘wet’ scrubbing abatement techniques. The elevated temperature of the gas cracking and quenching stages ensures that condensable hydrocarbons (tars and oils) do not reform in the gas and that the downstream gas cleaning system are effective in conditioning the gas.

The mineral fraction/inert material (ash, glass, stone etc) present within the waste is retained within the carbon char stream and removed from the pyrolysis system via a water cooled sealed screw conveyor and stored in a sealed container. The pyrolysis char is a high carbon, low ash material that is intended to be sold into the construction sector and used as a low carbon aggregate additive product. Any ash or particulate that may be entrained within the syngas will be removed through the syngas abatement system.

The syngas is then cooled further to below the dew point and any condensate collected. The condensate is low volume, clean and odour free. The condensate is discharged to a sealed vessel and returned into the scrubber liquor systems and reused within the process or collected and transferred offsite for offsite disposal at a suitably qualified third-party treatment process, as required. Syngas quench and scrubber liquors are all cooled using a non-contact heat exchanger connected to a evaporative cooling system and returned and recirculated through the process.

All syngas is monitored in real time using gas chromatography to ensure that the CV and gas composition are consistent with the requirements of the gas engines. The clean syngas is then combusted within the two Jenbacher type Gas Engines for the production of renewable electricity and heat.

During start-up scenarios, the pyrolysis plant is brought up to temperature using LPG auxiliary fuel supplied from an onsite tank farm. Once at temperature, the pyrolysis plant is operated using clean synthesis gas.

All electricity produced by the CHP engines is exported to local distribution network via the onsite 11kV transformer.

Emissions to Air

Emissions arising from the combustion of the syngas within the pyrolysis plant and gas engines will have no more environmental impact than those arising from the combustion of natural gas. Emissions from the pyrolysis plant and gas engines are low in pollutant concentrations by nature, similar to natural gas fired processes and are free from particulate, acids gases, halides, volatile organic compounds and dioxins / furans.

Emissions to atmosphere from the plant are via two emission points, the pyrolysis plant flue stack (Emission Point A1) and the multi-flue CHP engine flue stack (Emission Point A2). The site is also equipped with an emergency flare (Emission Point A3) for operation during start-up, shutdown and emergency scenarios.

All emissions from the combustion activities will be in accordance with the Medium Combustion Plant Directive (MCP) noting that Chapter IV of the Industrial Emissions Directive (IED) does not apply whereby Article 42 (1) is achieved.

Under Abnormal Operating Conditions it is anticipated that the plant will be required to mirror the Emission Limit Values (ELV) prescribed by Chapter IV of the IED.

Atmospheric emissions from the pyrolysis plant are continuous monitored using MCERTS certified CEMS equipment to ensure that MCPD emission limits are complied with and to ensure that the combustion products are free from acid gas and halide emissions such that that gas quality and cleanliness can be assured.

Fugitive Emissions

The operation of the site will not lead to any offsite odour impacts. All wastes accepted and processed by the facility are screened and free from organic (food waste) materials and are low odour in their nature. The only external activities on site relate to the storage of sealed feedstock bales. All incoming baled waste feedstock is required to be well wrapped and subjected to waste pre-acceptance and acceptance checks as well as visual site inspections. Any damaged, poorly wrapped or odorous bales are immediately removed and placed internally for processing. Any loose waste will be stored within a dedicated bay within the main processing building and be fully enclosed.

Vehicles delivering waste to site will be enclosed. On the basis of the above, there will be no fugitive emissions from either the transport, storage or movement of wastes.

All processing of wastes will take place internally. The internal processing of wastes reduces the opportunity for any fugitive dust and odour emissions being generated. Although baled feedstock will be stored externally, direct processing taking place internally reduces the opportunity for any fugitive dust and odour emissions being generated.

The plant has been designed to ensure that all noise emissions are abated and mitigated as far as reasonably possible. All external plant and equipment has been fitted with attenuation or screens to prevent

disturbance to nearby receptors. The site is subject to strict daytime and nighttime planning noise limits which limit the offsite noise impacts to <50dBA(daytime) and <40dBA(nighttime) respectively.

All noise emissions from the plant will be monitored to ensure that these limits are complied with at all times.

An Environmental Noise Survey has been undertaken in accordance with BS 4142:2014+A1:2019 and concludes that site operations are unlikely to exceed the limits defined and are therefore unlikely to have a material impact at any residential dwellings or HMP Bure. Please refer to *Annex E – Environmental Noise Survey* for more information.

Product and Waste Management

The process will produce two primary products:

- Clean syngas – which will be combusted within two gas engines on site to create heat and electricity; and
- Carbonaceous (bio)char – which will be collected and removed offsite.

The biochar produced by the process will be subject to extensive sampling and analysis as the intended future use will be carbon sequestration within the construction sector. Standard Gas is currently reviewing the possibility for disposal through sustainable routes by achieving end-of-waste status, however in the meantime the likely end users will be either the construction sector or cement kilns.

The process will also produce some other consumable and chemical wastes including waste water effluents from the gas scrubbing systems, oil residue from the pyrolysis plant and maintenance consumables (oil, grease, chemicals) all of which will be removed off site via a third-party waste contractor.

Emissions to Controlled Water

There will be no emissions to controlled waters arising from the installation.

There will be minimal emissions from the process from the scrubbing and condensing systems. All process effluents will be contained within a bunded storage vessel and the waste water removed from site by a third-party contractor for offsite disposal.

Uncontaminated clean surface water runoff captured from roof drainage and external roadways / car parking areas will be discharged to the existing surface water drainage system (W1).

In the event of a fire, the drainage system would be isolated to prevent any fire water escaping off site.

Emissions to Sewer

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

Emissions to Land

There will be no emissions to land arising from the Installation. The site will be constructed with robust protection measures in place. The entire site area comprises concrete hardstanding with no ‘soft’ ground being present within the installation boundary, this protects the underlying geology and groundwater.

1. INTRODUCTION

Standard Gas SG No.1 Limited (Standard Gas) is making a New Bespoke Installation Permit Application for the proposed operation of a synthesis fired CHP facility that incorporates Advanced Thermal treatment (ATT, pyrolysis) at their Hanger 2 site, Scottow Enterprise Park, Norfolk.

The proposed Installation is located at Hanger 2, Lamas Road, Badersfield, Scottow, Norfolk, NR10 5FB (National Grid Reference: TG 26104 23008).

Standard Gas's pyrolysis technology is a proven Advanced Thermal Treatment plant which thermochemically produces cracked and cleaned syngas from pre-processed non-hazardous solid wastes, principally Refuse Derived Fuel (RDF) and other similar combustible material to operate a series of gas fired CHP engines to generate power and provide heat to the wider Scottow Enterprise Park.

The Installation has been designed to process approximately 50,000 tonnes of pre-processed non-hazardous waste per annum (energy mass balance of the plant assumes an average of 6 tonnes per hour with a typical GCV of 11 – 15MJ/kg) to generate approximately 5MWe of renewable electricity and approximately 2.5MWth of heat.

The Standard Gas pyrolysis technology will produce a clean '*End of Waste'* synthesis gas and therefore meets the definition of an Installation as defined by Section 1.2 '*Gasification, liquefaction and refining activities*' paragraph A(1)(f)(iv) namely:

'Activities involving the pyrolysis, carbonisation, distillation, partial oxidation or other heat treatment of other carbonaceous materials.'

On the basis that all gas combusted by the process meets the 'End of Waste' criteria, the CHP engines will be regulated as Medium Combustion Plant (MCP) and Specified Generators (SG) and operated in accordance with the Environmental Permitting (England and Wales) Regulations 2018 (As amended).

All emissions from the combustion activities shall be in accordance with the MCP Directive, noting that Chapter IV of the Industrial Emissions Directive (IED) does not apply whereby Article 42 (1) is achieved – deeming syngas as no longer a waste and causing emissions no higher than combustion of natural gas.

A commissioning and validation process is currently underway which has been agreed by the EA under the conditions of a LEP and in accordance with Regulatory Position Statement 182 '*Carrying out research or trials with waste at sites without an Environmental Permit*'.

The LEP agreement allows Standard Gas to carry out a controlled and time limited commissioning test of their syngas production module (SG100). The test will confirm overall energy mass balance of the process in addition to demonstrating the cleanliness of the syngas produced by the plant will be comparable to natural gas and therefore meeting 'End of Waste' criteria. All evidence from the R&D trial will be available to the Environment Agency during the determination of the permit.

The remained of this application support document is structed accordingly:

- Section 2: Provides a detailed site description and 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, and land 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 comparison against the applicable guidance and Emission Limit Values for the Installation; and
- Section 7: Provides details of the environmental impact of the Installation against the requirements of the Habitats Directive.

All technical appendices associated with the Installation are included within the technical annexes and comprise the following:

- Annex A: Figures;
- Annex B: Technical Information;
- Annex C: Environmental Risk Assessment;
- Annex D: Air Quality Assessment and Human Health Risk Assessment;
- Annex E: Noise Assessment;
- Annex F: Site Condition Report;
- Annex G : Environmental Management System Summary;
- Annex H: Accident Management Plan;
- Annex I: Fire Prevention Plan;
- Annex J: Odour Management Plan;
- Annex K : CHP Ready Assessment; and
- Annex L: R&D FAT Trials.

The sites location, Installation Boundary and the proposed site layout is provided overleaf in Figures 1.1, 1.2, 1.3 and 1.4.

