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Title: Hazard Identification Study (HAZID) Report.

Subject: New AD Facility to Reduce COD of Effluent

Site Location: Haworth Scouring, Bradford. BD3 9 SX.

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Contents

QUALITY ASSURANCE

Revision History

Rev	By	Date	Revision Details
P1	P L Durrant	21/06/2024	For comment.

Document Control

This revision procedure shall apply to all documents, datasheets, reports etc.

Documents issued for information shall carry P status for preliminary. When documents are changed but remain preliminary the revisions shall be increased from initial issue P1 to P2, P3 etc.

When information becomes firm then the document shall be revised to revision 0 which is *issued for design* or *issued for construction* depending upon the type of document. On each subsequent change the revision number shall be increased to 1, 2, 3, 4 etc.

Whenever a document is revised and reissued the changes shall be identified in the revision history table. Changes shall be identified by a description of the change and shall indicate where it appears. For example, a datasheet shall identify the page number and line number. A report shall identify the page and paragraph number.

HOLDS

The following HOLDS require client response: none.

1.0 INTRODUCTION AND SIMPLIFIED PROCESS DESCRIPTION

1.1 Introduction

The identification and management of process hazards and associated risks are fundamental to the Haworth Scouring Process Safety Management System. To achieve this a range of risk assessment, hazard identification and quantification techniques can be applied depending on the process being studied, the purpose of the study and the maturity of design.

For this study a standard technique of hazard identification (HAZID) was used.

A HAZID study is a systematic and structured approach used to identify potential hazards and assess risks in industrial processes. The main objectives of a HAZID study are to identify potential hazards, evaluate the associated risks, and recommend measures to mitigate these risks to ensure the safety of operations, personnel, and the environment.

The HAZID study satisfies such elements such as:

- Process Safety
- Control Systems
- Design and Construction
- Asset Operation
- Regulatory Compliance

The meeting was held to identify hazards in the design and operation of an anaerobic digestion (AD) system provided by Fre Energy to Haworth Scouring.

The AD plant receives effluent from the scouring process and uses bacteria to break down the organic content producing biogas and digestate.

Biogas is combusted in an engine to make power and the effluent is sent to drain via the site's existing discharge route.

The principal purpose of the process is to reduce the sites environmental impact by reducing the carbon oxygen demand (COD) of the effluent.

Supporting benefits include significantly reducing the cost of effluent disposal via the trade effluent route, and cashflow earned from exporting power to the grid.

1.2 Simplified Process Description

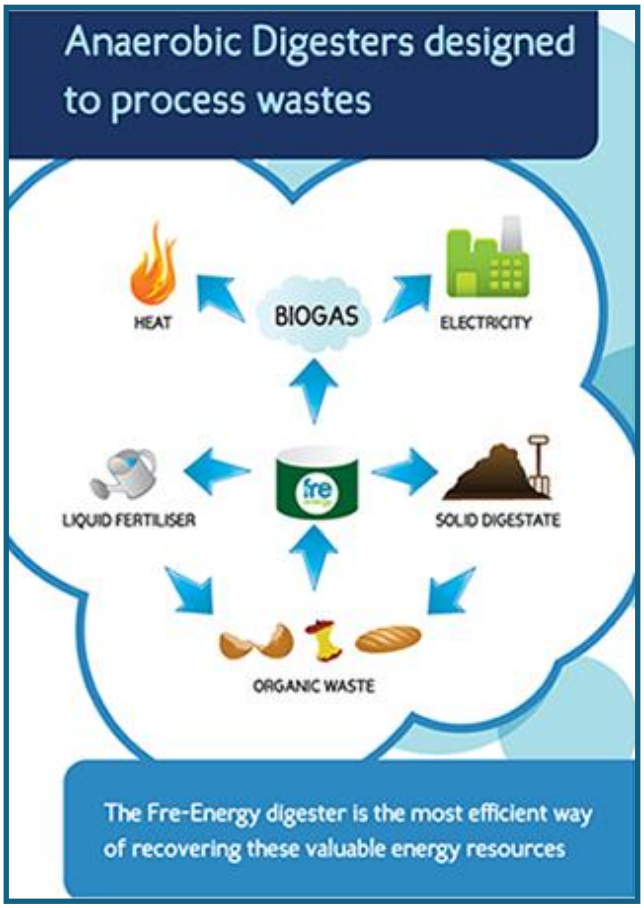
The main operating steps are:

