Best Available Techniques (BAT) Assessment

On Behalf of Eco Verde Energy Limited

Attleborough AD Plant, Ellingham Road, Attleborough, Norfolk, NR17 1AE

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1. Introduction

1.1.1 A Best Available Techniques (BAT) Assessment has been prepared by Earthcare Technical Ltd (ETL) on behalf of Eco Verde Energy Limited (EVE) to support a substantial variation permit application for a bespoke installation permit for an anaerobic digestion plant including the use of resultant biogas at, Ellingham Road, Attleborough, Norfolk, NR17 1AE herein termed 'the Site'. The plant will be operated by EVE. BioConstruct GmbH designed the plant and are building and commissioning it.

1.1.2 This report comprises a review of the proposed operation, activities, infrastructure, management systems, etc., in comparison to the requirements of indicative BAT as stated in How to comply with your environmental permit: Additional Guidance for Anaerobic Digestion[1] and Best Available Techniques Reference Document for Waste Treatment[2] to ensure that all relevant areas are included.

1.1.3 The aim of this report is to provide confidence to the Environment Agency that EVE has both considered the requirements of BAT and will operate the site in line with the requirements of Indicative BAT.

1.1.4 The report is structured in table format as set out in the 2018 Best Available Techniques (BAT) Reference Document for Waste Treatment to ensure a logical review of the requirements of indicative BAT. Next to each relevant requirement there is a summary of the proposals and a comparison against Indicative BAT.

1.1.5 The final section comprises conclusions and a discussion of areas where the proposals do not currently meet Indicative BAT.

[1] How to comply with your Environmental permit: Additional guidance for: Anaerobic digestion, LIT 8737, V.1, November 2013

[2] Best Available Techniques (BAT) Reference Document for Waste Treatment, European IPPC Bureau, 2018

2. BAT Assessment for Attleborough AD Plant

Environmental Management System

BAT 1	**BAT 1. In order to improve the overall environmental performance, BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the following features**	
I	Commitment of the management, including senior management;	Senior management of EVE have committed to the establishment and further development of an environmental management system (EMS). Ref: EMS Manual **(ATT-OD-01)**
II	Definition, by the management, of an environmental policy that includes the continuous improvement of the environmental performance of the installation;	The Environmental Policy includes a commitment to continual improvement. Ref: Environmental Policy **(EVE-OD-01)**
AD TGN Management systems	The company should adopt an environmental policy and programme which: • includes a commitment to continual improvement and prevention of pollution; • includes a commitment to comply with relevant legislation and other requirements to which the organisation subscribes; and • identifies, sets, monitors and reviews environmental objectives and key performance indicators independently of the Permit.	All these elements are included within the Environmental Policy **(EVE-OD-01).** The Environmental Policy is available in hard copy at the company head office and made available upon request. EVE will seek to proactively communicate with its external stakeholders about its EMS and the organisations goals in terms of environmental performance.
III	Planning and establishing the necessary procedures, objectives and targets, in conjunction with financial planning and investment by the management;	Management system procedures are in place and are summarised within the EMS Manual **(ATT-OD-01)** and the Master Document Control File **(EVE-OD-03).** The Environmental Risk Assessment (Appendix A of the EMS Manual) was used to determine environmental risks and the required control measures including management system controls. The Environmental Management System has been approved by senior management who are also responsible for financial planning and investment decisions.

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IV	Implementation of procedures paying particular attention to: • structure and responsibility, • recruitment, training, awareness and competence, • communication, • employee involvement, • documentation, • effective process control, • maintenance programmes, • emergency preparedness and response, • safeguarding compliance with environmental legislation;	There are management system documents and procedures covering all of these elements as summarised in the Master Document Control File **(EVE-OD-03).** There is a full set of operational documents in place for the existing AD plant 'Crop-AD Plant'. There is a draft set of operational procedures in place for the new AD plant 'Waste-AD Plant' which will be finalised and trained out to staff prior to the Waste-AD plant commencing operations. There is a focus on continual improvement of the existing documentation to ensure that the elements within BAT are incorporated. The EMS Manual **(ATT-OD-01)** describes how all these elements are incorporated into the EMS.
AD TGN Management Systems	Training systems, covering the following items, should be in place for all relevant staff which cover: • awareness of the regulatory implications of the Permit for the activity and their work activities • awareness of all potential environmental effects from operation under normal and abnormal circumstances • awareness of the need to report deviation from the Permit • prevention of accidental emissions and action to be taken when accidental emissions occur.	All staff will receive training on the permit requirements including reporting requirements and the relevant sections of the EMS and the Accident Management Plan **(ATT-OD-05)** including Section 6.2 Incident Reporting & Recording Procedure.
AD TGN Management Systems	The skills and competencies necessary for key posts should be documented and records of training needs and training received for these post maintained. The key posts should include contractors and those purchasing equipment and materials.	In accordance with Section 11.3 of the EMS Manual **(ATT-OD-01**): *The Operator will ensure all persons performing tasks for the organisation or on its behalf, whose work may have a significant impact on the environment, are competent based on appropriate education, training and/or experience, and will retain associated records.*

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		*The Operator has established and implemented procedures to identify the training needs associated with the EMS, the operation of the site and the retention of staff competencies. Training requirements will be determined following the Training Procedure **(ATT-SOP-04)**.* *It is essential that all staff are fully aware of the EMS to ensure that procedures and controls are upheld. All new staff joining EVE will receive appropriate training using the EMS and documented procedures to understand and reduce environmental impact of the organisation's activities.* *All formal training and Toolbox Talks received will be logged in the Skills and Competency Matrix **(EVE-OD-02**).* For training of contractors see section below.
AD TGN Management Systems	The potential environmental risks posed by the work of contractors should be assessed and instructions provided to contractors about protecting the environment while working on site.	Contractors will not be employed or allowed to start work unless they have provided the necessary evidence of competence and have signed to agree site rules and conditions of work. There will be an Approved Supplier List and inductions provided for all contractors. The work of contractors will be monitored by the Site Manager or Nominated Competent Person and if any of the conditions are not met then the contractor may be told to stop work.
AD TGN Management Systems	Where industry standards or codes of practice for training exist (e.g., WAMITAB) they should be complied with.	Technically Competent Management will be provided by the Site Manager Tom Thornton who holds the WAMITAB award: Waste and Resource Management – Biological Treatment Processing. All Technically Competent Managers will undertake Continuing Competence assessments at the required two-yearly interval to ensure that qualifications are maintained up to date and in accordance with regulatory requirements.
AD TGN Management Systems	Effective operational and maintenance systems should be employed on all aspects of the process whose failure could impact on the environment, in particular there should be: • documented procedures to control operations that may have an adverse impact on the environment,	There is a planned preventative maintenance programme in place. Maintenance is carried out in accordance with the Attleborough AD Maintenance planner **(ATT-MP-01)** and the BioConstruct Maintenance Plan on SCADA. The maintenance of some items will be contracted to third party contractors as detailed in section 12.5 of the EMS Manual **(ATT-OD-01)**. The Site Manager retains overall responsibility for the maintenance of all plant and equipment whether it is carried out in-house or by third party contractors.

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	• a defined procedure for identifying, reviewing and prioritising items of plant for which a preventative maintenance regime is appropriate, • a preventative maintenance programme covering all plant, whose failure could lead to impact on the environment, including regular inspection of major 'non-productive' items such as tanks, pipework, retaining walls, bunds, ducts and filters, • documented procedures for monitoring emissions or impacts. The maintenance system should include auditing of performance against requirements arising from the above and reporting the result of audits to top management.	It is the responsibility of the Site Manager to ensure that any new items of plant or equipment are incorporated into the preventative maintenance regime as appropriate, and that staff training is carried out as required. The Procedures / Work Instructions for maintenance tasks are detailed in the Master Document Control File **(EVE-OD-03)**. There are documented procedures in place for monitoring emissions or impacts e.g., Process Monitoring Procedure **(ATT-SOP-03)**, Monitoring Procedure **(ATT-SOP-04)** and Fugitive Emissions Plan **(ATT-SOP-05)**. The Site Manager reports significant maintenance check results and emission test results to the Cluster Operations Director.
AD TGN Waste treatment	The operator should carry out adequate inspection and maintenance (including planned preventative maintenance) to maintain the availability of the process and minimise unscheduled shut downs or any other event where equipment or process failure could lead to impact on the environment.	There is a comprehensive inspection and maintenance programme in place to minimise disruption to the process and unscheduled shut downs which will be extended to incorporate the new infrastructure once it is commissioned.
AD TGN – Management systems	The company should have demonstrable procedures (e.g., written instructions) which incorporate environmental considerations into the following areas: • the control of process and engineering change on the AD facility; • design, construction and review of new facilities and other capital projects (including provision for their decommissioning)	There is a Change Control Procedure **(EVE-SOP-03)** in place.
V	Checking performance and taking corrective action, paying particular attention to:	The management system incorporates:

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	• monitoring and measurement, • corrective and preventive action, • maintenance of records, • independent (where practicable) internal or external auditing in order to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained.	• Monitoring and measurement e.g., Process Monitoring Procedure **(ATT-SOP-03)**, Monitoring Procedure **(ATT-SOP-04)** • Control of records in accordance with Section 11.2 of the EMS Manual **(ATT-OD-01)** • Internal Auditing Procedure **(EVE-SOP-05)** which incorporates corrective and preventative actions.

AD TGN Management systems	The company should have a clear and logical system for keeping records including, but not limited to:
	
	• Policies,
	• roles and responsibilities,
	• targets,
	• procedures,
	• results of audits,
	• results of reviews.
		All the management system documents benefit from a document referencing and control system in accordance with the Section 11.2 of the EMS Manual **(ATT-OD-01).**
		
		The internally produced documentation associated with the EMS is presented in a consistent format including:
		• *Title of document*
		• *Document reference in the format XXX-XXX-NN where:*
		  ○ *XXX is either:*
		  ▪ *'**EVE**' for a companywide management system document which is used across all sites operated by EVE; or*
		  ▪ ***'ATT'** denoting a management system document specific to the Attleborough AD site.*
		  ○ *XXX is:*
		  ▪ *OD denoting an Overarching Document for example a management plan*
		  ▪ *SOP is a Standard Operating Procedure*
		  ▪ *MP is a Monitoring and / or Maintenance Schedule*
		  ▪ *FT is a Standard form template used to make records in relation to the EMS and associated procedures.*
		  ○ *NN is a unique number to identify the document.*

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		Roles and responsibilities are detailed in Section 10 of the EMS Manual **(ATT-OD-01)**. Furthermore, roles and responsibilities relating to individual tasks are detailed in standard operating procedures. The process for creating and reviewing documents is detailed in the Document Control Procedure **(EVE-SOP-01)**. The status of all management system documents is recorded within the Master Document Control File **(EVE-OD-03).** The results of internal audits and management reviews will be recorded the Internal Audit Report Form **(EVE-FT-07)** and the Management Review Report Form **(EVE-FT-08)** respectively and will be kept on the shared drive, in dedicated folders.
VI	Review, by senior management, of the EMS and its continuing suitability, adequacy and effectiveness;	ATT will carry out an annual Management Review in accordance with Management Review Procedure **(EVE-SOP-05)** which will be recorded on Management Review Report Form **(EVE-FT-08).**
VII	Following the development of cleaner technologies;	The Environmental Policy **(EVE-OD-01)** includes a commitment that new investments in plant and operations will incorporate the best environmental techniques that are commercially viable. EVE are members of the industry body Renewable Energy Association (REA) and have a network of contacts within the industry to keep well informed of industry developments. EVE will take the opportunity to adopt cleaner technologies where possible.
VIII	Consideration for the environmental impacts from the eventual decommissioning of the plant at the stage of designing a new plant, and throughout its operating life;	See below
AD TGN Management systems	Care should be taken at the design stage to minimise risks during decommissioning. Designs should ensure that: • underground tanks and pipework are avoided where possible (unless protected by secondary containment or a suitable monitoring programme);	• All pipes, ducts and cables are fixed on cable trays and stanchions positioned above the concrete containment, to not penetrate the containment floor or walls. This has been designed in accordance with CIRIA C736 to ensure any potential leakages are visible to onsite, operational staff whilst carrying out daily inspections of the containment bund structure. • Underground tanks and pipes have been avoided in the design where possible. The majority of pipework will be above ground. The underground pipe carrying waste digestate liquor from the separator in the Reception Building to the waste

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	• there is provision for the draining and clean-out of vessels and pipework prior to dismantling;
	• the design allows for the safe clearing of lagoons;
	• lagoons are designed with a view to their eventual clean-up or surrender;
	• insulation is provided that is readily dismantled without dust or hazard;
	• materials used are recyclable (having regard for operational or other environmental objectives);
	• either the removal or the flushing out of pipelines and vessels where appropriate and their complete emptying of any potentially harmful contents; and
	• as installed plans of all underground pipes and vessels are provided to the permit holder.
		digestate storage lagoon will be partially underground and, in this section, will have a pipe in pipe design (see Appendix G for design). There will also be a flow meter installed on this pipe.
		• The leachate tank (19.8m^3) is below ground but has an opening at surface level. It is constructed of reinforced concrete with all internal walls lined with MDPE and leak detection monitoring points around the tank, extending 1.50m below the base. The design is shown on Plandescil drawing 24727/100 Rev C (Appendix H) and described within the Drainage Report[9] supporting this permit application:
		  • *The below ground level leachate tank is to be of in situ reinforced concrete construction, with a 19.8m^3 storage capacity. The tank is to be 18m X 1m in plan area, with depths varying between 1.2m (East) to 1.0m (West). The internal concrete tank walls are to be lined with a sealed 2mm MDPE membrane. The covered tank has been designed with a single vent, and 5 No. 63mm Ø MDPE monitoring points positioned externally 0.5m from the outer wall face of the tank. The monitoring points are to extend to a minimum of 1.5m below the underside of the tank foundation, with open ends. The monitoring points are to be manually tested regularly for any signs of contamination with a probe by the site operators.*
		  • *A high-level overflow leachate gravity pipe is to discharge water to the adjacent dirty water pond in circumstances where there is no requirement for the leachate water to be used in the process. Otherwise, the leachate tank will discharge via a pumped above ground route to the process area, to be utilised within the various storage tanks, where deemed applicable during site operations.*
		  • *To aid in cleaning of the solid material from the leachate tank, a fall on the base on the sum has been designed*.
		• To maximise robustness and longevity of the leachate system for the silage clamps, all manholes are to be fully coated internally with bitumen paint, preventing deterioration of the pre-cast concrete rings. Furthermore, UPVC foul water pipe has been specified for all gravity leachate pipework on the site to mitigate the potential for any future leakages at joint locations.
		• The dirty water lagoon will be cleared out using vacuum tankers if required.
		• All new insulation material meets modern health and safety standards.

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		• Materials used are able to be recycled so far as is possible. • There will be plans of all as installed subsurface infrastructure (sumps).
AD TGN Management systems	Operations during the life of the Permit should not lead to any deterioration of the site. Should any instances arise which have, or might have, impacted on the state of the site, the operator should record them along with any further investigation or ameliorating work carried out. This will ensure that there is a coherent record of the state of the site throughout the life of the Permit. This is as important for the protection of the Operator as it is for the protection of the environment.	Incidents and Accidents are recorded on the Accident and Incident Report Form **(EVE-FT-01).** These records will be retained for the operational life of the site. The Site Condition Report[3] will be updated as appropriate during the operational life of the site.
AD TGN Management systems	Your management system must include information about the condition of the land before you start operations, and how you have protected it during the life of the permit and site closure.	The Site Condition Report describes the condition of the land before operations started.[3] The Site Condition Report will be updated during the life of the site and prior to surrender in accordance with current or future guidance.
IX	Application of sectoral benchmarking on a regular basis;	The Environmental Policy **(EVE-OD-01)** includes an objective to meet relevant legislative, regulatory and environmental codes of practice. Through industry connections and networking including as REA members EVE will compare environmental performance with other operators and strive to improve their performance through environmental objectives.
X	Waste stream management (see BAT 2);	See BAT 2
XI	An inventory of waste water and waste gas streams (see BAT 3)	See BAT 3
XII	Residues management plan - A residues management plan is part of the EMS and is a set of measures aiming to: • minimise the generation of residues arising from the treatment of waste,	There is a site-specific Residues Management Plan **(ATT-OD-08)** in place. The Residues Management Plan formalises the decisions regarding the fate of residues including packaging in line with the waste hierarchy. The resultant biogas and digestate produced from the treatment of waste materials are fully recovered.

[3] Site Condition Report, Earthcare Technical Limited, August 2021 (ETL573/SCR/V1.0)

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	• optimise the reuse, regeneration, recycling and/or recovery of energy of the residues, and • ensure the proper disposal of residues.	All residues will be handled in line with environmental permitting and duty of care legislation.
AD TGN Management systems	There should be an accident management plan founded on a risk assessment which: • identifies the likelihood and consequence of accidents, • identifies actions to prevent accidents and mitigate any consequences, The accident management plan should consider risk and impact of flooding and fires.	The Risk Assessment within the Accident Management Plan **(ATT-OD-05)** identifies the likelihood and consequence of accidents and appropriate actions and considers the risk and impact of flooding and fires. The Accident Management Plan includes several Emergency Response Procedures: • Incident Reporting & Recording Procedure (Section 6.2) • Control Panel Alarm Response (Section 7) • Fire and Explosion Response Procedure (Section 8) • Biogas Leak Response Procedure (Section 9) • Foam Response Procedure (Section 10) • Main Power Outage Response Procedure (Section 11) • Safe Shutdown Procedure (Section 12) • Mechanical Failure Procedure (Section 13) There is also a standalone company-wide Spill Control Procedure **(EVE-SOP-07).**
AD TGN Accidents and abnormal operation	Identification of the hazards to the environment should include, but should not be limited to, the following: • Biogas storage; • Biogas transfer operations; • arrangements for the receipt, and checking of incoming wastes, including rejection and quarantine; • arrangements for the storage, segregation and separation of differing waste types; • procedures for the internal transfer, including "bulking-up", of waste materials;	The Risk Assessment within the Accident Management Plan **(ATT-OD-05)** considers all the hazards listed in AD TGN.

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	• transfer of substances (e.g., filling or emptying of vessels); • overfilling of vessels; • emissions from plant or equipment (egg. leakage from joints, over-pressurisation of vessels, blocked drains); • failure of containment (egg. physical failure or overfilling of bunds or drainage sumps); • failure to contain firewater; • wrong connections made in drains or other systems; • incompatible substances allowed to come into contact; • unexpected reactions or runaway reactions; • release of an effluent before adequate checking of its composition; • failure of main services (e.g., power, steam, cooling water); • operator error; • vandalism; • Air/ventilation management; and • Abatement systems.	
AD TGN Accidents and abnormal operation	Identification of the techniques necessary to reduce the risks. The following techniques are relevant to most AD facilities: a) There should be an up-to-date inventory of substances, present or likely to be present, which could have environmental consequences if they escape. b) Where the AD facility is situated in a floodplain, consideration should be given to techniques which will minimise the risk of the flooding causing a pollution incident or making one worse.	a) An inventory of substances forms Appendix C of the Accident Management Plan **(ATT-OD-05).** b) The site is not located in a floodplain. c) The site will benefit from perimeter fencing, a locked gate at entrance, entrance barrier, CCTV system which can be remotely monitored and alarms in the office. d) Incidents and Accidents are recorded on the Accident and Incident Report Form **(EVE-FT-01).** Health and safety incidents and near misses are logged on the iAuditor system. New versions are recorded on the Master Document Control File **(EVE-OD-03)**. In accordance with the Document Control Procedure **(EVE-SOP-01)** any old/obsolete documents will be marked with "OBSOLETE

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	c) Security systems to prevent unauthorised access should be provided where appropriate. d) There should be formal systems for the logging and recording of all incidents, near misses, abnormal events, changes to procedures and significant findings of maintenance inspections. e) There should be procedures for responding to and learning from incidents, near-misses, etc. f) The roles and responsibilities of personnel involved in incident management should be formally specified. g) Clear guidance should be available on how each accident scenario might best be managed (e.g., containment or dispersion, to extinguish fires or to let them burn). h) Procedures should be in place to avoid incidents occurring as a result of poor communications between staff at shift change or during maintenance or other engineering work. i) Safe shutdown procedures should be in place. j) Communication channels with emergency services and other relevant authorities should be established, and available for use in the event of an incident. k) Procedures should include the assessment of harm following an incident and the steps needed to redress this l) Appropriate control techniques should be in place to limit the consequences of an accident, such as; fire walls, firebreaks isolation of drains, provision of oil spillage equipment, alerting of relevant authorities and evacuation procedures. m) Personnel training requirements should be identified and training provided.	DOCUMENT" and archived. Significant findings from maintenance inspections are logged in the Operations Log on SCADA. e) In accordance with the Accident Management Plan **(ATT-OD-05)** it is the responsibility of the Site Manager or Nominated Competent Person (NCP) to: • *Assist in a full incident / accident root cause analysis, review lessons learnt and recommend any changes to procedures.* • *Making a record of the accident and the subsequent investigation using Accident and Incident Report Form (EVE-FT-01) (for actual or potential environmental incidents); and* • *Review and update the Accident Management Plan and procedures as necessary.* f) The roles and responsibilities of personnel involved in incident management are specified in the Accident Management Plan **(ATT-OD-05)** and associated procedures covering abnormal operations. g) Accident Management Plan **(ATT-OD-05)** references individual procedures relevant to different abnormal operating procedures. h) With the expansion of the plant and more personnel on site staff handover is being reviewed. The Site Diary (Smartsheet) is used to communicate information to other employees. i) A Safe Shutdown Procedure is in place (Section 12 of the Accident Management Plan **(ATT-OD-05)**). j) Communication channels with the Fire and Rescue Service have been established and a site visit is being arranged. k) See e) above. l) Appropriate control techniques in place include: the secondary containment and drainage design, provision of spill kits, provision of appropriate fire controls, visible signage, and training on all emergency procedures. There will be no combustible waste stored on site. m) Staff training on procedures including emergency procedures will be carried out.

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	n) The systems for the prevention of fugitive emissions are generally relevant. In addition, for drainage systems: (i). procedures should be in place to ensure that the composition of the contents of a bund sump, or sump connected to a drainage system, are checked before treatment or disposal; (ii). drainage sumps should be equipped with a high-level alarm or with a sensor and automatic pump to storage (not to discharge); (iii). there should be a system in place to ensure that sump levels are kept to a minimum at all times; (iv). high-level alarms and similar back-up instruments should not be used as the primary method of level control. o) Duplicate or standby plant should be provided where necessary, with maintenance and testing to the same standards as the main plant. p) Spill contingency procedures should be in place to minimise accidental release of raw materials, products and waste materials and then to prevent their entry into water. q) Process waters, potentially contaminated site drainage waters, emergency firewater, chemically-contaminated waters and spillages of chemicals should be contained and, where necessary, routed to the effluent system and treated before emission to controlled waters or sewer. Sufficient storage should be provided to ensure that this can be achieved.	n) There is a Fugitive Emissions Plan in place **(ATT-SOP-05)**. Secondary Containment Checking & Emptying Procedure **(ATT-SOP-14)** is in place to ensure that the composition of the contents of the secondary containment sump is checked (visual and olfactory) before using a manually controlled pump to remove the liquid to the surface water lagoon (if clean) or back to the Waste-AD process if any suspicion that it is dirty. The sumps do not require a high-level alarm or sensor and pump as the sumps will be checked daily **(ATT-MP-01**). o) There will be a stand-by diesel generator on site to be used in case of electricity mains failure. The required capacity is being finalised at the time of writing, but it is likely to be a 250kVA generator; the generator will have an internal fuel tank (bunded) with 800 litres storage. The stand-by generator will be regularly maintained under a third party planned preventative maintenance contract. p) The Spill Control Procedure **(EVE-SOP-07**) covers potential spillages of raw materials, products, and wastes. q) Dirty areas will have segregated drainage and the dirty water will be routed back to the process for treatment. If there are spillages within the normally clean secondary containment area, then water will be routed back to the process or disposed of appropriately; Secondary Containment Checking & Emptying Procedure **(ATT-SOP-15).** The secondary containment systems are sized appropriately in accordance with CIRIA 736 (further detail under BAT 19) r) Any fire water would be contained within the site secondary containment system and handled appropriately. See above. s) The probability of accidental emissions is minimised through process control procedures including the use of the SCADA system controls. Process Monitoring is detailed within Section 12.2 of the EMS Manual **(ATT-OD-01**) and the Process Monitoring Procedure **(ATT-SOP-03).**

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	r) Any emergency firewater collection system should take account of the additional firewater flows and fire-fighting foams, and emergency storage lagoons may be needed to prevent contaminated firewater reaching controlled waters s) Consideration should be given to the possibility of containment or abatement of accidental emissions from vents and safety relief valves/bursting discs. Where this may be inadvisable on safety grounds, attention should be focused on reducing the probability of the emission.	
AD TGN Accidents and abnormal operation	t) Spillage prevention controls must be in place during the transfer of substances (for example, transfer of bulk liquid waste from tanker to storage vessels). The weakest link and subsequently the main source of spillage during transfer from the vehicle to storage arises from the transfer hoses. This is due to either: (i). "tanker drive-off" - a vehicle pulling away whilst still coupled (systems should be in place to prevent this); (ii). The hose couplings have become damaged or are incompatible. Although the spillages tend to be relatively small, measures should be taken to ensure that the couplings are the correct fit and system. This will prevent the coupling loosening or becoming detached, and in turn will also be helped by the AD facility providing and maintaining its own hoses. A more serious event would occur if the coupling were unable to withstand the	The risk of spillages during operations has been considered within the Environmental Risk Assessment (Appendix A of the EMS Manual **(ATT-OD-01)**) and within operational procedures. The receipt of liquid waste will be managed in accordance with the Liquid Waste Reception Procedure **(ATT-SOP-10).** Liquid waste will be delivered via a tanker connecting at the filling point inside the Reception Building from where it will be pumped to one of the three small pre-storage tanks within the secondary containment area. After that the waste can be fed directly into the Digesters or into the large pre-storage tank (PST1). The dispatch of digestate is be managed in accordance with the Digestate Handling Procedure **(ATT-SOP-06)** which has been updated in accordance with proposed site changes. There are different offtake/dispatch points for crop-only digestate and waste-derived digestate. To prevent "tanker drive-off", site operatives will themselves be trained and provide training and oversee the first delivery or dispatch for a new driver. Site operatives will check and replace hose couplings as required. The drainage design is such that any spillages resulting from delivery of liquid waste or collection of digestate liquor would be contained within the dirty water drainage system and be used in the AD process.

BAT 1	**BAT 1. In order to improve the overall environmental performance, BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the following features**	
	maximum shut valve pressure of the transfer pump. Spillages of this nature may also be a source of odour and represent poor "housekeeping" practice, requiring constant attention and cleaning. Protection of the transfer hose may not be necessary where a gravity feed system is in place. It will however still be important to maintain a sound coupling at each end of the transfer hose. A more acute accident situation may arise due to the failure of plant or equipment. This may include the failure of a pump seal or the blockage of a filter pot commonly used at transfer points. The prevention of these situations should be addressed by the provision of routine maintenance. Accumulations of liquids in bunds, sumps, etc., should be dealt with promptly.	Any spillages arising during delivery of liquid waste or off-take of digestate will be contained within a sump at the offtake point and managed promptly in accordance with the Spill Control Procedure **(EVE-SOP-07)**. Plant and equipment including pumps and filter pots are subject to routine inspection and maintenance in accordance with the Attleborough AD Maintenance planner **(ATT-MP-01)** and the BioConstruct Maintenance Plan on SCADA.
AD TGN Management systems	There should be written procedures for handling, investigating, communicating and reporting actual or potential non-compliance with operating procedures or emission limits.	In accordance with the Accident Management Plan **(ATT-OD-05)** it is the responsibility of the Site Manager or Nominated Competent Person (NCP) to: • *Assist in a full incident / accident root cause analysis, review lessons learnt and recommend any changes to procedures.* • *Making a record of the accident and the subsequent investigation using Accident and Incident Report Form (EVE-FT-12) (for actual or potential environmental incidents); and* • *Review and update the Accident Management Plan and procedures as necessary.*

BAT 1	**BAT 1. In order to improve the overall environmental performance, BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the following features**	
AD TGN Management systems	There should be written procedures for handling, investigating, communicating and reporting environmental complaints and implementation of appropriate actions.	Complaints are managed and recorded in accordance with the Complaints Procedure **(EVE-SOP-02).**
AD TGN Management systems	There should be written procedures for investigating incidents, (and near misses) including identifying suitable corrective action and following up	In accordance with the Accident Management Plan **(ATT-OD-05)** it is the responsibility of the Site Manager or Nominated Competent Person (NCP) to: • *Assist in a full incident / accident root cause analysis, review lessons learnt and recommend any changes to procedures.* • *Making a record of the accident and the subsequent investigation using Accident and Incident Report Form (EVE-FT-01) (for actual or potential environmental incidents); and* • *Review and update the Accident Management Plan and procedures as necessary.*
XIV	Odour management plan	See BAT 12.
XV	Noise and vibration management plan	See BAT 17.