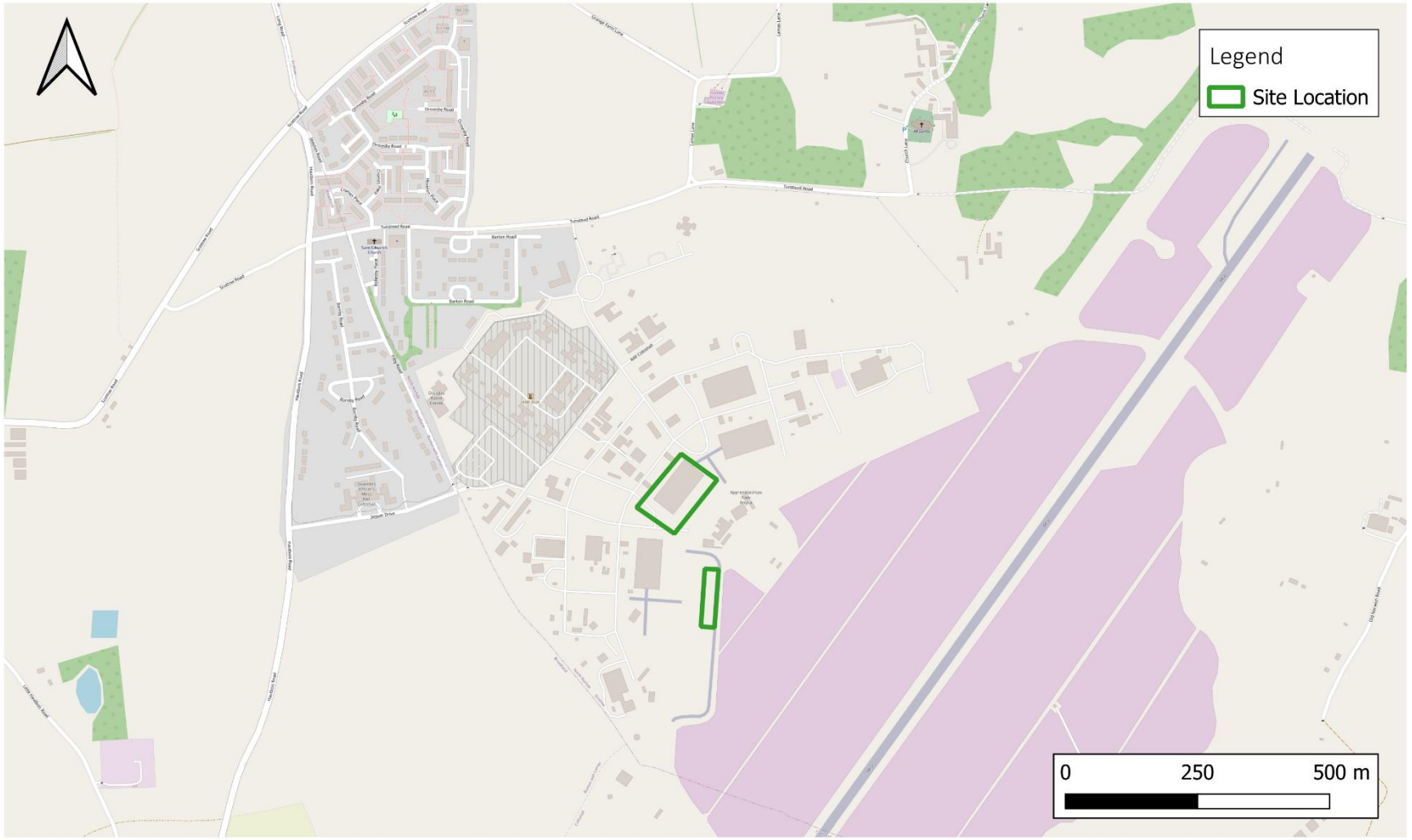

Figure 1.1 Site Location

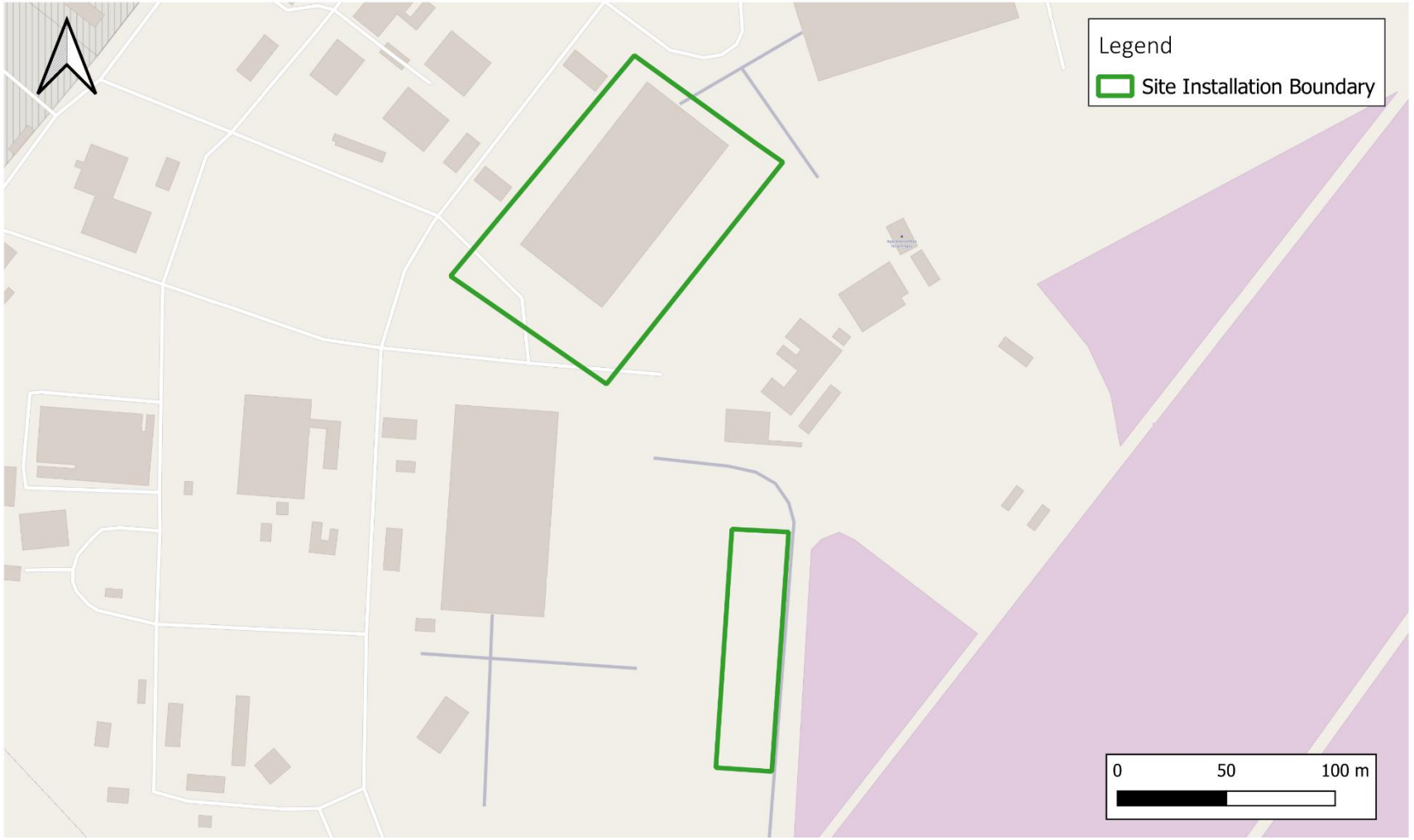

Figure 1.2 Proposed Site Installation Boundary

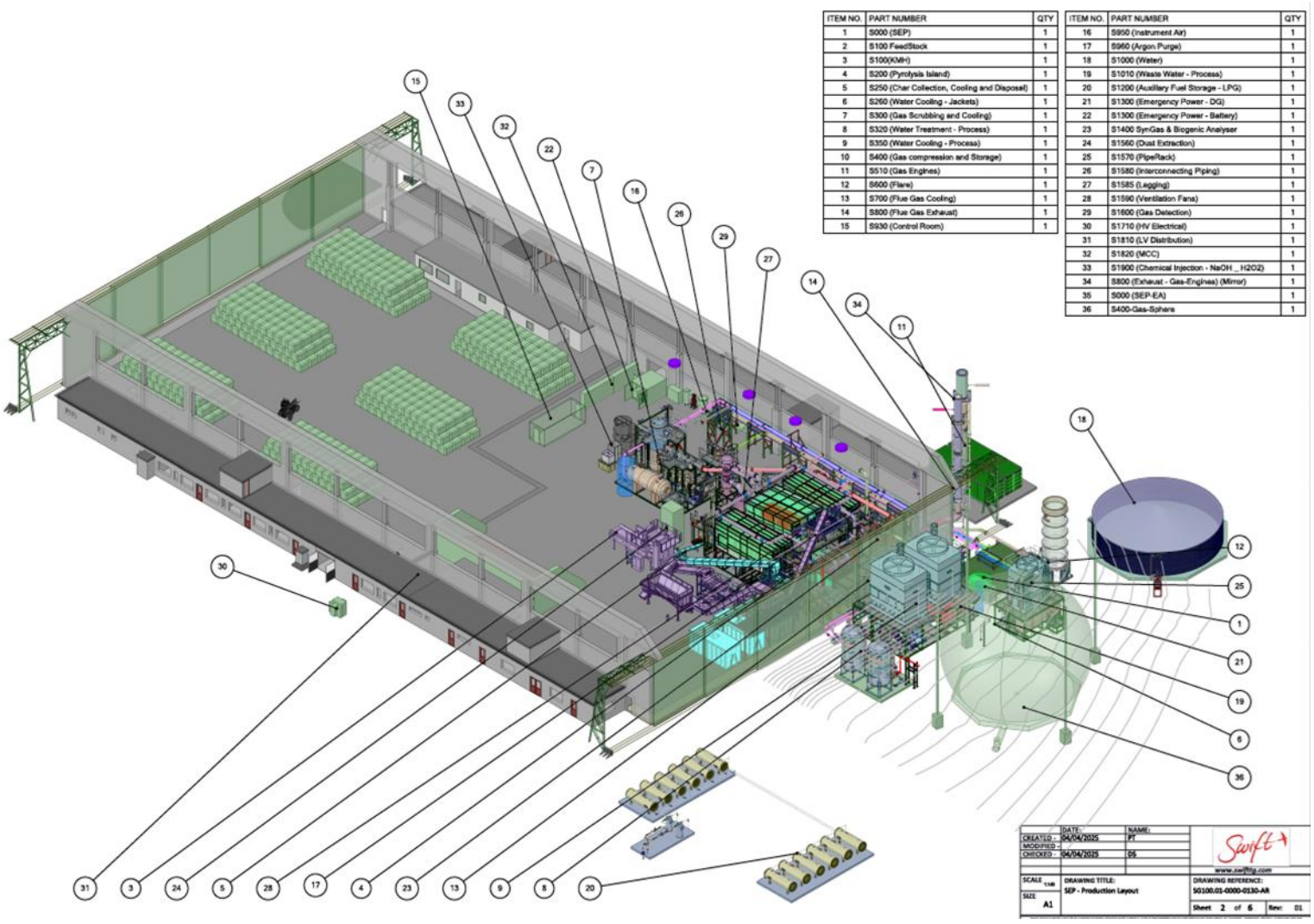

Figure 1.3 Proposed Internal Site Layout

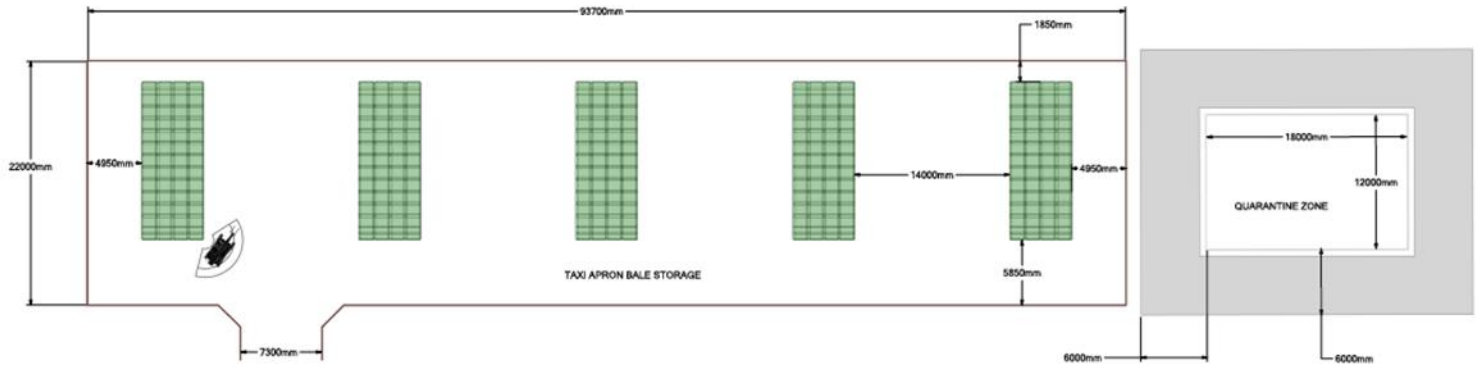

Figure 1.4 Proposed External Waste Storage Yard Layout

2. SITE DESCRIPTION

2.1 Site Setting

The site is located within Hangar 2 of the former airfield at RAF Coltishall between the villages of Badersley and Scottow in Norfolk. The Scottow Enterprise Park is located to the north of the airfield a majority of which is now a PV array solar farm.