- Receive scouring effluent from the existing process into the Input Buffer Tank.
- Feed tanks 1, 2 and 3 are sequentially fed in an overflowing cascade process over a four hour period eventually overflowing into the Output Buffer Tank. When feeding to Tanks 1, 2 and 3 is complete, Tanks 4, 5 and 6 are similarly fed over four hours and overflow to the Output Buffer Tank. Finally Tanks 7, 8 and 9 are fed as the other sets are. In this way each tank is fed three times in any 24 hour period.

- Tanks 1 to 9 contain bacteria which breaks down the organic content, releasing biogas (approximately 70% methane and 30% carbon dioxide in this application).
- Biogas is used to generate heat and renewable electricity by fuelling a generator.
- The effluent with reduced COD is transferred from the Output Buffer Tank to the site existing effluent system for discharge to sewer.
- Solids from the process are periodically removed from Tanks 1 to 9 and exported for use as a soil improver.

The generic process is depicted in overview below:

Figure 1: Generic overview of anaerobic digestion process



2. METHOD

2.1 Overview

HAZID Uses a systematic approach to review the process or system.

This can involve:

- Brainstorming sessions: Encourage open discussion to identify potential hazards.
- Checklists: Use predefined checklists tailored to the industry or specific process.
- Guidewords: Apply guidewords (e.g. leak, explosion, overpressure) to prompt the identification of hazards.

In this case a checklist approach was taken.

Once hazards were identified the consequences were stated, and mitigation existing in the design documented.

If the meeting decided that this was sufficient the next checklist item was considered. If not, then actions were assigned to improve safeguards.

2.2 Checklist Applied

Hazard	Guideword
Natural and Environmental Hazards	Climate Extremes - Temperature
	Climate Extremes - Rain
	Climate Extremes - Floods
	~~Climate Extremes – Waves.~~ Deleted as not feasible.
	Climate Extremes - Wind
	Climate Extremes - Dust
	~~Climate Extremes – Sandstorms~~ Deleted as not feasible.
	Climate Extremes - Ice, Snow & Blizzards
	Lightning
	Earthquakes
	Erosion
	Subsidence
Created (Man-made) Hazards	Security Hazards
	Terrorist Activity / Malicious intent
	Aircraft Impact
	Accidental Flammable Release
	Accide**n**tal Fire Originating from Outside and impacting AD Area
	Accidental Toxic Release from Outside AD area.
Effect of the Facility on the Surroundings	Geographical Infrastructure
	Proximity to Population
	Adjacent Land Use
	Proximity to Transport Corridors - Railway

Hazard	Guideword
	Environmental Issues
	Social Issues
Infrastructure	Normal Communications/Transportation Links
	Communications for Contingency Planning
	Supply Support
Environmental Damage	Continuous Plant Discharges to Air.
	Continuous Plant Discharges to Water
	Continuous Plant Discharges to Soil
	Emergency/Upset Discharges
	Contaminated Ground
	Facility Impact
	Waste Disposal Options
	Timing of Construction
Control Methods	Manning / Operational Philosophy
Philosophy	Operational Concepts
	Maintenance Philosophy
	Control Philosophy
	Manning Levels
	Emergency
	Response
	Concurrent Operations
	Start-up & Shutdown
Fire and Explosion Hazards	Stored, Transported and Transmitted Flammables
	Sources of Ignition - Electricity
	Sources of Ignition - Fuel
	Sources of Ignition - Oxidant
	Sources of Ignition - Static
	Sources of Ignition - Hot Surface.
	Equipment Layout - hazardous area classification / separation distances
	Fire Protection and Response
	Explosion Protection & Response
	Operator Protection - escape routes and refuge
Process Hazards	Inventory
	Release of Inventory
	Over Pressure
	Under Pressure
	Over / Under Temperature
	Excess / Zero Level
	Excess / Zero Level
	Wrong Composition / Phase
	Reaction Runaway - Additions
	Reaction Runaway - Conditions
	Operator / Maintenance Error (Mistreatment of process normally due to inadequate training or poorly written instructions)