Waste Management Measures

BAT 2	**In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.**	
Waste pre-acceptance		
a	Set up and implement waste characterisation and pre-acceptance procedures.	*Crop-AD:* All non–waste feedstock will be secured through the Feedstock Supply Contract with Ellough Feedstocks. On an annual basis EVE will agree the feedstock order schedule with Ellough Feedstocks. This will include the projected quantity and orders for energy crops,

BAT 2	**In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.**	
		(comprising maize and rye). The energy crops will be ordered based on growing area, given typical yields, and agreed specifications including dry matter. Feedstocks will be pre-ordered to ensure availability to enable continual operation. This allows for adequate storage and management of feedstocks entering the site. *Waste-AD:* EVE will carry out waste pre-acceptance checks on all wastes in accordance with the Waste Pre-acceptance Procedure **(EVE-SOP-08).** Wastes will only be accepted from account holders. Quality requirements or waste acceptance criteria will be clearly set out within agreements with account holders. All contractual agreements contain acceptance criteria which ensures a greater level of control over inputs. Should the material fail to meet these criteria, it will be rejected in accordance with the Waste Acceptance and Rejection Procedure **(ATT-SOP-11)**.
AD TGN Waste pre-acceptance	From the waste disposal enquiry the Operator should obtain information in writing relating to: • the type of process producing the waste, • the specific process from which the waste derives, • the quantity of waste, • compositional analysis, • the form the waste takes (solid, liquid, sludge etc.), • contingency for dealing with non-conforming waste and contingency planning in emergency.	Prior to receipt of new waste streams, the following actions shall be taken by the Feedstock Manager: 1. Request the following information in writing from potential supplier: a) details of the waste producer including their organisation name, address, and contact details b) the source of the waste (the process that gives rise to the waste) c) information on the nature and variability of the waste production process and the waste d) a description e) List of Waste code (EWC code) f) its physical form g) its composition (based on representative samples) h) any hazardous properties i) the odour potential j) the type of packaging (if applicable) k) an estimate of the quantity expected l) the potential for self-heating, self-reactivity or reactivity to moisture or air m) the age of the waste; and

BAT 2	**In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.**	
		n) Contingency for dealing with non-conforming waste and contingency planning in emergency. 2. Audit all information submitted by the waste supplier request further information if required so that the waste quality and any potential variations in quality can be assessed. 3. If sample data has not been provided by the potential waste supplier, then arrange for a representative sample to be taken and send off to NRM laboratories for testing. Follow Sampling Procedure **(ATT-SOP-09).** 4. Check all sample test results against written description to see if it is consistent. Ref: • Waste Pre-acceptance Procedure **(EVE-SOP-08)** • Supplier Assessment Form **(EVE-FT-04)**
AD TGN Waste pre-acceptance	Wastes should not be accepted at the AD facility unless they are suitable for AD treatment. Biological treatment facilities should be aware that agricultural land bank may not be available and alternative recovery/disposal routes may be needed.	Only suitable energy crops and non-hazardous wastes, namely food wastes will be accepted at the site. There is an understanding by EVE of the pressures upon waste producers to find a suitable recovery / disposal route for wastes and that acceptance of an unsuitable waste material may have far reaching impacts upon the biological processes, hence the control measures are in place.
AD TGN Waste pre-acceptance	The Operator should ensure that the sample is representative of the waste and has been obtained by a person who is technically competent to undertake the sampling process.	Representative samples of non-waste and waste feedstocks will be undertaken in accordance with Sampling Procedure **(ATT-SOP-07)** which includes the planned frequency and method of sampling for each feedstock type. Samples shall be analysed at a UKAS Accredited laboratory.
AD TGN Waste pre-acceptance	Analysis should be carried out by a laboratory with robust quality assurance and quality control methods and record keeping.	All samples will be set to a UKAS accredited, typically NRM Laboratories Ltd. Additional testing will be carried out on site including pH, Chemical Oxygen Demand, ammonia, sulphates, dry matter and FOS/TAC ratio.
AD TGN Waste pre-acceptance	Detailed feedstock characterisation by sampling and testing should be conducted as part of establishing a supply contract. Periodic sampling as part of a documented sampling plan should be conducted to test for variation and ensure feedstock is consistent with the supply agreement.	Feedstock characterisation will be carried out in accordance with the Waste Pre-acceptance Procedure **(EVE-SOP-08)** for waste feedstocks and the Crop Feedstock Acceptance and Rejection Procedure **(ATT-SOP-01)** for crop feedstocks. Periodic verification sampling will be carried out as required.

BAT 2	**In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.**	
AD TGN Waste pre-acceptance	Sampling and testing of feedstock should reflect the nature of the feedstock, how it arises and any potential variation within the feedstock. The number of samples and the period of sampling should derive a set of data that are representative of the specific feedstock and take account of short term or seasonal variations in feedstock. The following characteristics are required to be tested as part of a detailed feedstock characterisation: • Particle size distribution and physical contaminants • Total solids and volatile solids • Biochemical Methane Potential (BMP) • Total Organic Carbon • Nutrient analysis • Calorific value • Fibre content • pH and alkalinity • Volatile Fatty Acids • Ammonia and Kjeldahl Nitrogen • Heavy Metals and Potentially Toxic Elements (PTE) • Carbohydrate and Lipid Analysis	Sampling and testing of feedstocks will reflect the nature of the feedstocks. The parameters listed will be included in the testing parameters for feedstock characterisation as required.
Waste acceptance		
b	Set up and implement waste acceptance procedures	There is a Waste Acceptance & Rejection Procedure **(ATT-SOP-11)** in place.
AD TGN Waste acceptance	On arrival loads should: • be weighed, unless alternative reliable volumetric systems linked to specific gravity data are available; • not be accepted into site unless sufficient storage capacity exists, and site is adequately manned to receive waste • have all documents checked and approved, and any discrepancies resolved, before the waste is accepted. Waste quarantine procedures are to be in place.	All loads will be received over the weighbridge. The weighbridge will be calibrated annually, and calibration certificates will be retained. Weights will be recorded and with details of feedstock (type, description, origin, any interim storage, and transportation). In addition, digestate removal (date, amount) and digestate spreading (date and locations) will be logged over the weighbridge and recorded for each of the two types of digestate produced.

BAT 2	**In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.**	
	• have any labelling that does not relate to the contents of the container removed before acceptance on site.	Copies of the weighbridge tickets will be checked and approved. Copies are stored in the site office. Any unsuitable or non-permitted waste inadvertently accepted will be stored separately from other feedstocks (isolated) on the impermeable surface with sealed drainage. Waste will not be accepted in IBCs, drums, or other containers, apart from package food waste, so incorrect labelling of containers is not a risk.
AD TGN Waste acceptance	Load inspection: • Visual inspection. Where possible, confirmatory checks should be undertaken before offloading provided safety is not compromised. Inspection must in any event be carried out immediately upon offloading at the AD facility. • Check every container/load to confirm quantities against accompanying paperwork. Following inspection, the waste should then be unloaded into a dedicated sampling/reception area. • The inspection, unloading and sampling areas should have suitably sealed drainage systems.	In accordance with the Waste Acceptance & Rejection Procedure **(ATT-SOP-11)** Site Operatives in the Reception Building will: • If safe to do so, oversee the tipping of each load to visually check the suitability of the load as it is discharged. • Assess if contents match those described on the waste transfer documentation via communication with the Weighbridge Officer. • Move waste that requires depackaging into the relevant storage area. All waste is unloaded within the Reception Building which benefits from an impermeable surface and sealed drainage system.
AD TGN Waste acceptance	All wastes for on-site treatment must be sampled in accordance with the sampling plan and undergo waste acceptance verification and compliance testing.	This will be carried out in accordance with the Waste Pre-acceptance Procedure **(EVE-SOP-11)** and Waste Acceptance & Rejection Procedure **(ATT-SOP-11)**.
AD TGN Waste acceptance	The Operator should ensure that waste delivered to the AD facility is accompanied by a written description of the waste to comply with Duty Of Care.	Waste Duty of Care Waste Transfer Notes (WTN's) shall be produced for each waste stream and include the following information; • Description of the waste being transferred • List of Waste Regulations code • Quantity • How contained • Confirmation of duty to apply waste hierarchy • Producer details • Permit reference numbers • Sic code

BAT 2	**In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.**	
AD TGN Waste acceptance	On-site verification and compliance testing should take place to confirm suitability for the site's AD process.	This will be carried out in accordance with the Waste Pre-acceptance Procedure **(EVE-SOP-08)** and Waste Acceptance & Rejection Procedure **(ATT-SOP-11)**. The Site Manager or Nominated Competent Person will be responsible for verification testing. There will be an on-site laboratory where verification testing of feedstocks will be undertaken. There will be the facility to isolate loads in pre-storage tanks or the mixing pit whilst verification testing is carried out. Parameters include pH, Chemical Oxygen Demand, ammonia, sulphates, dry matter and FOS/TAC ratio.
AD TGN Waste acceptance	Wastes must not be deposited within a reception area without adequate space.	All feedstock is pre-booked to the required quantities to ensure security in feedstock supply and no over-supply. Capacity has been addressed within the design of the site. Storage areas/volumes have been constructed to the known parameters. The design incorporates contingency volume.
AD TGN Waste acceptance	Should the inspection or analysis indicate that the wastes fail to meet the acceptance criteria (including damaged or unlabelled container/load), then such loads should be stored in a dedicated quarantine area and dealt with appropriately. Such storage should be for a maximum of five working days. Written procedures should be in place for dealing with wastes held in quarantine, together with a maximum storage volume.	Any loads or part loads that are found to be unsuitable in accordance with the Crop Feedstock Acceptance & Rejection Procedure **(ATT-SOP-01)** and / or Waste Acceptance & Rejection Procedure **(ATT-SOP-11**) will be either immediately removed and returned to the waste producer for disposal or will be quarantined in a completely contained areas on the impermeable surface within the sealed drainage system prior to removal off-site to a suitably permitted facility within 5 working days.
AD TGN Waste acceptance	If the cause of failure to meet acceptance criteria is due to unsuitability, then the wastes should be segregated to remove cross contamination.	Any unsuitable materials will be segregated and quarantined immediately and stored on an impermeable surface within the sealed drainage system as described above.
AD TGN Waste acceptance	Tankered wastes should be sampled prior to acceptance. There should be no storage pending sampling.	Tankered waste is sampled prior to acceptance. There is no storage pending sampling. Ref: Waste Pre-Acceptance Procedure **(EVE-SOP-08)**.
AD TGN Waste acceptance	The driver of the vehicle carrying the waste may arrive at the AD facility with a sample that has been taken at some stage beforehand. This should be the exception and only be relied on if: • there are health and safety and environmental control considerations which make sampling difficult, and • the following written information has been supplied - the physical and chemical composition, incompatible	Samples taken before arrival on site will only be accepted in these circumstances.

BAT 2	**In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.**	
	substances and handling precautions, information specifying the original waste producer and process, and • the waste has been taken directly from the production site to the waste treatment AD facility.	
AD TGN Waste acceptance	The AD facility should have a designated sampling point or reception area.	The Reception Building has been designed to accommodate specific reception areas for unpackaged food waste, packaged food waste and liquid waste. Any samples will be taken from these reception points in accordance with the Sampling Procedure **(ATT-SOP-07)**. The silage clamps are the dedicated reception area and sample point for energy crops.
AD TGN Waste acceptance	The offloading, sampling point/reception and quarantine areas should have an impermeable surface with self-contained drainage, to prevent any spillage entering the storage systems or escaping off-site.	The Reception Building and the silage clamps benefit from impermeable surfaces and sealed drainage back into the process.
AD TGN Waste acceptance	Deliveries in bulk road tanker should be accompanied by a "wash-out" certificate or a declaration of the previous load so that contamination by this route can be checked.	In accordance with the Liquid Waste Reception Procedure **(ATT-SOP-10)** Site Operatives need to check the lorry "wash out" certificate or declaration of previous load to ensure it has been washed out from the previous load, to avoid cross contamination from an unacceptable waste.
AD TGN Waste acceptance	Sampling of bulk liquid wastes - The key requirement is to obtain a sample that is representative of the load, that is, the sample takes account of the full variation and any partitioning within a bulk load such that "separation" scenarios are accounted for.	Sample analysis results will be obtained from the waste producer in accordance with the Waste Pre-acceptance Procedure **(EVE-SOP-08)**. Verification samples of liquid wastes will be taken in accordance with the Sampling Procedure **(ATT-SOP-07)** to ensure that the sample to be analysed is representative of the load.
AD TGN Waste acceptance	Sampling drummed/IBC waste - The contents can only be identified with certainty if every container is sampled. Acceptance should involve sampling every container. However, analysis of composite samples is acceptable with such a sampling regime. A representative sample must be obtained by taking a core sample to the base of the container.	No waste in IBCs or drums will be accepted on site.
AD TGN Waste acceptance	Drum/IBC labelling - For drummed waste, controls should ensure each drum is given a label to facilitate it's on site storage and further use.	No waste in IBCs or drums will be accepted on site.

BAT 2	**In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.**	
AD TGN Waste acceptance	The operator should ensure that the installation personnel who may be involved in the sampling, checking and analysis procedures are suitably qualified to industry standards and adequately trained, and that the training is updated on a regular basis.	All staff will receive training on relevant operational procedures. All training will be formally recorded in the Skills and Competency Matrix **(EVE-OD-02).** The Site Manager is the Technically Competent Manager and will ensure that Continuing Competence certification is maintained.
AD TGN Waste acceptance	Analysis should be carried out by a laboratory to the correct test methods.	All samples are sent to a UKAS accredited laboratory.
AD TGN Waste acceptance	Samples should be retained on-site for a minimum of two days after the waste has been treated	• Samples will be retained on site for at least two days after the waste has been treated. • Analysis test results shall be stored with the relevant WTN's for waste imports. • Analysis forms part of the on-going process monitoring for the site. Should inspection or analysis indicate that wastes are not acceptable, they will not be accepted at the site. • All monitoring and measuring equipment will be fit for purpose, maintained, and calibrated to appropriate standards (MCERTS, UKAS approved where applicable). • Analysis will have been provided at pre-acceptance in accordance with initial characterisation information.
AD TGN Waste acceptance	Waste rejection procedures- The operator should have clear and unambiguous criteria for the rejection of wastes, together with a written procedure for tracking and reporting such non-conformance. This should include notification to the customer/waste producer and the Environment Agency. Written/computerised records should form part of the waste tracking system information. The operator should also have a clear and unambiguous policy for the subsequent storage and disposal of such rejected wastes. This policy should achieve the following: • identifies the hazards posed by the rejected wastes,	If waste is rejected it will be done so in accordance with the Waste Acceptance & Rejection Procedure **(ATT-SOP-11**). A Feedstock Rejection Record **(EVE-FT-03)** will be completed. The criteria for waste rejection are as follows: • Site Operatives are responsible for carrying out a visual inspection of all loads of waste brought into site as they are tipped and after tipping in the Reception Building. • Site Operatives are responsible for immediately informing the Site Manager or NCP by radio if the load is visibly contaminated with non-permitted waste and / or any of the following are observed:

BAT 2	In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.	
	• labels rejected wastes with all information necessary to allow proper storage and segregation arrangements to be put in place, • segregates and stores rejected wastes safely pending removal.	○ Cat 1 ABP materials (including animal carcasses unless passed as fit for human consumption) ○ Large quantities of bones or egg shell ○ Empty packaging ○ Ceramics ○ Steel/metal ○ Hazardous materials ○ Wood ○ Heavy duty plastic solid colour refuse bin liners ○ Highly odorous wastes • The Site Manager or NCP is responsible for making a final decision on whether the load should be rejected. • The Site Manager or NCP makes a final decision on whether the load should be rejected. The following actions shall be taken: Actions following rejection decision: <u>Haulier on site</u> If the decision is made to reject the load and the haulier is still on site, then the Site Operative will reload the vehicle. <u>Haulier left site</u> If the decision is made to reject the load and the haulier has left site, then the Site Manager or NCP will: ○ Isolate the rejected material in the quarantine area so it cannot contaminate clean materials on site. ○ Contact the waste producer to arrange collection of the material. ○ Ensure all Site staff are aware of the load of unsuitable waste and that appropriate signage installed to ensure the load is not used in error until the load has been removed. ○ Complete Feedstock Rejection Record **(EVE-FT-03)**. • The Site Manager will: ○ Arrange removal of unsuitable feedstock as soon as possible, in all cases within 5 days.

BAT 2	**In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.**	
		○ Complete a Feedstock Rejection Record **(EVE-FT-03)** and put one copy in file in the site office. ○ Send a copy to the waste producer / broker and follow up with them regarding the presence of unspecified materials and take steps to ensure ongoing feedstock quality.
Waste tracking		
c	Set up and implement a waste tracking system and inventory. A waste tracking system and inventory aims to track the location and quantity of waste in the plant. It holds all the information generated during waste pre-acceptance procedures (e.g., date of arrival at the plant and unique reference number of the waste, information on the previous waste holder(s), pre-acceptance and acceptance analysis results, intended treatment route, nature and quantity of the waste held on site including all identified hazards), acceptance, storage, treatment and/or transfer off site.	The waste tracking system is designed to control the types and tonnages of waste accepted on site as it is designed to track all waste accepted, rejected, stored, treated, and dispatched. The function of the waste tracking system is to ensure that: • waste will not be booked in unless there is sufficient appropriate storage capacity for that waste stream within the reception building bays, mixing pit and the liquid waste storage tanks as appropriate.; • the correct types of waste are available to produce the optimum pre-treated waste blend for the AD plant; and • waste is handled in accordance with a first-in first out procedure to minimise the odour potential of waste stored pre-treatment and during treatment in the reception building. Inputs to the waste tracking system are: • Overall site capacity for permitted types and tonnages of waste and waste storage capacities for each waste category (set by the permit and the site infrastructure); • Wastes sources and types which have met pre-acceptance checks and therefore able to be accepted and booked in as required; • Actual individual received waste details including: - a unique identifier reference number (generated at weighbridge). - date and time received; - tonnage / volume received;

BAT 2	In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.	
		- producer details and all previous holders of the waste; - a link to all pre-acceptance information on this waste stream; - identification of on-site storage: bay in reception building or liquid waste storage tank used (this information will be entered into waste tracking system by operatives in reception building). • Waste that is then pre-treated within the reception building to prepare blended feedstock ready for digestion. • Waste that is rejected whether this is at pre-acceptance stage, at the weighbridge or once it has been tipped. Note: All the above information will be held providing full traceability on waste materials. Outputs from the waste tracking system are: • The type and amount of all waste on site at any one time and where it is being stored. • The type and amount of waste that has been pre-treated in any given period. • Daily feed recipe for pre-treated waste production based on optimum balance of feedstocks and first in – first out for waste • The remaining storage capacity for all waste types at any point in time • Informed decisions on the tonnages of waste streams under supply contracts that are required. • Tracking against permitted limits and production of figures for quarterly waste return submissions to the Environment Agency. **Data Entry Responsibilities** The **Feedstock Manager** is responsible for ensuring that the following data is entered into the waste tracking system:

BAT 2	**In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.**	
		• Pre-acceptance information The **Weighbridge Operator** is responsible for ensuring that the following data is entered into the waste tracking system: 1. For each load: o Type of material (description) o EWC code o Source o Waste Transfer note reference o Net weight of waste o Date and time accepted o Haulier o Haulier's license number o Origin of waste o Time and date o Record declaration of previous load acceptable and wash out certificate provided if required (e.g., ABP waste) o Vehicle registration number 2. For each load rejected at the weighbridge: o Type of material o EWC code o Source o Waste Transfer note reference o Tonnage o Date & time rejected o Reason for rejection / potential hazard as appropriate o Rejected by (name of staff member) o Destination of rejected material

BAT 2	**In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.**	
		For each load rejected in the reception building the **Site Operative** is responsible for recording the following into the waste tracking system for each load / part load rejected upon visual inspection: o Type of material o EWC code o Source o Waste Transfer note reference o Tonnage o Date & time rejected o Reason for rejection / potential hazard as appropriate o Rejected by (name of staff member) o Destination of rejected material The **Site Manager** is responsible for checking the following data is entered into the waste tracking system correctly: • Waste that has been booked in • Waste that is rejected
AD TGN Waste acceptance	All records relating to pre-acceptance should be maintained and kept readily available at the AD facility for cross-reference and verification at the waste acceptance stage. Records should be held for a minimum of two years after the waste has been treated or removed off-site.	Compositional analysis test results shall be maintained with the WTN's. All WTN's shall be maintained for a minimum of 2 years in a secure place in the site office.
AD TGN Waste acceptance	The system adopted should be capable of reporting on all of the following: • total quantity of waste present on-site at any one time, in appropriate units, for example, 1 cubic metre IBC equivalents	See above.

BAT 2	**In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.**	
	• breakdown of waste quantities being stored pending on-site treatment • breakdown of waste quantities stored on-site awaiting onward transfer • breakdown of waste quantities by hazard classification if applicable • indication of where the waste is located on site relative to a site plan • comparison of the quantity on site against total permitted quantity • comparison of time the waste has been on-site against permitted time limit These records should be held in a designated area, as agreed with the Regulator, well removed from hazardous activities to ensure their accessibility during any emergency	
AD TGN Waste acceptance	Back-up copies of computer records should be maintained off-site.	Back up data shall be held remotely by EVE.
AD TGN Waste acceptance	Wastes should not be accepted without enough capacity being available. These checks should be performed before the waste acceptance stage is reached.	All feedstock is pre-booked to the required quantities to ensure security in feedstock supply and no over-supply. Capacity has been addressed within the design of the site. Storage areas/volumes have been constructed to the known parameters. The design incorporates contingency volume.
AD TGN Waste acceptance	The reception area for the feedstock/waste should be appropriately sized to accommodate the expected volume and properties of feedstock, to check the quality of feedstock and perform basic pre-treatment.	See above.
Output quality		

BAT 2	**In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.**	

d
 	
d
	Set up and implement an output quality management system	<u>Digestate quality</u>
		
		There is a Quality Management System (QMS) being developed for the separated digestate liquor and fibre from the Waste-AD plant. This is to prepare for a future application to be a producer under the Biofertiliser Certification Scheme.
		
		In accordance with Section 12.4 of the EMS Manual **(ATT-OD-01)**:
		
		• *The separated fibre separated liquor and dirty water are sampled and analysed to determine appropriate spreading rates in accordance with the Digestate Management Plan **(ATT-OD-06).***
		
		• *The samples are taken and dispatched to the laboratory in accordance with the Sampling Procedure **(ATT-SOP-07).** All samples are analysed at a UKAS accredited laboratory, (NRM Laboratories Ltd) prior to key periods of dispatch from the AD Plant. Typical minimum recommended testing frequencies:*
		
		  • *Digestate liquor will be tested quarterly*
		
		  • *Digestate fibre at least twice a year*
		
		• *The analysis results are supplied to the Nominated Contractor for the purposes of planning applications to land.*
		
		<u>Biomethane quality</u>
		
		The quality of the biomethane is controlled via the Grid Entry Unit which will reject any biomethane of insufficient quality which will be diverted to the flare.

AD TGN Waste treatment	Where ABP material is processed, pre-treatment must meet minimum particle size requirements as specified by the ABP regulations during pasteurisation.	In accordance with the Process Flow Diagram - Overview (Appendix A), all material is macerated and then passed through a 10mm screen, prior to the pasteurisers, which will ensure that the 12 mm minimum particle size requirement is met.

<table>
<tr><td>BAT 2</td><td colspan="2">In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.</td></tr>
<tr><td>AD TGN Waste treatment</td><td>AD facilities accepting ABP materials should be capable of raising the temperature of the feedstock in accordance with Table 9 (below)

<table>
<tr><th>Minimum Temperature</th><th>Minimum Time</th><th>Maximum Particle Size</th></tr>
<tr><td colspan="3">EU Standard</td></tr>
<tr><td>70°C</td><td>1 hour</td><td>12 mm</td></tr>
<tr><td colspan="3">National Standard (option for catering waste only)</td></tr>
<tr><td>57°C</td><td>5 hours</td><td>50 mm</td></tr>
<tr><td>70°C</td><td>1 hour</td><td>60 mm</td></tr>
</table></td><td>The pasteurisers will operate to the EU Standard i.e., material is heated and held at a minimum of 70 degrees centigrade for at least one hour.</td></tr>
<tr><td>AD TGN Waste treatment</td><td>Vessels should be fitted with an appropriate mixing/stirring mechanism for the type of vessel and waste to be processed to:

• ensure efficient mixing.
• ensure complete digestion; to prevent by-pass (whereby feedstock is diverted out of the digester before being fully treated); and
• to ensure uniform heat transfer; and
• to prevent sedimentation of silt and stratification in the reactor.</td><td>Crop-AD:
• The primary digesters (DG01 & DG02) have 2 paddle mixers and 1 submersible mixer on each tank.
• The after digester (DG03) has a paddle mixer and 2 submersible mixers.

Waste-AD:

Pre-storage tanks (PST)

The three small PSTs will have one central mixer installed in each tank. Tanks will be delivered with these mixers prefabricated by the manufacturer.

The large PST will have two submersible mixers installed. Manufacturer: Suma

Digesters

Each tank has two paddle mixers with horizontal mixing shaft. Electric motor and gear box are installed outside the tank. The mixing shaft is mounted on a metal frame fastened to the fermenter base. Manufacturer: Steverding

And two submersible mixers which are height and side adjustable from the outside. Manufacturer: Suma

Secondary Digester:</td></tr>
</table>

BAT 2	**In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.**	
		The Secondary Digester will have two paddle mixers with horizontal mixing shaft. Electric motor and gear box are installed outside the tank. The mixing shaft is mounted on a metal frame fastened to the fermenter base. Manufacturer: Steverding *Whole Installation:* The number, placement and design of the mixers has been determined by BioConstruct in line with many years of experience in anaerobic digestion plant design.
Waste segregation		
e	Ensure waste segregation. Waste is kept separated depending on its properties in order to enable easier and environmentally safer storage and treatment. Waste segregation relies on the physical separation of waste and on procedures that identify when and where wastes are stored.	Depackaged food waste, packaged food waste, pre-treated food waste and liquid waste will be stored separately prior to mixing and pre-treatment as required. The Reception Building benefits from two large waste storage bays; packaged and depackaged food waste can be stored separately. There will be a mixing pit for waste sludges or waste that doesn't require any pre-treatment, and which are readily mixable. The mixing pit will have a compulsory (or cyclone) mixer in it. Liquid waste will be stored in the three smaller pre-storage tanks.
AD TGN Waste reception & storage	The reception area should allow for the segregation of Animal by Product (ABP) wastes where accepted to reduce the risk of cross contamination.	All accepted solid waste will treated as if it were ABP. There is therefore no segregation of solid ABPs within the Reception Building. Blood waste may be accepted and will be stored in the small pre-storage tank(s) prior to treatment.
AD TGN Waste reception & storage	Where feedstock deliveries are required to be offloaded for inspection and acceptance sampling prior to pre-treatment the reception areas should be segregated (typically into bays) and managed to ensure waste is not stored for more than 5 days. Where a bay is utilised, it should be cleaned weekly.	Waste types will be segregated as described above under e). Solid waste and sludges may be stored for a maximum of 5 days (though more usually the maximum storage time will be 2 days) but any potentially odorous waste will be treated as a priority and a first in-first out procedure will be adopted in accordance with the Waste Loading & Management Procedure **(ATT-SOP-12)**. The Reception Building will be cleaned down daily in accordance with the Housekeeping Schedule **(ATT-SOP-13**).
AD TGN Waste treatment	The pre-treatment of wastes is to remove non-biodegradable material and contaminants from feedstock and also to provide optimal substrate characteristics to enable an effective and efficient digestion process. The objectives of pre-treating feedstock will typically include:	The Process Flow Diagram - Overview (Appendix A) shows the steps of waste pre-treatment. Non-packaged solid food waste is tipped into a bay from where it is fed into feeder and from there into the process. Packaged food waste is loaded into the depackaging plant where it is macerated, and the packaging washed and separated. Liquid waste is added to achieve the desired dry matter of the feedstock blend. The large pre-storage tank stores and mixes wastes prior to them being pumped to the primary digesters.

BAT 2	**In order to improve the overall environmental performance of the plant, BAT is to use all of the techniques given below.**	
	• Removing packaging material from food waste (depackaging). • Removing other non-biodegradable materials e.g., grit & metals, which are not affected by digestion and take up necessary space by sedimentation. • Removing plastics that can cause long term operational problems by the formation of floating layers. • Providing a uniform small particle size feedstock for efficient digestion. • Protecting the downstream plant from components that may cause physical damage. Removing materials which may decrease the quality of the digestate.	
f	Ensure waste compatibility prior to mixing or blending of waste	Due to the nature of the proposed feedstocks and waste pre-acceptance checks there is no potential for issues with waste compatibility.
g	Sort incoming solid waste	Sorting of incoming solid wastes will be carried out as described above.

Inventory of Waste Water and Waste Gas

BAT 3	**In order to facilitate the reduction of emissions to water and air, BAT is to establish and to maintain an inventory of waste water and waste gas streams, as part of the environmental management system (see BAT 1), that incorporates all of the following features:**	
i	Information about the characteristics of the waste to be treated and the waste treatment processes, including: • simplified process flow sheets that show the origin of the emissions; • descriptions of process-integrated techniques and waste water/waste gas treatment at source including their performances;	The Process Flow Diagram - Overview (Appendix A) and Drainage Process Flow Diagram (Appendix D) shows inputs and outputs including the origin of any emissions. A full process description is provided in Section 5 of the Environmental Management System Manual **(ATT-OD-01)** which forms part of this application. All the wastes that are treated are defined within Section 5.14 of the EMS Manual. The process description details biogas treatment for both the Crop-AD and Waste-AD plants. With respect to the Waste-AD plant, the digester tanks are equipped with desulphurisation nets and low-level oxygen injection to encourage microbial growth to reduce hydrogen sulphide (H_2S) levels and precipitate sulphur. Once out of storage the biogas passes through a gas cooling system to reduce moisture. (The resulting condensate goes to the condensate pit then to the Secondary Digester), then through a scrubber which uses sulphuric acid to remove ammonia and finally thorough a carbon filter to remove any excess hydrogen sulphide (H_2S) and Volatile Organic Compounds (VOCs). A drainage description is provided in Section 6.3 of the EMS Manual **(ATT-OD-01**). In summary, dirty water, washdown water, silage effluent and biogas condensate are all reused in the processes.
ii	Information about the characteristics of the wastewater streams	There will be no waste water as all dirty water generated will be required for use in the AD process to enable the correct dry matter of the feedstock blend to be achieved. Dirty water from the Waste AD will only be used within the Waste-AD process. Dirty water arising from the Crop-AD may be used within either process.
iii	Information about the characteristics of the waste gas streams, such as: • average values and variability of flow and temperature;	The biogas is stored in the domes above the digesters and the large pre-storage tank. All the digesters have desulphurisation nets within the biogas storage area. The efficacy of the microbes on these nets relies on a low-level injection of oxygen (in the region of 0.26%). The level of oxygen injected into the gas storage domes will be carefully controlled to ensure that explosive atmospheres are not created. Biogas has a lower

	• average concentration and load values of relevant substances and their variability (e.g., organic compounds, POPs such as PCBs); • flammability, lower and higher explosive limits, reactivity; • presence of other substances that may affect the waste gas treatment system or plant safety (e.g., oxygen, nitrogen, water vapour, dust).	explosive limit of approximately 6% by volume and a higher explosive limit of approximately 12% by volume. After storage the biogas then passes through a chiller to remove the moisture, a sulphuric acid scrubber to remove ammonia and finally through carbon filters to remove VOCs any excess hydrogen sulphide. The cleaned biogas is then either used in the CHP or is upgraded to biomethane. Waste gas may arise in the form of biogas during periods of extended breakdown and maintenance or in the form of off-specification biomethane if the in-line gas monitors detect it is unsuitable for injection to the grid. Waste biogas from the Crop-Ad is burnt in the emergency biogas flare. Biogas from the Waste AD or off-specification biomethane will be burnt in the dual fuel flare. A full Air Quality Impact Assessment[4] has been included in this permit application and this details the predicted characteristics of all emissions to air from the installation.

