CRES Biogas Ltd

Orchard's Farm AD Plant, Twemlow

Odour technical assessment of site suitability

V2 – 07/02/2013

Report prepared by:
Andrew Lyon, Technical Advisor
andrew.lyon@environment-agency.gov.uk Tel: 01522 785844
Nick Sauer, Technical Advisor
nick.sauer@environment-agency.gov.uk Tel: 01733 464322

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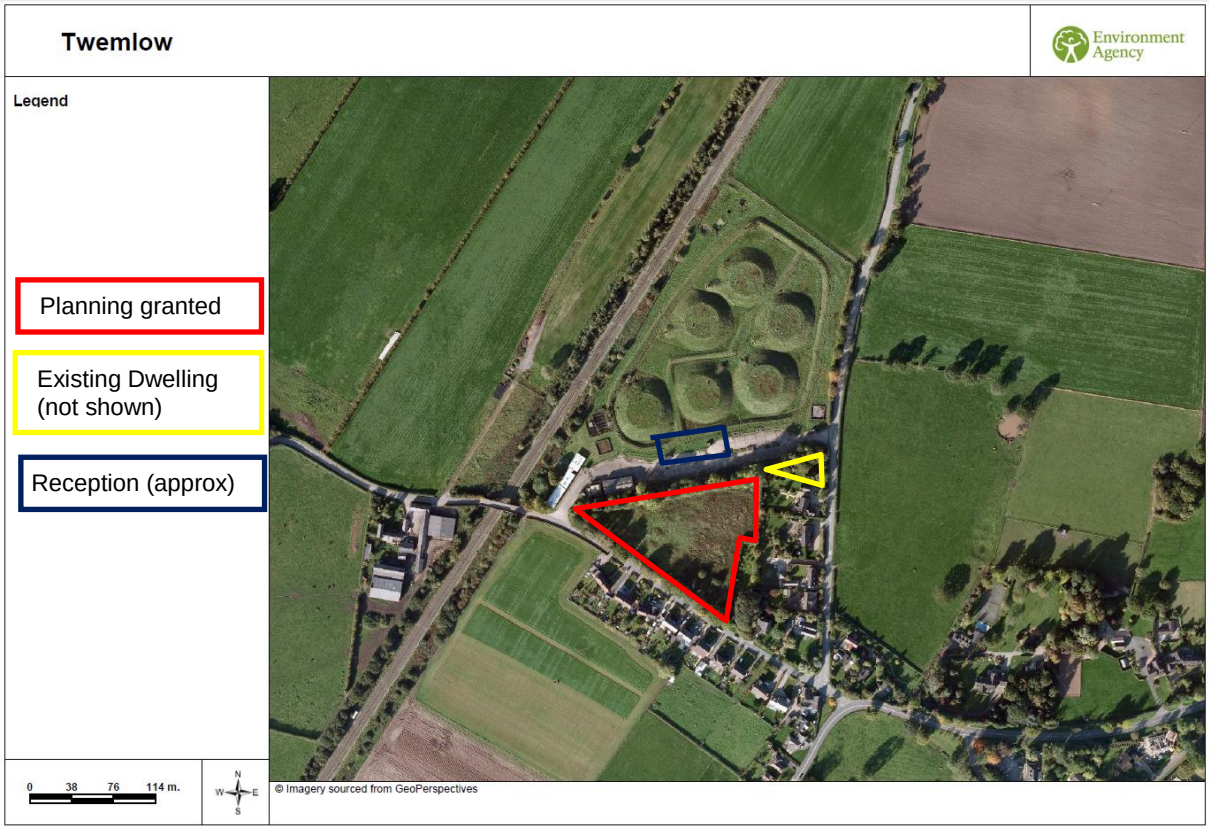
Purpose of report: - A technical review of the odour management plan (OMP) to assess the odour potential of site activities and to the extent possible, advise on any applicable best practice measures and their potential for mitigation of odour pollution.

Address: Orchard's Farm AD Plant Twemlow, Cheshire **Application Ref:** EAWML 104249	**NGR:** SJ 77930 68900



Executive Summary

Our overall conclusion is that it is unlikely that controls at the site can be implemented to a standard which would prevent significant pollution for nearby residents. Our concerns are strongly influenced by the combination of immediate proximity of residents and significant limitations in site infrastructure.

The Agency's Air Quality Modelling and Assessment Unit (AQMAU) revised report dated 6 February 2013, AQMAU_C927_Rp02, considered the dispersion model of stack (point source) emissions from the site and made important qualifications relating to the assumed validity of projected odour emissions. This revised report provides helpful clarification of the scope and conclusions.