Hazard	Guideword
	Mal-Operation of Openings - Equipment
	Mal-Operation of Openings - Human Error
	Material Problems- Flammability
	Material Problems- Thermal instability
	Material Problems- Flash points
	Material Problems- Safe storage temperature
	Material Problems- Safe storage pressure
	Material Problems- Toxicity
	Material Problems- Corrosivity
	Material Problems - Twin Flow (Two liquids, Twin Phase).
	Leak - Equipment Failure - Seal wear, corroded bolts, ductile failure bolts, vibration on pump/agitator.
	Leaks - Human Error - Poor Assembly, wrong fabrication of material.
	Equipment Instrument Malfunction
	Integrity Failure or Loss of Containment due to material failure.
	Analytical or Sampling Errors (e.g. Failure to Obtain Critical Process Data or Injuries to Personnel).
	Flow (Low or no flow occurs, high flows occurs, reverse flow occurs etc).
	Abnormal Operations (Purging, Flushing, Emergency Shutdown, Start-up.)
	Emergency Operations
	Environmental Releases (integrity failure, functioning vents, mechanical failures etc).
Failure of Utility Systems	Firewater Systems
	Fuel Gas / Natural Gas
	Heating Medium - Water for Heating
	Diesel Fuel
	Power Supply
	Steam
	Drains
	Inert Gas
	Chemical / Fuel Storage
	Waste Storage & Treatment/Sewerage
	Potable Water/ Cooling Water
	Refrigeration Failure
	HVAC failure
	Air Supply Failure
	Communication Systems Fail
	Contamination of Air, N2, Steam, Oil etc.
Maintenance Hazard	Potential maintenance activities, preparing resources, carrying out work, failure to do work, injuries to workers.
Health Hazards	Disease Hazards
	Asphyxiation Hazards
	Carcinogenic

Hazard	Guideword
	Toxic
	Physical
	Mental
	Working Hazards
	Transport

3. THE MEETING

3.1 Date and Venue

The meeting was held on the Haworth Scouring site on 5th June 2024.

In the morning the participants toured the site to look at the latest arrangements for the demolition of existing buildings to make way for the AD process.

In the afternoon the HAZID meeting was held.

Venue: Haworth Scouring. BD3 9SX.

3.2 Attendees

Name	Role	Company
Richard Norris	Managing Director	Haworth Scouring
Chris Morris	Technical Director	FRE Energy
Nicola Stanier	Office Manager	FRE Energy
Andrew Hallgarth	Principal Consultant and Managing Director HAZID Leader	ADH Risk.
Phil Durrant	Process Safety Consultant. HAZID Scribe	PDA.

3.3 Documents Studied

Fre Energy provided a flowsheet (see Appendix 9) and model views to illustrate the potential installation (which is not finalised).

3.4 Next Steps

A hazard and operability study (HAZOP) will be carried out once the design is finalised.