[4] Air Quality Impact Assessment, Earthcare Technical Limited, ETL537/IP/AQIA/V1.0 Attleborough, August 2021

Waste Storage

BAT 4	**In order to reduce the environmental risk associated with the storage of waste, BAT is to use all of the techniques given below.**	
a	Optimised storage location. This includes techniques such as: • the storage is located as far as technically and economically possible from sensitive receptors, watercourses, etc.; • the storage is located in such a way so as to eliminate or minimise the unnecessary handling of wastes within the plant (e.g., the same wastes are handled twice or more or the transport distances on site are unnecessarily long).	• Solid waste feedstock for the Waste-AD will be stored in a dedicated Reception Building benefiting from fast-acting roller shutter doors (12 seconds) and an odour abatement system. • Waste derived digestate will be stored within a dedicated sub-section of the Reception Building which will again benefit from fast-acting roller shutter doors and an odour abatement system. • Crop-based fibre digestate, as a non-waste digestate, will be kept separately from the waste derived digestate. The current set up is being improved such that the crop-based digestate is stored in a covered trailer prior to dispatch off site for temporary field storage and spreading.
b	Adequate storage capacity. Measures are taken to avoid accumulation of waste, such as: • the maximum waste storage capacity is clearly established and not exceeded taking into account the characteristics of the wastes (e.g., regarding the risk of fire) and the treatment capacity; • the quantity of waste stored is regularly monitored against the maximum allowed storage capacity; • the maximum residence time of waste is clearly established.	The Reception Building and the infrastructure within it have been designed to accommodate the proposed waste tonnages with added contingency. The proposed maximum annual tonnage of waste is 100,000 tonnes per year. The current Mass Balance for the operation indicates that the annual tonnage of waste will be 90,950 tonnes per year. The current permit variation application is for 100,000 tonnes per year to allow for increased process efficiencies over time and future proofing. The Depackaging Plant for package waste can process up to 22 tonnes per hour. The Feeding System for depackaged waste can process between 60-80 tonnes per hour. The Mixing Pit for waste not requiring treatment can hold up to 100m^3. The two storage bays in the Reception Building will have capacities of 456m^3 and 225m^3 if the waste is stacked to 3m high. The sizing of the bays and mixing pit within the Reception Building dictate that there will be no more than a total of 204 tonnes of solid waste stored within the building at any one time. This is based on 681m^3 storage in bays (total), 100m^3 in mixing pit and a typical solid food waste density of 0.26 tonnes per m^3. [5]

[5] Source – Environment Agency Waste Conversion Rates spreadsheet

BAT 4	**In order to reduce the environmental risk associated with the storage of waste, BAT is to use all of the techniques given below.**	
		In accordance with the Mass Balance for the Waste-AD (Appendix E) 160 tonnes of solid food waste may be processed in one day. Therefore, the storage capacity is between 1- and 2-days' worth of waste. Solid food waste and sludges will be typically stored for no longer than 2 days; however, in exceptional circumstances the storage time may be up to 5 days. Liquid waste may be stored for up to 10 days in the pre-storage tanks. The Reception Building allows ample space for separate storage of different feedstocks to allow feedstock blending, control of feedstocks to allow first in first out use and also enough space to quarantine rejected materials as required. Waste tonnages will be monitored and controlled through the Waste Tracking Spreadsheet (Smartsheet) and verified through a Daily Inspection **(ATT-MP-01).**
AD TGN Waste reception & storage	Storage capacities typically need to be designed to ensure continuity of supply over weekends (when traffic movements may be controlled) and holidays.	The planning consent permits vehicle movements at the weekends (Ref: FUL/2019/056) therefore there is no need to stockpile waste in order to ensure continuity of supply over weekend periods.
c	Safe storage operation. This includes measures such as: • equipment used for loading, unloading and storing waste is clearly documented and labelled; • wastes known to be sensitive to heat, light, air, water, etc. are protected from such ambient conditions; • containers and drums are fit for purpose and stored securely.	• There will be a dedicated telescopic handler for both the Crop-AD and Waste-AD plants. • The wastes streams accepted for processing are not sensitive to heat, light, air, water etc. and therefore do not need to be protected from ambient conditions. • There is no waste accepted in IBCs or drums.
d	Separate area for storage and handling of packaged hazardous waste. When relevant, a dedicated area is used for storage and handling of packaged hazardous waste.	Hazardous waste will not be accepted in accordance with Waste Pre-acceptance Procedure **(EVE-SOP-08)** and the Waste Acceptance & Rejection Procedure **(ATT-SOP-11).**

Waste Handling & Transfer

BAT 5	**In order to reduce the environmental risk associated with the handling and transfer of waste, BAT is to set up and implement handling and transfer procedures.**	
	Handling and transfer of waste are carried out by competent staff.	All waste handling and transfer activities will be carried out by trained staff in accordance with Standard Operating Procedures including Waste Acceptance and Rejection **Procedure (ATT-SOP-11),** Liquid Waste Reception Procedure **(ATT-SOP-10)** and Waste Loading & Management Procedure **(ATT-SOP-12).**
AD TGN Waste treatment	The operator should establish and make available to all relevant staff an operational manual which includes all procedures for the safe and efficient operation of the facility.	There will be an Operational Manual available to all staff and training on the relevant SOPs provided in accordance with roles and responsibilities.
	Handling and transfer of waste are duly documented, validated prior to execution and verified after execution;	All feedstocks coming into site will be recorded on the weighbridge and the data stored on the weighbridge computer. This will include feedstock type, tonnage, date, and time. *Crop-AD:* The tonnages of various feedstocks loaded into the feed hopper on a daily basis are measured on the weigh scales within the base of the feed hopper. These figures are then recorded by the site operatives on SCADA. *Waste-AD:* Flow meters will measure any liquid addition to the process including recirculate and there will be weigh scales within the feeder to measure the solid waste addition to the process.
	Measures are taken to prevent, detect and mitigate spills;	The Standard Operating Procedures include measures to prevent spillages occurring. However, in the case of a spillage occurring, it will be managed in accordance with the Spill Control Procedure **(EVE-SOP-07)**
	Operation and design precautions are taken when mixing or blending wastes (e.g., vacuuming dusty/powdery wastes).	Waste will only be mixed within the enclosed waste treatment infrastructure within the reception building and the Waste-AD plant.

Monitoring

BAT 6	**For relevant emissions to water as identified by the inventory of waste water streams (see BAT 3), BAT is to monitor key process parameters (e.g., waste water flow, pH, temperature, conductivity, BOD) at key locations (e.g., at the inlet and/or outlet of the pre-treatment, at the inlet to the final treatment, at the point where the emission leaves the installation).**
	There will be no emissions to water. Dirty water will be collected and reused in the process. Clean water will be collected and reused in the process. Additional water will be required for the process which will be abstracted from a borehole; up to 20m^3 per day only. There will be the facility to discharge clean surface water from the surface water lagoon to the watercourse at a maximum rate of 4l/s.

BAT 7	**BAT is to monitor emissions to water with at least the frequency given below, 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.**
	Not applicable, see BAT 6.

Monitoring of Point Source Emissions to Air

BAT 8	**BAT is to monitor channelled emissions to air with at least the frequency given below, 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.**	
H_2S	Once every six months. No EN standard available. See BAT 34	Odour monitoring will be carried out every 6 months in lieu of H_2S and NH_3 monitoring as per BAT 34.
NH_3	Once every six months. No EN standard available. See BAT 34	Odour monitoring will be carried out every 6 months in lieu of H_2S and NH_3 monitoring as per BAT 34.
Odour concentration	Once every six months EN 13725. The monitoring of NH_3 and H_2S may be used as an alternative to the monitoring of the odour concentration. See BAT 34	Odour monitoring will be carried out every 6 months as per BAT 34.
AD TGN Point source emissions to air	Where CHP plants involving biogas engines are used, routine servicing of the engine is also required to maintain combustion efficiency. As well annual monitoring requirements, additional monitoring of NOx and CO should also be undertaken periodically and the engine(s) re-tuned to ensure the energy recovery plant remains within the permitted emission limits. Further details regarding the methodology for such monitoring can be found in Appendix C to LFTGN08.	CHP engine maintenance will be carried out according to maintenance schedules specified by the third-party contractor who will carry out periodic additional monitoring of emissions to air to assess engine performance. Annual monitoring of the CHP emissions will be carried out in accordance with the Environmental Permit and the Monitoring Procedure **(ATT-SOP-04).**
AD TGN Point source emissions to air	Records should be kept by the operator of all monitoring undertaken and the monitoring results, maintenance undertaken, periods of operation of the auxiliary flare and releases of biogas from pressure relief valves.	Records of all routine monitoring and maintenance carried out in house are kept in the Site Office. The BioConstruct Maintenance Plan is on SCADA. Monitoring carried out by external contractors e.g., the reports from emission testing of the CHP will be kept on a shared drive. Hours of operation of the flare and releases from the pressure relief valves will be recorded on SCADA. However, the volume of biogas released from pressure relief valves can only be estimated from the data on SCADA.
AD TGN Point source emissions to air	Biogas storage and combustion should be appropriately sized to deal with the quantity of biogas generated from the AD process operating as designed. Biogas should not be routinely flared to atmosphere.	The biogas storage and usage systems for the Crop AD and the Waste AD are separated. This is shown schematically of the Gas Block Diagram (Appendix B).

<table>
<tr><td>BAT 8</td><td colspan="2">BAT is to monitor channelled emissions to air with at least the frequency given below, 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.</td></tr>
<tr><td></td><td></td><td>
Crop AD:

Biogas will be stored in the headspace of the tanks as per table below:

<table>
<tr><th>Tank type</th><th>Reference</th><th>Gas storage type</th><th>Gas storage capacity approx.(m^3)</th></tr>
<tr><td>Primary Digester</td><td>DG01</td><td>Double membrane gas storage roof</td><td>950</td></tr>
<tr><td>Primary Digester</td><td>DG02</td><td>Double membrane gas storage roof</td><td>950</td></tr>
<tr><td>After Digester</td><td>DG03</td><td>Double membrane gas storage roof</td><td>650</td></tr>
<tr><td>Total</td><td></td><td></td><td>2,550</td></tr>
</table>

This provides a total of 2,550m^3 of biogas storage. Approximately 659m^3 of biogas will be produced per hour from the Crop AD plant therefore the storage provision equates to about 3-4 hours of biogas production. However, the gas storage is not normally kept empty so in reality this would be less.

Biogas will not be routinely flared to atmosphere. The biogas flare will only be used during periods of extended CHP maintenance and during abnormal operating conditions. In the case of CHP maintenance, the back – up boiler will be used to generate heat, and this will utilise 115m^3 per hour of biogas.

Waste AD:

Biogas will be stored in the headspace of the tanks as per table below:
</td></tr>
</table>

<table>
<tr><td>BAT 8</td><td colspan="2">BAT is to monitor channelled emissions to air with at least the frequency given below, 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.</td></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Tank type</th><th>Reference</th><th>Gas storage type</th><th>Gas storage capacity approx.(m^3)</th></tr>
<tr><td>Pre-storage tank 1</td><td>PST1</td><td>Double membrane gas storage roof</td><td>100</td></tr>
<tr><td>Primary Digesters x 3</td><td>D1, D2 & D3</td><td>Double membrane gas storage roof</td><td>1,430 each</td></tr>
<tr><td>Secondary Digester</td><td>PF</td><td>Double membrane gas storage roof</td><td>1,430</td></tr>
<tr><td>Total</td><td></td><td></td><td>5,820</td></tr>
</table>
This provides a total of 5,820m^3 of biogas storage. In accordance with the mass balance, approximately 38,539m^3 of biogas will be produced per day from the waste AD plant therefore the storage provision equates to about 3.6 hours of biogas production. However, the gas storage is not normally kept empty so in reality this would be less.
Biogas will not be routinely flared to atmosphere. The dual fuel flare will only be used during periods of extended gas upgrade unit maintenance and during abnormal operating conditions when the gas storage on the waste AD plant is full. The dual fuel flare will also be used for off-specification biomethane.
</td></tr>
<tr><td>AD TGN Point source emissions to air</td><td>The main chemical constituents of the emissions should be identified. This will allow the appropriate abatement technology to be selected to clean incidental emissions.</td><td>The main chemical constituents of the biogas are understood. Therefore, in terms of biogas treatment the sulphuric acid scrubber has been designed to remove ammonia and the carbon filters are designed to remove hydrogen sulphide and Volatile Organic Compounds (VOCs). The pre-treatment of biogas will improve the CHP and boiler emissions and will reduce the potential of odourous fugitive emissions.</td></tr>
</table>

BAT 8	**BAT is to monitor channelled emissions to air with at least the frequency given below, 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.**	
		The odour abatement system for the reception building where waste will be stored and treated and waste digestate will be separated and fibre digestate stored, has been designed to remove the odourous compounds that are anticipated from these processes. Air from the mixing pit area will benefit from pre-treatment via the DEO system based on regenerative catalyst technology which targets sulphur containing compounds, aromatics, and other types of VOCs. Air from the Waste-AD digestate separation area will also benefit from bespoke pre-treatment for removal of hydrogen sulphide via the sulphared filter which is made from oxidised iron media. All the pre-treated air and all the air from the rest of the reception building then passes through the main treatment system which comprises: • UV treatment which uses radiation to fragment organic molecules and oxidise potentially odourous compounds by ozonolysis and photolysis. • A short/medium residence time carbon bed will be installed after the UV reactor. This contains an adapted volume of carbon for Low and Medium Concentration sources in the plant. The active carbon has a long lifetime as the excess ozone generated by the UV lamps helps to destroy organic compounds captured on the carbon thus significantly extending the carbon life. Technical information and drawings of the CentriAir system including a P&ID are Appendix J.
AD TGN Point source emissions to air / Odour control	Emphasis should be placed on the prevention of the production and displacement of pollutants. Abatement can be readily overloaded and become ineffective. Abatement techniques should not be used as an inline process tool as part of the treatment process.	In terms of point source emissions to air, emissions from the CHP are controlled through service and maintenance of the engine. Emissions from the pressure relief valves and the flares are minimised through regulation of gas pressure via process monitoring. The level of hydrogen sulphide in the biogas is controlled via the addition of ferric chloride liquid, the desulphurisation netting on the digesters, an acid scrubber, and a carbon

BAT 8	**BAT is to monitor channelled emissions to air with at least the frequency given below, 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.**	
		filter. Control of hydrogen sulphide at source in turn controls sulphur dioxide emissions from the CHP and potential fugitive odour emissions from biogas release. Odour release is controlled at source where possible through the implementation of a first in first out procedure for waste management within the reception building; Waste Loading & Management Procedure **(ATT-SOP-12)**. In addition, any particularly odourous waste may either be rejected in accordance with the Waste Acceptance and Rejection Procedure **(ATT-SOP-11)** or treated as a priority overriding the first in first out procedure. Odour release from the Crop AD feedstocks is controlled at source via the covering of silage within the clamps and careful management of the clamp face; Crop Feedstock Loading Procedure **(ATT-SOP-02)**. Odour from digestate is controlled by ensuring that feedstocks are well digested in the process and that stable digestate is produced. Process monitoring will ensure that the AD process is well controlled and that the digestate has a low residual biogas potential indicating stability. Breakdowns will be minimised through the use of a Planned Preventative Maintenance Programme; the Attleborough Maintenance Planner **(ATT-MP-01)** and the BioConstruct Maintenance Plan on SCADA.
AD TGN Odour control	Scrubbers should be monitored to ensure optimum performance, i.e., operating at correct pH, ensuring adequate chemical wash replenishment and replacement and pressure drop monitoring. Scrubbers should be alarmed to alert operators to conditions where performance may be adversely affected.	The acid scrubber used to treat biogas is replenished with water and sulphuric acid when required automatically as it is monitored continuously to maintain the optimum pH for efficient scrubbing. Hydrogen sulphide levels are tested before and after the carbon filter that is designed to remove the hydrogen sulphide from the biogas.
AD TGN Point source emissions to air / Odour control	Correctly operate and maintain the abatement equipment, including the handling and disposal of spent scrubber medium or spent carbon.	Spent carbon will be removed off site to an appropriately permitted site at the same time as fresh carbon is delivered. Therefore, carbon filter material will not be stored on site.

BAT 8	**BAT is to monitor channelled emissions to air with at least the frequency given below, 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.**	
		The ammonia scrubber will be maintained in accordance with the manufacturers recommendations as follows: • Cleaning out demister on top of the unit app. every 3-4 years. • Check/clean dirt trap downstream the circulation pump for scrubber liquid every month. The CentriAir system will be inspected and maintained in line with the manufacturers recommendations; a provisional maintenance schedule has already been provided.
AD TGN Point source emissions to air	Vent and chimney heights should be assessed for dispersion capability and an assessment made of the fate of the substances emitted to the environment.	The Air Quality Impact Assessment[4] which also supports this application was based on quantitative dispersion modelling to inform an evaluation of predicted air quality impacts at human and ecological receptors identified within relevant distance screening criteria from the facility.
AD TGN Point source emissions to air	The Operator should justify whether or not abatement is required, assessing the impact of the emissions.	An Air Quality Impact Assessment[4] has been undertaken based on the proposed emissions abatement measures incorporated into the facility design such that emissions will not have a significant impact.
AD TGN Point source emissions to air	Sampling facilities should be provided in line with Environment Agency M1 guidance for point source emissions.	Sampling facilities for the CHP stack will be provided in line with M1.

BAT 9 Not Applicable

BAT 10	**BAT is to periodically monitor odour emissions.**	
	Odour emissions can be monitored using: • EN standards (e.g., dynamic olfactometry according to EN 13725 in order to determine the odour concentration or EN 16841-1 or -2 in order to determine the odour exposure); • when applying alternative methods for which no EN standards are available (e.g., estimation of odour impact), ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality. The monitoring frequency is determined in the odour management plan (see BAT 12).	Monitoring will be carried out in accordance with EN standards (e.g., dynamic olfactometry according to EN 13725 in order to determine the odour concentration) as stipulated in the permit.

Material Efficiency

BAT 11	**BAT is to monitor the annual consumption of water, energy and raw materials as well as the annual generation of residues and waste water, with a frequency of at least once per year.**	
	Monitoring includes direct measurements, calculation or recording, e.g., using suitable meters or invoices. The monitoring is broken down at the most appropriate level (e.g., at process or plant/installation level) and considers any significant changes in the plant/installation	EVE will maintain a log of: • Feedstocks accepted for treatment via weighbridge computer and Waste Transfer Notes • Any residual waste removed off site (Waste Transfer Notes / Quarterly Waste Returns / Annual Pollution Inventory Reporting) • Water abstracted from borehole • Energy used • Raw materials used: diesel, oil, ferric chloride liquid, sulphuric acid, carbon • Digestate produced • Biogas production, electricity, and heat generation • Biomethane export EVE will report the following to the Environment Agency on an annual basis, or as stipulated in the Environmental Permit. • Waste in and out (waste returns) on a quarterly basis • Digestate production • Raw material usage • CHP engine usage • CHP engine efficiency • Biomethane exported • Emergency flare operation • Electricity exported • Energy usage; and • Water usage

Fugitive Emissions to Air

BAT 12	**In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to set up, implement and regularly review an odour management plan, as part of the environmental management system (see BAT 1), that includes all of the following elements:**	
	A protocol containing actions and timelines;	An Odour Management Plan (OMP) **(ATT-OD-04**) forms part of the permit application and includes a protocol containing actions and timelines.[6]
	A protocol for conducting odour monitoring as set out in BAT 10;	The OMP contains a section on odour monitoring as described in BAT 10. Monitoring will be carried out periodically and in accordance with EN standards (e.g., dynamic olfactometry according to EN 13725 in order to determine the odour concentration).
AD TGN Environmental monitoring	There should be in place daily olfactory odour monitoring programmes.	Odour monitoring is part of the daily checks programme; Odour Monitoring Form **(ATT-FT-01)**.
	A protocol for response to identified odour incidents, e.g., complaints;	The OMP details actions to be taken in response to odour being identified whether there is a complaint or not. The OMP contains a section detailing the protocol for responding to odour complaints.
	An odour prevention and reduction programme designed to identify the source(s); to characterise the contributions of the sources; and to implement prevention and/or reduction measures.	The OMP includes an odour prevention and reduction programme designed to identify the source(s); to characterise the contributions of the sources; and to implement prevention and/or reduction measures.

[6] Odour Management Plan, Earthcare Technical, ETL573/OMP/V1.0/Attleborough, July 2021

BAT 13	**In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to use one or a combination of the techniques given below.**	
a	Minimising residence times	Under exceptional circumstances, solid food waste will be stored inside the Reception Building for a maximum of 5 days before treatment. However, under normal operating conditions the storage periods will be 1-2 days as the Reception Building can accommodate between 1-2 days' worth of waste required for the process. Liquid waste will be stored in the pre-storage tanks (2-4) for a maximum of 10 days before treatment which reflects a lower odour risk from the storage of liquid wastes. The headspaces of the pre-storage tanks are linked to the biogas system to ensure any fugitive emissions are contained within the system.
b	Using chemical treatment	A sulphuric acid scrubber will be used to remove ammonia from biogas.
c	Optimising aerobic treatment	It is not proposed to use this technique.

BAT 14	**In order to prevent or, where that is not practicable, to reduce diffuse emissions to air, in particular of dust, organic compounds and odour, BAT is to use an appropriate combination of the techniques given below.**	
a	Minimising the number of potential diffuse emission sources. This includes techniques such as: • appropriate design of piping layout (e.g., minimising pipe run length, reducing the number of flanges and valves, using welded fittings and pipes); • favouring the use of gravity transfer rather than using pumps; • limiting the drop height of material; • limiting traffic speed; and • using wind barriers.	The plant design by BioConstruct is optimised to reduce pipe run lengths, flanges and valves. Vehicles are restricted to 5 miles per hour on site as a health and safety measure; this also reduces potential noise and dust emissions. Fugitive emissions of dust will be monitored daily; Daily Inspection **(ATT-MP-01**) and controlled in accordance with the Fugitive Emissions Plan **(ATT-SOP-05).** Fugitive emissions of odour will be monitored daily in accordance with the Odour Management Plan **(ATT-OD-04)** and recorded in the Odour Monitoring Form **(ATT-FT-01).**
b	Selection and use of high- integrity equipment. This includes techniques such as: • valves with double packing seals or equally efficient equipment; • high-integrity gaskets (such as spiral wound, ring joints) for critical applications; • pumps/compressors/agitators fitted with mechanical seals instead of packing; • magnetically driven pumps/ compressors/agitators;	BioConstruct have confirmed that the plant design incorporates all of the features listed below: • All valves will have double packing seals • All valves (except valves on gas pipework) will have ring joints gasket • All pumps/compressors/agitators will be fitted with mechanical seals instead of packing; • Pumps for the heating system are magnetically driven.
AD TGN Waste treatment	AD operators should demonstrate that all process equipment including vessels, ancillary pipework, valves and other mechanical and electrical items and controls are made of materials suitable for each unit operation and to achieve the stated availability and design life of the plant.	Consideration has been given between the purchaser and BioConstruct who are constructing the site that infrastructure and equipment are fit for purpose and will achieve the stated 20-year design life of the plant. BioConstruct have been building biogas plants for 20 years and the materials choices, design and construction are based upon this experience.
AD TGN Odour control	Emphasis should be placed on pre-acceptance screening and the rejection of specific wastes, for example, highly odorous materials that are only suitable for acceptance under special	Highly odourous wastes will not be accepted in accordance with the Waste Acceptance & Rejection Procedure **(ATT-SOP-11)**. Odourous materials that are deemed acceptable will be processed first. The odour abatement system for the Reception Building can be

BAT 14	**In order to prevent or, where that is not practicable, to reduce diffuse emissions to air, in particular of dust, organic compounds and odour, BAT is to use an appropriate combination of the techniques given below.**	
	handling requirements. These may include dedicated sealed handling areas with extraction to abatement.	adjusted to increase the number of air changes per hour as required however 3.5 air changes per hour for the main Reception Building will be standard.
c	Corrosion prevention	BioConstruct have been building biogas plants for 20 years and the design and construction is based upon this experience. Materials are selected for suitability and longevity. The design life of the BioConstruct plant is 20 years. However, this is of course subject to adequate and routine maintenance by the AD Plant operator.
d	Containment, collection and treatment of diffuse emissions	Odour emissions from the Reception Building are minimised by the building being under negative pressure. Emissions are abated via the CentriAir odour abatement system.
AD TGN Waste reception & storage / Odour control	The reception area should be within an enclosed building and will include a building ventilation system and an odour abatement system that maintains the building under negative air pressure in order to minimise odour and dust release and to reduce noise during unloading, storage or handling operations. The air extraction system should be sufficient to ensure at least 3 air changes per hour or equivalent, higher extraction rates may be appropriate for certain sensitive locations.	The Reception Building will benefit from an air handling system which will keep the building air under negative pressure. Air will be extracted from the building and will pass through the CentriAir odour abatement system prior to release from the stack. The air handling system will be capable of 3.5 air changes per hour or more.
AD TGN Odour control	Where odour releases are expected to be acknowledged in the Permit, (i.e., contained and treated prior to discharge or discharged for atmospheric dispersion) the regulator expects that: • For existing AD facilities, the releases should be modelled to demonstrate the odour impact at sensitive receptors. The target should be to minimise the frequency of exposure to ground level concentrations that are likely to cause pollution. • For new AD facilities, or for significant changes, the releases should be modelled and it is expected that the Operator will achieve the highest level of protection that is achievable with BAT from the outset.	Odour releases have been modelled to evaluate the odour impact at sensitive receptors and conclusions can be found in the Air Quality Impact Assessment that accompanies this permit application.[4] *The total odour impact was predicted to be 1.27ouE/m^3, predicted at the nearest receptor, H1, Crowshall Veterinary Services. The predicted impact is below the strictest odour benchmark of 1,5ouE/m^3. There is, therefore, not likely to be an odour nuisance due to the Site operation.* The assessment of odour impact covers a range of reasonably foreseeable odour generation and receptor exposure scenarios, including emergency events and the effect of different mitigation options.

BAT 14	**In order to prevent or, where that is not practicable, to reduce diffuse emissions to air, in particular of dust, organic compounds and odour, BAT is to use an appropriate combination of the techniques given below.**	
	• Where there is no history of odour problems then modelling may not be required although it should be remembered that there can still be an underlying level of pollution without complaints being made. Assessment of odour impact should cover a range of reasonably foreseeable odour generation and receptor exposure scenarios, including emergency events and the effect of different mitigation options.	
AD TGN Waste reception & storage	Operators should consider the use of air lock entrances for sites located in sensitive areas.	An air lock system is not proposed however the Reception Building will benefit from an air handling and odour abatement system and fast acting (12 seconds) roller shutter doors. The Air Quality Impact Assessment concluded for odour: *The total odour impact was predicted to be 1.27ouE/m^3, predicted at the nearest receptor, H1, Crowshall Veterinary Services. The predicted impact is below the strictest odour benchmark of 1,5ouE/m^3. There is, therefore, not likely to be an odour nuisance due to the Site operation.*
AD TGN Waste reception & storage	Fast acting roller shutter doors should be provided for access and egress by delivery and other vehicles.	Fast acting roller shutter doors (12 seconds) will be installed on all five of the vehicle access / egress points on the Reception Building.
AD TGN Waste reception & storage	Any tanks that contain odorous or potentially odorous waste should be enclosed/covered gas tight and with any venting via an appropriate odour abatement system.	All tanks containing potentially odorous waste are enclosed and gas tight. The tanks on both the Crop-AD plant and the Waste-AD plant, including the pre-storage tanks in the secondary containment area are linked into their respective gas pipework network (one for Crop AD and one for Waste AD) and therefore any off-gas will be contained and treated along with the biogas.
AD TGN – Fugitive emissions to air /	Emissions abatement systems must be specifically selected and designed to minimise the release of odour, bioaerosols and microorganisms, taking into account all relevant process parameters for the area of operations they are to control and	The CentriAir system has been specifically selected as it is suitable for its intended purpose. The bespoke design provided by CentriAir is based upon the types of materials that will be stored in the Reception Building and the air handling system ensures that

BAT 14	**In order to prevent or, where that is not practicable, to reduce diffuse emissions to air, in particular of dust, organic compounds and odour, BAT is to use an appropriate combination of the techniques given below.**	
Odour control	they should be installed, monitored and maintained so as to ensure their continued effective operation.	areas with potentially higher odour emissions benefit from more efficient air abstraction and treatment. See information provided in BAT 8.
e	Dampening	Dampening of external yard areas and road ways to abate dust using a water bowser will be carried out as required in accordance with the Fugitive Emissions Plan **(ATT-SOP-05).**
f	Maintenance	All plant and equipment are subject to a planned preventative maintenance programme in accordance with the Attleborough AD Maintenance planner **(ATT-MP-01)** and the BioConstruct Maintenance Plan on SCADA.
g	Cleaning of waste treatment and storage areas	Cleaning of the Reception Building will be carried out in accordance with the Housekeeping Schedule **(ATT-SOP-13)**.
h	Leak detection and repair (LDAR) programme	After commissioning EVE will establish a Leak Detection and Repair (LDAR) programme to measure diffuse emissions of ammonia, VOCs including methane and odour from all sources identified in the LDAR. This may include but not be limited to gas storage membrane, PRVs, stacks and vents on biogas upgrading plant.
AD TGN Fugitive emissions to air	Fugitive biogas emissions must be prevented as they pose fire and/or explosion risks, as well as toxicity from gases such as H_2S and the potential for nuisance from the release of highly odorous compounds. A programme of regular scheduled checks and maintenance, including leak detection tests and other plant monitoring, must be developed and followed.	As above.
AD TGN Fugitive emissions to air	The following general techniques should be employed where appropriate: • Covering of skips and vessels, • Avoidance of outdoor or uncovered stockpiles (where possible),	• All tanks containing potentially odorous waste or digesting material are enclosed. • The trailer containing Crop-based digestate fibre will be covered as will the shute leading to it from the separator. The waste fibre digestate and associated separator will be contained inside the Reception Building. • All solid waste will be stored inside the Reception Building.

