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1. Purpose

- 1.1 This Site Specific Instruction describes the methods applied to locating, identifying and mitigating against fugitive emissions to air as part of the Environmental Permitting Regulations requirements.

2. Scope

- 2.1 This Site Specific Instruction is applicable to Anaerobic Digestion (AD) sites which produce biogas for consumption in the Combined Heat and Power (CHP) engines and generate a source of electricity. It details the maintenance requirements to identify fugitive biogas emissions from seals, flanges, valves, pumps, pipework and tanks.
- 2.2 Note – Emissions of sludge to the environment are minimal due to site surfacing and regular operator site tour inspections therefore not included in this plan.

3. Responsibility


- 3.1 The Production Manager for the AD site is responsible for ensuring environmental permit conditions are complied with. The Statutory Maintenance Team are responsible for planning a third party contractor to undertake the optical gas imaging survey. The stewards of the reports store them on the statutory SharePoint library:
<https://uusp/engdel/OpEng/OE/MS/Gas%20Camera%20Survey%20Reports/Form%20s/AllItems.aspx>
 Any defects on the reports are to be escalated and proactive / reactive work orders are to be raised for any remedial work required.

4 Asset Monitoring Schedule

- 4.1 The following assets are scheduled for routine proactive inspection by thermal imaging camera on an annual basis. This asset list is based on the potential for biogas leakage at each specific location.

The below assets are also monitored daily as part of the operator's site tour and monthly Environmental Regulatory Advisors compliance inspection which whilst not identifying individual assets on a schedule use human senses to detect leakage which are reported centrally and a work order raised for repair by the appropriately skilled operative.

If the source of the emission is unknown during the daily and monthly human senses tour then the use of Optical Gas Imaging will be requested to attend site and undertake an assessment to locate the source.

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Identifying Assets – the above assets are all uniquely identified within the table.

Monitoring – The sequence of events when monitoring assets on site are outlined in Appendix B. EPA Guidance (Method 21 – Determination of Volatile Organic Compound Leaks) is the generally accepted method of monitoring being followed.

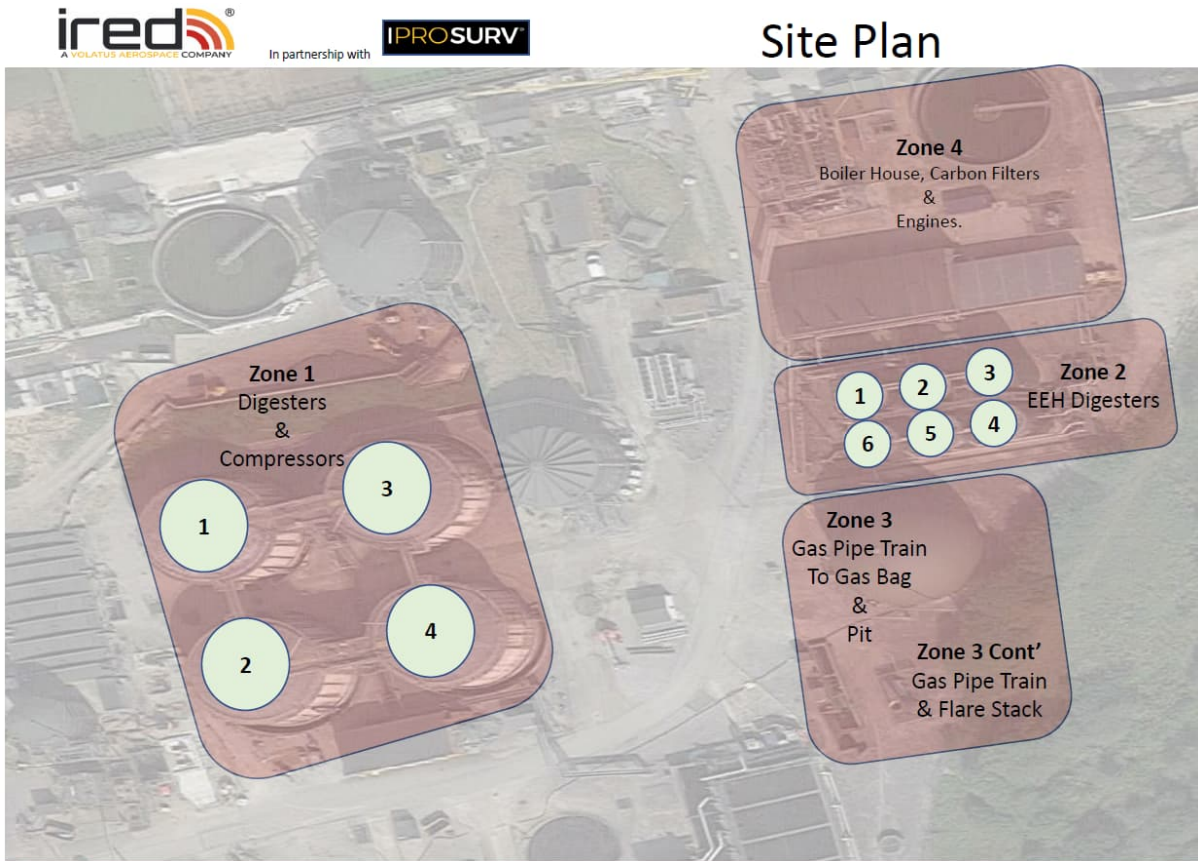
Leak Repair – On detection of a gas leak the monitoring operative will inform the Site Manager/Controller who is responsible for raising work order to enable the work to be scheduled to an appropriate Field Service Engineer for repair and an audit trail is available.

