22nd November 2022

EA Permit Variation Application – Further information
Application Ref: EPR/AB3036RT/V005

This document provides further information as part of Malaby Biogas's response to the request for information contained in the Not Duly Made letter dated 8 November 2022.

Set our below are the responses to each of the items in the letter.

1. Odour Management Plan
The current Odour Management Plan (Rev G) is included in the response documents.

2. Pest Management Plan
The Pest Management Plan (Rev A) is included in the response documents.

3. Model input files
The model files supplied by Redmore Environmental have been included in the response documents.

4. Proposed activities

a. **Gas upgrading**
In 2020-2021 life cycle assessment was conducted by Bath University which identified the potential to double the net carbon negativity of the Bore Hill Farm Biodigester by utilising additional biogas created in excess of the demand of the existing CHP engines to create a renewable transport fuel by upgrading the biogas to compressed biomethane as an alternative to the fossil diesel fuel used to transport feedstock and digestate to and from the facility. This would act as a catalyst to increase operational and biological efficiency and allow investment in onsite renewable compressed biomethane fuel production technology. As a clean and dispatchable fuel the upgrading process would be inherently lower in site emissions than CHP uses. At this scale the green gas fuel production plant would provide technical development of biogas upgrading to support future transition of the site from CHP power generation to renewable fuel production. Additional options include the downstream addition of equipment to capture the stripped out carbon dioxide to further enhance the GHG emissions savings credentials of the site (see section b below).

As part of the improvement in efficiency in the operation of the site, Malaby Biogas has been planning to upgrade excess biogas as it is produced as a diversion from flare consumption and to improve the renewable energy output from the site without the addition of onsite combustion plant. The biogas will flow at low pressure to a specially designed, modular biogas upgrading system to produce biomethane for storage and use as a dispatchable fuel (heat or transport).

The biogas flow system will be valved and piped to the upgrading system and flow will be controlled via automated valve control as part of the overall gas consumption management system for the plant. Thus flow to the biogas upgrader will be managed in priority to the flow to the flare which will be retained as backup safety provision as the 4th level priority consumer after (1) CHPs, (2) Biogas boilers (x2), and (3) biogas upgrader.

Biomethane from the upgrader will be compressed as part of the upgrading system and stored for distribution and dispensing as compressed biomethane transport fuel. These volumes will be used to support decarbonisation of transport fuel used in the operations of the Bore Hill Farm Biodigester by replacing diesel powered vehicles delivering feedstocks and collecting biofertiliser.

Technological solutions include modular, purpose-built water scrubbing or membrane filtration processes to remove carbon dioxide and impurities from the biogas to create biomethane. Integrated compressors will compress the biomethane for storage in modular storage vessels for dispensing via connected dispenser into vehicles for use and transfer. While Malaby Biogas has been waiting for progression of the permit variation it has been exploring technological options

and will commission detail design and development proposals to specifically address regulatory and operational parameters. Of particular note is the need for the biogas upgrading to operate in varying conditions and under varying flow rates to ensure safe operation and supply chain integration. Malaby Biogas will be procuring appropriate vehicles to operate using upgraded biogas as their fuel in order to meet circular economy and climate reduction targets. Choosing technology providers that are able to demonstrate operation efficiency and performance during biogas supply intermittencies and a limited loads are important factors to ensure successful demonstration of transition from CHP combustion to biomethane production and application.

Technology providers have been considered and preferred suppliers Finnish engineering company Metener Oy are shortlisted with integrated biogas upgrade and storage systems in containerised units according to the defined process throughputs. Subject to the permit variation being in place, additional feedstock inputs and the extension of permit boundary limits will allow installation to comply with construction, planning and operational constraints. A compound area for green gas fuel production (biogas upgrading) has been identified on the extended permitted land. Once the permit variation is approved, Malaby Biogas is ready to install the modular upgrading system while maintaining safe operational movements across the wider site.

Initial assessment of biogas production arising from the permit application is that approx. 60-100 m3 per hour of biogas will be treated via the biogas upgrading plant. Additional information is included within the Metener OY information provided and online:
https://www.metener.fi/en/biogas-upgrading-technology/

b. CO2 capture and storage

Following the site specific LCA research in 2020-2021 published by Bath University, Malaby Biogas explored options to install independent CO2 capture, use and storage equipment to install downstream of the gas upgrading plant. While the scalable technology solutions in the market place are limited to larger scale CO2 capture on gas to grid AD plants (e.g. www.biocarbonics.com) less than 10% of UK biogas plants fit this scale. The remainder are predominantly CHP electricity generating plants which emit CO2 from flue gases. At this scale, together with cross over sites such as Bore Hill Farm Biodigester which will be switching from CHP only to additional gas upgrading, smaller 'bolt on' and containerised systems are emerging which can be added on to existing processes. The advantages of such systems at Bore Hill Farm are that they can be installed once the gas upgrading plant is installed and operational. Scaled modules in containers would allow installation near the gas upgrading plant in a configuration which would enable the CO2 vent from the gas upgrader to feed the CO2 capture unit and enable clean up (removal of oxygen and nitrogen from the air and water vapour from the exhaust vent) and compression to liquify the bio-CO2 for distribution off site into new markets (industrial, food & beverage, feed production and animal husbandry etc).