BAT 14	**In order to prevent or, where that is not practicable, to reduce diffuse emissions to air, in particular of dust, organic compounds and odour, BAT is to use an appropriate combination of the techniques given below.**	
	• Where dust creation is unavoidable, use of sprays, binders, stockpile management techniques, windbreaks and so on. • Regular wheel and road cleaning (avoiding transfer of pollution to water and wind blow), • Closed conveyors, pneumatic or screw conveying (noting the higher energy needs), minimising drops. Filters on the conveyors to clean the transport air prior to release, • Regular housekeeping.	• The silage clamps will be covered with an impermeable cover. • Dust creation will be minimised by the use of sealed surfaces for vehicle movements. If dust does arise a water bowser will be used in accordance with the Fugitive Emissions Plan **(ATT-SOP-05).** • Internal roadways will be cleaned using a tractor mounted sweeper or road sweeper as required in accordance with the Housekeeping Schedule **(ATT-SOP-13).** • On the Crop-AD plant once the solid feedstocks are loaded into the solids feeder and they are conveyed into the process, the treatment process thereafter is enclosed. • On the Waste AD plant the whole process is enclosed. • The whole site is checked daily in accordance with the Daily Inspection **(ATT-MP-03)** and the Housekeeping Schedule **(ATT-SOP-13).** The Housekeeping Rules are within the Operators Manual 10 (Housekeeping).

Emissions from Flaring

BAT 15	**BAT is to use flaring only for safety reasons or for non-routine operating conditions (e.g. start-ups, shutdowns) by using both of the techniques given below.**	
a	Correct plant design. This includes the provision of a gas recovery system with sufficient capacity and the use of high-integrity relief valves.	Biogas storage for both the Crop-AD and the Waste-AD is detailed under BAT 8. *Crop-AD:* Biogas will not be routinely flared to atmosphere. The biogas flare will only be used during periods of extended CHP maintenance and during abnormal operating conditions should the biogas storage for this side of the plant become full. In the case of CHP maintenance or shut-down the back-up boiler would be used to generate heat for the process. The regulation of gas pressure is fully automated. The control of the biogas plant and of the flare stack is interlocked such that if the gas pressure reaches a trigger level of 3 mbar in any one of the gas storage domes the flare will automatically start. This is before the set point at which the PRVs release biogas (4 mbar). These levels are set by the operator and may be changed however, the flare will always be set to ignite at a lower pressure that that which triggers the release of biogas from the PRVs. *Waste-AD:* The dual fuel flare for the Waste-AD would only be used during extended maintenance of the gas upgrade plant when the biogas storage for this side of the plant become full. To reduce the risk of this the gas volumes in the storage domes will be maintained relatively empty thus minimising the likelihood of the dual fuel flare operating due to excess biogas. The pressure at which the PRVs will release depends on the max. / min. pressure the PRVs are designed for (see 10- Biogas Storage) and the set point which will be chosen by the operator close to these critical pressure values. The setting on SCADA will dictate

		that the flare will automatically start before the PRVs will release gas meaning that they are only in place for unforeseen emergency use. Flaring is the more favourable environmental outcome than release of raw biogas through pressure relief valves though both will be minimised as much as possible by efficient running of the site.
b	Plant management. This includes balancing the gas system and using advanced process control.	Gas pressure is monitored and regulated through process monitoring and resulting process management including regulation of feed rate as detailed in Section 12.2 (Process Monitoring) of the EMS Manual **(ATT-OD-01).**

BAT 16	**In order to reduce emissions to air from flares when flaring is unavoidable, BAT is to use (both of) the techniques given below.**	
a	Correct design of flaring devices. Optimisation of height and pressure, assistance by steam, air or gas, type of flare tips, etc., to enable smokeless and reliable operation and to ensure the efficient combustion of excess gases.	**Crop-AD:** The ground- enclosed flare is made by VAR Engineering and can burn 1,000m^3/hr. Ignition temperature is 700^{o}C. The flare stack is 5,600mm high and 1,300mm in diameter. **Waste-AD:** The flare is a UF10-1850 Combustion Flare manufactured by Uniflare. It is a bivalent flare suitable for 925Nm^3hr Biogas @50% and 475Nm^3hr Biomethane @50%. In line with BAT the flare will burn at >1,000^{o}C for in excess of 0.3 seconds. The flare stack is 7,670mm high and 2,500mm in diameter.
AD TGN Biogas treatment and storage	An enclosed biogas flare with a minimum residence time of 0.3 seconds at 1000ºC should be provided to burn collected biogas where the biogas upgrading or energy recovery plant becomes unavailable.	As above the proposed flare for the Waste–AD plant meets BAT requirements. The existing biogas flare for the Crop-AD plant doesn't meet the time and temperature requirements however, the biogas being burnt in it will be derived from non-waste feedstocks which present a low risk of generating compounds within the biogas that require a higher temperature for destruction.
b	Monitoring and recording as part of flare management. This includes continuous monitoring of the quantity of gas sent to flaring. It may include estimations of other parameters (e.g., composition of gas flow, heat content, ratio of assistance, velocity, purge gas flow rate, pollutant emissions (e.g., NO_x, CO, hydrocarbons), noise). The recording of flaring events usually includes the duration and number of events and allows for the quantification of emissions and the potential prevention of future flaring events.	Each event and the number of operating hours of both flares will be recorded on SCADA and this information will be submitted to the Environment Agency annually in accordance with the Environmental Permit. The recording of the time that each of the flares are in use allows a calculation to be made to estimate the amount of biogas that has been burnt in the flare, and the quantity of emissions. It is in economic interests of EVE to reduce the amount of biogas lost to flaring and to conduct a root cause analysis to reduce the potential for future flaring events.

Noise & Vibration

BAT 17	**In order to prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to set up, implement and regularly review a noise and vibration management plan, as part of the environmental management system (see BAT 1), that includes all of the following elements:**	
	A protocol containing appropriate actions and timelines;	A Noise Impact Assessment (NIA) has been carried out by RSK[7] to incorporate the proposed changes which concluded that the predicted the noise level contribution from the AD facility site on the nearest residential receptors, and with proposed operational parameters observed, will adhere to the low impact criteria set out in BS 4142 for weekday daytime, weekday night and weekend daytime hours between 07.00 and 23.00. Proposed site operational night-time hours of 23.00 to 07.00 will result in one low to adverse impact at 'Arcadia' during the weekend night-time period, however with an increase of +3.6 dB above background level at this property, this magnitude of impact is considered within the limits of audible subjectivity. The site layout has changed since the NIA was carried out however, RSK have confirmed (June 2021) that: *Our noise specialist has reviewed both the new location and revised data from the equipment, they agree that it is more concealed and shielded by other site buildings, so it is now in a more convenient spot with potentially less noise emissions emanating in all directions.* *They have compared the source data from the consented to the proposed and it does show an improvement on the some of the previous noisy items (Compressor biogas and instrument air GUU). Furthermore, they are now also housed inside a sound-reduction container which has reduced their emitted levels considerably.* *With this in mind, an update to the original assessment should not be required.* The applicability of BAT 17 requirements is restricted to cases where a noise or vibration nuisance at sensitive receptors is expected and/or has been substantiated. Whilst it is understood that noise or vibration at sensitive receptors is not expected nor

		has been substantiated, a Noise and Vibration Management Plan (NVMP) in line with BAT requirements has been prepared.
	A protocol for conducting noise and vibration monitoring;	Not applicable, as above.
	A protocol for response to identified noise and vibration events, e.g., complaints;	Not applicable, as above.
	A noise and vibration reduction programme designed to identify the source(s), to measure/estimate noise and vibration exposure, to characterise the contributions of the sources and to implement prevention and/or reduction measures.	Not applicable, as above.

BAT 18	**In order to prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to use one or a combination of the techniques given below.**	
a	Appropriate location of equipment and buildings. Noise levels can be reduced by increasing the distance between the emitter and the receiver, by using buildings as noise screens and by relocating building exits or entrances.	The proposed site layout is such that the majority of noise generating equipment will be on the southwest side of the site away from sensitive receptors to the north east. In addition, the digester tanks stand between the majority of noise sources and the sensitive receptors. Please refer to Noise Impact Assessment[7] carried out by RSK.
b	Operational measures. This includes techniques such as: • inspection and maintenance of equipment; • closing of doors and windows of enclosed areas, if possible; • equipment operation by experienced staff; • avoidance of noisy activities at night, if possible; • provisions for noise control during maintenance, traffic, handling and treatment activities.	Operational measures to reduce noise emissions include: • Planned preventative maintenance of plant and equipment including the gas upgrade unit, the flares, and the CHP. • White noise reversing bleepers are fitted as standard on all mobile plant operated on the site. • Only trained staff will be able to operate equipment. • The normal operational hours will be 06:00 to 19:00, Monday to Sunday inclusive, thus avoiding night time operations. The planning permission restricts deliveries or dispatch to: o 07:30 - 19:30 during the period December to September. o 06:00 – 22:00 Monday to Friday and 07:00 to 22:00 Saturday and Sunday during October / November. • There is a 5mph speed limit on site.
c	Low-noise equipment. This may include direct drive motors, compressors, pumps and flares	This technique is not currently utilised.
d	Noise and vibration control equipment. This includes techniques such as:	Noise and vibration control equipment includes:

[7] Noise Impact Assessment, 297703-RSK-RP-001-(05), RSK, March 2020

	• noise reducers; • acoustic and vibrational insulation of equipment; • enclosure of noisy equipment; • soundproofing of buildings.	• The CHP is housed in a sound proofed container with noise level not exceeding 69dB (A) at 10m distance.
e	Noise attenuation. Noise propagation can be reduced by inserting obstacles between emitters and receivers (e.g., protection walls, embankments and buildings).	The new site layout has reduced noise propagation as the fans will not sit at the base of the CHP and noise from the CHP will be reduced due to the plant being between it and the closest sensitive receptors.

Emissions to Water

BAT 19	**In order to optimise water consumption, to reduce the volume of waste water generated and to prevent or, where that is not practicable, to reduce emissions to soil and water, BAT is to use an appropriate combination of the techniques given below.**	
a	Water management. Water consumption is optimised by using measures which may include: • water-saving plans (e.g., establishment of water efficiency objectives, flow diagrams and water mass balances); • optimising the use of washing water (e.g., dry cleaning instead of hosing down, using trigger control on all washing equipment);	The drainage process flow diagram is Appendix D. A water mass balance has been carried out to determine how much water will be required in the process. The clean and dirty water drainage systems are separate. Dirty water from the Crop-AD apron is collected and stored in dirty water lagoon for reuse in the process. Silage effluent is collected and stored one 19.8m^3 below ground tank from where the effluent will be pumped back for use on the AD process. There will be an overflow in place to contain any excess silage effluent within the dirty water lagoon in exceptional circumstances when not all the leachate produced is required. The water mass balance has informed site design including the size of the water tank inside the Reception Building (67m^3) (to be fed via abstraction from borehole), the surface water lagoon (936m^3), the leachate storage tank (1 No. 19.8m^3) and the dirty water lagoon (175m^3). There is a predicted shortfall of water even with reuse of all available water and acceptance of liquid wastes therefore up to 20m^3 of water will be abstracted from a borehole. Rainwater will be collected from the Reception Building roof and clean apron areas and stored in the surface water lagoon prior to use in the AD process; circa 5m^3 an hour needed for the process. The abstraction of additional water (up to 20m^3 per day) will be required to make up the shortfall in water from liquid waste, dirty run off and rainwater collection.
b	Water recirculation	As described above the recirculation of clean and dirty water is optimised.

BAT 19	**In order to optimise water consumption, to reduce the volume of waste water generated and to prevent or, where that is not practicable, to reduce emissions to soil and water, BAT is to use an appropriate combination of the techniques given below.**	
c	Impermeable surface. Depending on the risks posed by the waste in terms of soil and/or water contamination, the surface of the whole waste treatment area (e.g., waste reception, handling, storage, treatment and dispatch areas) is made impermeable to the liquids concerned.	The whole site, both clean and dirty areas, benefit from an impermeable surface - concrete or asphalt as appropriate. The dirty areas where feedstocks or digestate are stored or handled benefit from a sealed drainage system from which dirty water is collected and reused in the process.
AD TGN Waste reception & storage	The reception area should be designed to facilitate cleaning including drainage to allow discharge of wash waters into gullies and to a sump for use within the process.	The water from washing down of vehicles within the Reception Building prior to exit will all collect within the Reception Building drainage system which will discharging to the mixing pit (cast into the building floor) for re-use in the process.
AD TGN Waste reception & storage	All reception areas must have an impermeable surface with self-contained drainage, to prevent any spillage entering the storage systems or escaping off-site. The design should prevent the contamination of clean surface water.	The Reception Building will have a concrete floor and sealed drainage to discharging to the mixing pit (cast into the building floor) for re-use in the process. The falls within the building mean that all dirty water will be collected, and it will not contaminate the clean water drainage system.
AD TGN Waste reception & storage	The provision of water and steam should be considered in order to allow for cleaning of vehicles and other transport equipment following delivery. Steam cleaning should be conducted in an enclosed area.	There will be a hot pressure washer to clean vehicles after they have tipped in the Reception Building as they drive out.
d	Techniques to reduce the likelihood and impact of overflows and failures from tanks and vessels. Depending on the risks posed by the liquids contained in tanks and vessels in terms of soil and/or water contamination, this includes techniques such as: • overflow detectors; • overflow pipes that are directed to a contained drainage system (i.e., the relevant secondary containment or another vessel); • tanks for liquids that are located in a suitable secondary containment; the volume is normally sized	• All the tanks benefit from high level sensors and alarms. • Boundary level sensors will prevent any more liquid going into a tank and hence prevent overflow occurring. • The containment capacity is designed in accordance with CIRIA C736, with the calculations demonstrating 25% of the combined volume to be a greater volume than 110% of the largest tank volume (shown on the calculation spreadsheet within the containment report). • The secondary containment design in detailed in a report by Plandescil Consulting Engineers which is included in the permit application as a supporting document.[8]

[8] Containment Bund Design Report, Job No. 24727, Plandescil Consulting Engineers, December 2021, Revision 0

BAT 19	**In order to optimise water consumption, to reduce the volume of waste water generated and to prevent or, where that is not practicable, to reduce emissions to soil and water, BAT is to use an appropriate combination of the techniques given below.**	
	to accommodate the loss of containment of the largest tank within the secondary containment; • isolation of tanks, vessels and secondary containment (e.g., closing of valves).	
AD TGN Waste reception & storage	Any above ground tanks used for the storage of feedstock, digestate or any other liquids whose release could be harmful to the environment must be located on an impermeable surface with sealed construction joints and must be provided with appropriate secondary containment that can accommodate a volume at least 110% of the largest vessel or 25% of the total tankage volume, whichever is the greater. Any bunds used shall be regularly inspected to ensure that rainwater is regularly emptied, and all connections and fill points should be within the bunded area with no pipework penetrating the bund wall.	The proposed construction of the drainage and secondary containment systems including sealed construction joints is detailed in the Plandescil Drainage and Containment Reports.[8] [9] All the tanks are within a secondary containment system in accordance with CIRIA C736. The containment capacity is designed in accordance with CIRIA C736, with the calculations demonstrating 25% of the combined volume to be a greater volume than 110% of the largest tank volume (shown on the calculation spreadsheet within the containment report). The secondary containment design in detailed in a report by Plandescil Consulting Engineers which is included in the Non-Technical Summary as a supporting document. All pipes, ducts and cables are fixed on cable trays and stanchions positioned above the concrete containment, so as to not penetrate the containment floor or walls. This has been designed in accordance with CIRIA C736 to ensure any potential leakages are visible to on-site, operational staff whilst carrying out daily inspections of the containment bund structure in accordance with Daily Inspection **(ATT-MP-03).** As part of the operational management of the facility, any containment bund liquid captured within the drainage sumps will be routinely checked and tested prior to being discharged in accordance with the Secondary Containment Checking & Emptying Procedure **(ATT-SOP-14)**. If the containment sump water is determined to be 'clean', via visual and olfactory checks then the liquid will be pumped over the containment wall into the surface water lagoon. If there is any suspicion that the water may be 'dirty', the water will either be pumped to the pre-storage tank of the Waste-AD plant. All options involve manually operated pumped pipework.

[9] Drainage Design Report, Job No. 24727, Plandescil Consulting Engineers, December 2021, Revision 0

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AD TGN Emissions not controlled by emission limits to water	Bunds should: • Be subject to regular visual inspection and any contents pumped out or otherwise removed under manual control after checking for contamination. • Where not frequently inspected, be fitted with a high-level probe and an alarm, as appropriate. • Where possible, locate tanker connection points within the bund, otherwise provide adequate containment. • Be subject to programmed engineering inspection (normally visual but extending to water testing where structural integrity is in doubt). • Be designed, constructed and maintained to meet with the specifications outlined in the Construction Industry Research and Information Association guidance document titled CIRIA 164 (now superseded by CIRIA C736).	The secondary containment bund will be checked daily and pumped out as required as described above. The proposed maintenance regime consists of daily visual leak inspections within the bund and weekly inspections of the containment bund structure. The daily inspection will include checks for visual signs of leakage coming from the storage tanks or mechanical equipment located within the containment bund. If any tanks are found to be leaking, repair works will be undertaken immediately by trained personnel to prevent any contamination of surface water within the containment bund. The weekly inspections will include visual inspection of the containment bund walls and floor for any signs of cracking within the concrete. If any cracks are found, remedial works will immediately be undertaken using Sikaflex resin injection 'Sikadur 52' to fill and seal the cracks. This process will be carried out by a trained operative or specialist. The drainage system on site will be checked annually as a minimum. The site operatives will check for sediment build up in manholes and pipes. The drains will be jetted where required. Manholes will be sludge gulped and checked for any signs of wear and tear, the joints will be resealed, and the internal chambers painted with bitumen paint if required.**Error! Bookmark not defined.**
AD TGN Waste reception & storage	Any below ground tanks or sumps should be constructed with secondary containment and an appropriate leak detection system.	• All leachate manholes will be coated internally with bitumen sealant (bottom and sides). • The leachate tank is above ground (with an opening at surface level) but benefits from secondary containment and leak detection. . It is constructed of reinforced concrete with all internal walls lined with MDPE and leak detection monitoring points around the tank, extending 1.50m below the base. The design is shown on Plandescil drawing 24727/100 Rev C (Appendix H) and described within the Drainage Report[9] supporting this permit application: • *The below ground level leachate tank is to be of in situ reinforced concrete construction, with a 19.8m3 storage capacity. The tank is to be 18m X 1m in plan area, with depths varying between 1.2m (East) to 1.0m (West). The*

BAT 19	**In order to optimise water consumption, to reduce the volume of waste water generated and to prevent or, where that is not practicable, to reduce emissions to soil and water, BAT is to use an appropriate combination of the techniques given below.**	
		internal concrete tank walls are to be lined with a sealed 2mm MDPE membrane. The covered tank has been designed with a single vent, and 5 No. 63mm Ø MDPE monitoring points positioned externally 0.5m from the outer wall face of the tank. The monitoring points are to extend to a minimum of 1.5m below the underside of the tank foundation, with open ends. The monitoring points are to be manually tested regularly for any signs of contamination with a probe by the site operators. • *A high-level overflow leachate gravity pipe is to discharge water to the adjacent dirty water pond in circumstances where there is no requirement for the leachate water to be used in the process. Otherwise, the leachate tank will discharge via a pumped above ground route to the process area, to be utilised within the various storage tanks, where deemed applicable during site operations.* *To aid in cleaning of the solid material from the leachate tank, a fall on the base on the sum has been designed*.
AD TGN Waste treatment	Vessels used for treatment should be equipped appropriately e.g., high-level, temperature and gas pressure monitors.	*Crop-AD:* All treatment tanks benefit from high-level, temperature and gas pressure monitors. *Waste-AD:* All treatment tanks will benefit from temperature and gas pressure monitors. There will be one level sensor and one max. level sensor in each tank. All sensors will be connected to a SCADA system and the operator will get an alarm if the max. level sensor is triggered.

BAT 19	**In order to optimise water consumption, to reduce the volume of waste water generated and to prevent or, where that is not practicable, to reduce emissions to soil and water, BAT is to use an appropriate combination of the techniques given below.**	
AD TGN Waste treatment	Monitors and meters should be automatic, continuous and linked to a clear display in the control room or laboratory together with an audible alarm.	The operation of the plant is fully automated from an on-site central control panel which monitors information transmitted from field instrumentation around the plant (SCADA). The Crop-AD and Waste-AD each have their own SCADA systems to detect any faults and show the Operator via a graphical interface where the fault is. Both systems can be operated remotely. The information from the AD plant includes temperature, tank levels, gas volumes, gas quality, mixer operation, CHP operation and gas upgrade operation. This information can be viewed on site and also remotely to ensure optimisation of the AD process. There are several alarms that will be received in the control room and also via telemetry.
AD TGN Waste treatment	Depending on the operational model, location, and manning levels, process monitoring may be interlocked so that, for example, reactor feeding stops when an alarm condition is evident. The detailed requirements for process monitoring, alarms and interlocking should be informed by risk assessment such as HAZOP.	There are several interlocked processes including the use of boundary level sensors which stop feeding going into each individual tank should a sensor be triggered, and an Alarm Code occurs within the SCADA system. The system is monitored both on site and remotely by site operatives. There may be further interlocks put in place following the completion of the HAZOP (due to be carried out in August 2021).
e	Roofing of waste storage and treatment areas	All waste storage and treatment will be carried out in the Reception Building. Rainwater from the roof will be collected along with water from clean apron areas and will be stored in the surface water lagoon prior to use in the process.
f	Segregation of water streams	As described within the drainage report[9] and the Drainage Description (Section 6.3 of the EMS Manual **(ATT-OD-01),** the site has been designed with segregation of clean and dirty water which will be stored in different areas; clean water in water storage tank or surface water lagoon, leachate captured within leachate tank and dirty water in the covered dirty water lagoon. Dirty water from activities within the reception building collects to the mixing pit for re-use in the process. The only exception to this is the secondary containment area from which water can be pumped into either the clean

BAT 19	**In order to optimise water consumption, to reduce the volume of waste water generated and to prevent or, where that is not practicable, to reduce emissions to soil and water, BAT is to use an appropriate combination of the techniques given below.**	
		water or the dirty water system depending on the water quality decided following daily checks.
g	Adequate drainage infrastructure. The waste treatment area is connected to drainage infrastructure. Rainwater falling on the treatment and storage areas is collected in the drainage infrastructure along with washing water, occasional spillages, etc. and, depending on the pollutant content, recirculated or sent for further treatment.	As previously described the waste storage and treatment area benefits from a building and an appropriate drainage arrangement; all dirty water is reused in the process.
h	Design and maintenance provisions to allow detection and repair of leaks. Regular monitoring for potential leaks is risk-based, and, when necessary, equipment is repaired. The use of underground components is minimised. When underground components are used and depending on the risks posed by the waste contained in those components in terms of soil and/or water contamination, secondary containment of underground components is put in place.	Underground tanks and pipes have been avoided in the design where possible. The majority of pipework will be above ground. The underground pipe carrying waste digestate liquor from the separator in the Reception Building to the waste digestate storage lagoon will be partially underground and, in this section, will have a pipe in pipe design. There will also be a flow meter installed on this pipe. (Design drawings in Appendix G). The pipework will be pressure tested at 1.5 times the operating pressure prior to commissioning. After commissioning there will be pressure testing carried out every 5 years. The leachate tank for storage of leachate and dirty water is below ground but has an opening at surface level and leak detection, as shown on Plandescil drawing 24727/100 Rev C (Appendix H). The leachate tank is reinforced concrete with all internal walls lined with MDPE and leak detection monitoring points around the tank, extending 1.50m below the base. As described within the supporting Drainage Report:[9] • *The below ground level leachate tank is to be of in situ reinforced concrete construction, with a 19.8m3 storage capacity. The tank is to be 18m X 1m in plan area, with depths varying between 1.2m (East) to 1.0m (West). The internal concrete tank walls are to be lined with a sealed 2mm MDPE membrane. The covered tank has been designed with a single vent, and 5 No.*

BAT 19	**In order to optimise water consumption, to reduce the volume of waste water generated and to prevent or, where that is not practicable, to reduce emissions to soil and water, BAT is to use an appropriate combination of the techniques given below.**	
		63mm Ø MDPE monitoring points positioned externally 0.5m from the outer wall face of the tank. The monitoring points are to extend to a minimum of 1.5m below the underside of the tank foundation, with open ends. The monitoring points are to be manually tested regularly for any signs of contamination with a probe by the site operators. • *A high-level overflow leachate gravity pipe is to discharge water to the adjacent dirty water pond in circumstances where there is no requirement for the leachate water to be used in the process. Otherwise, the leachate tank will discharge via a pumped above ground route to the process area, to be utilised within the various storage tanks, where deemed applicable during site operations.* • *To aid in cleaning of the solid material from the leachate tank, a fall on the base on the sum has been designed*. There will be a programme of inspection in place for the leak detection systems for the underground pipework and the leachate tank.
AD TGN Emissions not controlled by emission limits to water	For subsurface structures: • Establish and record the routing of all AD facility drains and subsurface pipework. • Engineer systems to minimise leakages from pipes and ensure swift detection if they do occur, particularly where polluting substances are involved. • Provide secondary containment and/or leakage detection for sub-surface pipework, sumps, treatment and storage vessels. • Establish an inspection and maintenance programme for all subsurface structures, e.g., Pressure tests, leak tests, material thickness checks or CCTV.	As above Upon completion of current expansion and improvement works there will be an as built drawing showing the route of all sub-surface drains. All underground pipework for gas or substrate will be pressure test upon commissioning and then there will be a programme of inspection in place for the leak detection system. After commissioning there will be pressure testing carried out every 5 years. See above re control measures with respect to the leachate tank.
AD TGN – Environme	Groundwater monitoring should take place where:	Groundwater monitoring is not deemed necessary based on the containment measures in place as detailed within this document.

BAT 19	**In order to optimise water consumption, to reduce the volume of waste water generated and to prevent or, where that is not practicable, to reduce emissions to soil and water, BAT is to use an appropriate combination of the techniques given below.**	
ntal monitoring	• there are any subsurface structures carrying or holding waste or other harmful substances • there is uncertainty about surfaces on operational areas and drainage systems, especially on older sites.	
AD TGN Emissions not controlled by emission limits to water	All sumps should: • be impermeable and resistant to stored materials; • be subject to regular visual inspection and any contents pumped out or otherwise removed after checking for contamination; • where not frequently inspected, be fitted with a high-level probe and alarm, as appropriate; and • be subject to programmed engineering inspection (normally visual but extending to water testing where structural integrity is in doubt).	• The 4. No. Leachate sumps are coated internally with bitumen sealant (bottom and sides). • Leachate drains to a single below ground leachate tank (19.8m^3) which has been designed by Plandescil Drainage Engineers. . The tank is below ground but has an opening at surface level. It is constructed of reinforced concrete with all internal walls lined with MDPE and leak detection monitoring points around the tank, extending 1.50m below the base. The design is shown on Plandescil drawing 24727/100 Rev C (Appendix H) and described within the Drainage Report[9] supporting this permit application: • *The below ground level leachate tank is to be of in situ reinforced concrete construction, with a 19.8m3 storage capacity. The tank is to be 18m X 1m in plan area, with depths varying between 1.2m (East) to 1.0m (West). The internal concrete tank walls are to be lined with a sealed 2mm MDPE membrane. The covered tank has been designed with a single vent, and 5 No. 63mm Ø MDPE monitoring points positioned externally 0.5m from the outer wall face of the tank. The monitoring points are to extend to a minimum of 1.5m below the underside of the tank foundation, with open ends. The monitoring points are to be manually tested regularly for any signs of contamination with a probe by the site operators.* • *A high-level overflow leachate gravity pipe is to discharge water to the adjacent dirty water pond in circumstances where there is no requirement for the leachate water to be used in the process. Otherwise, the leachate tank will discharge via a pumped above ground route to the process area, to be utilised within the various storage tanks, where deemed applicable during site operations.*

BAT 19	**In order to optimise water consumption, to reduce the volume of waste water generated and to prevent or, where that is not practicable, to reduce emissions to soil and water, BAT is to use an appropriate combination of the techniques given below.**	
		• *To aid in cleaning of the solid material from the leachate tank, a fall on the base on the sum has been designed*. The drainage system on site will be checked annually. The plant operatives will check for sediment build up in manholes and pipes. The drains will be jetted where required. Manholes will be sludge gulped and checked for any signs of wear and tear, the joints will be resealed, and the internal chambers painted with bitumen paint if required. The secondary containment sumps will be checked and emptied as appropriate daily as previously described; Secondary Containment Checking & Emptying Procedure **(ATT-SOP-14)**.
AD TGN Emissions not controlled by emission limits to water	For surfacing: • Design appropriate surfacing and containment or drainage facilities for all operational areas, taking into consideration collection capacities, surface thicknesses, strength/reinforcement; falls, materials of construction, permeability, resistance to chemical attack, and inspection and maintenance procedures. • Have an inspection and maintenance programme for impervious surfaces and containment facilities. • Unless the risk is negligible, have improvement plans in place where operational areas have not been equipped with: – an impermeable surface – spill containment kerbs – sealed construction joints – connection to a sealed drainage system	The surfacing, drainage and containment systems have been designed by specialist contractors in line with current guidance as detailed in other sections of this report. Inspection and maintenance of surfacing, drainage and containment is carried out in accordance with the details provided earlier in this section.
i	Appropriate buffer storage capacity is provided for waste water generated during other than normal operating conditions using a risk-based approach (e.g. taking into account the nature of the pollutants, the effects of downstream waste water treatment,	Waste water generated during abnormal operating conditions would be stored within the secondary containment systems, the sizing and suitability of which have been described in preceding sections.