We recommend engineering confirmation of the emissions values used in the dispersion model. Doubts remain about whether these emissions values are in fact consistently achievable, but as long as they are imposed as an emissions limit value (as recommended) they are enforceable and the operator can be required to operate to these levels.

The combined impact assessment and our preliminary OMP review notes should have covered all of the odour related issues with this site. However, there was an important gap between these two assessments. This is because of two critical assumptions which we did not recognise until late in the review process.

The first assumption is that fugitive emissions can be consistently controlled to a high standard and the second is that the process will always be under control. If either of these two assumptions is not true, then the proximity of receptors magnifies the consequences of any failures. In the event of a major process failure, we are concerned that immediate neighbours may be in acute danger from episodic releases or explosion risks (see Potential impacts resulting from incidents below).

These issues were belatedly recognised as significant for this site at the peer review stage of our report in early January 2013. Also at this time, important new and concerning information about the site infrastructure and the presence of an additional dwelling adjacent to the site became available. At the time of writing, we have just learned that planning permission has also been granted for 14 new homes to be built in the field adjoining the southern boundary of the site.

Odour impact assessments

Modelled exposure from point sources

The Agency's H4 guidance states '*Any modelled results that project exposures above these benchmark levels, after taking uncertainty into account, indicates the likelihood of unacceptable odour pollution. You should also take evidence from other assessment methods and site specific influences into account when drawing final conclusions.*'

It is clear from stated assumptions in the AQMAU report that fugitive odour sources were not part of the modelled impact assessment. Both stack emissions and fugitive releases will depend heavily on the effectiveness of process controls. While it is appropriate to assume process control for a modelling exercise, the limitations imposed by this assumption must still be recognised.

Fugitive emissions

The perception of odour by humans occurs over an interval of about one to two seconds. This means that hourly average probability assessments from modelling are not directly indicative of odour annoyance potential. Rather, they are used as benchmark levels more generally associated with annoyance to assist decision making. These benchmarks are therefore most useful for point source emissions which can be quantified and are relatively constant.

Fugitive emissions are very difficult to measure and even indirect estimates of emission rates are fraught with difficulty. Furthermore, fugitive emissions are often associated with transient events, such as opening doors, waste handling activities or the arrival of a load of waste.

Even when transient emissions are relatively low, they can have a disproportionate annoyance impact on nearby receptors. The reason for this is partly because the emissions are at ground level so, unlike elevated stacks, there is no need for the emissions to disperse before reaching the receptor. Another reason is that fugitive emissions can be very transient. This means that while average odour concentrations may be quite low, peak levels are many times higher. Since the olfactory sense responds to very short periods of exposure, the impact is driven by peak levels.

Short, sharp, peaks of odour due to limited episodic emissions are believed to dissipate fairly quickly with distance (within hundreds of metres), so that people further away will start to experience the same emissions more gradually and with a lower peak intensity. When we consider that the nearest receptor is the other side of the fence from the facility and within 100 metres from the waste reception area (even closer for houses just granted planning permission), the potential for dissipation of emissions is minimal.

The peak levels of odorous emissions will be largely governed by the odour potential of air behind containment features which are temporarily removed (doors opened) or that of materials which are disturbed (digestate loading). Given that AD sites handle many materials which rapidly putrefy, have high protein levels and high energy levels, it is a valid generalisation to say that these facilities receive, hold, process and produce highly odorous materials. Any short term fugitive releases can have devastating amenity impacts on nearby receptors.

As with all waste management facilities, good management practices can mitigate this underlying odour potential to a degree. However, the mitigation opportunities for high risk materials, such as raw meat, in this context are limited.

Potential impacts resulting from incidents

Poor levels of process control are responsible for adverse odour impacts from a wide range of waste management facilities and are extremely common. Good quality OMPs will allow the likelihood of these problems to be minimised while recognising problems early so that they can rapidly be brought back under control. Where distances to receptors are satisfactory, people may experience levels of odour exposure which are unpleasant, but acceptable for short periods of time. However, without the benefit of any meaningful dispersion, intense foul odours associated with process failures can cause significant distress and discomfort.

With processes such as AD, it is also prudent to consider that significant loss of process controls may have impacts over short distances which go well beyond nuisance. As a normal part of their functioning, AD sites produce significant quantities of biogas, which is about 50% methane. Equipment failures have the potential to suddenly release this highly flammable and asphyxiating production gas. Loss of process controls due to production surges, foaming or flow restrictions have also been known to cause pressure relief valves on digesters to blow off and vent gas to atmosphere.