Hangar 2 is within the Enterprise Park, surrounded by other industrial or commercial units, with Gravitilab Aerospace Services to the east, Vdepot Ltd to the north, and KMR Motorsport and EMH Joinery to the west. To the northwest lies HMP Bure (prison) with the Douglas Bader School and residential properties associated with the village of Badersfield beyond.

The surrounding area is predominantly agricultural, with the solar farm dominating the southern area associated with the airfield. The closest water feature comprises a pond approximately 375m east, beyond which is an unnamed stream within Stewards Plantation at 1.2km distant. The River Bure is located 1.6km to the west of the site. Residential properties on Barton Road are the closest in proximity to the site located approximately 400m to the northwest.

The site lies within Flood Zone 1 with a negligible chance of flooding.

2.2 Site History

The site itself comprises an existing commercial Hangar, associated with the former airfield. It is currently occupied by the Swift Technology Group, who are the designers and manufacturers of the SG100 technology and operate a factory within the building. Table 2.1 outlines the existing planning on site.

Table 2.1 Existing Planning

Reference	Year	Description
PF/23/1796	2023	Temporary installation and testing of proprietary pyrolysis plant and equipment adjacent to Hangar 2. To include the associated temporary storage of suitable feedstock for the duration of pyrolysis plant trials. This application is currently undetermined.
PF/17/1057	2021	Change of use of existing buildings within the enterprise park area from former military use and various commercial uses to a range of B1, B2 and B8 designations (light industrial/office/research and development, general industrial and storage/distribution uses). Use of former taxiways and hard standing areas for low-speed vehicle driver training. Indicative route shown as land reserved for second site entrance. This planning permission came with several Planning Conditions which are relevant to the proposal. This includes the following: *- There shall be no more than 60 movements of HGV's during any day;* *- All traffic within- and use of- the former airfield shall be managed and operated in full accordance with the submitted and approved Traffic Management Plan document OPS-M-05 Rev C, dated January 2018, received 24.01.18, and the traffic control measures set out there in shall be provided in full within three months of the date of this permission, and shall be retained as such thereafter.* *- The rating level of the noise emitted from any activity within the Enterprise Park site, either singularly or cumulatively, as measured at any boundary of the Scottow Enterprise Park, shall not exceed 50dB over a daily average between Monday-Friday during the hours of 0800 - 1800 or 0800 - 1300 on Saturdays, nor shall it exceed 40dB at any other time. The noise level assessments shall be made according to BS.4142:1997.*
GF/98/0292	1998	Refurbishment of existing hangar

3. PROPOSED ACTIVITIES

3.1 Type of Permit

The Applicant is making an application for a Bespoke Part A(1) Environmental Permit for the proposed operation of a pyrolysis plant. The listed activities are provided in Table 3.1.

Standard Gas's pyrolysis technology is a proven Advanced Thermal Treatment plant which thermochemically produces cracked and cleaned syngas from pre-processed non-hazardous solid wastes, principally Refuse Derived Fuel (RDF) and other similar combustible material to operate a series of gas fired CHP engines to generate power and provide heat to the wider Scottow Enterprise Park.

The Installation has been designed to process approximately 50,000 tonnes of pre-processed non-hazardous waste per annum to generate approximately 5MWe of renewable electricity and approximately 2.5MWth of heat.

The proposed pyrolysis activities meet the definition of an Installation as defined by Section 1.2 '*Gasification, liquefaction and refining activities*' paragraph A(1)(f)(iv) namely:

'Activities involving the pyrolysis, carbonisation, distillation, partial oxidation or other heat treatment of other carbonaceous materials.'

The CHP engines will be regulated as Medium Combustion Plant (MCP) and Specified Generators (SG) and operated in accordance with the Environmental Permitting (England and Wales) Regulations 2018 (As Amended).

The facility has been designed to accept non-hazardous wastes 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.

Table 3.1 Listed Activities

Activity listed in EP Regulations 2013	Description of Specified Activity	Limits of Specified Activity	Specified Waste Management Operation
Section 1.2 Gasification, liquefaction and refining activities Part A(1)(f)	Activities involving pyrolysis, carbonisation, distillation, partial oxidation or other heat treatment	The reception, storage and combustion of non-hazardous waste feedstocks to produce steam for the generation of renewable electricity. Installation includes all ancillary activities including 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
Directly Associated Activities			
Electricity Generation	Generation of power and heat within 2 x CHP Engines	From receipt of syngas to export of heat and electricity for either on-site use or export to the grid.	
Back-up Electricity Generation	Standby Diesel generator	Emergency use to a maximum of 500 hours operation per year.	

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

- Non-hazardous and Inert Waste: Appropriate Measures for Permitted Facilities;
- Waste Incineration BREF BAT Conclusions;
- Medium combustion plant and specified generators: environmental permits; 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 installation boundary. A figure showing the proposed site layout and installation boundary has been provided in Section 2, Figures 2.2 and 2.3.

A Site Condition Report (SCR) that provides a baseline conceptual model for the site has been completed and included within *Annex F – H5 Site Condition Report.*

The SCR identifies no historical contamination at the site with no significant pollution incidents occurring. In addition, it does not identify any aspect of the new Installation that presents a potential contamination risk to the environment.

All aspects of the new installation have been designed in accordance with the Environment Agencies Pollution Prevention Guidance and Horizontal Guidance Notes.

3.3 Infrastructure and Design

The key infrastructure and design of the site will comprise the following:

- Main processing building;
- External baled storage area;
- Feed system with de-baler and screening equipment;
- Pyrolysis Island;
- Syngas cleaning and conditioning system;
- Pyrolysis exhaust stack (A1);
- Emergency flare (A3);
- Char collection and cooling system;
- 2 x CHP Engines with associated exhaust stack (A2); and
- Emergency diesel generator and associated auxiliary fuel storage.

3.3.1 Site Drainage Arrangements

There will be no direct process emissions to controlled water arising from the installation. The site benefits from a fully sealed drainage system.

Uncontaminated clean surface water runoff captured from roof drainage and external roadways / car parking areas will be discharged to the existing surface water drainage system (W1).

There are no surface water drains on site or within the immediate vicinity of site. All site infrastructure (roads, surfacing, drainage systems and equipment) will be inspected on a weekly basis by the competent person. Any faults and repairs will be carried out as soon as practicable and a note made of them in the site diary.

With the exception of the storage of bales externally, all activities will take place internally within the onsite building. The building provides both secondary and tertiary containment. Any spillages, leaks or incidents arising within the buildings will be effectively contained and captured within the building footprint.

The only waste water emissions from the facility relate to small volumes of wastewater from the scrubbing and condensing systems which will be collected within dedicated tanks and removed from the site for treatment by third parties at a suitable licenced treatment facility.

There are no emissions to sewer from the proposed facility.

Fire Water

The site is equipped with a sealed site drainage system that meets the requirements of the Fire Prevention Plan Guidance. The site has been designed to ensure the following in the event of a fire:

- All fire water will be contained onsite;
- The drainage system can be isolated via a penstock valve; and
- All firewater is to be pumped and tankered off site for disposal.

The processing building and the surrounding concrete apron do not have any external or internal drains. In an event of a fire within the building, all firewater will be contained within the building footprint via a bunding system to stop any potentially contaminated firewater escaping.

In the event of a fire within the external baled storage area, the drainage system would be isolated to prevent any fire water escaping off site.

3.3.2 Tanks and Bunds

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

- Environment Agency - Pollution prevention for businesses;
- Environment Agency - Report an Environmental incident;
- CIRIA 736: Design of containment systems for the prevention of Water Pollution from Industrial sites; and
- CIRIA C598: Chemical storage tank systems – good practice.

Suitable spill kits will be readily available on site with operator training made available.

3.3.3 Roadways and External Areas

All internal roadways have been designed to give safe access to all areas of the site.

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

3.4 Raw Materials

Waste Feedstocks

The pyrolysis plant has been designed to process an average of 6 tonnes per hour of feedstock, equating to 50,000 tonnes per annum at the stated bulk density and moisture content. The maximum amount of feedstock processed per day will be 120 tonnes per day.

All feedstock will either be delivered to site loose or in pre-prepared sealed bales. Bales will either be stored externally within a designated storage area or internally within the main processing building. All loose waste will be stored within a dedicated bay within the main processing building and will be fully enclosed.

All waste being provided to site will meet the following fuel specification outlined in Table 3.2.

Table 3.2 Incoming Waste Feedstock Specification

Parameter	Value
Calorific Value	11 – 15 MJ/kg
Density Requirements	Higher than 250 kg/m^3 Lower than 350 kg/m^3
Particle Size of Fuel	Individual particle size is to be 30 mm in any direction (3D) +/- 5mm Fuel particle size requirements are as follows: • 90 % by weight less than 30 mm • 97 % by weight less than 35 mm
Moisture Content	Moisture content of the fuel is to be <20%, by weight
Ash Content	0 – 32 weight % (dry)
Nitrogen Content	< 1.5 weight % (dry)
Sulphur Content	< 0.4 weight % (dry)
Chlorine Content	< 0.1 weight % (dry)
Fluorine Content	< 0.01 weight % (dry)

Prior to storage, all wastes accepted into the site will be subject to stringent waste acceptance criteria in accordance with the Company's Environmental Management System and associated procedures:

- SP-E01 – Waste Pre-Acceptance;
- SP-E02 – Waste Acceptance; and
- SP-E03 – Waste Rejection.

The European Waste Catalogue (EWC) codes of wastes that will be accepted by the site is provided in Table 3.3 below.

Table 3.3 Proposed Feedstock EWC Codes and Types

Waste Code	Description
02	WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION, FOOD PREPARATION AND PROCESSING
02 01	agriculture, horticulture, aquaculture, forestry, hunting and fishing

02 01 03	plant tissue waste
02 01 04	waste plastics (except packaging)
02 01 07	wastes from forestry
03	**WSATES FROM WOOD PROCESSING AND THE PRODUCTION OF PANELS AND FURNITURE, 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 vaneer other than those mentioned in 03 01 04
03 03	**wastes from pump, paper and cardboard production and processing**
03 03 01	waste bark and wood
03 03 07	mechanically separated rejects from pulping of wastepaper and cardboard
03 03 08	wastes from sorting of paper and cardboard destined for recycling
04	**WASTES FROM THE LEATHER, FUR AND TEXTILE INDUSTRIES**
04 02	**wastes from the textile industry**
04 02 21	wastes from unprocessed textile fibres
04 02 22	wastes from processed textile fibres
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 01	paper and cardboard packaging
15 01 02	plastic packaging
15 01 03	wooden packaging
15 01 06	mixed packaging
17	**CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES)**
17 02	**wood, glass and plastic**
17 02 01	wood
17 02 03	plastic
19	**WASTES FROM WASTE MANAGEMENT FACILTIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE**
19 02	**wastes from physico/chemical treatments of waste (including dechromatation, decyanidation, neutralisation)**
19 02 10	combustible wastes other than those mentioned in 19 02 08 and 19 02 09
19 12	**wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified**
19 12 01	paper and cardboard
19 12 04	plastic and rubber
19 12 07	wood other than that mentioned in 19 12 06
19 12 08	textiles
19 12 10	combustible waste (refuse derived fuel)

19 12 12	other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 19 12 11)

Process Consumables / Raw Materials

All Raw Materials that will be utilised on site are provided within Table 3.4 below.