BAT 19	**In order to optimise water consumption, to reduce the volume of waste water generated and to prevent or, where that is not practicable, to reduce emissions to soil and water, BAT is to use an appropriate combination of the techniques given below.**	
	and the receiving environment). The discharge of waste water from this buffer storage is only possible after appropriate measures are taken (e.g., monitor, treat, reuse).	

BAT 20 – not applicable (waste water treatment)

Emissions from Accidents and Incidents

BAT 21	**In order to prevent or limit the environmental consequences of accidents and incidents, BAT is to use all of the techniques given below, as part of the accident management plan (see BAT 1)**	
a	Protection measures. These include measures such as: • protection of the plant against malevolent acts; fire and explosion protection system, containing equipment for prevention, detection, and extinction; and • accessibility and operability of relevant control equipment in emergency situations.	The plant can be operated remotely via a telemetry linked to the SCADA system. The site will benefit from perimeter fencing, a locked gate at entrance, entrance barrier, CCTV system which can be remotely monitored and alarms in the office. A DSEAR assessment will be carried out in August 2021 and any recommendations carried out to ensure appropriate explosion protection measures are in place. Fire extinguishers will be placed at strategic locations around the site and in all mobile plant.
AD TGN Treatment	When loading, the empty air space in the digester should be flushed with nitrogen (or other inert gas) gas in order to prevent the creation of explosive atmospheres.	When loading the tanks will be purged with biogas produced in the plant to prevent the creation of explosive atmospheres. This is detailed in a Safe Start-up Procedure provided by BioConstruct (Appendix K).
b	Management of incidental/accidental emissions. Procedures are established and technical provisions are in place to manage (in terms of possible containment) emissions from accidents and incidents such as emissions from spillages, firefighting water, or safety valves	The Accident Management Plan **(ATT-OD-05)** includes several Emergency Response Procedures: • Incident Reporting & Recording Procedure (Section 6.2) • Control Panel Alarm Response (Section 7) • Fire and Explosion Response Procedure (Section 8) • Biogas Leak Response Procedure (Section 9) • Foam Response Procedure (Section 10) • Main Power Outage Response Procedure (Section 11) • Safe Shutdown Procedure (Section 12) • Mechanical Failure Procedure (Section 13) There is also a standalone company-wide Spill Control Procedure **(EVE-SOP-07).**
c	Incident/accident registration and assessment system. This includes techniques such as: • a log/diary to record all accidents, incidents, changes to procedures and the findings of inspections; and	In accordance with the Accident Management Plan **(ATT-OD-05)** it is the responsibility of the Site Manager or Nominated Competent Person (NCP) to: • *Assist in a full incident / accident root cause analysis, review lessons learnt and recommend any changes to procedures.*

	• procedures to identify, respond to and learn from such incidents and accidents.	• *Making a record of the accident and the subsequent investigation using Accident and Incident Report Form (EVE-FT-01) (for actual or potential environmental incidents); and* • *Review and update the Accident Management Plan and procedures as necessary.*

Material Efficiency

BAT 22	**In order to use materials efficiently, BAT is to substitute materials with waste.**	
a	Waste is used instead of other materials for the treatment of wastes (e.g., waste alkalis or waste acids are used for pH adjustment, fly ashes are used as binders).	Opportunities will always be sought to use waste materials in place of raw materials. The process makes good use of recycled dirty water and liquid waste to create a prepared feedstock in the correct dry matter range for anaerobic digestion. There is limited use of raw materials. The Waste-AD process primarily uses waste materials in order to recover biogas and digestate. Raw material use is minimised where possible.
AD TGN Raw materials selection	The Operator should have procedures for the regular review of new developments in raw materials and for the implementation of any suitable ones with reduced environmental impact.	Opportunities will be sought to review the selection of raw materials and the availability of alternative raw materials which are less hazardous or polluting. This will include, where possible: • Substituting raw materials with waste or waste-derived products. • Changing the raw materials to less hazardous or polluting alternatives where operationally viable. • Ensuring that quality assurance procedures are followed to control the content of raw materials.
AD TGN Raw materials selection	The Operator should complete any longer-term studies needed into the less polluting options and should make any material substitutions identified.	As above.

Energy Efficiency

BAT 23	**In order to use energy efficiently, BAT is to use both of the techniques given below.**	
a	Energy efficiency plan. An energy efficiency plan entails defining and calculating the specific energy consumption of the activity (or activities), setting key performance indicators on an annual basis (for example, specific energy consumption expressed in kWh/tonne of waste processed) and planning periodic improvement targets and related actions. The plan is adapted to the specificities of the waste treatment in terms of process(es) carried out, waste stream(s) treated, etc.	The predicted energy production and energy use have been calculated to inform site design. A Sankey diagram is provided in Appendix F and a Heat Process Flow in Appendix C. Heat and electricity are provided by the CHP engine (shown as 'External Heat Source') except in the case of power failure. Power is then provided by the on-site stand-by diesel generator. Energy consumption will be continuously monitored, and records will be retained and reviewed to understand energy flows around the site. Records of primary energy used, energy generated, and energy exported, etc. will be maintained and an annual return will be made to the EA in accordance with permit requirements. An Energy Efficiency Plan is provided in Appendix I.
AD TGN Basic Energy Requirements	Operating, maintenance and housekeeping measures should be in place in the following areas, where relevant (Indicative checklists of appropriate measures are provided in Appendix 2 of the guidance note H2 Energy efficiency for IPPC): • air conditioning, process refrigeration and cooling systems (leaks, seals, temperature control, evaporator/condenser maintenance) • operation of motors and drives • compressed gas systems (leaks, procedures for use) • steam distribution systems (leaks, traps, insulation)	There is a planned preventative maintenance programme in place to ensure that all components are maintained as fit for purpose to prevent waste through leaks, faults etc. Daily, weekly, monthly etc. checklists will be followed, and records kept. Attleborough Maintenance Planner **(ATT-MP-01)** and the BioConstruct Maintenance Plan on SCADA

BAT 23	**In order to use energy efficiently, BAT is to use both of the techniques given below.**	
	• space heating and hot-water systems • lubrication to avoid high-friction losses • boiler operation and maintenance, e.g., optimising excess air • other maintenance relevant to the activities within the AD facility	
AD TGN Basic Energy Requirements	Basic low-cost physical techniques should be in place to avoid gross inefficiencies. These should include insulation, containment methods, (such as seals and self-closing doors), and avoidance of unnecessary discharge of heated water or air (e.g., by fitting simple control systems such as timers and sensors).	Heat generated by the CHP is utilised in heating the digesters and the pasteurisers as shown on the Sankey Diagram (Appendix F). There will inevitably be losses of heat through the heating system, but this is minimised through the insulation of all infrastructure transferring or storing heat is lagged with a minimum of 55mm Rockwool in accordance with Ofgem requirements. Energy flows around the site are continuously monitored. Results will be regularly reviewed to understand where energy saving improvements can be made.
b	Energy balance record. An energy balance record provides a breakdown of the energy consumption and generation (including exportation) by the type of source (i.e., electricity, gas, conventional liquid fuels, conventional solid fuels, and waste). This includes: • information on energy consumption in terms of delivered energy; • information on energy exported from the installation; • energy flow information (e.g., Sankey diagrams or energy balances) showing how the energy is used throughout the process. The energy balance record is adapted to the specificities of the waste treatment in terms of process(es) carried out, waste stream(s) treated, etc.	See Sankey Diagram (Appendix F).

BAT 23	**In order to use energy efficiently, BAT is to use both of the techniques given below.**	
AD TGN Basic Energy Requirements	The operator should provide details on associated environmental emissions. This is dealt with in the operator's response to the emissions inventory using the H1 software tool.	Emissions associated with the AD plant are detailed in the Air Quality Impact Assessment.[4]

Waste Reduction

BAT 24	**In order to reduce the quantity of waste sent for disposal, BAT is to maximise the reuse of packaging, as part of the residues management plan (see BAT 1).**	
	Packaging (drums, containers, IBCs, pallets, etc.) is reused for containing waste, when it is in good condition and sufficiently clean, depending on a compatibility check between the substances contained (in consecutive uses). If necessary, packaging is sent for appropriate treatment prior to reuse (e.g., reconditioning, cleaning).	Packaging removed from packaged waste feedstocks will be washed in the process to ensure maximum removal of organic materials. The resulting packaging material will be compacted and sent off site to be used in an energy from waste plant which is currently the best option for this waste stream in line with the waste hierarchy. See Residue Management Plan **(ATT-OD-08).** Any IBCs used for e.g., sulphuric acid will be returned to the producer for re-use. Waste will not be received in IBCs or drums for treatment within the AD process.

BAT 25-32 Not Applicable (mechanical treatment of waste when it is not combined with biological treatment)

General BAT conclusions for the biological treatment of waste

BAT 33	**In order to reduce odour emissions and to improve the overall environmental performance, BAT is to select the waste input.**	
	The technique consists of carrying out the pre-acceptance, acceptance and sorting of the waste input (see BAT 2) so as to ensure the suitability of the waste input for the waste treatment, e.g., in terms of nutrient balance, moisture or toxic compounds which may reduce the biological activity.	The Waste Pre-acceptance Procedure **(EVE-SOP-08)** and the Waste Acceptance & Rejection Procedure **(ATT-SOP-11)** ensure that waste is only accepted at the facility unless it is suitable for treatment within an anaerobic digester. The AD plant will be fed in accordance with a daily recipe which has been informed by process monitoring and process management as detailed in Section 12.2 and 12.3 of the EMS Manual **(ATT-OD-01)** respectively to maximise plant efficiency and reduce odour emissions from both the AD facility and the resulting digestate.

BAT 34	**In order to reduce channelled emissions to air of dust, organic compounds and odorous compounds, including H_2S and NH_3, BAT is to use one or a combination of the techniques given below.**	
a	Adsorption	Active carbon filters are proposed as part of the biogas treatment process (after the ammonia scrubber) on the Waste-AD plant. Biogas will flow through a VOC filter operating with active carbon and two 'normal' active carbon filters before it goes into the GUU. On the Crop-AD plant there are also carbon filters prior to the CHP to remove hydrogen sulphide.
b	Biofilter	Not proposed.
c	Fabric filter	Not proposed.
d	Thermal oxidation	Not proposed.
e	Wet scrubbing	*Waste-AD:* The raw gas from the gas holders will first go through a gas washing and cooling unit which is an ammonia scrubber and uses sulphuric acid. The principle of the scrubber's operation is based on the thermal separation process of "chemical absorption". Inside the scrubber, a cleaning solution (absorbent) is introduced into the contact zone, where it is brought into direct and extensive contact with the raw gas and the pollutants (absorptive), contained therein. A material transfer of the contaminants from gaseous to liquid phase then occurs at the phase boundary. The absorptive is first dissolved into solution and then converted chemically into stable salts and neutralized. During operation, the scrubbing liquid is enriched by the absorbed substances and their chemical reaction products. Before the maximum permissible concentration is reached, the scrubbing liquid is renewed. The spent scrubbing solution ammonium sulphate (a fertiliser) will be discharged to the Secondary Digester. A piping system with centrifugal fan delivers the raw gas to the scrubber. The scrubber itself is designed as a vertical, randomly packed column with a square cross-section and fully executed in plastics. It is counter-streamed by the raw gas, flowing from

		bottom to top. Above the random column packing, the scrubbing liquid is distributed finely by means of a nozzle system, wetting the columns complete cross-section. The scrubbing liquid passes the packing, trickling through it with free gradient, then flows back into the receiver tank. The packing represents the actual contact zone, where the transfer of the water-soluble contaminants from the gaseous to the liquid phase takes place. Upon passing the packing, the gas passes a droplet separator system. There, drops of the scrubbing liquid that are carried along with the gas flow are separated and held back. The receiver tank for the scrubbing liquid is located directly underneath the column. By means of a centrifugal pump, the scrubbing solution is conveyed from the tank into the circuit and up to the nozzle system. The receiver tank is equipped with level switching points, required for the process of renewing the scrubbing liquid. The neutralizing agent is added, depending on the pH-value of the scrubbing solution. To limit the concentration of the scrubbing solution, its conductivity is measured. Upon reaching a predetermined value of conductivity, part of the scrubbing liquid is discharged from the fluid circuit and then replaced by fresh water.	
BAT-associated emission levels (BAT-AELs) for channelled NH_3, odour, dust and TVOC emissions to air from the biological treatment of waste			
Ref	**Parameter**	**BAT-AEL (Average over the sampling period)**	
Table 6.7	NH_3 - mg/Nm^3 *	0.3 - 20	Either the BAT-AEL for NH3 or the BAT-AEL for the odour concentration applies. It is proposed that odour monitoring will be carried out.
	Odour concentration - ou_E/Nm^3 *	200 - 1,000	Odour monitoring against this BAT-AEL will be carried out every 6 months in accordance with BAT 8

* Either the BAT-AEL for NH_3 or the BAT-AEL for the odour concentration applies.

BAT 35	**In order to reduce the generation of waste water and to reduce water usage, BAT is to use all of the techniques given below.**	
a	Segregation of water streams	This is detailed within the response to BAT 19.
b	Water recirculation	This is detailed within the response to BAT 19.
c	Minimisation of the generation of leachate	Leachate will inevitably be produced from the ensiled energy crops in the silage clamps, though they will be harvested at the correct dry matter level, (monitored on receipt by measurement) to minimise the quantity produced. Any leachate will be used within the AD process as previously described and hence waste water will not be generated.

BAT 36-37 Not Applicable

BAT conclusions for the anaerobic treatment of waste

Process Monitoring

BAT 38	**In order to reduce emissions to air and to improve the overall environmental performance, BAT is to monitor and/or control the key waste and process parameters.**	
	Implementation of a manual and/or automatic monitoring system to: • ensure stable digester operation, • minimise operational difficulties, such as foaming, which may lead to odour emissions, • provide sufficient early warning of system failures which may lead to a loss of containment and explosions. This includes monitoring and/or control of key waste and process parameters, e.g.: • pH and alkalinity of the digester feed; • digester operating temperature; • hydraulic and organic loading rates of the digester feed; • concentration of volatile fatty acids (VFA) and ammonia within the digester and digestate; • biogas quantity, composition (e.g., H_2S) and pressure; • liquid and foam levels in the digester.	As detailed in Section 12.2 of the Environmental Management System Manual **(ATT-OD-01)** the following process monitoring takes place: ***Continuous monitoring (recorded on SCADA):*** 1. Gas production 2. Gas pressure 3. Gas quality 4. Temperature ***Daily Process Monitoring:*** 5. Odour at site boundary and main potential odour sources (Odour Monitoring Form **(ATT-FT-01**)) 6. Gas readings (CH_4, H_2S and O_2) 7. Visual check on appearance and level of digesters (crust, foam, mixing speed) ***On-site testing:*** 8. The on-site testing equipment will be used to test: • Samples from the digesters for pH, FOS/TAC and dry matter; three times a week • Feedstock dry matter content

BAT 38	**In order to reduce emissions to air and to improve the overall environmental performance, BAT is to monitor and/or control the key waste and process parameters.**	
		Samples for laboratory testing: 9. A sample will be taken from each of the digesters monthly in accordance with the Sampling Procedure **(ATT-SOP-07)** and sent off to a UKAS Accredited laboratory for analysis: • pH • FOS/TAC • Dry matter • Volatile fatty acids • Trace elements Frequency of testing may be increased if required to enhance process monitoring around abnormal operation events. Process monitoring data will be used by the Site Manager to inform process decisions including the feed plan, mixing regime and the addition of trace elements.
AD TGN Waste treatment	The operator must establish and follow appropriate process monitoring arrangements to facilitate process optimisation and maintain stable digestion. As a minimum the following parameters should be regularly monitored and recorded: • pH – the digester should be maintained between pH 6.5 and 8.0 by ensuring a stable FOS/TAC ratio. • Alkalinity – the alkalinity within the digester should be maintained between 2000-4000 mg litre-1 (as $CaCO_3$) • Temperature - the optimum operating temperature should be defined depending on the ecology (mesophilic or thermophilic) deployed. The digester should be held within +/- 2 degrees Celsius of the optimum temperature. • The organic loading rate and hydraulic residence time should be managed to deliver a stable and sanitised digestate.	The AD process is maintained within the parameters as described through process monitoring as described above and process management daily. The Crop-AD plant is thermophilic, and the Waste-AD plant will be mesophilic. Digestate samples will be analysed periodically to verify that process controls have been effective in producing stable digestates.

BAT 38	**In order to reduce emissions to air and to improve the overall environmental performance, BAT is to monitor and/or control the key waste and process parameters.**	
	Maximised removal (stabilisation) efficiencies for volatile solids reduction or COD reduction in the substrate should be clearly demonstrated. • Monitor and control process parameters in order to ensure a stable digestion process	
AD TGN Waste treatment	Monitoring of these parameters requires sampling of digester feed, substrate within the digester, digestate and biogas at key points in the process. Periodic digester capacity testing should also be undertaken. The system design should allow for this. Regular laboratory testing will be required to analyse samples and the operator should consider provision for on-site laboratory facilities at large scale AD facilities.	Crop feedstocks are tested for dry matter content as they come in during harvest. Feedstocks may also be tested for biochemical methane potential (BMP). Test results are used to inform the feed plan for the plant. Waste feedstocks will be sampled and analysed as part of pre-acceptance checks in accordance with the Waste Pre-acceptance Procedure **(EVE-SOP-08)**. There are dedicated sample points on the pre-storage tanks and all the digesters. Samples can either be tested on site (for dry matter, pH and FOS/TAC) or will be sent to a laboratory for more extensive analysis (including dry matter, pH and FOS/TAC to verify on-site results). Digestate samples will be taken on the Crop-AD plant as a minimum: • quarterly for digestate liquor • every six months prior to seasonal use for digestate fibre The Waste-AD site will be sampled and tested in accordance with the determined requirements of the Biofertiliser Certification Scheme requirements as per the BSI PAS110:2014 Specification. There are points within the biogas system at which hand-held gas monitors can be used to check the inline gas quality readings. Digester samples will be analysed in-house at least three time as week to monitor the process and visually checked. Should there be a noticeable grit in samples the process/

BAT 38	**In order to reduce emissions to air and to improve the overall environmental performance, BAT is to monitor and/or control the key waste and process parameters.**	
		tank will be checked further. Should tank integrity testing be required internal examination will be conducted to accurately assess grit content.
AD TGN Waste treatment	For large scale AD facilities, monitoring processes should incorporate the use of Supervisory and Control and Data Acquisition Equipment (SCADA) to monitor, record and display data for continuously monitored parameters such as temperature, digester feeding and gas production rates.	SCADA is used to monitor, record and display data for continuously monitored parameters including temperature, digester feeding and gas production rates.

BAT 39-53 Not applicable (other waste treatment activities)

Indicative BAT from AD TGN not incorporated above

AD TGN	Indicative BAT requirements for biogas treatment	
1	Requirements for biogas treatment depend on the gas quality requirements for the intended end use of the biogas. When treating raw biogas the following factors need to be taken into account: • Dewatering • Removal of hydrogen sulphide (potentially corrosive to engines) • Removal of oxygen and nitrogen (where present) • Removal of ammonia • Removal of siloxanes (if treating Sewage Sludge) • Removal of particulates; and • Removal of carbon dioxide (for upgrading to biomethane). Taking these treatment factors into account will protect the plant infrastructure including the engines, reduce downtime and maintenance, improve the operating life of the engines and reduce emissions to the environment.	Biogas is stored on top of the digesters and the pre-storage tank within the double membrane gas storage domes. The digesters tanks are equipped with desulphurisation nets and low-level oxygen injection to encourage microbial growth to reduce hydrogen sulphide (H_2S) levels and precipitate sulphur. *Crop-AD:* On leaving storage the biogas passes through a condensate pit to remove any moisture, through a chiller to reduce the temperature and then through a carbon filter to remove any excess hydrogen sulphide (H_2S) prior to going to the CHP. *Waste AD:* On leaving storage the biogas passes through a gas cooling system to reduce moisture (condensate goes to condensate pit then to the secondary digester) then through a scrubber which uses sulphuric acid to remove ammonia. Finally, the biogas passes through active carbon filters; first a VOC filter operating with active carbon and then two 'normal' active carbon filters targeting H_2S before it goes into the gas upgrade unit (GUU). The SCADA system manages the biogas treatment and gas distribution system.
2 - Dewatering	The removal of water from the biogas must be undertaken in order to protect the collection system, energy recovery plant and auxiliary flare. This can be achieved by water removal techniques such as moisture traps, condensate pots or water taps at low point in the gas line. Additional water removal techniques include; • Cooling / Condensation • Compression • Adsorption and • Absorption	Water is removed from the biogas through cooling/condensation as described above.

AD TGN	Indicative BAT requirements for biogas treatment	
3 – Biogas monitoring	As a minimum requirement in small scale AD facilities gas flow to the consumer unit, and flow rates to gas holders should be continuously monitored and composition of the principal biogas components, methane and carbon dioxide, should be monitored or periodically tested.	*Crop-AD:* Gas quality is monitored continuously via in-line analyser prior to the CHP. The following parameters are measured: • Methane (CH_4) • Oxygen (O_2) • Hydrogen sulphide (H_2S) • Carbon dioxide (CO_2) *Waste-AD:* One central gas quality measurement / gas analyser will be installed. The measured parameters are methane, hydrogen, sulphide, carbon dioxide and oxygen. The analyser will be connected to the gas pipe before and after the biogas conditioning unit (gas washing/cooling etc.) and after the carbon filter respectively in front of the GUU inlet. Furthermore, the gas in the gas holder roofs of the Digesters and the Secondary Digester will be monitored. Inside the GUU Pentair will install an internal gas quality measurer called Biosense to measure and allow control on the quality of incoming gas, too. The gas analysers will monitor the gas quality periodically. The interval at each measuring point will be between 60 and 90 minutes. Gas quality may be checked using a hand-held gas monitor. The hand-held gas monitor is calibrated annually or sooner if there is a significant difference between the in-line and handheld device readings.

AD TGN	Indicative BAT requirements for biogas treatment	
4 – Biogas monitoring	Large scale AD facilities should be equipped with Continuous Monitoring Systems (CMS) including output information and alarms.	The continuous monitoring system for biogas is connected to SCADA. The interface will ensure that alarms will be triggered if biogas parameters move out of optimum range.
5 - Biogas monitoring	All biogas monitoring systems should provide continuous biogas pressure monitoring with an alarm mechanism. Any application should specify the maximum pressure above which there should be no feed to the AD reactor which should be interlocked.	The gas pressure monitors are linked via cable to the SCADA system which will alarm if the gas pressure moves outside the set range. *Crop- AD:* The control of the crop biogas plant and of the flare stack is interlocked such that if the gas pressure reaches a trigger level of 3 mbar in any one of the biogas storage domes the flare will automatically start. This is before the set point at which the PRVs release biogas (4 mbar). There is no interlock between gas pressure and feeding. *Waste-AD:* Gas pressure is not interlocked with feeding. The flare will start burning biogas if the set point of +3.3 mbar in the gas holder roof is reached. The flare needs a gas pressure of 80-120 mbar on its inlet. Therefore, there is a deviation from BAT relevant to both sides of the AD plant such that feeding is not interlocked with gas pressure. The operator can manually adjust feeding as required but there is a lag time between feeding and gas production such that this is not deemed an appropriate measure. However, if gas pressure is high then the gas consumers for the Crop-AD and Waste-AD (the CHP and GUU respectively) will start to operate at 100% capacity. If the gas pressure is not brought down swiftly enough by this measure, then the flare on either side of the installation will automatically ignite. The high gas pressure and the ignition of either flare will raise an alarm via SCADA.
6 - Biogas monitoring	Biogas methane levels are required to be measured both as an indicator of output from the process but also to protect	Methane is measured continuously via in-line analyser as described under '3- Biogas Monitoring'

AD TGN	Indicative BAT requirements for biogas treatment	
	downstream energy generation equipment such as gas engines or CHP units.	
7 - Biogas monitoring	All equipment in contact with biogas should be ATEX certified.	All equipment in contact with biogas is ATEX certified. A DSEAR assessment is scheduled to be carried out in August 2021.
8 - Biogas monitoring	Hydrogen sulphide levels in the biogas should also be monitored both before and after gas cleaning equipment in order to monitor the efficiency of the removal process	Hydrogen sulphide levels will be monitored after the biogas conditioning unit (gas washing/cooling etc.) and after the carbon filter in front of the GUU inlet to check the efficacy of the carbon filter. Gas quality monitoring/reading will be done every 90 minutes.
9 - Biogas storage	Biogas should be collected from all digesters and all other vessels where methane is generated.	Biogas will be collected from the pre-storage tank on the Waste-AD plant and all digesters including the secondary digesters across the installation.
10 - Biogas storage	Where vessels are sealed for biogas collection they should be fitted with over pressure and vacuum relief valves. Isolating valves should be incorporated to enable inspection and maintenance	*Crop-AD* The digester tanks have the following number of PRVs installed: • Primary digesters (DG1-DG2) – 1 PRV on each tank • Secondary digester (DG3) – 1 PRV on each tank The PRVs are water filled; glycol is added in winter months to prevent the water from freezing. The PRVs will operate at -1.00mbar / +4.00 mbar. *Waste-AD:* The following tanks will have the following number of PRVs installed: • Large pre-storage tank (PST1) - 1 PRV • Primary Digesters 1-3 (DG1-DG3): 2 PRVs on each tank • Secondary Digester (PF): 3 PRVs

AD TGN	Indicative BAT requirements for biogas treatment	
		All PRVs are water-filled PRVs. No need to add glycol in the winter because all PRVs installed at the Digesters and the Secondary Digester will be connected to the tank heating systems and operate with warm water. The PRV at the PST will be electrically heated. The PRVs are designed for max. / min. operation pressures of [all values in mbar]: • PST 1: +3,50 / -1,00 and a max. design pressure: +4.03 mbar • DG 1: +3,50 / -1,00 and a max. design pressure: +4.03 mbar • DG 2: +4,50 / -1,00 and a max. design pressure: +5.18 mbar • DG 3: +3,50 / -1,00 and a max. design pressure: +4.03 mbar • PF: +3,00 / -1,00 and a max. design pressure: +3.45 mbar There are no isolating valves on the PRVs as the PRVs are the final safety measure to prevent any damage on the gas domes; the presence of an isolation valve introduces the potential for operator error as the isolation valves could be left closed by mistake. This is a deviation from BAT.
11 - Biogas storage	Biogas upgrading or energy recovery plant should form part of the design and operation of the facility. Any plant that combusts biogas (boilers, CHP, Flare) must incorporate appropriate flame arrestors to prevent flash back and automatic isolation valves.	*Waste-AD:* The flare will benefit from flame arrestors and automatic isolation valves. *Crop-AD:* The CHP and the flare benefit from flame arrestors and automatic isolation valves.
13 - Biogas storage	The use of pressure relief valves (PRVs) must be restricted to emergency situations only and be carefully controlled and monitored in order to minimise the release of fugitive gas emissions.	*Waste-AD:* The pressure that the PRVS will release depends on the max. / min. pressure the PRVs are designed for, and the set point determined by the operator which must be close to these critical pressure values. The setting on SCADA will dictate that the flare will

AD TGN	Indicative BAT requirements for biogas treatment	
		automatically start before the PRVs will release gas, meaning that they are only in place for unforeseen emergency use. *Crop-AD:* The control of the whole biogas plant and of the flare stack is interlocked such that if the gas pressure reaches a trigger level of 3 mbar in any one of the gas storage domes the flare will automatically start. This is before the set point at which the PRVs release biogas (4 mbar). These set points can be changed by the operator, but it will be ensured that the gas pressure which triggers the flare ignition will be lower than that which triggers a PRV release. Across the installation gas pressure will be monitored and regulated through process monitoring and resulting process management including regulation of feed rate as detailed in Sections 12.2 and 12.3 of the Environmental Management System Manual **(ATT-OD-01).**
14 - Biogas storage	Biogas and air must not be allowed to mix as explosions may result. Where air is used for H_2S removal, oxygen must be monitored automatically, and a high-level alarm set to automatically stop air addition before the lower explosive limit is reached.	Oxygen is injected into the digester headspace. If the oxygen concentration reaches 0.25% vol there will be a warning issued on SCADA, if it reaches 0.3% vol then SCADA will issue an action and if 0.35% vol is met then there will be a shutdown of the oxygen injection system.
15 - Biogas storage	Pressure sensors should be provided on top of the digestion tanks and the gas storage tank. In a situation of excessive pressure build up in these tanks, due to pipe damage or blockage, an alarm signal should be triggered with immediate venting systems instigated.	Each tank holding gas has a pressure sensor. These pressure sensors are linked to SCADA and the flare and PRVs will operate automatically as described under point 13 above.
16 - Biogas storage	The design of the gas collection system should ensure that excessive negative pressures cannot be imposed on the digester vessel or the gas collection vessel.	The design of the biogas collection system prevents negative pressures as a pressure sensor will be triggered which will switch off the CHP and flare (Crop AD plant) and / or Flare and GUU (Waste-AD plant). As a fail-safe the PRVs will operate at -1.0mbar.
17 - Biogas storage	The correct system operating pressure should be maintained by the gas storage device.	The operating pressure is maintained through continuous process monitoring and process management. The CHP / GUU will be operated based on the average gas level in gas domes. If the pressure becomes too low a pressure sensor is triggered which will

AD TGN	Indicative BAT requirements for biogas treatment	
		shut down the CHP / GUU. As previously described if this measure doesn't sufficiently reduce gas pressure, then the flare will automatically start.
18 - Biogas storage	To protect critical infrastructure safety relief valves set to operate at a slightly higher than designed operational gas pressure but at a safe level to protect the digesters and gas holders should be provided.	The Crop-AD flare automatically starts if the gas pressure in the storage domes reaches + 3.0 mbar. The Waste-AD flare will automatically start burning biogas if the set point of +3.3 mbar in the gas holders is reached. The pressure relief valves will only trigger at a higher pressure as detailed in '10- Biogas Storage' above.
19 - Biogas storage	The gas actuated pressure relief valves should be protected against environmental and climatic conditions.	The Crop-AD PRVs are water sealed and each PRV has glycol added over the winter period of required. The Waste-AD PRVs are water sealed and each PRV is trace heated to keep the water from freezing. The PRV at the PST will be electrically heated.