Recordkeeping –Third party reports are stored on the statutory maintenance share point. See Appendix A for extract of typical report.

Type & Quantity of Emission – All combusted biogas is emitted to air via a point source emission point directly from the combustion unit therefore any likely fugitive emission will be of non-combusted biogas as this accounts for the majority of stored gas with a composition of Methane (60-70%) and Hydrogen Sulphide (50-<100ppm). The quantity emitted will be variable dependant on, the location of the emission source i.e. a hole in a gas storage vessel has the potential to release a large quantity in comparison to an isolated pipework length, when the leakage was detected and the pressure of the contained gas.

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4. Asset Location Plan





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Zone 1 : Digesters & Compressors

Location	Description / Observation	St. Image	End Image	Dist M	Page No	Pre RAG	Cur RAG
Digester 1	Digester 1 purge point	17692	17693	4m	12		
"	Digester 1 purge point x2	17694	17695	4m	12		
"	Digester 1 purge point x4, flow meter, inspection window	17696	17697	4m	12		
"	Digester 1 PRV	17698	17699	4m	12		
"	Digester 1 purge point & flow meter	17700	17701	4m	12		
"	Gas train outgoing valves & flanges	17702	17703	4m	12		
"	Gas train outgoing valves & meters	17704	17705	4m	13		
Gantry - Top of Digesters	Gas train outgoing valves & flanges	17706	17707	4m	13		
Digesters	Gas train outgoing flange	17708	17709	4m	13		
"	Gas train outgoing flange	17710	17711	4m	13		
Digester 3	Gas train outgoing valves & meters	17712	17713	4m	13		
"	Gas train outgoing valves & flanges	17714	17715	4m	13		
"	Gas train outgoing flange	17716	17717	4m	14		
"	Gas train outgoing flange	17718	17719	4m	14		
"	Digester 3 purge point x4, flow meter, inspection window	17720	17721	4m	14		
"	Digester 3 PRV	17722	17723	4m	14		
Digester 4	Digester 4 purge points x2, flow meter	17724	17725	4m	14		
"	Digester 4 valve	17726	17727	4m	14		
"	Digester 4 PRV	17728	17729	4m	15		
"	Gas train outgoing valve & purge point	17730	17731	4m	15		