Where receptors are some distance from the site, then the danger from these incidents will be largely limited to workers on site. However, with a site bordered on one side by residences, and on another by an electrified main rail line, the potential for harmful or fatal accidents may extend beyond the site boundaries. It is beyond our expertise to quantify these extreme outcome risks, but we strongly advise that they should be considered by people with experience in these areas.

Odour Management Plan assessment

Introduction

The Environment Agency's approach to odour regulation requires the operators of potentially odorous sites to submit an Odour Management Plan (OMP) for review and approval by the Agency. The submission of an acceptable OMP is a requirement of most Environmental Permits where odour could be an issue.

The review assesses OMPs against headings that reflect Environment Agency Technical Guidance Note H4 – Odour Management, Section 4 (Control measures), Section 5 (Monitoring) and Appendix 4 (What we are looking for in an odour management plan). The review asks:

1. Is the inventory of odorous materials complete?
2. Does the plan describe appropriate methods for the management of odorous materials held on site?
3. Does the plan describe appropriate methods for preventing or reducing evaporation of odorous chemicals from odorous materials?
4. Does the plan describe appropriate methods for the containment and abatement of any evaporated odorous chemicals?
5. Does the plan describe appropriate measures for improving the dispersion of odorous releases before neighbours are exposed?
6. Does the plan describe appropriate measures for minimising annoyance among neighbours who may be exposed to odorous emissions?
7. Does the plan consider how odorous emissions might be affected by emergencies or incidents?

Overview

An odour management plan (OMP) for the proposed CRES Biogas plant at Twemlow was forwarded to Nick Sauer (National Odour Team Leader) from Barry Curtis (National Permitting) for review on the 28th June 2012. It was forwarded to Andrew Lyon (National Odour Team) for assessment on the same day.

Andrew produced three informal OMP reviews (on three revisions) which focused on best practice at the anaerobic digestion (AD) site and the quality of the OMP itself. However, he did not look at the impact assessment (which was reviewed by AQMAU) and the proximity of receptors did not feature in his preliminary reviews.

AQMAU did consider the impact assessment and made their recommendations in a report dated the 6th September 2012 (revised 6 Feb, 2013). The AQMAU report considered the dispersion modelling report of stack emissions and made important qualifications relating to the assumed validity of projected odour concentrations from the stack. Andrew's preliminary reports recommended an engineering confirmation that those emissions values were achievable. Doubts remain about whether these emissions values are in fact consistently achievable, but as long as they are imposed as an emissions limit value (as recommended) they are enforceable and the operator can be required to operate to these levels.

This combination of impact assessment and OMP reviews should have covered all of the issues, but there was an important gap between the two assessments. This is because of two further assumptions which were not recognised as critical at an early stage. The first assumption is that fugitive emissions can be controlled to a high standard and the second is that the process will always be under control. If either of these two assumptions is not true, then the proximity of receptors magnifies the consequences of any failures.

These issues were belatedly recognised as significant for this site at the peer review stage of the formal OMP review in early January 2013. Important new, and concerning, information about the site infrastructure and the presence of an additional dwelling adjacent to the site also became available at this time. We have just learned that planning permission has also been granted for the construction of 14 new homes adjacent to the site.

Receptors

Although the OMP does identify a dwelling in very close proximity in a table of receptors, it is not shown on the plan in the OMP. Investigation showed that this property is neither shown on Agency mapping systems nor Google Street View. The recent photos below show that the property is within a few metres of the southern boundary of the site. It is also within 100 metres of the waste reception hall. Furthermore, we understand that planning permission has just been granted for 14 houses in a field adjoining the site.

Tank design considerations

The OMP did not discuss the digestion process in specific detail, however, it was noted that this may be because these are contained within the site management system. This document is also a requirement of the permit and so this operational detail may not necessarily be discussed within the OMP.

However, a search of the internet revealed a number of photographs which were taken by adventurers (presumably trespassing) from inside the tanks. These photos, and other aerial photos, showed that the tanks were round (~30m diameter), flat bottomed and about 5m high with at least five rows of vertical roof supports.

The shape of digestion tanks is a very important design consideration for mixing characteristics, solids deposition and removal, and gas separation and removal. Heating requirements and feed locations also need to be factored into the design criteria.

The volume, diameter and height of the tank is usually calculated from the flow, organic loading rate and solids content. An aspect ratio of approx. 1:1 for the diameter to top water level (TWL) will improve mixing. Mixing is important to blend materials thereby avoiding stratification, reducing foaming, maximising solids destruction and gas production. These measures help to avoid short circuiting, dead/stagnant zones and maximise the active volume.

While good mixing will help avoid excessive solids accumulation and the base shape. Internal baffles and bottom drains are also key features.