AD TGN	Indicative BAT requirements for digestate treatment and storage	
1 - Separation	The separation (solids/fibres from liquid) of digestate must take place within an enclosed building which is kept under negative air pressure.	*Crop- AD:* The digestate is separated in the open within a dedicated fibre bay. The fibre will fall into a covered trailer via a covered shute. This is a deviation from BAT. *Waste-AD:* The digestate is separated inside within a sub-section of the Reception Building; the fibre will be stored in a dedicated bay below the separator. The building benefits from an air handling / odour abatement system and is kept under negative pressure as previously described.
2 - Separation	The building should have fast acting roller shutter doors provided for access and egress.	The Reception Building will benefit from fast-acting roller shutter doors (12 seconds).
3 – Separation	Exhaust air from processing/separating and storage areas will require abatement prior to discharge to atmosphere.	The Reception Building benefits from an air handling / odour abatement system and is kept under negative pressure as previously described.
4 – Separation	The separation/processing of digestate should be carried out on an impermeable surface with a sealed drainage system.	*Crop- AD:* The separator and the fibre storage area are on a concrete apron in the dirty water drainage area. This area will drain to the Dirty Water Lagoon prior to being used in the process. *Waste-AD:* The Reception Building has a concrete floor and drains to a sump the contents of which are routed back to mixing bay for treatment in the AD process.
5 - Separation	Where separated digestate fractions do not meet the Biofertiliser Certification Scheme (PAS 110 & ADQP), these fractions must continue to be treated as wastes and the guidelines for the storage of wastes will apply.	*Crop-AD:* The digestate liquor and fibre are agricultural waste which may be spread to land not subject to Environmental Permitting rules but will be spread to land in accordance with all relevant regulations and guidance.

AD TGN	Indicative BAT requirements for digestate treatment and storage	
		Waste-AD: The digestate liquor and fibre will be managed initially as a waste and spread under a mobile plant permit for landspreading and appropriate deployment applications. The Waste-AD plant will work to a Quality Management System and apply to the Biofertiliser Certification Scheme to ensure the digestate liquor and fibre will be produced to BSI PAS110 Specification and applied to land as a product.
6 - Storage	Digestate must be stored within covered tanks or covered lagoons and should be of a design and capacity fit for purpose. Lagoons should have a free board of minimum 750 mm and tanks a freeboard of 300 mm.	*Crop-AD:* The Crop-AD site has a lined, covered lagoon of 10,000 m^3 capacity. The lagoon will be operated with a freeboard of 750mm. *Waste-AD:* The Waste-AD digestate will be stored in dedicated covered, lined 10,000m^3 lagoon on site with a freeboard of 750mm maintained.
7 - Storage	All such storage areas (including those for the storage of solid fractions) should be provided with appropriate emissions control and abatement systems.	*Crop-AD:* Emissions from the storage of digestate liquor are controlled by virtue of the fact that the lagoon is covered, and the fibre will be stored in a covered trailer on-site. This is a deviation from BAT as there is no emissions abatement for the storage of digestate. *Waste-AD:* Digestate liquor will be stored in a covered lagoon with vents. As previously described digestate fibre will be stored in the Reception Building which will benefit from air handling and odour abatement.
8 - Storage	In order to maximise recovery of biogas, operators should consider including a system to collect additional biogas produced from the storage of digestate.	It is not operationally feasible to collect biogas from under the lagoon covers. Process controls will be in place to ensure that stable digestate are produced with low residual biogas potential.
9 - Storage	Digested material must be stored upon an impermeable surface supplied with a sealed drainage system.	*Crop- AD:*

AD TGN	Indicative BAT requirements for digestate treatment and storage	
		The separator and the fibre storage area are on a concrete apron in the dirty water drainage area. This area will drain to the Dirty Water Lagoon prior to being used in the process. *Waste-AD:* The Reception Building has a concrete floor and drains to a sump the contents of which are routed back to Mixing pit for treatment in the AD process.
10 - Storage	Operators must ensure that sufficient provision has been made for digestate storage prior to distribution.	*Crop-AD:* Based on the feedstock tonnage of 30,000 tonnes per year approximately 5,940 tonnes of solid fibre digestate and 21,060 tonnes of digestate liquor are produced per year. The digestate storage lagoon therefore affords between 5- and 6-months storage capacity for digestate liquor. *Waste-AD:* In accordance with the mass balance 77,308m^3 of whole digestate per year will be produced. This will be separated to 13,915m^3 per year of fibre and 63,392m^3 per year of digestate liquor. The proposed storage provision for digestate liquor of 10,000m^3 affords around 2 months on site storage provision. An additional onsite lagoon is planned to increase storage capacity to 6 months in 2022 which will meet demand versus planned production levels. Contingency offsite storage will be sourced should timing of works be precited to not meet demand for storage.
11 - Storage	Digestate must be stored in a manner that will minimise odour and not give risk to pollution. Storage provision should take into account situations where the land-bank may be unavailable for prolonged periods, for example, where the land is waterlogged or frozen.	*Crop-AD:* Emissions from the storage of digestate liquor are controlled by virtue of the fact that the lagoon is covered, and the fibre will be stored in a covered trailer on-site. This is a deviation from BAT as there is no emissions abatement for the storage of digestate.

AD TGN	Indicative BAT requirements for digestate treatment and storage	
		Waste-AD: Digestate liquor will be stored in covered lagoons with vents. As previously described digestate fibre will be stored in the Reception Building which will benefit from air handling and odour abatement. See 10-Storage re contingency storage provisions.
12 - Storage	Where digestate is stored pending application on agricultural land, sufficient storage capacity must be available to span the winter no spread periods.	See 10-Storage re contingency storage provisions.
13 - Storage	Where the digestate does not meet the PAS 110 and ADQP, the digestate must continue to be treated as waste and the guidelines for the storage of wastes will apply.	*Crop-AD:* The digestate is crop derived only and therefore treated as an agricultural waste and not subject to Environmental Permitting rules. *Waste-AD:* The digestate liquor and fibre will be managed initially as a waste and spread under a mobile plant permit for landspreading and appropriate deployment applications. The Waste-AD plant will work to a Quality Management System and apply to the Biofertiliser Certification Scheme to ensure the digestate liquor and fibre will be produced to BSI PAS110 Specification and applied to land as a product. Waste status digestate will be stored on the permitted facility or within suitably permitted offsite stores prior to spreading.
AD TGN Waste reception & storage	The storage of digestate that is scheduled for spreading to land needs to take into account the closed season for spreading to land and the likelihood of adverse weather conditions that may affect the ability to spread digestate. Storage capacity of digestate needs to take these factors into account.	See 10-Storage re contingency storage provisions. In the event of pro-longed adverse weather conditions during spreading periods feed quantities may be reduced to optimise storage use.

3. Conclusions and recommendations

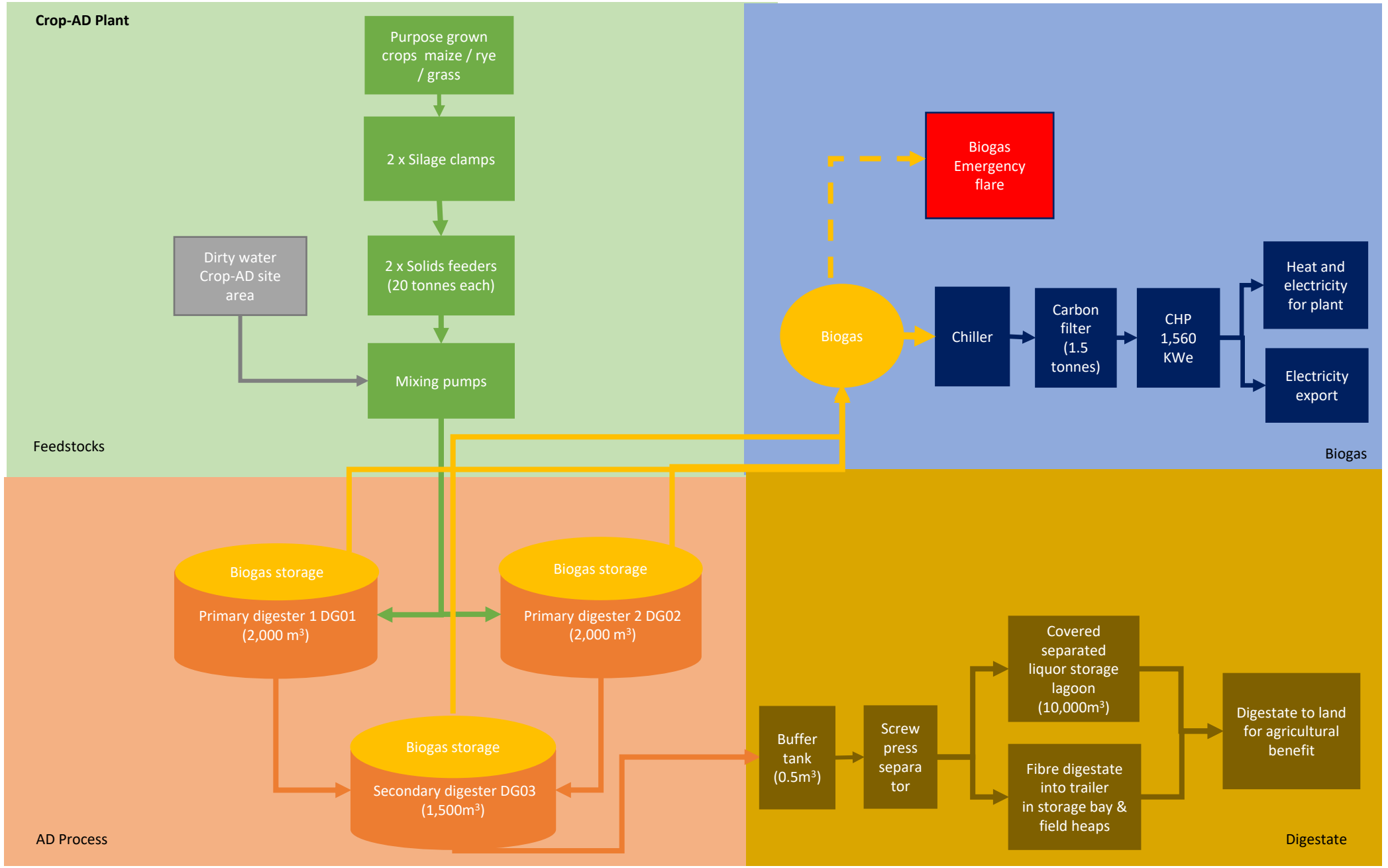
3.1.1 The review has highlighted that proposals are generally compliant with indicative BAT as stated in How to comply with your environmental permit: Additional Guidance for Anaerobic Digestion1 and Best Available Techniques Reference Document for Waste Treatment.[2] However, there are five deviations from BAT. These are listed below:

- On the Crop-AD plant, the biogas flare is a ground- enclosed flare which has an ignition temperature of 700^{o}C which is below the 1,000^{0}C stated as Indicative BAT for a waste installation. This flare will burn biogas from the crop derived feedstocks only. The biogas being burnt in it will be derived from non-waste feedstocks which present a low risk of generating compounds within the biogas that require a higher temperature for destruction
- There is a deviation from BAT relevant to both sides of the AD plant such that feeding is not interlocked with gas pressure. The operator can manually adjust feeding as required but there is a lag time between feeding and gas production such that this is not deemed an appropriate measure. However, if the gas pressure is high then the gas consumers for the Crop-AD and Waste-AD r (CHP and GUU respectively) will start to operate at 100% capacity. If the gas pressure is not brought down swiftly enough by this measure, then the flare on either side of the installation will automatically ignite. High gas pressure and the ignition of either flare will raise an alarm via SCADA.
- There are no isolating valves on the PRVs which is a deviation from BAT. The PRVs are the final safety measure to prevent any damage on the gas domes and therefore the presence of an isolation valve introduces the potential for operator error i.e., the isolation valves could be left closed by mistake rendering the PRV ineffective.
- On the Crop-AD plant, the digestate separator is not within a building.
- On the Crop-AD plant, the fibre digestate is not produced or stored inside a building. However, the proposal is that the fibre will fall from the separator via a covered shute into a covered trailer to reduce odour emissions from the digestate fibre. The odour potential of the digestate Crop-AD fibre digestate will be controlled through the limitation of crop-only feedstocks; manure feedstocks which can lead to elevated ammonia emissions from digestate will not be used. In addition, process monitoring and management is in place to ensure that a stable digestate is produced with a low odour potential.

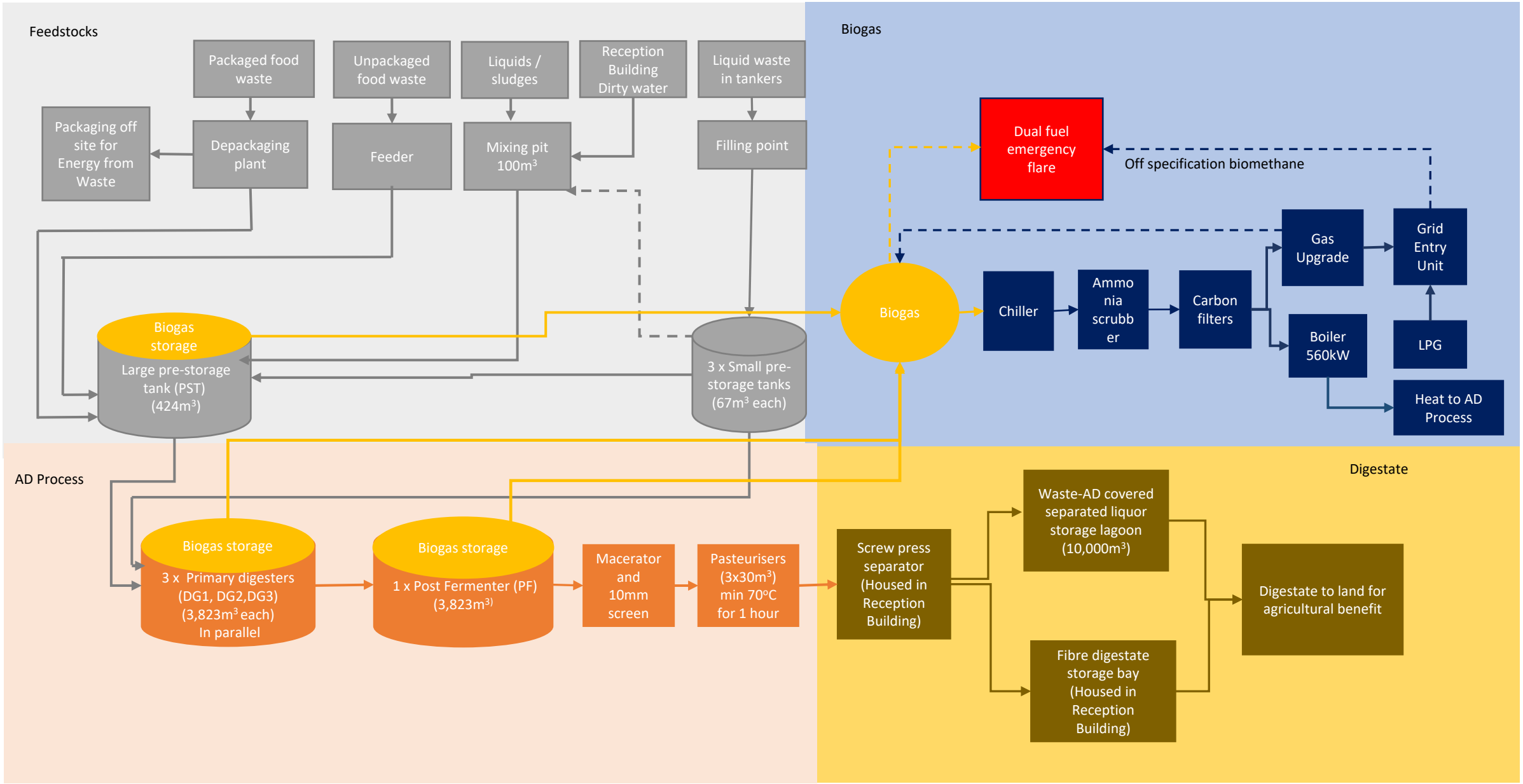
3.1.2 The guidance states that any deviation from BAT must be accompanied by a justification. Justifications are provided above and are considered to provide an acceptable alternative to BAT with regards to this AD site.

Appendix A - Process Flow Diagram – Overview

Attleborough AD Plant, Process Flow Diagrams (ATT-OD-03) V2.0



Waste-AD Plant



Appendix B - Gas Block Diagram

Block Diagram
Attleborough
01.06.2021

New biogas plant

Cooling

Biogas
Max 1645 Nm³/h

H2S & VOC
Removal

Boiler
560 kW

Biogas
Max 100 Nm³/h

condensate pit

Biogas
T=10-25 °C
Max 1545 Nm³/h
CH4 min: 60 Vol %

Flare

Gas Upgrading
Unit

Existing – not in scope of Bioconstruct

Existing CHP

cooling &
cleaning

existing
Biogasplant

Biomethane
Max 1000Scm/h
p=100 mbar
Minimum CV = 36 MJ/m³

BioConstruct

Customer

DN100 PN16

Customer

BioConstruct

DN50 PN16

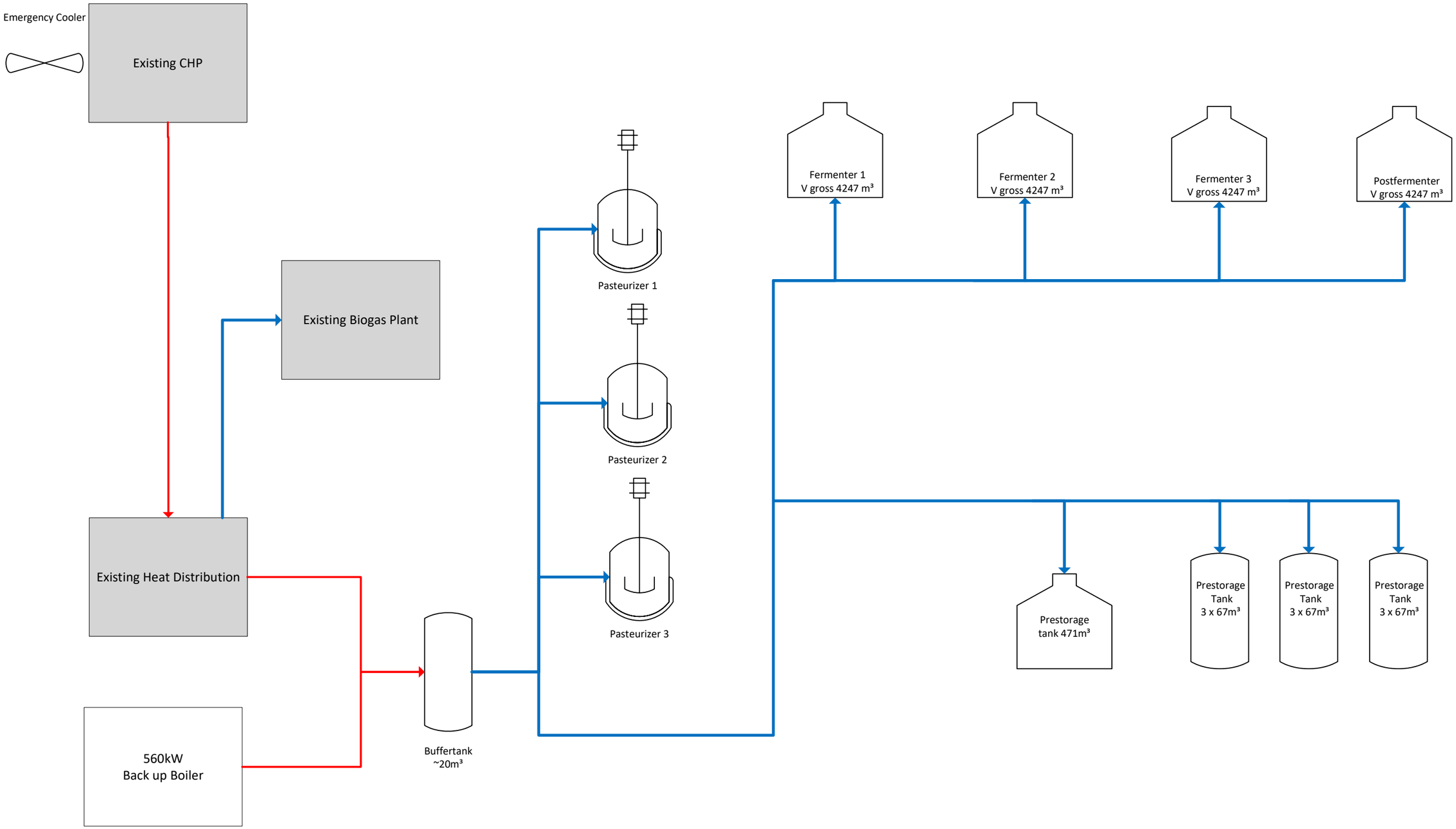
LPG

Orbital

Grid

Biomethane
Max 1000 Scm/h

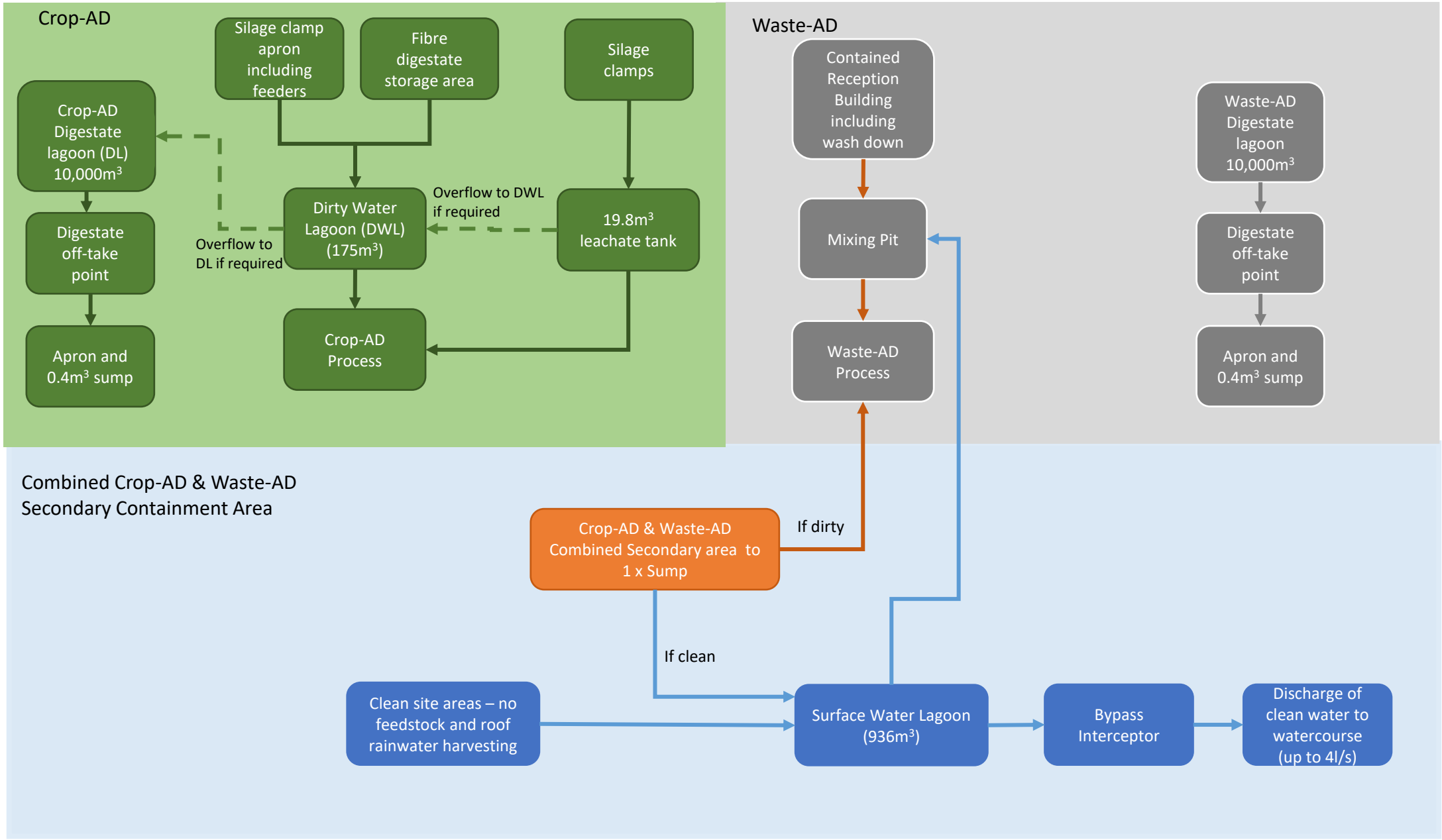
Appendix C - Heat Process Flow



			date:	31.05.2021	project: Attleborough	BIOCONSTRUCT	page discription: PFD Heating System	project number: X	
			reviser:	AF					
			tested:					project:	blade: 1
modification:	date:	name:							total: 1

Appendix D - Drainage Process Flow Diagram

ATT-OD-02 Attleborough AD, Drainage Process Flow Diagram V1.1



Appendix E – Mass Balance (Waste-AD)

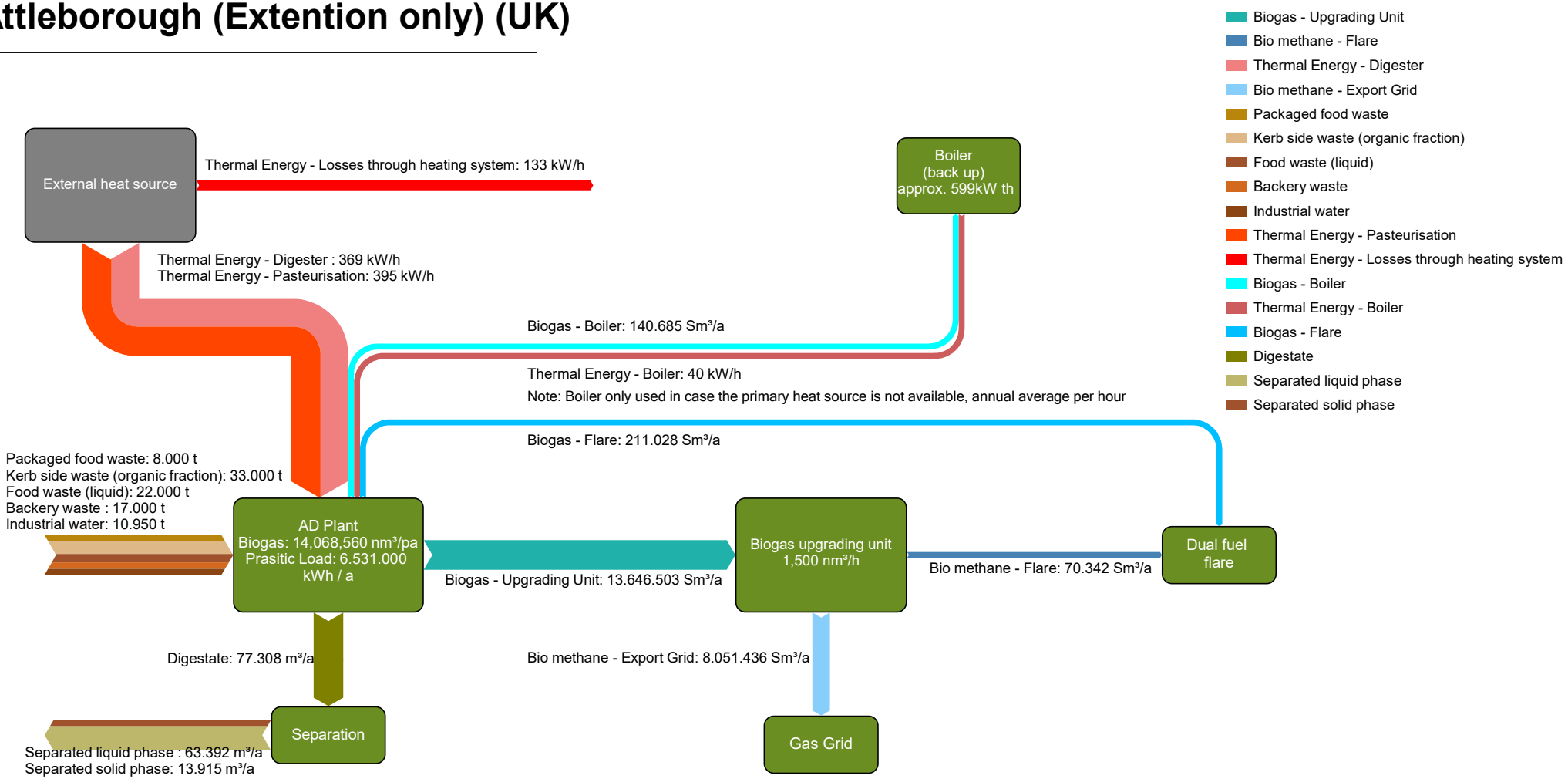
AD Plant Attleborough	*Forecast of yields*

Input Amount [t/a]	Input Amount [t/d]	Input Amount [%]	Input material	Dry matter (DM) [%]	Organic dry matter (oDM) [% DM]	Specific gas yield [l/kg oDM]	Absolute gas yield [m³/t]	Me-thane con-tent [%]	Me-thane yield [m³/t]	Daily biogas yield [m³/d]	Gross energy yield [kWh/d]	Group classification
8,000	21.92	9%	Packaged food waste (values after depack)	22.000	98.700	768.00	167	60.000	100	3,655	21,843	1
33,000	90.41	36%	Kerb side waste (organic fraction)	37.186	90.000	550.00	184	58.000	107	16,642	96,138	1
22,000	60.27	24%	Food waste liquid	12.000	94.000	700.00	79	69.000	54	4,759	32,707	3
17,000	46.58	19%	Bakery waste	37.633	97.000	793.00	289	58.000	168	13,483	77,886	2
10,950	30.00	12%	Industrial Water	0	0	0	0	0	0	0	0	0.0
90,950	**249.18**		**Total amount per day:**	**25.36%**	**93.06%**					**38,539**	**228,574**	