Table 3.4 Raw Materials Summary

Material	Total Quantity Stored	Use	Storage Arrangements	Fate
Feedstock (pre-processed non-hazardous solid wastes, principally RDF and other similar combustible material)	50,000 tonnes per annum External storage – 1,325m^3 (720 bales) Internal storage – 2,040m^3 (864 bales and 450m^3 of loose feedstock)	Used in the pyrolysis process to generate 'End of Waste' compliant syngas.	Either stored within the external baled storage area or internally with dedicated storage areas.	Pyrolised by plant and equipment. Co-product char cooled, contained, and removed from site.
Activated Carbon	2 x 10 tonne beds	Process water VOC removal	2 x Activated Carbon beds	Units delivered and exchanged by supplier when spent
Hydrogen Peroxide	2-4 x IBC's	Quench and dosing chemical	Stored in sealed containers, IBCs	IBCs delivered and exchanged by supplier when spent
Sodium Hydroxide	1-2 x IBC's	Quench and dosing chemical	Stored in sealed containers, IBCs	IBCs delivered and exchanged by supplier when spent
Diesel	1-2 x IBC's	For operation of emergency standby generator to safely shutdown plant in the event of grid failure	Stored in sealed containers, IBCs	Combusted
LPG	12 x 2 tonne tanks	For thermal plant start-up and shut down	Stored externally, installation by approved sub-contractor	Combusted
Hydraulic and Lubricating Oils	Minimal amounts required for commissioning	Use in plant and machinery	Stored in sealed containers	Disposal to waste oil re-processor
Argon	2 x 165m^3 bottle banks	Purging the pyrolysis and syngas system prior to operation	Stored in compressed gas canisters	Lost to atmosphere and emitted via stack A1.

3.5 Description of the Process

The process has been designed to process pre-prepared baled and wrapped feedstock at approximately 6 tonnes per hour to produce clean syngas. The key plant and processes comprise the following:

- Feedstock Reception and Storage;
- Fuel Transfer;
- Pyrolysis;
- Gas Cleaning and Conditioning;
- Biochar Production;
- Syngas Storage and delivery to the gas engines;
- Emergency flare and thermal oxidiser; and
- Ancillaries (cooling towers, auxiliary fuel storage)

The above processes are discussed in further detail within this section.

A simplified process layout is provided in Figure 3.1 below. Additionally, a process flow and plant technical details are provided in *Annex B – Technical information.*

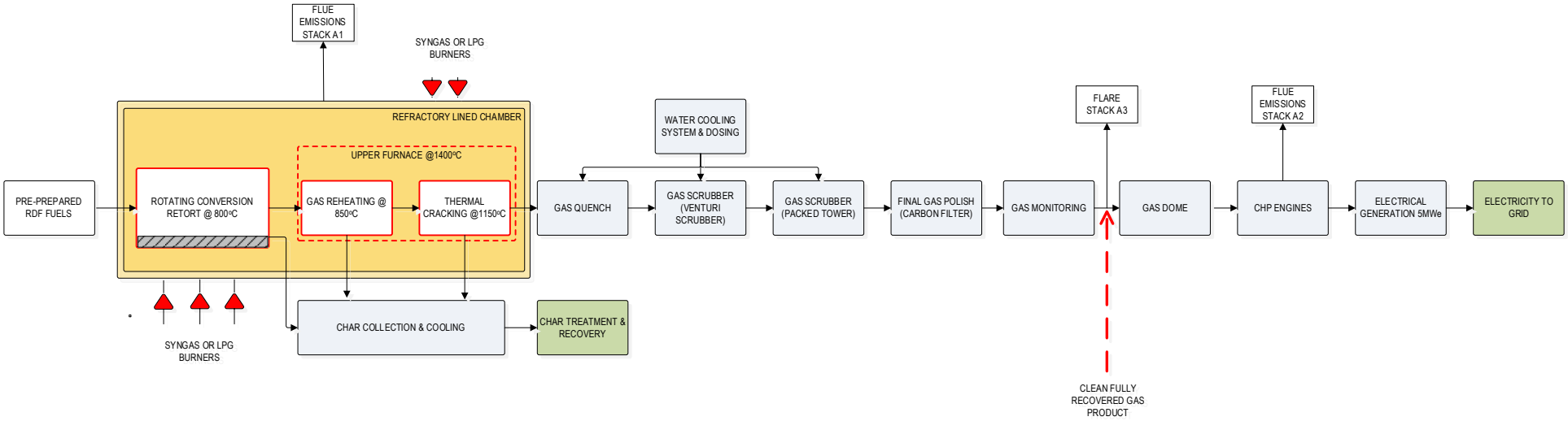

Figure 3.1 Process Flow Diagram

Fuel Acceptance and Reception

All feedstock will either be delivered to site loose or in pre-prepared sealed bales. Bales will either be stored externally within a designated storage area or internally within the main processing building. All loose waste will be stored within a dedicated bay within the main processing building.

All feedstock will be subjected to waste pre-acceptance and acceptance checks as well as visual site inspections. Any damaged, poorly wrapped or odorous bales will be immediately removed and placed internally for processing.

It is key to note that all waste will be delivered to an agreed specification, and apart from de-baling (if required), do not require any further processing in advance of pyrolysis.

All waste will be stored in accordance with the site Fire Prevention Plan which is provided within *Annex I – Fire Prevention Plan.*

The typical turnover of all storage will be 5 – 7 days. However, in the event of a plant breakdown waste may be stored for longer periods of time (no longer than 3 months).

All storage within the internal and external storage areas, will be rotated on a first in, first out priority system.

Fuel Transfer

All feedstock will be inspected via a dedicated quality assurance site operative. When required, the waste will be loaded directly into a sealed and contained hopper, de-baled (if required) and pre-processed via screening equipment. Once processed, the feedstock will be conveyed directly into SG100 pyrolysis chamber feed system. The SG100 has a dedicated feed hopper and associated transfer conveyor, both of which are sealed with no potential for emissions to atmosphere.

Photo 1: Feed System

Pyrolysis

All incoming fuels are passed into the SG100 and thermochemically converted to synthesis gas. The pyrolysis process provides the correct oxygen free conditions to occur to enable the production of a high purity synthesis gas, which combined with the controlled thermal cracking stages creates a concentrated high quality syngas stream.

The pyrolysis process comprises the following:

Conversion Chamber and Synthesis Gas Generation

The feedstock will be continuously fed into the pyrolyser from the main screw feed system. On entering the pyrolyser, the feedstock is delivered into the pyrolysis conversion chamber which is heated to a temperature of approximately 850°C.

The construction of the conversion chamber with highly conductive specialist materials ensures that a very high level of thermal transfer between the outer casing and inner chamber takes place.

The capacity of the conversion chamber is approximately 1 tonne, and is fitted with an internal arrangement of auger flights that maximises internal contact time and ensures that very quick gas conversion takes place.

The high thermal conductivity of the retort is a key factor in ensuring that the mass conversion of the feedstock is substantially increased whilst ensuring that the char conversion rate is high, resulting in the gas yield being significantly increased.

The pyrolyser conversion chamber is heated via low NOx dual fuel gas fired burners located both in the upper and lower portions of the pyrolysis plant and at the top base of the of pyrolysis plant.

The pyrolysis burner system at full load has a rated thermal capacity of 8MW which is provided by the dual fuel burners. The burners have been deigned to operate on both LPG and syngas.

All start up and shutdown operations will be carried out using LPG. Prior to start-up, the retort and associated feed systems and gas extract systems are purged with argon to ensure that an oxygen free environment can be maintained during the pyrolysis process.

Within the pyrolysis chamber, thermal decomposition of the material and its by-products takes place to produce a raw synthesis gas and residual material, in the form of solid carbon char. Due to the rate of thermal conversion, neither the feedstock nor the decomposition materials (gas or char) are retained within the chamber for sufficient time to allow their temperature to dip below 350 – 400°C.

This relatively low temperature is below the volatilise temperature of a majority of the Class 1 and 2 contaminants (heavy and toxic metals) within the feedstock meaning they are retained within the char and not released into the gas.

This temperature also ensures that a majority of the Class 3 (highly volatile) contaminants are retained in the solid phase with only limited release to gaseous phase.

Both the gas and the chars exit the main conversion chamber at this stage.

Photo 2: Central Retort Chamber

Gas Reheating and Thermal Cracking

Upon exit from the conversion chamber, the synthesis gas is taken through a two stage reheating process in temperatures of approximately 850^{o}C to 1150^{o}C.

The gas reheating and thermal cracking process ensures that any secondary and tertiary tars present within the gas are thermally decomposed, thus converting any aromatic hydrocarbons to form gaseous hydrogen, hydrogen chloride and carbon particulate.

Other than the clear benefits associated with increased gas conversion efficiency, the reduction in tar formation (i.e. the formation of long chain aromatic hydrocarbons) and the presence of a highly reduced oxygen environment helps to ensure that dioxin formation is prevented.

The elevated gas temperature within the cracking process also exceeds that of ammonia, which subsequently converts to nitrogen.

The retention of the gas during the thermal cracking stages is approximately 8 seconds, thus significantly exceeding the 850^{o}C / 2 seconds temperature and retention requirements recognised as being the required temperature and retention times for thermal destruction within Chapter 4 IED Article 50.

The action of the gas flow within the thermal cracking process enhances the removal of the particulates from the gas stream.

All gas is then rapidly quenched through the use of scrubbers where the gas undergoes final cleaning.

Primary Syngas Treatment using Thermal Cracking - Technical Justification

In order to permanently break the chemical bonds of the longer hydrocarbon chains within the gas to form new chemicals an endothermic reaction is required. This additional energy is provided in the thermal cracking stage, where the temperature of the syngas is increased to over 1000°C.

Standard Gas are not unique in their use of thermal cracking at temperature in excess of 1000°C as a primary means of treatment of syngas. Hydrocarbon cracking at this temperature range is common in the petrochemical sector and has been utilised in processes such as pyrolysis and gasification as a highly efficient means of conversion of complex hydrocarbons and tars into simpler gases like methane (CH_4) and hydrogen (H_2). Thermal cracking is an industry BAT solution for the reduction of long chain hydrocarbons within synthesis and producer gases.

Typically, thermal cracking is used in Steam Methane Reforming (SMR) processes, which occurs at temperatures between 800-1000°C to produce hydrogen and carbon monoxide, which are components of syngas. Gas treatment within this temperature range is also a proven means of thermally cracking any ammonia within the gas to nitrogen and hydrogen, reducing the need for downstream scrubbing.

The key properties required for effective and efficient thermal cracking are as follows:

- **High Temperatures are Key:** Temperatures in the range of 800-1000°C are crucial for effective syngas cracking.
- **Cracking of Tars and Hydrocarbons:** During thermal cracking, complex organic compounds (tars and higher hydrocarbons) are broken down into simpler gases.
- **Efficiency and Yield:** The efficiency of syngas cracking depends on factors like temperature, pressure, residence time, and the composition of the syngas. Standard Gas achieve both elevated temperatures and extended residence time (8 – 11 seconds) within their 2 stage cracking process.

Ultimately, thermal cracking is a proven, highly effective means of producing a cleaner syngas stream with higher H_2 content, lower tar and ammonia content than would otherwise be achieved by conventional pyrolysis or gasification. The resulting syngas can then be further conditioned and cleaned, without putting additional burden on the downstream processes.

Gas Cleaning and Scrubbing

The synthesis gas is rapidly quenched primarily to create the necessary vacuum to draw the gas through the process but also to prevent de-novo dioxin formation. The quench is the first stage of a two stage scrubbing process to condense out any moisture within the gas, remove acid gases (such as SO_2, HCl, HF and H_2S), to remove any residual tars (of which there should be none) and to trap any residual particulate materials.

The two stages of the scrubbing processing involve the application of industry standard plant and equipment involving:

- Inline eductor scrubber – acts as a rapid quench; and
- Packed tower scrubber.