Zone 1 : Digesters & Compressors

Location	Description / Observation	St. Image	End Image	Dist M	Page No	Pre RAG	Cur RAG
Digester 4	Gas train outgoing valves & meters	17732	17733	4m	15		
"	Gas train outgoing valves & flanges	17734	17735	4m	15		
"	Gas train outgoing valves & meters	17736	17737	4m	15		
Gantry - Top of Digesters	Gas train outgoing valves & flanges	17738	17739	4m	15		
Digester 2	Gas train outgoing valves & meters	17740	17741	4m	16		
"	Gas train outgoing valves & flanges	17742	17743	4m	16		
"	Leak to bolt. Seq video 744. Digi 1	17744	17744	2m	32		
"	Gas train outgoing flange	17746	17747	4m	16		
"	Gas train outgoing flange	17748	17749	4m	16		
"	Digester 2 PRV & purge points x2	17750	17751	4m	16		
"	Digester 2 purge point x5, flow meter, inspection window	17752	17753	4m	16		
Digesters ground level	Digester 1 vertical pipe double flange	17754	17755	10m	17		
"	Digester 1 vertical pipe single flange	17756	17757	4m	17		
"	Digester 1 vertical pipe single flange	17758	17759	4m	17		
"	Digester 2 vertical pipe double flange	17760	17761	10m	17		
"	Digester 2 vertical pipe single flange	17762	17763	4m	17		
"	Digester 2 vertical pipe single flange	17764	17765	4m	17		
"	Digester 3 vertical pipe double flange	17766	17767	10m	18		
"	Digester 3 vertical pipe single flange	17768	17769	4m	18		
"	Digester 3 vertical pipe single flange	17770	17771	4m	18		



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Location	Description / Observation	St. Image	End Image	Dist M	Page No	Pre RAG	Cur RAG
Digesters Ground Level	Digester 4 vertical pipe double flange	17772	17773	10m	18		
"	Digester 4 vertical pipe single flange	17774	17775	4m	18		
"	Digester 4 vertical pipe single flange	17776	17777	4m	18		
"	Compressors & condensate pots set up LHS between digesters 4 & 2	17778	17779	4m	19		
"	Compressors & condensate pots set up RHS between digesters 4 & 2	17780	17781	4m	19		
"	Compressors & condensate pots set up LHS between digesters 1 & 3	17782	17783	4m	19		
"	Compressors & condensate pots set up RHS between digesters 1 & 3	17784	17785	4m	19		
"	Compressors & condensate pots set up between digesters 1 & 3. Leak to gauge. Seq video 786 . Digi 2	17786	17786	2m	33		
"	Compressors & condensate pots set up between digesters 2 & 4. Leak to flex conn. Seq video 787 . Digi 3	17787	17787	2m	34		

Zone 2 : EEH Digesters

Location	Description / Observation	St. Image	End Image	Dist M	Page No	Pre RAG	Cur RAG
EEH Digesters	Main PRV	17788	17789	4m	19		
"	No 6-mixing valves & inspection window	17790	17791	4m	19		
"	No 6-purge point & double flange	17792	17793	4m	20		
"	No 6-main gas connection & flow meter	17794	17795	4m	20		
"	No 6-purge point & double flange	17796	17797	4m	20		
"	No 6-inspection hatch	17798	17799	4m	20		
"	No 1-mixing valves & inspection window	17800	17801	4m	20		
"	No 1-purge point & double flange	17802	17803	4m	20		
"	No 1-main gas connection & flow meter	17804	17805	4m	21		
"	No 1-purge point & double flange	17806	17807	4m	21		
"	No 1-inspection hatch	17808	17809	4m	21		
"	No 5-mixing valves & inspection window. Leak to middle pipe connection. Seq video 810. Digi 4.	17810	17810	2m	35		
"	No 5-purge point & double flange	17811	17812	4m	21		
"	No 5-main gas connection & flow meter	17813	17814	4m	21		
"	No 5-purge point & double flange	17815	17816	4m	21		
"	No 5-inspection hatch	17817	17818	4m	22		
"	No 2-mixing valves & inspection window	17819	17820	4m	22		
"	No 2-double flange	17821	17822	4m	22		
"	No 2-main gas connection & flow meter	17823	17824	4m	22		
"	No 2-inspection hatch	17825	17826	4m	22		



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Zone 2 : EEH Digesters

Location	Description / Observation	St. Image	End Image	Dist M	Page No	Pre RAG	Cur RAG
EEH Digesters	No 4-mixing valves & inspection window	17827	17828	4m	22		
"	No 4-purge point & double flange	17829	17830	4m	23		
"	No 4-mixing purge point & inspection hatch	17831	17832	4m	23		
"	No 3-mixing valves & inspection window	17833	17834	4m	23		
"	No 3-double flange	17835	17836	4m	23		
"	No 3-main gas connection & flow meter	17837	17838	4m	23		
"	No 3-inspection hatch	17839	17840	4m	23		