Organic loading rate of total digestion volume [kg oDM/ d*m³]:	**3.7**		**Hydraulic retention time in the fermenters:**	**63 days**	**Methane content Ø 59.3%**
Calculated minimum volume of all fermenters:		**15698 cubic meters**			

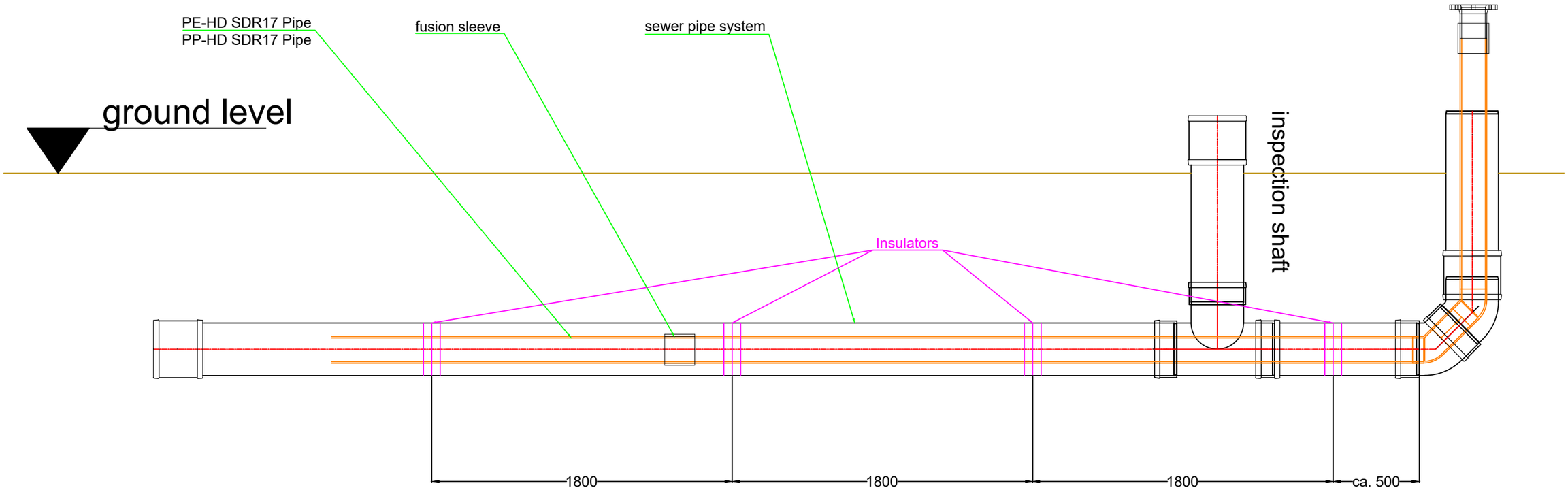
Appendix F - Sankey Diagram

Attleborough (Extention only) (UK)



Appendix G - Double –walled (Pipe in pipe) design for underground substrate pipe

principle sketch - doublewalled pipe



BIOCONSTRUCT

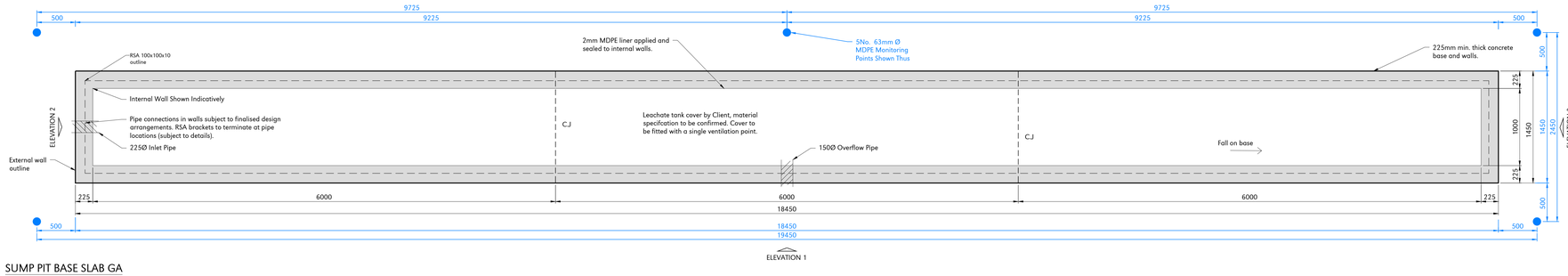
principal scetch - doublewalled pipe

Planverfasser: BioConstruct GmbH, Wellingstraße 66, D-49328 Melle
Tel.: +49 (0)5226 / 5932-0, Fax: +49 (0)5226 / 5932-11

Dateiname: doublewalled pipe_JAS_210622.dwg

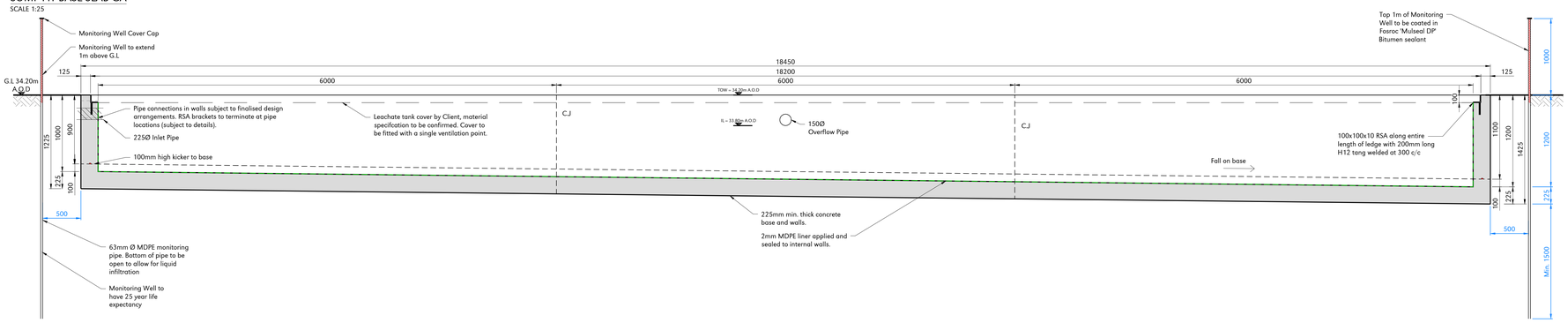
Projektnr./Zeichnungsnr.:	Maßstab:	Zeichenblattgröße:	Gezeichnet:
	1:25	DIN A3	22.06.21/JAS

Appendix H – Leachate Tank Design Drawing



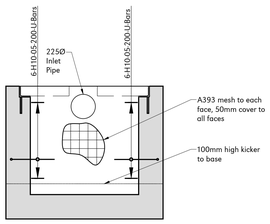
SUMP PIT BASE SLAB GA

SCALE 1:25



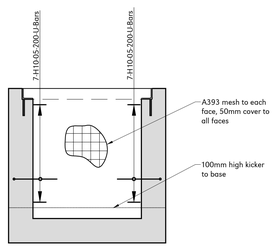
SUMP PIT RETAINING WALL GA (ELEVATION 1, 2No. THUS)

SCALE 1:25



ELEVATION 2 RC (1No. THUS)

SCALE 1:10



ELEVATION 3 RC (1No. THUS)

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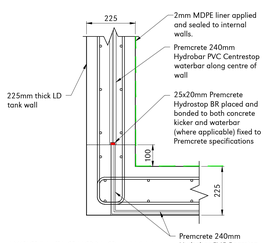
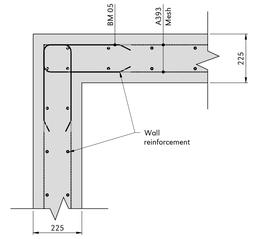


TYPICAL SECTION OF WALL WATERPROOFING DETAIL

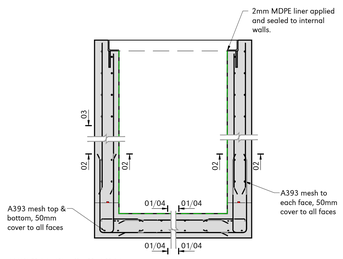
Scale 1:10



TYPICAL WALL CORNER REINFORCEMENT DETAIL PLAN (4No. THUS)

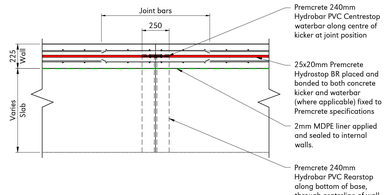
SCALE 1:10

Note: Base Reinforcement to be cut to suit at corner location



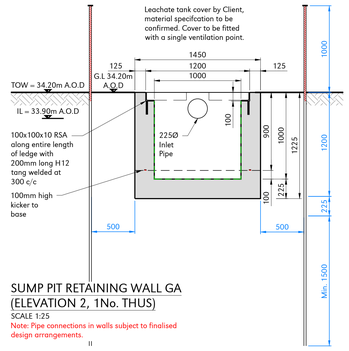
TYPICAL PIT SECTION

SCALE 1:20



TYPICAL PLAN OF WALL WATERPROOFING THROUGH CONTRACTION JOINT (C.J)

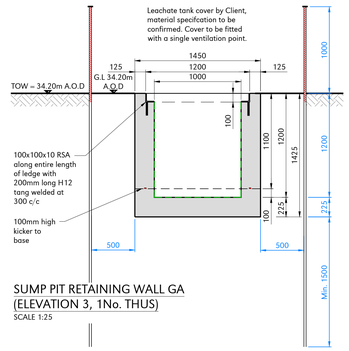
Scale 1:20



SUMP PIT RETAINING WALL GA (ELEVATION 2, 1No. THUS)

SCALE 1:25

Note: Pipe connections in walls subject to finalised design arrangements.



SUMP PIT RETAINING WALL GA (ELEVATION 3, 1No. THUS)

SCALE 1:25

NOTES:

1. All dimensions noted are in millimetres unless stated otherwise.
2. All levels to be above Ordnance Survey Datum defined levels (A.O.Dm) unless noted otherwise.
3. Do not scale from this drawing, if dimensions are not clear ask.
4. This document has been created in accordance with Plandescil Ltd. Terms & Conditions along with the scope of works provided by the client to Plandescil Ltd. Any use of this document other than for its original purpose is prohibited, Plandescil Ltd. accept no liability for any third party uses of this document.
5. Plandescil Ltd. to be immediately notified of any suspected omissions or discrepancies.
6. This drawing is to be read in conjunction with all other relevant documents relating to the project.
7. All setting out to be coordinated by the Contractor and to be checked onsite prior to construction.
8. To be read in conjunction with the following Plandescil Drawings, schedules and documents:
   24727/550 - Proposed Site Layout
   24727/100/01 BS - Bar Bending Schedule
9. Pipe connections in walls subject to finalised design arrangements.

REINFORCED CONCRETE:

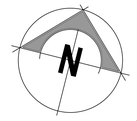
10. Insitu Concrete to be RC40/50 with max w/c ratio 0.45, 360kg/m³ cement/combination content (III-A), with 20mm max. aggregate, chloride content class 0.4cl and minimum slump of class S3 (90mm Slump).
11. Insitu Concrete to be in accordance with BS 8110 & BS 8500-1.
12. Reinforcement to be Grade H 500N/mm² High Yield, Deformed Type 2 Bar detailed in accordance with BS 4449 and BS 8666.
13. Walls nominal 225mm thick, 50mm cover to bottom, sides and top.
14. Slab nominal 225mm thick, 50mm cover to bottom, sides and top.
15. Floor Classification to meet FM3 standard for Flatness and Level ±5mm. Construction tolerance to be in accordance with the NSCS for Building Structures.
16. Slab to have brushed finish to exposed surface and fair face shutter finish to sides.
17. Walls to have fair faced shuttered finish to sides and top.

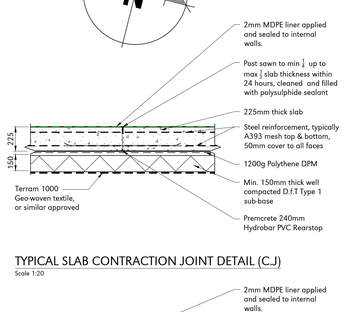
CONCRETE JOINT NOTES:

18. All joint dowel/reinforcement shall be set level and perpendicular to the joint face prior to casting. Damage or bent dowels are to be re-aligned or replaced prior to casting.
19. All formed joints are to be cleaned of concrete overruns to ensure accidental restraint is not created
20. All joints are to be sufficiently cured and cleaned of all contaminations prior to sealing.
21. All sealants are to be installed as per manufacturers specification and must be suitable for the joint type.

FOUNDATION NOTES:

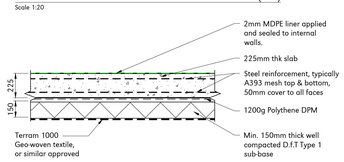
22. Assumed GBP value of 225kN/m² has been used. Value provided by O'Brien Moran Ltd, following an initial ground treatment Confirmation of minimum GBP of 225kN/m² required prior to construction.
23. Any soft spots or deleterious material is to be removed & taken down to virgin ground level & replaced with compact D.f.T Type 1 or suitable hogging material.
24. Overdig to be made up in compacted D.f.T. Type 1 or lean mix concrete.





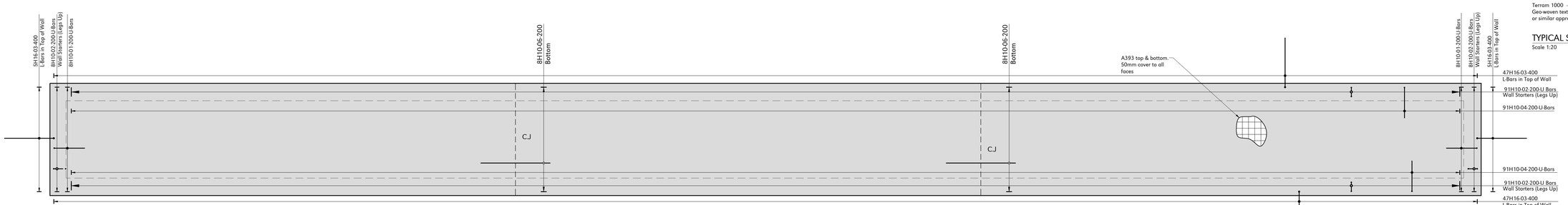
TYPICAL SLAB CONTRACTION JOINT DETAIL (C.J)

Scale 1:20



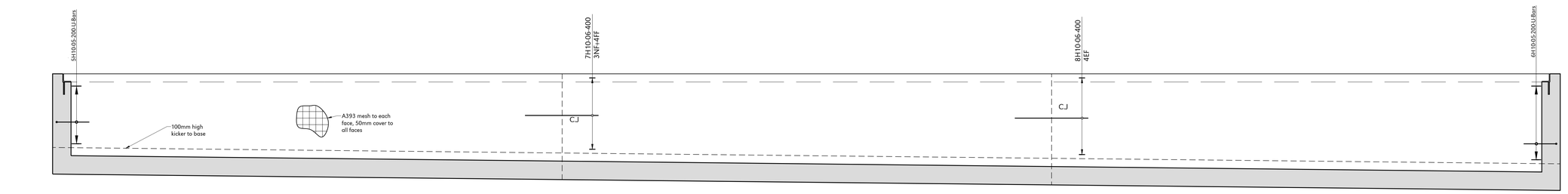
TYPICAL SLAB CONSTRUCTION

Scale 1:20



SLAB REINFORCEMENT PLAN

SCALE 1:20



ELEVATION 1 RC (2No. THUS)

SCALE 1:20

Reinforcement specification subject to final detailing. Bars only shown for provisional purposes.

APPROVAL & COMMENT

PROVISIONAL

Rev	Date	Chkd	Description
C	01-12-21	OAJ	Tank Design Amended
B	27-10-21	OAJ	Tank Design Amended
A	13-01-20	OAJ	Client Name Amended
0	10-01-20	OAJ	First Issue

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civil / structural / environmental / surveying

Client

Attleborough AD Plant Limited

Project

Attleborough AD Plant, Attleborough, Norfolk, NR17 1AE

Drawing Title

Leachate Tank GA & RC Details

Scale U.N.O.	Date	Drawn By
As Noted (A0)	January 2020	JHB

Drawing No.	Rev
24727/100	C

Appendix I - Energy Efficiency Plan

AD plant Attleborough

Energy Efficiency plan

Content

General process description

The general aim of the Attleborough AD facility is to produce Biogas. This gas is either used to be upgraded and fed into the local gas network as well as for the operation of the CHP to produce electricity and heat for the parasitic load demand of the AD plant. The produced electricity and heat is used for the process of gas production and the digestate upgrading. The Biogas production takes place in three Fermenters and a Post Fermenter which are heated to appr. 40°C via internal heating coils. The Fermenters and the Post Fermenter are stirred with 2no large wing mixers and 2 submersible mixers. Dosing systems allow the addition of Ferric chloride and oxygen.

Feeding the plant with food waste is achieved with one solid feeding system for unpackaged solids, one de-packaging system for packaged wastes and a filling station for liquid wastess. The solid feeding system feeds via an auger and a belt with metal detection into a mixing pump systems. The mixing pump mixes the solids that are entering the mixing chamber with recirculate from Fermenters. The mixture is then chopped by a RotaCut unit and send into one of the Fermenters. The de-packaging unit separates packaging from organic substances. At the same time water is added to make the material pumpable. A pump sends the feedstock either directly into the Fermenters or into a Pre-storage-tank where it can be mixed with liquid feedstocks. The Liquid feedstock is received in the Reception building. A pump unloads the trucks and pumps the material into one of the three Pre-storage-tanks. Furthermore the plant is equipped with two central pumps. Each pump has an individual distribution, to enable it to full fill two tasks at the same time.

Following the substrate stream after digestion the substrate is pumped via another Rotacut into one of the three Pasteurisation tanks, where the substrate is heated to at least 70°C for one hour before its separated and brought off site or stored in a lagoon.

The produced gas is collected in gas holders on top of the Fermenter tanks and the Post Fermenter. From that gas storage the gas is taken into the gas pre-treatment. The pre-treatment cools the gas to approximately 5°C, it washes ammonia out and compresses the gas to appr. 100mbar. From the gas blowers the gas is directed through carbon filters that absorb any H2S and VOC´s in the gas. Now the gas is directed to the to the different gas consumers like CHP and GUU. A separate compressor supplies gas to the dual fuel flare which is capable of burning either Biogas or Biomethane.

Consumer list

The Consumer list below is showing the estimated power consumption and runtimes of the major components. Where ever possible consumers work on operation – pause sequencing or in many cases motors are inverter driven. High efficient IE3 Motors ensure low power consumption of the plant at all times and inverter driven motors will automatically ramp up and down to work most efficient. The Attleborough AD Facility has an installed consumer capacity of more than 1600kW. With intelligent process technology and a Scada system that allows the operator to understand the power consumption and makes it easy to archive massive power savings. The expected power consumption is less than half of the installed capacity. The intelligent process controls are that reliable that they allow grid connection for the AD facility to be sized a lot lower than the installed capacity without losing flexibility in the operation of the plant.

BIOCONSTRUCT

Consumer List (Scope of delivery of Bioconstruct) - PRELIMINARY
BGP Attleborough

Electrical demand BGP Attleborough *(Scope of delivery of Bioconstruct)- PRELIMINARY*

consumer	number	installed capacity	sum	average consumption	h/ d	h/ a	kWh/ a
Feeding system / Depacking unit:							
Hydraulic unit push floor	1	11,0 kW	11,0 kW	5,5 kW	4,0 h	1460 h	8.030 kWh
Oil cooler hydraulic unit	1	0,3 kW	0,3 kW	0,1 kW	4,0 h	1460 h	0.183 kWh
Desintegration roller	3	3,0 kW	9,0 kW	2,1 kW	8,0 h	2920 h	18.396 kWh
Collector screw push floor	1	5,5 kW	5,5 kW	3,9 kW	8,0 h	2920 h	11.242 kWh
Inclined conveyor screw	1	22,0 kW	22,0 kW	15,4 kW	8,0 h	2920 h	44.968 kWh
Separation sizer	1	75,0 kW	75,0 kW	52,5 kW	8,0 h	2920 h	153.300 kWh
Hydraulic unit separator sizer	1	0,6 kW	0,6 kW	0,4 kW	2,0 h	730 h	0.281 kWh
Waste conveyor 1	1	3,0 kW	3,0 kW	2,1 kW	8,0 h	2920 h	6.132 kWh
Waste conveyor 2	1	4,0 kW	4,0 kW	2,8 kW	8,0 h	2920 h	8.176 kWh
Collector screw 1+2 separator sizer	2	2,2 kW	4,4 kW	1,5 kW	8,0 h	2920 h	8.994 kWh
Pump depacking system	1	15,0 kW	15,0 kW	10,5 kW	8,0 h	2920 h	30.660 kWh
Sum depacking unit system			149,7 kW				*290.361 kWh*
Feeding system Big Mix:							
Hydraulic unit push floor	1	7,5 kW	7,5 kW	3,8 kW	4,0 h	1460 h	5.475 kWh
Vertical mixer	1	22,0 kW	22,0 kW	11,0 kW	8,0 h	2920 h	32.120 kWh
Discharge screw conveyor	1	4,0 kW	4,0 kW	2,8 kW	8,0 h	2920 h	8.176 kWh
Mixing Pump	1	18,5 kW	18,5 kW	13,0 kW	8,0 h	2920 h	37.814 kWh
Rota cut feeding	1	16,5 kW	16,5 kW	11,6 kW	6,0 h	2190 h	25.295 kWh
Sum feeding system			241,6 kW				*108.880 kWh*
Fermenter 1:							
Submersible mixer	2	15,0 kW	30,0 kW	15,0 kW	8,0 h	2920 h	87.600 kWh
Large wing mixer	2	15,0 kW	30,0 kW	10,5 kW	8,0 h	2920 h	61.320 kWh
Support air blower	2	0,2 kW	0,4 kW	0,1 kW	24,0 h	8760 h	2.208 kWh
Sum tank:			60,4 kW				*151.128 kWh*
Fermenter 2:							
Submersible mixer	2	15,0 kW	30,0 kW	15,0 kW	8,0 h	2920 h	87.600 kWh
Large wing mixer	2	15,0 kW	30,0 kW	10,5 kW	8,0 h	2920 h	61.320 kWh
Support air blower	2	0,2 kW	0,4 kW	0,1 kW	24,0 h	8760 h	2.208 kWh
Sum tank:			60,4 kW				*151.128 kWh*
Fermenter 3:							
Submersible mixer	2	15,0 kW	30,0 kW	15,0 kW	8,0 h	2920 h	87.600 kWh
Large wing mixer	2	15,0 kW	30,0 kW	10,5 kW	8,0 h	2920 h	61.320 kWh
Support air blower	2	0,2 kW	0,4 kW	0,1 kW	24,0 h	8760 h	2.208 kWh
Sum tank:			60,4 kW				*151.128 kWh*

BIOCONSTRUCT

Consumer List (Scope of delivery of Bioconstruct) - PRELIMINARY
BGP Attleborough

Electrical demand BGP Attleborough *(Scope of delivery of Bioconstruct)- PRELIMINARY*

consumer	number	installed capacity	sum	average consumption	h/ d	h/ a	kWh/ a
Post fermenter:							
Submersible mixer	2	15,0 kW	30,0 kW	15,0 kW	8,0 h	2920 h	87.600 kWh
Large wing mixer	2	15,0 kW	30,0 kW	10,5 kW	8,0 h	2920 h	61.320 kWh
Support air blower	2	0,2 kW	0,4 kW	0,1 kW	24,0 h	8760 h	2.208 kWh
Sum tank:			60,4 kW				*151.128 kWh*
Buffer tank:							
Submersible mixer	2	15,0 kW	30,0 kW	15,0 kW	4,0 h	1460 h	43.800 kWh
Support air blower	1	0,2 kW	0,2 kW	0,1 kW	24,0 h	8760 h	1.104 kWh
Sum tank:			30,2 kW				*44.904 kWh*
Mixing pit:							
Compulsory mixer	1	15,0 kW	15,0 kW	15,0 kW	4,0 h	1460 h	21.900 kWh
Submersible mixer	1	15,0 kW	15,0 kW	15,0 kW	4,0 h	1460 h	21.900 kWh
Substrate pump mixing pit	1	18,5 kW	18,5 kW	13,0 kW	2,0 h	730 h	9.454 kWh
Hydraulik unit cover pit	1	1,5 kW	1,5 kW	1,1 kW	0,2 h	73 h	0.077 kWh
Sum mixing pit:			48,5 kW				*53.330 kWh*
Pre-storage tanks 1-3 / Water tank:							
Central mixer	4	4,0 kW	16,0 kW	2,8 kW	5,0 h	1825 h	20.440 kWh
Sum tanks:			16,0 kW				*20.440 kWh*
Pasteurisation tanks:							
Central mixer	3	7,5 kW	22,5 kW	5,3 kW	16,0 h	5840 h	91.980 kWh
Sum tanks:			22,5 kW				*91.980 kWh*
Substrate technology:							
Central pump	2	15,0 kW	30,0 kW	10,5 kW	16,0 h	5840 h	122.640 kWh
Rota cut pasteurisation	1	16,5 kW	16,5 kW	11,6 kW	6,0 h	2190 h	25.295 kWh
Clean pump	1	15,0 kW	15,0 kW	10,5 kW	8,0 h	2920 h	30.660 kWh
Separator	1	22,0 kW	22,0 kW	15,4 kW	8,0 h	2920 h	44.968 kWh
Separation pump	1	15,0 kW	15,0 kW	10,5 kW	8,0 h	2920 h	30.660 kWh
Feeding pump pre-storage tank	1	15,0 kW	15,0 kW	10,5 kW	6,0 h	2190 h	22.995 kWh
Water pump	1	7,5 kW	7,5 kW	5,3 kW	3,0 h	1095 h	5.749 kWh
Feeding pump buffer tank	1	15,0 kW	15,0 kW	10,5 kW	3,0 h	1095 h	11.498 kWh
Sum substrate technology:			136,0 kW				294.464 kWh

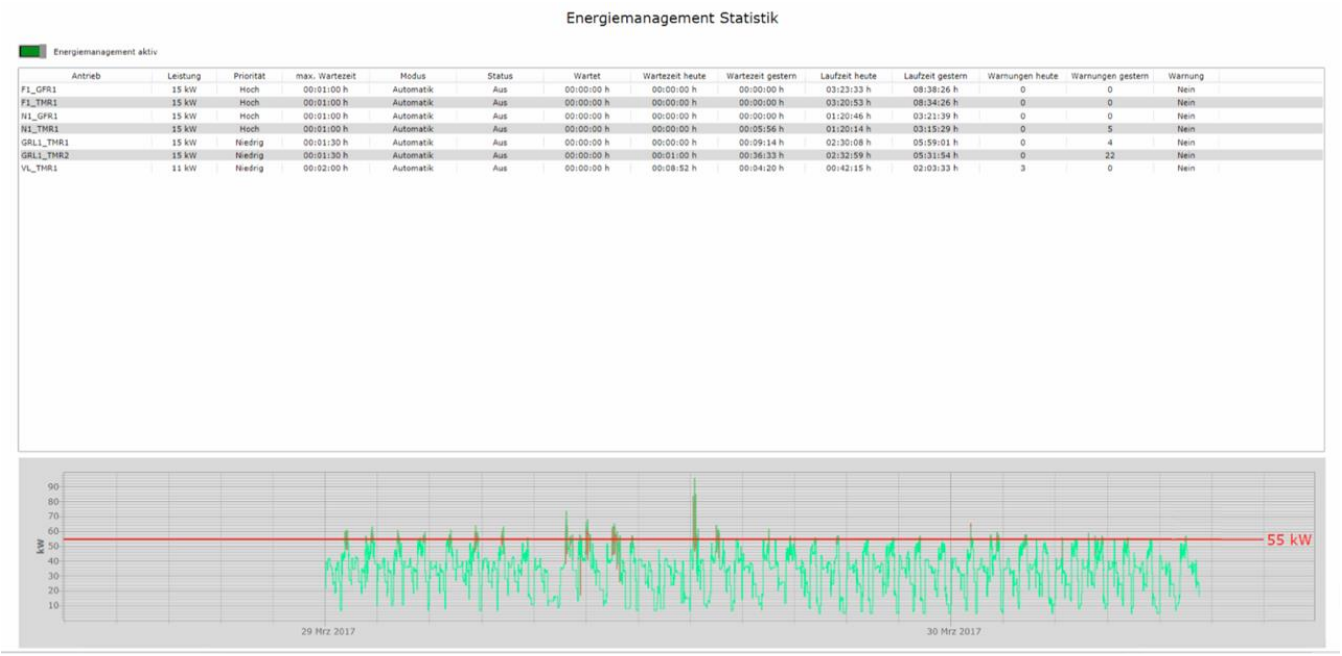
Consumer List (Scope of delivery of Bioconstruct) - PRELIMINARY
BGP Attleborough

Electrical demand BGP Attleborough *(Scope of delivery of Bioconstruct)- PRELIMINARY*

consumer	number	installed capacity	sum	average consumption	h/ d	h/ a	kWh/ a
Gas engineering / desulphurisation:							
Condensate pit pump	1	1,9 kW	1,9 kW	1,3 kW	0,5 h	183 h	0.243 kWh
Condensate pot pump	1	1,1 kW	1,1 kW	0,8 kW	0,5 h	183 h	0.141 kWh
Gas compressor	1	15,0 kW	15,0 kW	10,5 kW	23,1 h	8432 h	88.531 kWh
Gas compressor gas flare	1	5,5 kW	5,5 kW	3,9 kW	0,2 h	73 h	0.281 kWh
Gas cooling unit	1	45,0 kW	45,0 kW	31,5 kW	12,0 h	4380 h	137.970 kWh
Centrifugal pump ammoniak w ashing unit	1	1,5 kW	1,5 kW	1,1 kW	23,1 h	8432 h	8.853 kWh
Discharge pump ammoniak w ashing unit	1	0,4 kW	0,4 kW	0,3 kW	2,0 h	730 h	0.189 kWh
Diaphragm dosing pump	1	0,2 kW	0,2 kW	0,1 kW	1,0 h	365 h	0.046 kWh
Gas flare	1	0,5 kW	0,5 kW	0,4 kW	0,2 h	73 h	0.026 kWh
Oxygen generator	1	15,0 kW	15,0 kW	10,5 kW	24,0 h	8760 h	91.980 kWh
Iron cloride dosing system	1	1,1 kW	1,1 kW	0,8 kW	1,0 h	365 h	0.281 kWh
Sum gas engineering / desulphurisation:			87,2 kW				*328.540 kWh*
Gas consumer:							
CHP	1	25,0 kW	25,0 kW	12,5 kW	23,1 h	8432 h	105.394 kWh
Boiler	1	4,5 kW	4,5 kW	2,3 kW	2,0 h	730 h	1.643 kWh
Gas upgrading unit - main components	1	500,0 kW	500,0 kW	350,0 kW	23,1 h	8432 h	2.951.025 kWh
Gas upgrading unit - cooling unit	1	93,7 kW	93,7 kW	65,6 kW	23,1 h	8432 h	553.022 kWh
Gas upgrading unit - others	1	28,8 kW	28,8 kW	20,2 kW	23,1 h	8432 h	169.979 kWh
Grid entry unit	1	50,0 kW	50,0 kW	35,0 kW	23,1 h	8432 h	295.103 kWh
Sum gas consumer:			702,0 kW				*4.076.165 kWh*
Sub- systems							
Heating pump CHP, boiler, PtH	2	1,3 kW	2,6 kW	0,9 kW	23,1 h	8432 h	15.345 kWh
Heating pump fermenter	2	0,7 kW	1,4 kW	0,5 kW	12,0 h	4380 h	4.292 kWh
Heating pump heating distributor	1	3,0 kW	3,0 kW	2,1 kW	18,0 h	6570 h	13.797 kWh
Heating pump PAS and tanks	1	1,5 kW	1,5 kW	1,1 kW	19,0 h	6935 h	7.282 kWh
Air compressor	2	4,0 kW	8,0 kW	2,8 kW	8,0 h	2920 h	16.352 kWh
Defoaming pump	1	1,1 kW	1,1 kW	0,8 kW	1,0 h	365 h	0.281 kWh
collection pit pump	1	3,5 kW	3,5 kW	2,5 kW	1,0 h	365 h	0.894 kWh
Control system	2	2,0 kW	4,0 kW	1,4 kW	24,0 h	8760 h	24.528 kWh
Sum sub-systems:			25,1 kW				*82.772 kWh*
						Electricity consumption per year:	**5.996.345 kWh**
	Sum electrical connections:		**1700,2 kW**			**/8760 h:**	**685 kW**
	Summe elektrische		**1190,1 kW**				
Just assumptions for the energy provider!							
These calculation are only for orientation. Customer doesn't have any warranty from this.							