All scrubbing liquors are dosed and pH controlled using hydrogen peroxide and sodium hydroxide. The purpose of these chemicals are:

- Conversion of any hydrogen sulphide into sulphur dioxide; and
- Removal of soluble components, namely sulphur dioxides, hydrogen chlorides and other acid gas forming compounds from the syngas.

The condensate from the scrubbing process is low volume, clean and odour free and is discharged to a sealed vessel for offsite disposal at a suitably qualified third-party treatment process.

Photo 3: Scrubbers

Syngas Conditioning using Packed Tower Scrubbers – Technical Justification

Packed tower scrubbers offer high gas treatment efficiencies, often exceeding 90% for many pollutants, with some systems achieving 99% or higher, making them BAT for use in the gas treatment sector.

The scrubbing efficiency is influenced by factors like the specific gas contaminant, the type of absorber used, and the operating conditions. In the case of Standard Gas the specific concentrations of acid gas compounds such as sulphur, chloride and fluoride are comparatively low and present in low quantities within the feedstock material.

The factors which affect scrubbing efficiency are as follows:

- **Pollutant Solubility:** Sulphur, Chlorides and Fluorides are readily dissolved in water based solutions and neutralised through simple reagent reactions with alkaline solutions. Pollution reduction efficiency of 99% are expected.
- **Packing Material:** The packing materials with the scrubbers used by Standard Gas have a very high surface area and are packed in in order to maximise the gas-liquid contact time and mass transfer efficiency.
- **Gas and Liquid Flow Rates:** The Standard Gas scrubbers have been designed to optimise the gas and liquid flow rates through the packing bed ensures efficient contact and contaminant removal.
- **Low Pressure Drop:** The scrubbers have been specified and designed using CFD to ensure a low pressure drop is achieved primarily to ensure energy use is minimised, but also to maximise overall removal efficiency.
- **Scrubbing Solution:** The scrubbing solutions selected are specifically to target the removal of acid gases (e.g., water, caustic solution) and are proven for the effective removal of acid gases.

Typical Removal Efficiencies:

- **Acid Gases (HCl, HF, SO_2, etc.):** Packed scrubbers are highly effective in removing acid gases, with removal efficiencies often exceeding 99% in many applications.
- **VOCs:** Packed towers can achieve high VOC removal efficiencies, often exceeding 90% and sometimes reaching 99% or more depending on the specific system and pollutants.

The final stage of gas cleaning is achieved through carbon filtration to ensure that the highest gas cleanliness standards are met.

Syngas Polishing using Activated Carbon Filtration – Technical Justification

The effectiveness of activated carbon filters stems from their porous structure and adsorption capabilities. The porous nature provides a large surface area for contaminants to adhere to, essentially trapping them within the carbon matrix.

Activated carbon exhibits a particularly high affinity towards organic molecules, thanks to its chemical composition, further enhancing its adsorption capacity.

The primary mechanism by which activated carbon filters work is adsorption. Adsorption is the adhesion of molecules from a gas, liquid, or dissolved solid to a surface. The activated carbon's high surface area and porous structure allow it to trap and hold impurities within its pores as water, air or certain gases pass through.

Activated Carbon Filtration is recognised BAT for the industrial gas treatment and the biogas sector for the removal of unwanted contaminants, such as VOC's, toxic metals, dioxin and furans (industrial gases) and hydrogen sulphide and siloxanes, from biogas and biomethane gas streams.

Typical Removal Efficiencies:

- Activated carbon filters achieve removal efficiencies of over 98% for a majority of specific pollutants.
- Powdered activated carbon can remove up to 99.9% of dioxins.

Atmospheric emissions from the pyrolyser resulting from the combustion of clean gas are released directly to atmosphere via an 18.3m stack (Emission Point A1). All emissions from the combustion activities will be in accordance with the Medium Combustion Plant Directive (MCP) noting that Chapter IV of the Industrial Emissions Directive (IED) does not apply whereby Article 42 (1) is achieved.

The syngas cleanliness will therefore be specified to meet the following standards, shown in Table 3.5 below.

Table 3.5 Syngas End of Waste Specification

Parameter	'End of Waste' Limits	Basis of Limit
Total Sulphur	3.85	Odorised Concentration from JEP Report[1]
Hydrogen Sulphide	0.4	Top of range from natural gas analysis
Total halogenated hydrocarbons	0.07	Top of range from natural gas analysis
Heavy Metals (Hg, Cd, Tl, Sb, As, Pb, Cr, Co, Cu, Mn, Ni, and V ans their compounds (Total)	0.16	Top of range from natural gas analysis excluding outlier
Total Aromatic Hydrocarbons expressed as Xylene	2.6	Top of range from natural gas analysis
HF	5	Limits from Biomethane Quality Protocol
HCl	1.5	

[1] 1 JEP11SG01: EMISSION FACTORS FOR SULPHUR IN NATURAL GAS – February 2012

Calorific Value	-	No limit but monitored so that syngas results can be adjusted to account for lower CV than natural gas

The Standard Gas technology has been demonstrated to meet the EA's End of Waste requirements across a wide range of wastes, so will therefore be free from contamination at the point of combustion. A commissioning and validation process is currently underway which has been agreed by the Environment Agency under the conditions of a Local Enforcement Position (LEP) and in accordance with Regulatory Position Statement 182 '*Carrying out research or trials with waste at sites without an Environmental Permit*'.

The LEP agreement allows Standard Gas to carry out a controlled and time limited commissioning test of their syngas production module (SG100). The test will confirm overall energy mass balance of the process as well as demonstrating the cleanliness of the syngas produced by the plant will be comparable to natural gas and therefore meeting '*End of Waste*'. All evidence from the R&D trial will be available to the Environment Agency during the determination of the permit.

Please refer to *Annex L – R&D FAT Trials* which provides more information on the trials that are currently being carried out on site.

It is recognised that the pre-application advice has requested analysis of the syngas produced during the FAT trials, however this is not currently available. This will either be submitted to the Environment Agency during the determination of the permit or it is requested that this is addressed via an Improvement Condition.

Heat Recovery

Heat will be recovered as far as possible by the system with any residual heat being cooled by a bank of external cooling towers and chillers.

Photo 4: Cooling Towers

Electrical Generation

The cleaned syngas will be stored within a gas storage bladder prior to combustion with the CHP engines.

When required, the syngas will then be transferred to 2 x Jenbacher type Gas Engines for the production of heat and power. Emissions from the engines will be via a multi-flue CHP stack (Emission Point A2).

An energy mass balance is provided within *Annex B – Technical Information.*

All emissions from the combustion activities will be in accordance with the Medium Combustion Plant Directive (MCP) noting that Chapter IV of the Industrial Emissions Directive (IED) does not apply whereby Article 42 (1) is achieved.

Biochar Production

The temperature zone within the pyrolysis retort is sufficiently elevated and oxygen free to ensure that all material is fully converted to elemental carbon and ash. Char is subsequently extracted from the process by a cooled scroll units and stored within a dedicated external sealed container.

The char material is a very high-grade carbonaceous material which has a potential commercial value. The biomass content of the feedstock determines the composition of the char materials.

The biochar produced by the process will be subject to extensive sampling and analysis as the intended future use will carbon sequestration. Standard Gas is currently reviewing the possibility for disposal through

sustainable routes by achieving end-of-waste status, however in the meantime the likely end users will be cement kilns or waste to energy plants.

Gas Flare

In order to comply with Gas Safety Regulations the site will be fitted with an emergency flare which will only be used in emergency scenarios and / or abnormal operating conditions. The flare is a low level, sealed unit that will combust the gas in a combustion chamber in the event of a controlled shutdown.

Photo 5: Emergency Flare

All of the gas that is produced by the plant will be continuously monitored by an OFGEM approved Gas Chromatograph which will monitor gas composition, temperature etc.

In the event that the syngas product does not meet the required specification, the system has the capability of reintroducing the syngas back through the reheating, cracking and quenching stages.

In the event that the plant has to undergo an emergency shutdown, any gas within the system will be directed to the emergency flare systems. The flare systems have been designed to ensure complete thermal destruction of the gas.

The flare will not be used routinely.

Plant Process Control Parameters

There are a number of key controls associated with the retort and associated ancillary plant. The entire system will be controlled using a digital control system (DCS) linked to a SCADA. All aspects of the pyrolysis plant and ancillary equipment have been subject to a detailed HAZOP study, with the overall process designed to fail safe.

Some applicable control parameters are provided below:

- Temperature Control: The temperature of the retort, the syngas and the gas crackers are all controlled within a narrow temperature band through the use of thermocouple banks that are linked back to the control system and interlocked to shut the combustion system down if the plant falls outside of the setpoint range. The retort is controlled so that the syngas remains at approximately 500°C and the thermal cracker operated at approximately 1250°C.
- Combustion Control: The burner control systems are operated through the continuous monitoring of the O_2, CO and NOx concentrations in the exhaust to ensure that efficient combustion is achieved at all times. The retort burners are initially fed with LPG until such a time that the burners are ready to switch to synthesis gas.
- Auger Rotational Speed: The rotational speed of the Inlet and Outlet Auger is controlled using variable speed drive. The system is interlocked so it cannot introduce feedstock unless the pyrolysis plant and cracking chambers (and other critical systems) are at their set points.
- Retort Rotational Speed: Continuously monitored and varied dependant on the gas pressure and volume generated.
- Water Jacket Flow Rate and Temperature: The retort water jacket is a key safety feature to ensure that the gas seal of the retort is maintained and the heat conducted through the outlet pipe is reduced. The water seal is a key safety system that is controlled and monitored to ensure that the flow is maintained, and the temperature does not exceed 40°C.
- Retort Pressure: The retort is designed to operate at a slight negative pressure and monitored continuously.
- Gas scrubbing and Cooling: All water systems associated with the gas quenching and scrubbing systems are continuously monitored for water flow rate, temperature and pressure. The gas scrubbing systems are also monitored for pH.
- Water Cooling: All cooling plant is continuously monitored for water level, temperature, pump operation and flow rate.

The system monitors its status independently and checks all measured values and messages to ensure continued operation within the relevant limits and ranges. Any deviations cause the implementation of safety measures (such as power reduction or shut down) and transmits a message to a higher-level control system.

The instrumentation and control components, including all safety related sensors and actuators are supplied by an uninterruptible power supply, ensuring controlled shutdown of the digital control system and continued recording of measured values in the unlikely event of a power failure at the site.

The plant has been fully designed to the appropriate DSEAR and ATEX standards.

The SG100 has undergone extensive safety assessment through the HAZID and HAZOP processes and the plant designed to operate safely under all normal, abnormal and emergency conditions. All key plant and ancillaries have been designed with adequate resilience, redundancy and safety features. The plant has been

designed to shut down safely in all instances and has both auxiliary power and fuel supplies to ensure that the plant can be safely shut down without any risk to the environment.

3.6 Controls and Environmental Management System

The site shall be operated in accordance with corporate standards and procedures as part of an Environmental Management System (EMS). The system will be designed to meet the requirements of ISO 14001:2015.

All assets owned and operated by Standard Gas will be operated in accordance with a suite of procedures, policies and controls. All aspects of the site operations will be managed in accordance with the management system through a lifecycle approach, e.g. pre-acceptance, acceptance, rejection procedures.

The EMS will be structed 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 risks 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 an annual external audit by a competent third party; and
- The keys 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 EMS 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 when the permit is issued and a copy of the EMS will be kept at a convenient location on site.

3.7 Operator Competence

All personnel working at the facility will be trained and overseen by the technology developer and manufacturing team.

All personnel, irrespective of discipline will be trained in necessary sections of Standard Gas' operational procedures and management plans.