Zone 3 : Gas Bag & Flare Stack

Location	Description / Observation	St. Image	End Image	Dist M	Page No	Pre RAG	Cur RAG
Gas bag & flare stack	Pipe train to gas bag single flange	17841	17842	4m	24		
"	Pipe train to gas bag single flange	17843	17844	4m	24		
"	Pipe train to gas bag single flange	17845	17846	4m	24		
"	Pipe train to gas bag valve	17847	17848	4m	24		
"	Condensate pot from gas bag pit Top	17849	17850	4m	24		
"	Condensate pot from gas bag pit Bottom	17851	17852	4m	24		
"	Gas bag pit pots & valves	17853	17854	4m	25		
"	Gas bag pit pots & valves	17855	17856	4m	25		
"	Valve & meter to flare stack	17857	17858	4m	25		
"	Valve & flange main connector to flare stack	17859	17860	4m	25		

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Zone 4 : Boiler House, Carbon Filters & Engines

Location	Description / Observation	St. Image	End Image	Dist M	Page No	Pre RAG	Cur RAG
Boiler House CHP	Main pipe inlet single flange 1	17861	17862	4m	25		
"	Main pipe inlet single flange 2	17863	17864	4m	25		
"	Main pipe inlet single flange 3. Leak to gasket. Seq video 865. Digi 5. (Pink arrow)	17865	17865	2m	36		
"	Main inlet to CHP various valves, meters & flanges	17866	17867	4m	26		
"	Pipe train bridge to engines single flange	17868	17869	4m	26		
"	Pipe train bridge to engines single flange	17870	17871	4m	26		
"	Pipe train bridge to engines double flange	17872	17873	4m	26		
"	Pipe train bridge to engines single flange	17874	17875	4m	26		
"	Pipe train bridge to engines single flange	17876	17877	4m	26		
Inside Boiler House	Main low level gas pipe flange & probe	17878	17879	4m	27		
"	Main low level gas pipe flange	17880	17881	4m	27		
"	Branch connection to boiler 1 single flange	17882	17883	4m	27		
"	Boiler 1 booster set	17884	17885	4m	27		
"	Boiler 1 main connection	17886	17887	4m	27		
"	Branch connection to boiler 2 single flange	17888	17889	4m	27		
"	Boiler 2 booster set	17890	17891	4m	28		
"	Boiler 2 main connection	17892	17893	4m	28		
"	Branch connection to boiler 3 single flange	17894	17895	4m	28		
"	Boiler 3 booster set	17896	17897	4m	28		
"	Boiler 3 main connection	17898	17899	4m	28		

Zone 4 : Boiler House, Carbon Filters & Engines

Location	Description / Observation	St. Image	End Image	Dist M	Page No	Pre RAG	Cur RAG
Engines, carbon filters & boosters	Gas main to filters condensate pot	17900	17901	4m	28		
"	Gas main to filters flange & valve	17902	17903	4m	29		
"	Gas main to filters valve & purge points	17904	17905	4m	29		
"	Gas main to filters condensate pot	17906	17907	4m	29		
"	Main manifold to filters LHS	17908	17909	4m	29		
"	Main manifold to filters RHS	17910	17911	4m	29		
"	Carbon filter 1 & 2 top	17912	17913	4m	29		
"	Carbon filter 1 & 2 bottom	17914	17915	4m	30		
"	Gas boosters 1 & 2, filter 3 & various valves, meters and flanges LHS	17916	17917	4m	30		
"	Gas boosters 1 & 2, filter 3 & various valves, meters and flanges RHS	17918	17919	4m	30		
"	Gas boosters 1 & 2, filter 3 & various valves, meters and flanges LHS	17920	17921	4m	30		
"	Gas boosters 1 & 2, filter 3 & various valves, meters and flanges RHS	17922	17923	4m	30		
"	Main gas connection to engine 1	17924	17925	4m	30		
"	Main gas connection to engine 2	17926	17927	4m	31		

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5. Key Personnel


Responsibilities for implementation of the LDAR plan are outlined in Section 3. A more detailed list is shown in the below table.