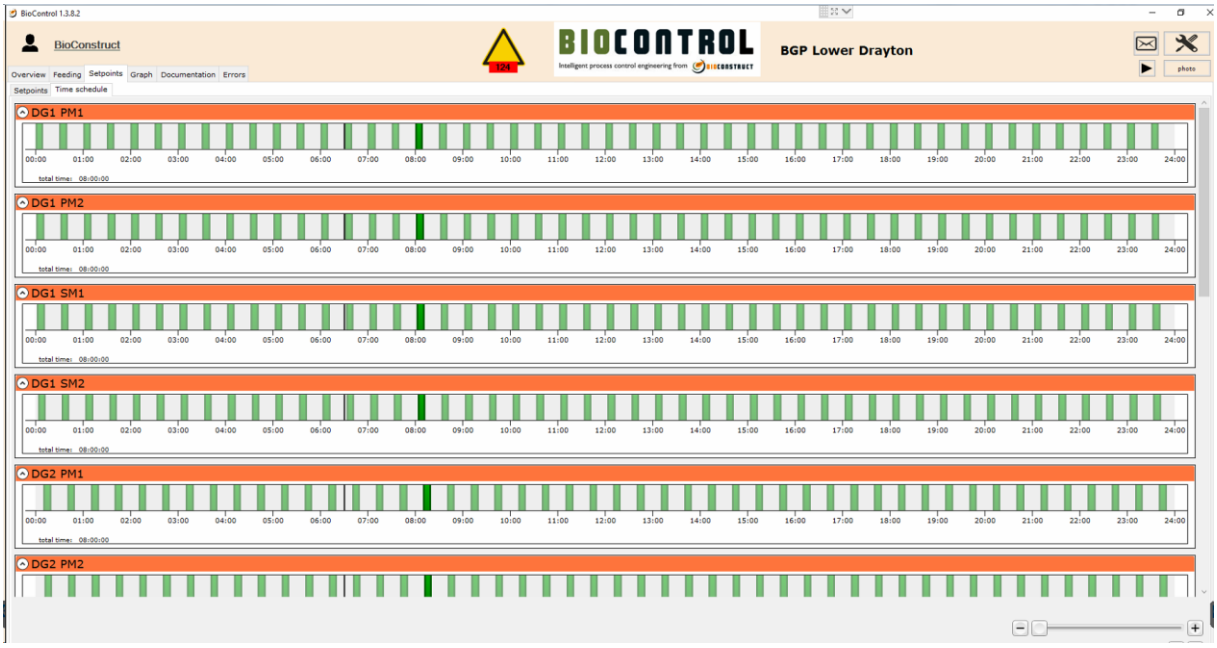
Energy Management

The Energy management system allows the operator to improve the efficiency of the plant. It provides an overview of the power consumption of the plant and allows the operator to adjust a power limit for the plant. The energy page of the BioControl Scada system provides an overview of the efficiency of the power limit and the possibility of setting the energy set point. By selecting priorities for the motors the operator can decide how important certain consumers are for the process of the plant. The system will then try to meet the power limit that was adjusted by putting low priority consumers on hold while the system is consuming too much power. At times when the power consumption is low it will automatically catches up the tasks that have been missed. That way the plant can reduce peak loads and ensure an even and low power consumption at all times. It will also flag up where adjustments could be optimised because pause times are increasing too much. The BioControl Scada system visualises these parameters and consumptions in a way that the operator can understand it and can improve the consumption of the plant without detailed electrical knowledge.



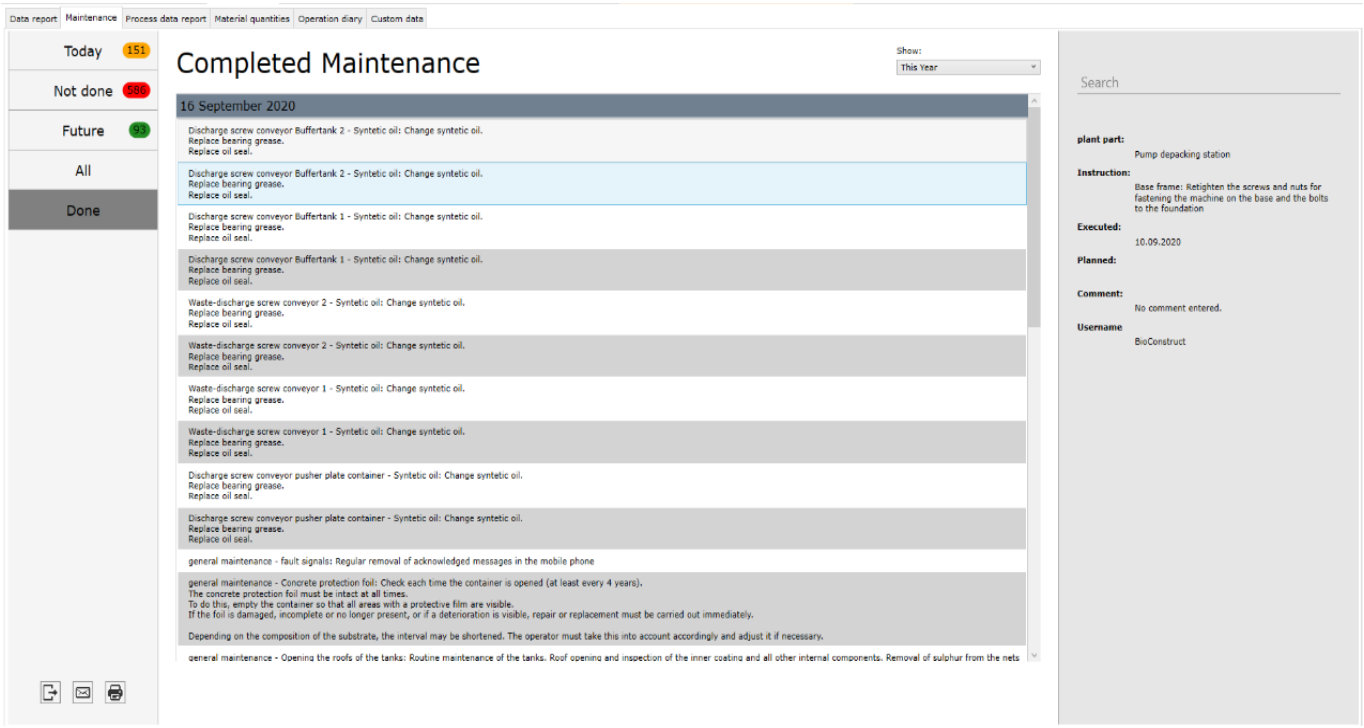
Mixer Schedule

Smart adjustment of the mixing saves power. The BioControl Scada Mixing time schedule allows accurate optimised mixing. Each mixer can be easy adjusted for its best mixing time. Every green Bar shows an operational task for one mixer. Each bar can be adjusted minute by minute. If the operator stops feeding for an hour every day to load the hopper the mixer in the Fermenters can be adjusted to have shorter operation times in that particular hour. When no fresh material is entering the tank the mixers can work less and just keep the tank content mixed up without having to process the fresh material. Furthermore the start times can be delayed so the mixer start in a sequence rather than all the same time. This will help to reduce peak loads in the power demand.



Maintenance Schedule

Preventative maintenance reduces power consumption. The BioControl maintenance management schedule is another tool which can help reducing the power demand of the AD facility. The Scada system informs the operator automatically that a maintenance is due. With the digital maintenance Schedule the system compares runtimes of the components with the recommendations of the supplier for maintenance. That way the system shows not only which maintenance is pending it also informs the operator about maintenance tasks coming up so he can order spare parts on time. In many cases this does not only increase the plant availability it also ensures that pumps and mixer can work most efficient. Late of even missed maintenance will increase the power consumption as motors cannot run under optimum conditions. Another advantage is that a good maintenance management for example pumps will be maintained before the flow rates drop of more than desired. This reduces runtimes and therefore reduces the power consumption.



CO2 Saving

The Attleborough AD Facility is already saving a lot of Energy because of the way its build and the chosen components. The smart Scada technology is what makes this site really efficient. The way the system is configured gives lots of opportunities to safe more energy once the system is in operation. Assuming that each kW of electrical power creates 401g CO2, the expected CO2 savings could be potentially the following:

Plant general control system compared to uncontrolled operation:

Uncontrolled 10425,28 MW/a

Standard PLC control 7297,70 MW/a

CO2 saving with standard control system including usage of inverters

3127,5MW/a * 401kg/MW = 1254,13t/a

Mixer schedule:

Without mixer schedule 7297,70 MW/a

With mixer schedule 6713,88 MW/a

CO2 saving using the mixer schedule and adjusting mixing according to the needs of the plant

416,18MW/a * 401kg/MW = 166,88t/a

Energy management:

Without energy management 6713,88 MW/a

With energy management 6181,80 MW/a

CO2 saving using the mixer schedule and adjusting mixing according to the needs of the plant

532,08MW/a * 401kg/MW = 213,36t/a

Maintenance Schedule:

We assume that the without the maintenance Schedule 20% of critical maintenance activities could get missed which would lead to poor efficiency of pumps and motors which would cause in average 3% more consumption. That way this system could potentially save 21,17kW per hour or 185,45MW/a, which equals 74,38t of CO2

Summery:

Biogas plants from BioConstruct are built to safe energy and produce green energy. With every new project we develop new technologies which make the plants more efficient. We believe that the combination of innovative equipment and the BioControl Scada system in combination archive maximum CO2 savings. A team of software engineers are developing the system constantly to archive even better results. Our design team checks the best available technology constantly and if there is new and better technology available it can even be retro fitted to the plant to improve the system.

Appendix J – CentriAir System

DEO-100™
Catalytic conversion of VOC and odour

centriair

Key benefits:

- High and stable performance
- Insensitive to VOC and odour concentration
- No media or media changes required
- Life cycle cost savings
- Low energy consumption
- Compact and easy installation

DEO™ - operating principle:

- DEO™ - one-step recuperative catalysis of H2S and other VOCs
- Mesh-type catalysts coated with catalytic material. Mesh can be shaped and adapted for optimal reactor design.
- The process gas is preheated by passing one of the heat exchangers.
- If energy content in gas is insufficient for auto-thermal operation, the electrical heater tops up the gas to set temperature (250 to 400°C)
- The hot process gas is led to the catalyst where VOC and odour removal occur
- After the oxidation process the gas is led through the heat-exchanger to preheat new process gas after which is led out through the stack
- Control and monitoring of the unit is done through a PLC.

DEO-100™ is a regenerative catalyst system for elimination of VOC and odour emissions from industrial processes.

The system offers a compact, high performing, low-maintenance and energy efficient solution to most VOC and odour issues.

DEO-100™ is tried and tested on a wide range of applications including various industrial processes and waste applications such as biogas production, substrate and sludge holding tanks, hygienization, sewage pipelines, pumping stations and sewage treatment plants.

VOC and odour compounds are eliminated through patented mesh catalyst technology allowing for optimized and compact reactor geometry, large catalyst area and excellent heat capacity.

The unit is low-maintenance, requires no media or media changes and offers significant cost savings and stable performance throughout the lifecycle. Just push the start button and let DEO-100™ do the job.

DEO-100™ achieves a conversion rate of more than 98% of most VOCs, including those that are difficult to eliminate with conventional technologies such as Ionization, Ozonolysis, UV radiation, Scrubbers and Active Carbon.

High conversion rates maintain also in cases of extreme VOC concentrations, a condition where competing technologies will rapidly become inefficient or uneconomical. In fact, the higher the VOC concentration, the lower the need for external energy input.

The RCO – unit comes with a built-in heat exchanger where thermal energy is regenerated to heat the process gas and keep the reactor at desired operating temperature with minimum energy consumption.

Small dimensions allow it to fit into the trunk of a standard car, can be handled manually, and is very easy to install. Just plug it in, connect inlet to emission source and release exhaust straight through the wall. No stack or chimney needed in most cases.

The unit comes equipped with remote monitoring and alarm capabilities and an intuitive control panel.

catator

centriair
DEO - 100™

Technical data DEO-100™

Application:
Conversion of reduced sulphur compounds (e.g. hydrogen sulphide and mercaptans), ammonia and other types of VOCs in waste application such as biogas production, biogas upgrading, sludge holding tanks, hygienization tanks, sewage pipelines, sewage pumping stations and sewage treatment plants.

Performance:
> 95 % VOC and odour removal

Pressure drop:
< 100 Pa

Weight:
65 kg

Connection flanges:
100 mm straight flange

Dimensions:
(W x D x H): 477 x 660 x 773 mm

Process gas flow:
100 m^3/h

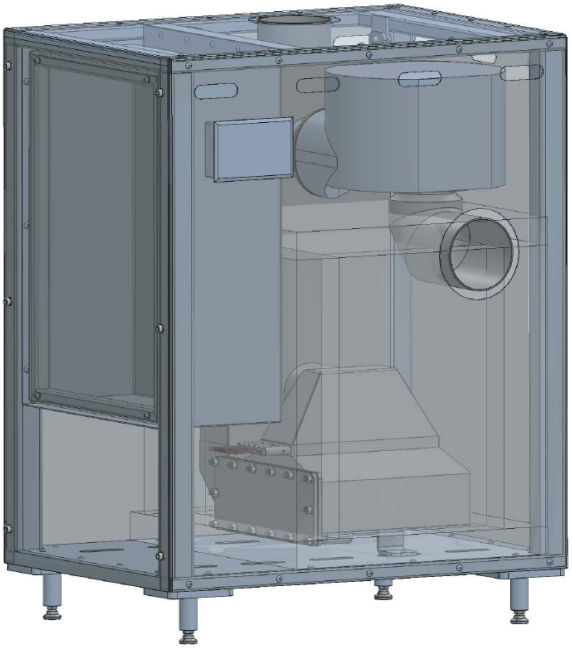
Electrical connections:
380-400 V / 3-ph + Neutral/50 Hz
or
480 V/3-ph+Neutral/60 Hz

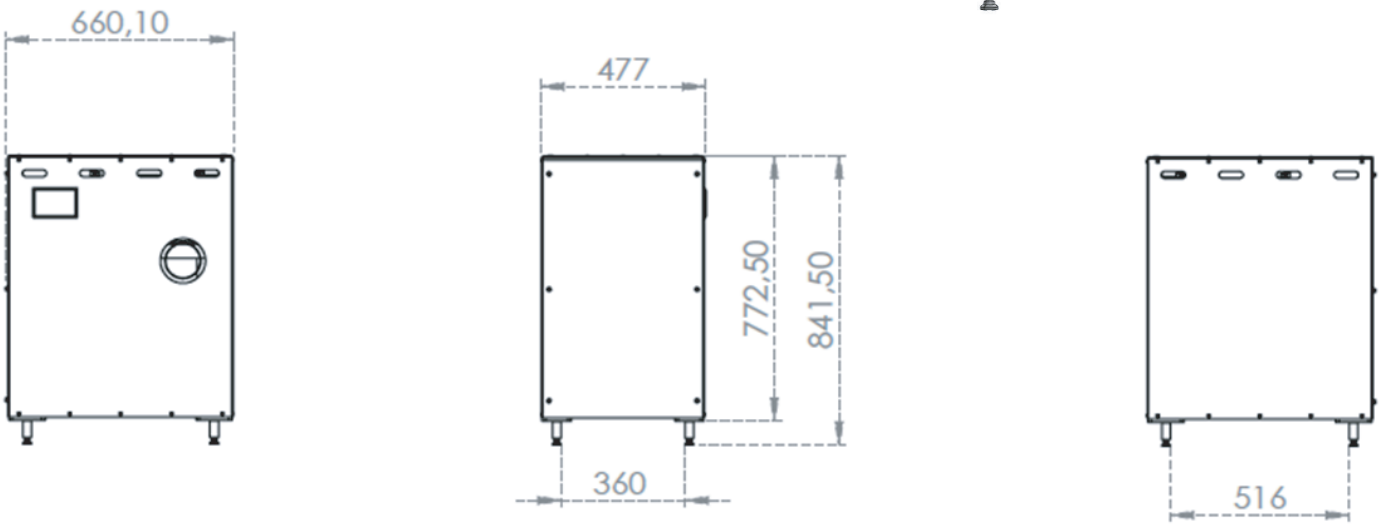
Installed power:
6 kW

Material:
Oxidized aluminum exterior

Operating temperature:
330-350 °C

Catalyst life:
Minimum 3 years





Appendix K – Safe Start-up Procedure

Biogas Plant Attleborough

Ellingham Road
Attleborough
NR17 1AE

Safe start up procedure

CONTENTS

1.0 INTRODUCTION

This document sets out the proposed “Safe start up procedure” for the Attleborough AD facility. The goal is to archive a safe start up and purging of the gas holding tanks and to eliminate the risk of any explosions while first filling/gas production of the tanks. The dates asserted within the “Safe-start-up-procedure” will be subject to change during the installation and commissioning process. These dates will be amended in the Commissioning Programme but the “Safe-start-up-procedure” will not be periodically updated to complement.
The AD Plant address is - Ellingham Road, Attleborough, NR17 1AE.

2.0 GENERAL DESCRIPTION OF THE FACILITY

2.1 Plant Description

The Attleborough plant is primarily waste Biomethane generation plant.

The facility is designed to receive mainly solid feedstocks, via 1 no. feeding system and a depacking pre-treatment plant. The main feedstocks used will be: packaged food waste, kerb site waste, food waste liquid, bakery waste and industrial water.

The feedstock is pumped into 1 of the 2 no. fermenters for fermentation at mesophilic (40°C) temperatures. After digestion in the three primary Fermenters the substrate is pumped into the Post-Fermenter. After that, the substrate will be pasteurized and separated into a solid and liquid fraction. Trucks and containers take the solids away and the liquid is stored in onside in Fermenter 2.

The biogas is fed into a gas cleaning process where moisture, hydrogen sulphide and ammonia is removed from the gas before it will be upgraded to biomethane to be exported into the gas grid.

A gas flare is also included to combust off-spec or excess gas from the digesters as well as from the gas upgrading unit.

2.2 Purging zones

The plant can be divided into the following principal purging zones. The main process elements are listed underneath that comprise each zone.

1. Fermenters 1 and 3 (BE1+3)
2. Post Fermenter and Fermenter 2 (BE2+4)
3. Pre Storage Tank BE5
4. Gas cooling system including ammonia scrubber
5. Activated carbon and VOC filters

3.0 DETAILS OF COMMISSIONING TEAM

The commissioning team will comprise the following members of staff:

Role	Name	Deputy
Commissioning Engineer	Serge Dorfmann	n/a
Plant Manager	tbc	n/a
Clients Representative	tbc	n/a
Environmental manager	tbc	n/a
Health & Safety manager	tbc	n/a

4.0 PURGING PROCEDURE

4.1 Purging Process Description

Purging of the plant starts with the introduction of 2000m³ of warm digestate to two of the primary Fermenters (BE1+3). Prior to the step of inoculating, the digestate or slurry (1900m³) will be filled into the Fermenters. The slurry/digestate with a temperature of appr. 10°C does not produce significant amounts of Methane that could create a critical concentration of methane and therefore an explosive atmosphere. Critical level of methane which is likely to cause an explosion is between 4.5-15%. 4.5% of methane is known as the “lower explosion level (LEL)” and 15% is known as the “upper explosion level (UEL). This means that up to the point of inoculation no further explosion prevention is necessary. The digesters are heated with a temporary boiler to <32°C whilst the inoculation takes place. With first introduction of an active biology into the heated digester and the temperature being raised above 32°C the first gas production will take place. To keep the area of risk as small as possible purging is carried out in the following steps, in which one step must be completed to start the next step. We assume that all interconnecting valves of gas holding vessels are closed and cold commissioning is carried out for the relevant area.

The purging is carried in steps as follows:

1. Purging of Fermenter1+3 (BE1+3)
   With the first introduction of inoculum (2000m3 of live digestate in total from crop plant digester or post digester) gas production takes place. The Archaea bacteria will be inhibited at to cool temperatures and will not produce significant amounts of methane but they will not die. First gas production will be very slow and mainly CO2 will be produced. The Archaea will reactivate and start producing significant amounts of methane at temperatures above 30°C.
   From the experience of building more than 400 Biogas plants we know that the time in between LEL and UEL for this type of primary digester is no more than 24h as long as a minimum liquid level of 2500m³ and a head space no more than 1510m³ are given. Once the UEL is passed the risk of an explosion is as low as for a Biogas plant which is in operation. With the gas potential of the introduced digestate the digester can be purge to reduce the O2 down to >2% which equals a normal operational level without introducing any additional feed stock. To reach the operational O2 level it is necessary to purge for roughly 7 days from reaching 30°C.
   Following actions will take place while purging the Fermenter tanks:

- Prior to any filling BE1/3G S300/301/3002 will be opened to release air and low quality gas
- The condensate pit KS1 will be checked and siphons will be filled with water
- The mixer BE1/3S R100, BE1/3S R101, BE1/3S R110, BE1/3S R111 will be isolated to minimise any risk for sparks from electrical devices
- Fermenter walkways/staircase will be blocked and access is strictly forbidden for visitors or untrained staff/ not special trained staff. Gas release points release gas near the walkway, so access onto the stairs must be blocked against unauthorised access.
- The gas analyser GT1G QT300 measures the gas quality hourly
- Access for trained staff is only allowed with a gas warning tool. Staff need to take wind direction into account and approach release points with extra care
- Additional the quality can be checked manually with a hand held meter at BE1/3S LA+100
- Once the UEL is reached the Fermenter can be operated normal but access for normal operator is only possible once the Fermenter is purged as they share the same stair case
- When the gas quality is higher than 50% methane purging of Fermenter can be started

2. Purging of Fermenter 2 and Post Fermenter (BE2+4)

When the gas quality in the Fermenters has reached 50%, the purging of the Post Fermenter and Fermenter 2 can takes place. Depending on the needs of the plant the purging can also take place at a later stage but the system of purging stays the same. The gas produced in Fermenter1 and 3 will be directed into Post Fermenter and or Fermenter 2. From our experience we know that it takes roughly 5 times the Volume of the Fermenter + Gasholder to purge down to >2% oxygen which equals normal operation level. Based on the amount of feedstock we will be feeding at this time, it will take two weeks to purge the Post Fermenter.

- Prior to purging the Post Fermenter and Fermenter 2 needs to be filled with at least 10cm water or substrate to protect the concrete base against the gas
  Volume = $r^2 * \pi *$ level
  $53{,}1m^3 = 13m * 13m * 3.1415 * 0.1m$
- Also prior to any filling BE4G S300 will be opened to release air and low quality gas while purging
- All mixer stay isolated till the UEL is reached BE2/4S R100, BE2/4S R101, BE2/4S R110, BE2/4S R111

- Open BE2/4G Y300, BE2/4G Y301 when gas quality in Fermenter1/3 is higher than 50% to allow gas flow into Post Fermenter and Fermenter 2
- Tank walkways/staircase will be blocked and access is strictly forbidden for visitors or untrained staff/ not special trained staff. Gas release points release gas into the walkway, so access stairs must be blocked against unauthorised access.
- The gas analyser GT1G QT300 measures the gas quality hourly
- Access for trained staff is only allowed with a gas warning tool
- Staff need to take wind direction into account and approach release points with extra care
- Additional the quality can be checked manually with a hand held meter at BE2/4S LA+100
- To get from LEL to UEL will take roughly 24h
- After 10 days the quality will be good enough to purge the first storage tank
  Tank 4.247m³ + Gas holder 1.510m³ = Total volume 5.737m³
  Gas needed for purging 5 * 5.737m³ = 28.685m³
  Gas produced in 11 days 29.700m³

3. Purging of Pre-Storage Tank (BE5)
   When the gas quality in the Fermenters has reached 50%, the purging of the Pre-Storage Tank can takes place. Depending on the needs of the plant the purging can also take place at a later stage but the system of purging stays the same. The gas produced in Fermenter1 will be directed into the Pre Storage Tanks. From our experience we know that it takes roughly 5 times the Volume of the Pre Storage Tank + Gasholder to purge down to >2% oxygen which equals normal operation level. Based on the amount of feedstock we will be feeding at this time, it will take two weeks to purge the Pre Storage Tank.

- Prior to purging the Fermenter needs to be filled with at least 10cm water or substrate to protect the concrete base against the gas
  Volume = $r^2 * \pi *$ level
  7,85m³ = 5m * 5m * 3.1415 * 0.1m
- Also prior to any filling BE5G S300 will be opened to release air and low quality gas while purging
- All mixer stay isolated till the UEL is reached BE5S R110; BE5S R111
- Open BE5G Y300, BE5G Y301 when gas quality in Fermenter1/2/3 is higher than 50% to allow gas flow into Pre-Storage Tank
- Fermenter walkways/staircase will be blocked and access is strictly forbidden for visitors or untrained staff/ not special trained staff. Gas release points release gas into the walkway, so access stairs must be blocked against unauthorised access.

- The gas analyser GT1G QT300 measures the gas quality hourly
- Access for trained staff is only allowed with a gas warning tool
- Staff need to take wind direction into account and approach release points with extra care
- Additional the quality can be checked manually with a hand held meter at BE5S LA+100
- To get from LEL to UEL will take roughly 24h
- After 5 days the quality will be good enough to purge the first storage tank
  Tank 471m³ + Gas holder 50m³ = Total volume 521m³
  Gas needed for purging 5 * 521m³ = 2.605m³
  Gas produced in 1 days 2.700m³

4. Purging of the gas cooling unit
   When the gas quality in Fermenters has reached 50%, the purging of the gas cooling unit takes place. The gas produced in both Fermenter tanks will be directed via gas lines into the Gas cooling unit.

   - The air is released through valve GT1G Y302 ball valve
   - The gas cooling unit stays electrical fully isolated for purging. The pressure in the Fermenter is roughly 2,5mbar which is enough to push the gas through the gas cooling unit
   - Additional safety is the over/under pressure valve on the Fermenter which release gas if the pressure exceeds 3.5mbar
   - Open BE4G Y300 and GT1G Y300 when gas quality in Final storage tank is higher than 50% to allow gas flow into the gas cooling system
   - The area around the gas cooling unit will be blocked with fences and access is strictly forbidden for visitors or untrained staff not special trained staff
   - To get from LEL to UEL will take roughly 10min
   - The gas quality will be measured with atex rated hand held analysers at the release point.

5. Purging of the active carbon filter (GT3G F300/ GT4G F300/ GT5G F300/ GT6G F300) When the gas quality in the gas cooling unit has reached 50%, the purging of the carbon filters takes place. The gas produced in the Fermenter tank will be directed into the gas cooling unit where the gas compressors will push the gas through the carbon filters.

    - The air is slowly released through a ball valve GT3G U302 / GT4G U302 / GT5G U302 / GT6G U302 on top of the carbon filter
    - The pressure in carbon filter is roughly 150mbar and the flow is limited by the small ½ inch ball valves
    - Additional safety is the compressor itself, it cannot produce more than 150mbar
    - Open GT3G Y300/ GT4G Y300/ GT5G Y300/ GT6G Y300 when gas quality in the gas cooling unit is higher than 50% to allow gas flow into the carbon filter
    - The area around the carbon filter will be blocked with fences and access is strictly forbidden for visitors or untrained staff not special trained staff
    - To get from LEL to UEL will take roughly 5min each tank
    - The gas quality is measured with a hand held gas meter
    - Once the gas quality has reached >50% the flare can be started
    - The fresh carbon will be absorbing the CO2 in the gas, which leads to an increased gas quality up to 90% Methane
    - The gas flare will be operated for at least 2 hours to bring the gas quality down to a normal level below 65%
    - Now the gas can be burned in the CHP engines