Subject to permit variation to increase the permitted boundary, carbon capture and use equipment would fit on the land area near the gas upgrading plant and be services from the same road access and parking/turning area. Connection to the CO2 vent would allow the replacement of the gas upgrading vent with a smaller vent for other air gases (O2 & N) to atmosphere or redirection to the existing biofilter discharge stack (either before or after the biofilter depending on regulatory approval).

Working with technology providers Purifire Labs Ltd, Malaby Biogas would install carbon capture and storage equipment as containerised units which would separate off-gas from the upgrade unit, condense and compress the CO2 for liquified storage and dispatch (see enclosed presentation from Purifire with respect to their GHG Liquefaction Technologies).

This system has been developed at Cranfield University as simple 'plug and play' modules to respond to policy need to address the Climate Emergency and the need to diversify the supply of CO2 following the supply constraints experienced in 2021. As locally designed and home-grown engineered solutions such systems offer scalable potential for further CO2 capture as part of the drive to Net Zero.

c. Treatment of digestate

The digestate output from Bore Hill Farm Biodigester is a certified end of waste product called Biofertiliser which meets the current AD Quality Protocol and PAS110 specification. Malaby Biogas currently contracts the biofertiliser to be taken from the facility to farms for storage and spreading on land in accordance with prevailing agricultural guidance and regulations. As commercial and regulatory changes have emerged over recent years in response to changes in legislation and economic pressures, Malaby Biogas has been exploring a range of technologies to improve the quality of its Biofertiliser to reduce its environmental impacts on air and land, reduce risk of nutrient run off to water and enable it to meet the expectations of existing and future markets. To this end it has participated in innovative R&D projects which aim to develop solutions for digestate. Coupled with existing technologies, the field application and demonstration of solutions to valorise digestate require onsite implementation and development.

Existing systems such as HRS Ltd.'s digestate concentration system, third party sludge thickening processes used in waste water treatment industries and innovative multistage treatment processes have been reviewed and considered. Primary among these is the NOMAD project, a combined EU/UK initiative to address a number of digestate constraints such as volume, residual contamination and nutrient concentration.

Malaby Biogas is a leading UK AD partner in the NOMAD project and aims to host the digestate treatment system in the UK following field trials across Europe. Initial site assessments and project development work has been undertaken and a planned arrival of the NOMAD system is expected to occur during Q1-Q2 2023 subject to approvals and upstream project progress. As a mobile system the NOMAD equipment will be parked on the open area to the north of the AD facility and deployed into the AD plant according to operational milestones such as process integration connections, power supply, staff attendance, air handling integration and H&S approvals etc. Pending the outcome of the NOMAD project installation at Bore Hill Farm, design development of larger scale digestate treatment processes will be undertaken for installation within the building. See attached documents for further information on the NOMAD technologies:

- NOMAD digestate treatment system support email
- R6558-PM-0009 Demonstration Specification (UK)

In order to invest in digestate treatment processes as part of and subsequent to the installation and operation of NOMAD, Malaby Biogas needs to ensure that there is sufficient space within the permitted site to safely and properly accommodate a wholly enclosed treatment system.

d. BAT Assessment Addendum

This section should be read in conjunction with the BAT Assessment submitted as part of the permit variation application, which remain valid**.**[1]

- BAT 3 (Maintain an inventory of waste water and waste gas streams) - the anticipated emissions from the upgrade plant are carbon dioxide, oxygen, nitrogen and trace gases. We would expect an improvement or pre-operational condition to verify the composition of gaseous venting from the upgrading plant as part of the permit variation notice. However, biogas composition is known and there are unlikely to be significant variance from this. There is also a proposal for a 'bolt-on' carbon dioxide capture plant which would remove the carbon dioxide from the vent emissions.
- BAT 8 – we would anticipate an improvement condition within the permit variation notice to carry out emissions monitoring on the vent from the biogas upgrade unit (EP7) although it may be feasible to route the off-gas through the existing stack for the odour abatement plant in order to maximise dispersion, in which case EP7 would be redundant.
- BAT 15 - installation of the biogas upgrading plant would minimise flaring of biogas as any excess biogas will be directed to the upgrade plant in favour of flaring.

[1] SPC/0014/Variation/BAT/V1_Malaby Biogas/February 2022 with apps

- BAT 13 (odour) and BAT 18 (noise) – the upgrading plant and CO2 capture plant are not anticipated to be a significant source of odour or noise.
- BAT 19 and BAT 20 - There is no proposed change to emissions to water. However, water recirculation from the digestate treatment will increase water reuse in accordance with BAT.
- BAT 21 (Accidents and incident) – the Accident Management Plan (Site Emergency Action Plan SOP999) would be updated in line with revised HAZOP and DSEAR assessments incorporating the new proposed plant and equipment.
- BAT 35 – to reduce the generation of waste water and to reduce water usage the proposed digestate treatment process is in direct compliance with an example of BAT:

  Recirculating process water streams (e.g. from dewatering of liquid digestate in anaerobic processes)

There are no other relevant changes with respect to BAT.