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

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. The operator will maintain written operation instructions for all plant and monitoring equipment present on site.

Operational Times

The site will be operational 24/7 with deliveries and collections of waste limited to daylight hours.

3.8 Site Security

Scottow Enterprise Park has fully manned security and a single point of access, as such access to Hangar 2 can only be achieved via the security gatehouse.

As the site is a former RAF base, the perimeter security is substantive. Furthermore, the wider development of the solar farm at the site has further increased the perimeter security and facilitated the installation of CCTV camera monitoring systems.

As such the site security systems can be summarised as follows:

- A secure perimeter fence which is inspected periodically to ensure that the site security has not been compromised;
- CCTV monitoring of the site perimeter and airfield;
- Single point of entry across gatehouse;
- 24 hour site security; and
- Lockable gated access.

3.9 Accidents and Emergencies

The site has developed and implemented an Accident Management Plan (AMP) based around the specific risks associated with the site operations.

The key aspects of the sites AMP 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;

- Spillages and uncontrolled release;
- Plant or equipment failure;
- Vandalism; and
- Flooding.

- Identifies events or failures that could damage the environment;
- Assesses the likelihood and the potential environmental consequences from accidents at the site; and
- Proposes actions to minimise the potential causes and consequences of accidents.

In the event of an accident, the EA will immediately be notified and informed of the necessary measures implemented to minimise environmental impact of the accident and measures to prevent further possible accidents.

The sites AMP is included in *Annex H – Accident Management Plan.*

Incident Reporting

The reporting of incidents and non-conformities will form a key component of the companies EMS. 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.

Furthermore, the site's EMS 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 AND THEIR ABATEMENT

4.1 Emissions to Air

Emissions to atmosphere from the plant are via two emission points, the pyrolysis plant flue stack (Emission Point A1) and the multi-flue CHP engine flue stack (Emission Point A2). The site is also equipped with an emergency flare (Emission Point A3).

Please refer to the emission point plan provided in *Annex A – Figures.*

All emissions from the combustion activities will be in accordance with the Medium Combustion Plant Directive (MCP) noting that Chapter IV of the Industrial Emissions Directive (IED) does not apply whereby Article 42 (1) is achieved. Normal stack emission parameters are shown in Table 4.1 below. Under Abnormal Operating Conditions it is anticipated that the plant will be required to mirror the Emission Limit Values (ELV) prescribed by Chapter IV of the IED as shown in Table 4.2 below.

Detailed dispersion modelling in accordance with the EA H1 methodology has been undertaken to determine the potential air quality impacts associated with the proposed facility. All reports and modelling files associated with the assessment has been included in *Annex D – Air Quality Assessment and Human Health Risk Assessment.*

Table 4.1 Stack Emission Parameters for A1 (Pyrolyser) and A2 (CHP Engines Combined)

Parameter	A1	A2
Stack height (m)	18.2	18.2
Flue exit diameter (m)	0.7	1.0
Temperature of release (ºC)	500	365
Actual flow rate (Am^3/s)	12.5	24.3
Moisture content (%v/v)	7.58	10.0
Oxygen content (%v/v dry)	10.75	7.8
Normalised flow rate (Nm^3/s)	2.11 (a)	20.78 (c)
	4.18 (b)	12.38 (d)
Emission velocity at flue exit (m/s)	24.7	24.7
Emission Concentration (mg/Nm^3)	**ELV**	**ELV**
NOx – normal operation	100 (a)	95 (c)

(a) For normal operation, 3% O2 273K, 101.3 kPa, dry

(b) For abnormal operation, 11% O2 273K, 101.3 kPa, dry

(c) For normal operation, 15% O2 273K, 101.3 kPa, dry

(d) For abnormal operation, 11% O2 273K, 101.3 kPa, dry

Table 4.2 IED Emission Limits – Abnormal Operating Conditions

Pollutant	ELV (Referenced to 11% O_2)
Daily Average	
Total dust	10
Total organic carbon (TOC)	10
Hydrogen chloride (HCl)	10
Hydrogen fluoride (HF)	1
Sulphur dioxide (SO_2)	50
Oxides of nitrogen (NOx)	200
Carbon monoxide (CO)	50
Half-Hourly Average	
Total dust	30
Total organic carbon (TOC)	20
Hydrogen chloride (HCl)	60
Hydrogen fluoride (HF)	4
Sulphur dioxide (SO_2)	200
Oxides of nitrogen (NOx)	400
Carbon monoxide (CO)	100
Average over a sample period between 30-Minutes and 8-Hours	
Group 1 metals (a)	0.05
Group 2 metals (b)	0.05
Group 3 metals (c)	0.5
Average over a sample period between 6-Hours and 8-Hours	
Dioxins and furans (d)	1×10^{-7}

(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) I-TEQ

4.2 Emissions to Controlled Waters

Uncontaminated clean surface water runoff captured from roof drainage and external roadways / car parking areas will be discharged to the existing surface water drainage system (W1).

With the exception of small volumes of wastewater emissions from the scrubbing and condensing systems, there are no process releases from the process. All process effluents will be contained within a bunded storage vessel and the waste water removed from site by a third-party contractor for offsite disposal.

Under the requirements of the Environmental Permitting Regulations, all storage, processing areas and tanks will be equipped with pollution prevention measures (secondary containment, bunded compounds, controlled storage etc) to ensure that there is no potential for surface water runoff to be contaminated.

There are no releases or discharge points to controlled water from any aspect of the process. There are no surface water drains on site or within the immediate vicinity of site.

The site surface water drainage system will be protected at all times to ensure that no pollution can be allowed to enter.

4.3 Emissions to Sewer

There are no proposed emissions to sewer.

4.4 Emissions to Land

There are no emissions to land arising as a result of the installation.

All operational and storage areas on site are surfaced with impermeable concrete hardstanding.

4.5 Fugitive Emissions

There is a very limited potential for fugitive emission of dust to arise from the storage and handling of the proposed feedstock.

The only external activities on site relate to the storage of sealed feedstock bales. All incoming baled waste feedstock is required to be well wrapped and is subject to waste pre-acceptance and acceptance checks as well as visual site inspections. Any damaged or poorly wrapped bales are immediately either sent for processing or rejected from site.

Any loose waste will be stored within the main building within a fully sealed environment. Once transferred to the pyrolysis feed system, all fuel and char conveyor systems are sealed and subject to extraction and filtration.

Additionally, all aspects of the processing plant are located upon impermeable concrete hardstanding. As such there is no risk to ground, groundwater or surface water in the unlikely event of any spillage.

4.5.1 Odour

Due to the design of the building structure and the fully enclosed processing activities, there is very little potential for offsite odour emissions and impacts to arise from the site. Furthermore, all wastes accepted on site are required to be pre-processed and in accordance with an agreed specification. All waste accepted on site is inspected on arrival to ensure compliance and that it does not have any malodourous properties.

The delivery and reception of waste will not produce any odour emissions.

The pyrolysis process itself has no significant potential for odours as the combustion system thermally oxidises any odorous compounds. Any potentially odorous emissions arising for the storage and processing of wastes within the Hangar Building are extracted and thermally oxidised through the plant.

The only external site activity is the temporary storage of baled feedstock. Potential for odour emissions from this activity is limited due to the following measures:

- No odorous baled materials will be accepted onsite;
- All externally stored bales are required to be well wrapped (6 layers) and a site inspection is undertaken twice daily; and

- Any damaged, poorly wrapped or odorous bales are immediately removed and placed internally for processing.

Although there is very little potential for odour emissions from site due to the control measures described above, an Odour Management Plan has been produced as part of the sites Environmental Management System. Please refer to *Annex J – Odour Management Plan* for more information.

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

4.5.2 Noise

The design of the installation has taken into account the potential noise impacts on the environment and neighbouring receptors. The site is not located in an area considered to be sensitive to noise.

The processing plant and associated equipment has been designed in accordance with best practice and to ensure that 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 any sensitive receptors.

All noise emissions from the plant are controlled to ensure that they will not create noise nuisance of disturbance. The plant will incorporate a number of noise control measures, such as noise enclosures and stack exhaust attenuators to ensure that all impacts are mitigated.

An Environmental Noise Survey has been undertaken by Socotec Ltd assessing noise emissions from the external fans of the cooling towers in accordance with BS 4142:2014+A1:2019. The report concludes that site operations are unlikely to exceed the necessary limits and are therefore unlikely to have a material impact at any residential dwellings or HMP Bure.

Please refer to *Annex E – Environmental Noise Survey* for more information.

4.6 Waste / By-Product Generation and Management

Types and Amount of Waste / By-Product

The syngas generation facility will not inherently produce significant quantities of waste.

The main wastes / by-products produced from the operation of the facility will be:

- Aqueous Effluent;
- Oil residues; and
- Carbonaceous (bio)char.

Table 4.3 below shows a tabular summary of site wastes.

Table 4.3 Waste / By-Product Summary

Waste	EWC Code	Approx. Quant (tonnes)	Source	R / D Code	Environmental Fate
Aqueous Effluent	19 01 06*	100 tonnes	Gas cleaning and scrubbing	D9 (offsite treatment)	Tankered off site for treatment
Oil residue	19 01 17*	250 tonnes	Pyrolysis system	D9 (offsite treatment)	Tankered off site for treatment
Biochar	19 01 18 / 19 01 17	5,000 tonnes	Pyrolysis system	R5 (offsite treatment)	Dispatched off site for re-use

These will be removed from site when required and transferred to an appropriately licensed disposal/recovery facility.

The high carbon biochar has a number of uses in industry. Standard Gas is currently reviewing the possibility for disposal through sustainable routes by achieving end-of-waste status, however in the meantime the likely end users will be either the construction sector or cement kilns.

5. ENVIRONMENTAL MONITORING

5.1 Emissions to Air

The main emissions from site, as identified in Table 4.1, arise from the gas engine and pyrolyser exhaust stacks (Emission Point A1 and A2).

Despite the syngas being both clean and meeting the standards required to achieve the EA's 'End of Waste' requirements, the pyrolyser retort flue will be fitted with a full MCERTS Continuous Emissions Monitoring System which meets the requirements of BS EN 15259 Air quality – Measurement of Stationary Source Emissions and Environment Agency Technical Guidance Note M2.

The CEMS will be IED complaint and monitor HCl, NOx, NH_3, O_2, SO_2, VOC, particulates, H_2O, temperature, pressure and flow.

TOC will be analysed by a Flame Ionisation Detector.

HF will be calculated through the measurement of HCl as a surrogate.

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.

The primary purpose of the CEMS equipment is to provide a 'policeman' to permanently monitor the gas combustion products to demonstrate that the syngas is free of pollutants and to provide feedback to the pyrolysis control system and to ensure that the process remains within its operational control parameters at all times. Given that all combusted synthesis gas is produced by the same sources, monitoring is only required in one single location.

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:

- 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.

For all emissions from the gas engine, Standard Gas will carry out periodic sampling of nitrogen oxide (NOx), and carbon monoxide (CO) in accordance with the Medium Combustion Plant Directive.

All sampling equipment and associated platforms and sampling ports installed on site meet the requirements of the Environment Agency Technical Guidance Notes M1 and M2 and will be MCERTS approved.