It is therefore difficult to see how these tanks can provide a suitable environment for anaerobic digestion, given that thorough mixing will be extremely difficult to implement, there does not appear to be a mechanism for removing solids and there does not appear to be consideration of feed location or how temperature will be controlled within the tank.

Section 4.2.6 of the OMP states that providing a two stage digestion process with a lengthy 114.3 day retention time ensures minimal residual gas content of the digestate. It is also supposed to provide good opportunity for the complete stabilisation of the digestate and ensure that sulphur containing compounds are broken down to minimise potential for generation of odorous compounds such as hydrogen sulphide. However, one parameter of long retention time that cannot be determined is whether the right microorganisms are present in the digester to reduce and control the potential for odour.

It is therefore important to carefully monitor the biogas process, making it possible to detect problems in a timely manner and catch them before things have gone so far that the process deteriorates. For example, the process temperature must be closely monitored because anaerobic microorganisms are very sensitive to temperature fluctuations. Alkalinity and pH, the concentration of fatty acids and ammonium/ NH3, and the carbon dioxide and methane contents of the gas are other important parameters that should be followed throughout the process in order to minimise odour problems. Without effective mixing, this monitoring is very difficult.

Other parts of the process that should be considered are:

- whether pasteurised feedstock needs to be cooled to the required digestion temperature via heat exchangers prior to introduction into the second digester;
- whether biogas treatment is required to remove hydrogen sulphide (potentially corrosive to engines);
- whether the biogas will require dewatering which could be very odorous and will require condensate management; and
- backup flare arrangements.

Containment and abatement measures

Experience shows that, on their own, buildings rarely function as adequate containment features. In part this is due to short-term fugitive releases from the opening of doors, vehicle unloading etc. The fact that receptors are so close means that even if the proposed containment features operated perfectly there is still likely to be significant odour pollution at the nearest receptors due to transient emissions. It is unlikely that there are any measures that could consistently mitigate these impacts at such a short distance.

The management of a building as a containment feature requires consideration of air movement within the building. Other concerns include how condensate management within the air handling system will be addressed. Often such systems typically handle warm acidic gases which will condense on cooler pipework (such as ducting outside the building to the biofilters) which can lead to corrosion and leakage of condensate which is either odorous or collects in pools and becomes odorous.

Localised containment is provided for the slurry store (direct ventilation to biofilter), import bunker and depackaging skip. However, it is not clear whether there is there any monitoring to ensure that there is continuous extraction for the slurry store.

Containment will also be provided in the digestate shed with provision for a further biofilter if this material proves more odorous than anticipated. Should this material become odorous, a wide range of chemical compounds such as ammonia, VOCs, nitrogen organic compounds and reduced sulphur compounds could be generated. Ammonia could be unavoidable when temperature and/or pH is high. Therefore, it is important to keep the temperature and pH under control through the process. It may be necessary to consider ammonia stripping from digestate when it has more odour than anticipated, potentially causing odour nuisance for nearby receptors.

As discussed above the suggested emission figure from the proposed biofilter appears extremely optimistic and is unlikely to be met in practice.

The Odour team provides the following services and products:

- Development of guidance (e.g. H4)
- Introduction to odour seminars
- Seminars on the role of Odour Management Plans
- Development of formal training for field officers scheduled for 2012
- Development of odour monitoring tools for field officer use (e.g. field dilution olfactometry)
- Sponsor of the Odour Network of Area Odour Advisors, (includes training, support and physical resources)
- Site specific advice on best practice for the control of odours (site audit reports)
- Advice on odour monitoring strategies
- Desk top studies on odour pollution at specific sites (Investigation of data resources such as NIRS, Regis)
- Odour expert witness services

Resources:

- O Drive
- Odour Regulation intranet page
- Odour Network Advisors
- Odour Library – contact Michelle Gallagher

Odour Team:

Nick Sauer – Technical Advisor 1 – (*Odour Network, OMP & audit support, external liaison (AfOR etc), influence strategic direction for odour regulation, expert witness, training and guidance)*

Nana Ampomah – Technical Advisor 2 – *(Odour Network, SHPI, Pre app meetings, permitting, Biowaste and AD assistance)*

Ibtisam Hantoosh – Technical Advisor 2 - (*Odour Network, WTS OMP template, SHPI, site audits, site specific assistance for LFs, desktop studies)*

Michelle Gallagher – Technical Advisor 2 – (*Odour Network, Nasal Ranger training, Odour sensitivity pen training, Std permit OMP template for WTS, site audits, desk top studies, odour advice, Std permit OMP for composting)*

Andrew Lyon – Technical Advisor 2 – *(Std permit OMP for composting, OMP reviews, Odour Network, internal/external promotion of team, odour advice, AD, biofilters and composting assistance)*