Title	Responsibility
Site Production Manager	Ensuring the LDAR is implemented on site and any asset repairs are undertaken in a timely manner. Responsible for Health & Safety of site personnel.
Statutory Maintenance Manager	Overall management of the Statutory maintenance team including work completion
Statutory maintenance Team Leader	Day to day management of the Thermography contract including escalating risk and H&S requirements
Thermography Engineer (Contractor)	Undertaking the site based leakage monitoring to the required standards and raising any leakage via the relevant processes
Production Engineer	Technical specialist in relation to the biogas system and to be made aware of any leakage detected
Environmental Regulatory Advisor	Company contact with the local EA officer. Responsible for assessing and reporting permit non-compliance. Undertakes monthly site inspection which may detect leakage
Site Operational Staff	Operation of the site assets. Detection and reporting of leakage if discovered during site tours

6. Planned Leakage Detection Process

The third party contractor in Infrared advanced gas detection will attend site and follow the requirements of the 'Safety Method Statement' ensuring all site access and safety requirements are being met.

All biogas assets (as listed) in the schedule are monitored for leakage. The relevant asset are located within the permit boundary as shown in the Asset

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Location Plan. Any detection of leakage should be escalated using the 'Gas Leak Detection Form'.

7. Reactive Leakage Detection Process


Reactive requests to monitor for biogas emissions are also directed to the team for example when new assets are installed and leakage checks are required before putting back into operation. The same processes as above are followed for monitoring and escalation.

8. Training & Calibration

Personnel involved in undertaking leak detection using specific equipment are trained in the use of that equipment and all relevant Health & Safety requirements e.g. DSEAR awareness before attending sites. Equipment such as the thermal imaging camera are calibrated as per the manufacturer's recommendations.

9. References

Best Available Techniques (BAT) Reference Document for Waste Treatment; Conclusion 14
 EPA Leak Detection & Repair Plan – A Best Practice Guide
 Gas Leak Detection Notification Form (see Appendix A)
 Flir gas camera Method Statement & Escalation Procedure (see Appendix B)
[Best Available Techniques \(BAT\) Reference Document for Waste Treatment; Conclusion 14](#)
 Maintenance Work bank download 19/11/2021

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Appendix A



In partnership with




Summary Page

Site Visit Summary

An Optical Gas Imaging (OGI) survey was conducted to investigate for any fugitive methane gas leaks from within the site waste processing system.

A record of each asset inspected is attached with accompanying still images. Where gas leaks have been identified, the record is annotated with a RAG rating and a short video of each affected asset is presented on a separate page.



Mr S. Faulkner

Survey Date:	24.02.2023
Site Induction – RAMS update led by:	Martin Quinn
Access:	Good
Camera Equipment:	FLIR GF320
Calibration:	23/12/2022 – C220018
Thermographer:	Steve Faulkner
Qualification:	ABBE L4, <u>ired</u> Cat2 (Electro/mechanical)

+


Environmental Conditions			
Date:	24.02.2023		



RAG Rating	
	Immediate Investigation recommended
	Check at next routine inspection
	No further action required

Air temperature:	8°C / 11°C		
Cloud cover:	100%		
Wind speed & Dir:	1 – 3m/s		
Precipitation:	None		
General conditions:	Good		

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Appendix B

Typical Third Party Sequence of Events

First Visit

1. Meet designated site representative during operational hours.
2. Pre-survey meeting to discuss risk assessments, limitations of access (D.S.E.A.R), first aid and safety procedures.
3. Site tour to familiarise layout, potential dangers and access routes. If appropriate, digital photos are also taken at this stage to assist with report analysis.
4. Survey / Inspection Tours
4. On arrival, sign in or report to security. Outline intentions and obtain update for any site safety or operational changes.
5. Ensure generic United Utilities Passport is valid and in date. Ensure date specific work permit is issued covering the day or estimated time on site. Note: This is to be a N.D.T (Non-Destructive Test). Therefore, the engineer / thermographer will not actually touch any of the assets under investigation.
6. Obtain a local site induction and check that the planned route is suitable.
7. Switch on thermal imaging camera and allow it to acclimatise for approximately 10 – 20 minutes
8. Check all equipment to be carried around site.
9. Record environmental and weather conditions.
10. Setup camera and tripod for landscape imaging, or prepare camera with isotherms for scanning, or input settings for individual thermograms. Capture and record findings as appropriate.
11. Record environmental and weather conditions at the end of survey.
12. Sign out and leave site.