Table 5.1 Monitoring Frequency

Emission Point	Parameter	Monitoring Frequency	Methodology
A1	• Oxides of nitrogen (NO and NO_2 expressed as NO_2) • Nitrous oxide (N_2O) • Particulate Matter • Hydrogen Chloride • Carbon Monoxide • Sulphur Dioxide • Ammonia • Total Organic Carbon	Continuous daily average and ½ hour average for all parameters	MCERTS certified CEMS equipment
A1	• Cadmium and thallium and their compounds (total) • Mercury and its compounds • Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V and their compounds (total) • Hydrogen Fluoride • Dioxin / Furans • Dioxin like PCB's • Specific Individual PAH's	Quarterly	EA Monitoring Guidance M1/M2 compliant extractive sampling
A2	• Oxides of nitrogen (NO and NO_2 expressed as NO_2); • Carbon Monoxide	Periodically	Medium Combustion Plant Directive.

Synthesis Gas Quality Monitoring

All synthesis gas being produced by the plant will be subject to continuous measurement and analysis. The analysers used by the plant will comprise high speed process gas analyser for monitoring and control of Calorific value, Wobbe Index, Specific gravity and the Air/Fuel ratio of process gas.

This analyser will feed back directly into the SCADA control system and be used to control a number of the key input parameters of the plant (i.e. retort speed, fuel feed rate etc).

In addition, the synthesis gas produced by the plant will be subject to periodic compliance sampling to double check and verify the online analysers and to confirm other gas quality aspects (gas chemical analysis etc).

5.2 Emissions to Controlled Waters

There will be no direct process emissions to controlled waters arising from the installation.

Therefore, no monitoring is required.

5.3 Emissions to Sewer

There will be no emissions to sewer, therefore no monitoring is required.

5.4 Emissions to Land

There are no process emissions to land arising from the facility, therefore no monitoring is required.

6. BEST AVAILABLE TECHNIQUES AND APPROPRIATE MEASURES APPRAISAL

A review of the Environment Agency (EA) Appropriate Measures Guidance and Best Available Techniques (BAT) requirements has been undertaken and the proposed installation does not directly align with any of the EA Guidance / BREF guidance documents.

A review has been conducted against the Non Hazardous and Inert Waste: Appropriate Measures for Permitted Facility guidance a due to seeming the most appropriate. This review is provided in Table 6.1. A review has also been completed against the relevant BAT conclusions in the Waste Incineration BREF as requested by the enhanced pre-application advice, however it is important to note that the process is not considered incineration, and the majority of the conclusions are not applicable. This is provided in Table 6.2.

Table 6.1 Non-Hazardous and Inert Waste: Appropriate Measures for Permitted Facilities

Appropriate measures reference	Appropriate measures	Justification
1. When appropriate measures apply		
1.1 Who this guidance is for	This guidance applies to permitted waste management facilities – full details provided within the appropriate measures guidance.	The proposed installation does not directly align with any of the EA guidance/ BREF guidance documents and therefore this guidance has been adopted as most appropriate.
1.2 Assessing appropriate measures for your site	-	-
1.3 Implementing appropriate measures at new and existing facilities	-	-
1.4 Site design and suitability	Consideration to the potential impacts of climate change when selecting a site, especially flood risk, drought, extreme temperature and extreme weather events.	The application and proposed operations on site have considered the potential impacts of climate change. An Environmental and Climate Change Risk Assessment has been conducted to identify, mitigate and assess the risks posed to the facility from climate change, as well as the risk the facility could pose to the environment and human health. The Environmental and Climate Change Risk Assessment is included in *Annex C – Environmental and Climate Change Risk Assessment*.
2. General Management Appropriate Measures		
2.1 Management System	You must have an up to date written management system, and activities at your facility must follow it. Your management system must incorporate the	The site shall be operated in accordance with corporate standards and procedures as part of an Environmental Management System (EMS). The system will be designed to meet the requirements of ISO 14001:2015. Section 3.5 above details the aspects of the EMS on site.

	features detailed within the appropriate measures guidance.	
2.2 Staff Competence	Staff competence in accordance with the aspects detailed within the appropriate measures guidance.	This condition has been met. All personnel working at the facility will be trained and overseen by the technology developer and manufacturing team. All personnel, irrespective of discipline will be trained in necessary sections of Standard Gas' operational procedures and management plans. All staff working for and on behalf of the site will be suitably trained and competent (e.g. professional maintenance engineers, electricians, equipment operators etc). All personnel working on site will be trained in the necessary sections of the EMS and associated procedures. 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. The operator will maintain written operation instructions for all plant and monitoring equipment present on site.
2.3 Accident Management Plan	As part of your written management system you must have a plan for dealing with incidents or accidents that could results in pollution, including near misses. The accident management plan must identify and assess the risks the facility poses to human health and the environment. Particular areas to consider are detailed within the appropriate measures guidance.	This condition has been met. Standard Gas operate in accordance with an Accident Management Plan (AMP) which is included in *Annex H - Accident Management Plan.* Section 3.8 above details the key aspects of the AMP and overview of incident reporting.
2.4 Contingency Plan and Procedures	Implement a contingency plan in accordance with the appropriate measures guidance.	This condition will be met. Standard Gas will implement a contingency plan with associated procedures in accordance with the appropriate measures guidance.
2.5 Facility Decommissioning		This condition will be met. Facility decommissioning will be implemented within the company's EMS.
3. Waste pre-acceptance, acceptance and tracking		
3.1 Waste pre-acceptance	Implement waste pre-acceptance procedures in accordance with the appropriate measures guidance.	This condition has been met. Prior to processing, all wastes accepted on site will be subjected to stringent waste pre-acceptance and acceptance criteria in accordance with the sites EMS and associated waste procedures.

3.2 Waste acceptance	Implement waste acceptance procedures in accordance with the appropriate measures guidance.	This condition has been met. Prior to processing, all wastes accepted on site will be subjected to stringent waste pre-acceptance and acceptance criteria in accordance with the sites EMS and associated waste procedures.
3.3 Quarantine	Quarantine requirements in accordance with the aspects detailed within the appropriate measures guidance.	This condition has been met. The site will benefit from a quarantine area which is provided in *Annex A – Figures*. The quarantine area is in accordance with the Fire Prevention Plan requirements for site.
3.4 Waste tracking	Waste tracking in accordance with the appropriate measures guidance.	This condition has been met. All waste entering and leaving the site will be tracked in accordance with the sites EMS and associated waste procedures.
4. Waste Storage		
Waste storage	Appropriate measures for waste storage at a regulated facility permitted to store, treat or transfer (or both) non-hazardous and inert waste. Waste storage in line with the requirements detailed within the appropriate measures guidance.	This condition has been met. Incoming waste will be accepted on site either in baled or loose form. If baled, the bales will be stored within the external storage area or internally within the main processing building. Loose feedstock will only be stored within the main building within a fully sealed environment. The storage of SRF/RDF will be carried out in line with the appropriate measures requirements.
4.1 Segregation	Different types of waste should be segregated if contamination would inhibit the recovery of waste.	This condition has been met. The site will only accept pre-processed non-hazardous waste in baled or loose form. If baled, the bales will be stored within the external storage area or internally within the main processing building. Loose feedstock will only be stored within the main building within a fully sealed environment. There is no risk of contamination.
5. Waste treatment		
Waste treatment	Waste treatment in accordance with the requirements detailed within the appropriate measures guidance.	This condition has been met. Prior to arriving on site all incoming waste will undergo waste pre-acceptance and acceptance checks and rejection procedures if required. Waste treatment will be conducted in accordance with the sites EMS and associated operating procedures which will detail waste treatment activities, processes and abatement and control equipment.
5.1 Soils and inert waste	N/A	N/A
5.2 Waste treatment outputs, including fines	N/A	N/A

5.3 Waste treatment for landfill	N/A	N/A
6. Emissions control		
6.1 Enclosure within buildings	Activities to be undertaken within a building as potential mitigation should be conducted in line with the appropriate measures guidance.	This condition will be met. Only baled feedstock will be stored externally. All processing of waste is undertaken internally within an enclosed building.
6.2 Point source emissions to air (channelled emissions)	Point source emissions to air to be undertaken in accordance with the requirements detailed within the appropriate measures guidance.	This condition has been met. An Air Quality Assessment has been undertaken and is included in *Annex D – AQA and HHRA.*
6.3 Fugitive emissions to air	The site must implement appropriate measures to prevent and minimise fugitive emissions to air, including dust, mud and litter, odour and noise and vibrations. Additional requirements are detailed within the appropriate measures guidance.	This condition has been met. Fugitive emissions to air have been screened out within the Environmental and Climate Change Risk Assessment provided in *Annex C – Environmental and Climate Change Risk Assessment.* All wastes accepted on site will be subjected to stringent waste pre-acceptance, acceptance and rejection criteria in accordance with the sites EMS and associated waste procedures.
6.4 Point source emissions to water (including sewer)	The site must identity the main chemical constituents of the facilities point source emission of water and sewer as part of an inventory of emissions. Additional requirements are detailed within the appropriate measures guidance.	This condition has been met. There will be no emissions to controlled waters arising from the installation. Uncontaminated clean surface water runoff captured from roof drainage and external roadways / car parking areas will be discharged to the existing surface water drainage system (W1). With the exception of small volumes of wastewater emissions from the scrubbing and condensing systems, there are no process releases from the process. All process effluents will be contained within a bunded storage vessel and the waste water removed from site by a third-party contractor for offsite disposal. There will be no emissions to sewer.
6.5 Fugitive emissions to land and water	You must use appropriate measures to control potential fugitive emissions and make sure that they do not cause pollution. The sites design should be designed in consideration with the appropriate measures guidance.	This condition has been met. There will be no fugitive emissions to land and water arising from the installation. Only baled feedstock will be stored externally and will be transferred inside prior to processing. Any loose feedstock will be stored within the main processing building. All storage tanks associated with the process are installed with secondary containment and are designed to comply with EA and CIRCA guidance.
6.6 Pests	You must manage waste in a way that prevents pests and in accordance with the appropriate measures guidance.	This condition has been met. Pests are unlikely to become an issue on site. Monitoring for evidence of pests will be included during the daily site perimeter inspection. However, if

		a problem does develop, reasonable measures will be taken to use commercially available products and services to control pests.
7. Emission monitoring and limits		
7.1 Emissions to air	The facilities emissions inventory must include relevant characteristic of emissions to air as detailed within the appropriate measures guidance. Consideration must be given to fugitive emissions to air and the potential to cause pollution to sensitive receptors.	This condition will be met. The site will have a detailed emissions inventory detailing all the required monitoring in line with the site permit.
7.2 Medium Combustion Plant Directive	Operate in accordance with the points detailed within the appropriate measures guidance.	This condition has been met. The plant will be monitored in accordance with the Environment Agency Guidance 'Monitoring Stack Emissions: MCPs and Specified Generators) as detailed within Section 5.
7.3 Emissions to water and sewer	The facilities emissions inventory must include relevant characteristics of point source emissions to water or sewer and key process parameters as those detailed within the appropriate measures guidance.	N/A – there are no point source emissions to water or sewer arising from the installation.
8. Process efficiency and appropriate measures		
8.1 Energy Efficiency (Installations only)	Create and implement an energy efficiency plan at your facility and undertake the requirements detailed within the appropriate measures guidance.	This condition will be met. Standard Gas will have an energy efficiency plan in place which will be regularly reviewed and integrated within the company's EMS.
8.2 Raw Materials (Installations only)	Operate in accordance with the requirements detailed within the appropriate measures guidance.	This condition will be met. A list of raw materials will be maintained on site.
8.3 Water use (Installations only)	Operate in accordance with the requirements detailed within the appropriate measures guidance.	This condition will be met. Water use and optimisation measures will be implemented on site, regularly reviewed and operated in accordance with the sites EMS.
9. Waste Minimisation, recovery and disposal		

9.0 Waste minimisation, recovery and disposal	Implementation of a residues management plan and additional requirements detailed within the appropriate measures guidance.	This condition has been met. A Residuals Management Plan will be implemented on site.

Table 6.2 Waste Incineration BREF BAT Conclusions

BAT Ref	BAT Conclusion	Comment
Environmental Management Systems		
BAT 1	In order to improve the overall environmental performance, BAT is to elaborate and implement an environmental management system (EMS) that incorporates the features provided within the BREF document.	The site shall be operated in accordance with corporate standards and procedures as part of an Environmental Management System (EMS). The system will be designed to meet the requirements of ISO 14001:2015. Section 3.5 above details the aspects of the EMS on site.
Monitoring		
BAT 2	BAT is to determine either the gross electrical efficiency, the gross energy efficiency, or the boiler efficiency of the incineration plant as a whole or of all the relevant parts of the incineration plant.	N/A – the plant is not considered an incineration plant. However the efficiency of the plant will be regularly monitored by Standard Gas.
BAT 3	BAT is to monitor key process parameters relevant for emissions to air and water including those given in Guidance.	N/A – all process monitoring will take place as detailed within Section 4 of this document. There will be no point source emissions to water arising from the installation. There will be no bottom ash treatment carried out on site.
BAT 4	BAT is to monitor channelled emissions to air with at least the following frequency given below and in accordance with EN standards. If the EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.	N/A – all emissions monitoring will take place as detailed within Section 5 of this document.
BAT 5	BAT is to appropriately monitor channeled emissions to air from the incineration plant during Other Than Normal Operating Conditions (OTNOC).	N/A – the plant is not considered an incineration plant.
BAT 6	BAT is to monitor emissions to water from FGC and/or bottom ash treatment with at least the frequency given in the guidance and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.	N/A – there are small volumes of wastewater emissions from the scrubbing and condensing systems however this is removed from site by a third-party contractor for offsite disposal. There will be no bottom ash treatment carried out on site.
BAT 7	BAT is to monitor the content of unburnt substances in slags and bottom ashes (LOI & TOC) at the incineration plant at least every 3 months and in accordance with EN standards.	N/A – not applicable to the site. Biochar will be monitored in accordance with the site permit.

BAT 8	For the incineration of hazardous waste containing POPs, BAT is to determine the POP content in the output streams (e.g. slags and bottom ashes, flue-gas, waste water) after the commissioning of the incineration plant and after each change that may significantly affect the POP content in the output streams.	N/A – no hazardous waste is accepted on site.
General Environmental and Combustion Performance		
BAT 9	In order to improve the overall environmental performance of the incineration plant by waste stream management, BAT is to use all of the techniques (a) to (c) given below, and, where relevant, also techniques (d), (e) and (f).	Standard Gas will operate stringent waste pre-acceptance and acceptance procedures which will form part of the companies EMS. The sites EMS will be complete with details on the following: ▪ The waste that can be processed on site; ▪ Pre-acceptance procedures; ▪ Waste acceptance procedures; ▪ A waste tracking system and inventory; and ▪ Waste segregation.
BAT 10	In order to improve the overall environmental performance of the bottom ash treatment plant, BAT is to set up and implement an output quality management system	N/A – there is no bottom ash treatment proposed on site.
BAT 11	In order to improve the overall environmental performance of the incineration plant, BAT is to monitor the waste deliveries as part of the waste acceptance procedures (see BAT 9c) including, depending on the risk posed by the incoming waste, the elements given in the guidance.	Waste deliveries will be monitored in accordance with the waste acceptance procedures. This will include: Weighing of the waste deliveries; Visual inspection; and Periodic sampling of waste deliveries and analysis of key properties/substances (e.g. calorific value, content of halogens and metals/metalloids). Due to the type of waste accepted on site, site radioactivity detection will not be provided.
BAT 12	In order to reduce the environmental risks associated with the reception, handling and storage of waste, BAT is to use both of the techniques given in the guidance.	The site benefits from impermeable hardstanding and a sealed drainage system. Periodic verification of impermeable surfaces will be incorporated into the sites planned preventative maintenance and inspection schedules. No waste will be accepted on site unless there is the capacity to do so.
BAT 13	In order to reduce the environmental risk associated with the storage and handling of clinical waste, BAT is to use a combination of the techniques given in the guidance.	N/A – no clinical waste is accepted on site.
BAT 14	In order to improve the overall environmental performance of the incineration of waste, to reduce the content of unburnt substances in slags and bottom ashes, and to	All waste will be accepted on site in accordance with an agreed specification. When ready for processing, the feedstock will be loaded into a sealed and contained hopper, de-baled if required,

	reduce emissions to air from the incineration of waste, BAT is to use an appropriate combination of the techniques given in the guidance.	and pre-processed via screening and separation equipment. The plant will be controlled using a digital control system (DCS) linked to a SCADA system.
BAT 15	In order to improve the overall environmental performance of the incineration plant and to reduce emissions to air, BAT is to set up and implement procedures for the adjustment of the plant's settings, e.g. through the advanced control system, as and when needed and practicable, based on the characterisation and control of the waste (see BAT 11).	The plant will be controlled using a digital control system (DCS) linked to a SCADA system.
BAT 16	In order to improve the overall environmental performance of the incineration plant and to reduce emissions to air, BAT is to set up and implement operational procedures (e.g. organisation of the supply chain, continuous rather than batch operation) to limit as far as practicable shutdown and start-up operations.	Procedures will be in place to limit shut-down and start-up operations as far as practically possible.
BAT 17	In order to reduce emissions to air and, where relevant, to water from the incineration plant, BAT is to ensure that the FGC system and the waste water treatment plant are appropriately designed (e.g. considering the maximum flow rate and pollutant concentrations), operated within their design range, and maintained so as to ensure optimal availability.	The syngas cleaning system and water treatment plant are appropriately designed for the facility, will be operated within the design range and maintained to ensure optimal availability.
BAT 18	In order to reduce the frequency of the occurrence of OTNOC and to reduce emissions to air and, where relevant, to water from the incineration plant during OTNOC, BAT is to set up and implement a risk-based OTNOC management plan as part of the environmental management system (see BAT 1) that includes all of the elements within the guidance.	N/A – OTNOC is not a requirement for this type of facility.
Energy Efficiency		
BAT 19 – BAT 20	Energy efficiency BAT conclusions.	N/A – heat will be recovered as far as possible by the system with any residual heat being cooled by a bank of external cooling towers and chillers. Energy efficiency will be optimised during the operation of the plant.
Emissions to Air		
BAT 21 – BAT 31	Emissions to air BAT conclusions.	N/A – all emissions to air will be monitored as detailed within Section 5 of this document.
Emissions to Water		
BAT 32 – BAT 34	Emissions to water BAT conclusions.	N/A – there are no point source emissions to water arising from the installation.
Material Efficiency		

BAT 35 – BAT 36	Material efficiency BAT conclusions.	N/A – there is no treatment of slags and bottom ashes on site.
Noise		
BAT 37	In order to prevent or, where that is not practicable, to reduce noise emissions, BAT is to use one or a combination of the techniques in the guidance.	The site has undertaken a Noise Assessment Survey which is provided within *Annex E – Noise Assessment Survey*. Operational measures for the reduction of noise on site include: ▪ Improved inspection and maintenance of equipment; ▪ Closing of doors and windows of enclosed areas, if possible; ▪ Operation of equipment by experienced staff; ▪ Avoidance of noisy activities at night, if possible; ▪ Provisions for noise control during maintenance activities.

7. IMPACT TO THE ENVIRONMENT

7.1 Impacts to Air

Detailed air quality modelling using the UK ADMS dispersion model has been undertaken to predict the impacts associated with stack emissions from the proposed facility.

Scope of the Assessment

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

- 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 and modelling of emissions data which has been used as an input to the UK Atmospheric Dispersion Modelling System (ADMS) dispersion model.

The assessment for the facility comprises a review of emission parameters for the installation 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 levels/ loads for the protection of sensitive ecosystems and vegetation.

7.1.2 Sensitive Human Health Receptors

The location of the discrete sensitive receptors selected for the assessment is presented in Table 7.1.

Table 7.1 Human Health Receptors

Ref.	Receptor	Type	Easting	Northing
D1	3D at Depth	Commercial/industrial	626183	322937
D2	October Studios	Commercial/industrial	626074	323034
D3	Specialist Vehicle Training	Commercial/industrial	625992	322999
D4	HM Prison	Residential	625884	323105
D5	Filby Road	Residential	625679	323025
D6	Barton Road	Residential	625764	323384
D7	West Lodge	Residential	626176	323633
D8	Manor Farm	Residential	626657	323474
D9	Malthouse Farm	Residential	627447	323034
D10	Honeysuckle Cottage	Residential	626473	322058
D11	The White House	Residential	625380	321990

The report concludes that taking into consideration the worst-case assumptions adopted for the assessment, predicted maximum off-site concentrations are well below the relevant air quality standards for all pollutants considered.

Please refer to *Annex D – AQA and HHRA* for more information.

7.1.3 Sensitive Habitat Sites

The Environment Agency's Risk Assessment Guidance[2] 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[3];
- Special Protection Areas (SPAs) and potential SPAs designated under the EC Birds Directive[4]; and
- Ramsar Sites designated under the Convention on Wetlands of International Importance[5].

Within 2 km of the source:

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

However, the habitat screening for MCP installations is 5 km for European sites and 2 km for SSSI. There are no European sites within 5 km or SSSIs within 2 km. Therefore, for normal operation the impact of emissions on habitat sites can be screened out of the assessment.

For abnormal operation, habitat receptor designations and locations relevant to the assessment are presented in Table 7.2. There are three European sites within 10 km, no SSSI's within 2 km and there are three LWS within 2 km of the facility site. The Broads SAC and Broadland SPA/Ramsar are co-located and multiple areas of these sites occur at various locations around the site. Therefore, the nearest areas have been identified (four locations) and the maximum predicted concentration or deposition rate is compared to the relevant critical level or critical load.

Table 7.2 Sensitive Habitat Receptors

Receptor	Primary Habitat	Approx. Location (Relative to Site)
H1_1. The Broads SAC	Transition mires and quaking bogs	Various locations within 10 km
H1_2. Broadland SPA/Ramsar	Northern wet heath and dwarf shrub heath	Various locations within 10 km
H2. Norfolk Valley Fens SAC	Valley mires, poor fens and transition mires and bogs	8.2 km west
H3. Scottow Pond and Oak Belt LWS	Assumed broadleaved deciduous woodland	1.7 km north
H4. Stakebridge Beck LWS	Assumed neutral grassland	1.6 km northwest

2 https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit
3 Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.
4 Council Directive 79/409/EEC on the conservation of wild birds
5 Ramsar (1971), The Convention of Wetlands of International Importance especially as Waterfowl Habitat.

H5. Low Common and Plantations LWS	Assumed broadleaved deciduous woodland	1.9 km north

The report concludes that the predicted process contributions are negligible compared with the critical levels for airborne NOx, SO_2 and HF and critical loads for nutrient nitrogen deposition and acidification at nearby sensitive habitat sites.

Please refer to *Annex D – AQA and HHRA* for more information.

7.2 Impacts to Controlled Waters

There will be no impact to controlled waters arising from this installation.

All process effluents are tankered off site for treatment and disposal.

7.3 Impacts to Sewer

There will be no impact to sewer arising from this installation.

7.4 Impacts to Land

There will be no impact to land arising from this installation.

7.5 Fugitive Emissions, Noise and Odour

All emissions of noise, dust and odour are minimised and controlled at source to ensure that there are no potential offsite impacts. Across site, all emissions of noise, dust and odour will be subject to operational management and monitoring plant to ensure that none of the nearby offsite receptors are adversely impacted.