4. ACTION SUMMARY

ID	Recommendation	Responsible Person / Organisation (TBC).
R1.	Requires a specific procedure for disposal of rainwater - 'clean' surface water to drain. Contaminated water to existing effluent treatment or AD process if space available (direct to Input Buffer Tank?).	FRE Energy
R2.	Ensure Haworth staff are trained in procedures for disposal of effluent.	FRE Energy & Haworth Scouring
R3.	CFD requires wind model.	PDA / ADH Risk
R4.	Consider wind speeds in structural design, especially for high structures and equipment.	FRE Energy
R5.	Lightning Risk Assessment (LRA) required for AD plant location and flare, if located at high level.	PDA / ADH Risk
R6.	Assess if the flare needs a propane or natural gas pilot flame. Account for this in HAZOP and DSEAR Risk Assessment if provided.	FRE Energy determine whether propane is needed. PDA / ADH Risk account for this in HAZOP / DSEAR Assessment if provided.
R7.	Ensure that there is a secure palisade fence around the new installation. (Especially important for flare if located on roof). Control system to be inside a secure room, container or kiosk type enclosure.	FRE Energy
R8.	CFD modelling required to model dispersion of gas bag releases at low level location.	PDA / ADH Risk
R9.	Confirm effects on nearby housing by CFD dispersion modelling (Please review with R8 & R10 in combination).	PDA / ADH Risk
R10.	CFD dispersion modelling to take account of local rail track (Please review with R8 & R9 in combination).	PDA / ADH Risk
R11.	H_2S and CO_2 releases to be modelled in CFD gas dispersion assessment.	PDA / ADH Risk
R12.	Fire Strategy for new AD plant required for design input as well as for the rest of the Howarth Scouring's facility.	Haworth Scouring
R13.	Consider a Procedural Deviation Analysis.	Howarth Scouring / FRE Energy
R14.	Consider biogas dump valve to vent in safe area, in parallel with flare.	Howarth Scouring / FRE Energy
R15.	Consider isolations / flare operation in the event of an emergency in HAZOP.	Howarth Scouring / FRE Energy
R16.	Further studies required, such as DSEAR and PUWER assessments.	Howarth Scouring / FRE Energy

5. HAZID WORKSHEETS

Hazard	Guideword	Causes	Consequences	Safeguards	Recommendations	Responsible Person / Organisation
Natural and Environmental Hazards	1. Climate extremes - temperature	See ice / freezing.	N/A	N/A	N/A	N/A
	2. Climate extremes - rain	a) Bund fills with rain. b) Recent layout modifications give a larger surface area footprint.	Lose capacity if there is a major leak and possibly overflow bunded area leading to an environmental release.	a) There is a facility in the design for recycling contaminated water into process for treatment. b) Gutters to drain to surface water. c) Design adequate for increased footprint from collection of rainwater. d) Lab facilities available on site to test for Chemical Oxygen Demand (COD) before being release to main city drain system.	R1. Requires a specific procedure for disposal of rainwater - 'clean' surface water to drain. Contaminated water to existing effluent treatment or ad process if space available.	FRE Energy
					R2. Ensure Haworth staff are trained in procedures for disposal of effluent.	FRE Energy & Haworth Scouring
	3. Climate extremes - floods	Excessive rain.	Flash flooding experienced in low part of factory	a) Unexpected in the AD location.	N/A	N/A
	4. Climate extremes - waves	not relevant	N/A	N/A	N/A	N/A
	5. Climate extremes - wind	Damage to equipment from excessive wind speeds.	Potential to damage structural components of AD plant, which may lead to LoC event which could lead to fire, explosion, toxic release, environmental, asset and business interruption hazards. NOTE: Potential to have channelling wind effect due to building corridor into AD plant area.	a) Location of AD plant is partially sheltered by surround plant buildings.	R3. CFD requires wind model.	PDA / ADH Risk
					R4. Consider wind speeds in structural design, especially for high structures and equipment.	FRE Energy
	6. Climate extremes - dust	Not credible.	N/A	N/A	N/A	N/A
	7. Climate extremes - sandstorms	Not credible.	N/A	N/A	N/A	N/A

Hazard	Guideword	Causes	Consequences	Safeguards	Recommendations	Responsible Person / Organisation
	8. Climate extremes - ice, snow & blizzards	Low temperature.	Freezing of pressure relief devices / liquid lutes leading to overpressure and failure of tank or gas bag. Potential fire / toxic release.	a) Liquid lute pressure relief route has an ATEX certified heater to prevent freezing - set at 10mbarg. b) Vacuum relief in the form of a liquid lute on each group of 3 vessels set at -2.5mbarg. c) Pallet loaded PRV operates at +6 / -2 mbarg.	N/A	N/A
	9. Climate extremes - ice, snow & blizzards	Low temperature.	Freezing pipelines leading to no flow in a liquid line. No mechanism of freeze / thaw damage.	a) Operating manual requires antifreeze in lutes if there is an extended period to low ambient temperature. b) Operating manual states that if there is to be a shutdown in low ambient to consult FRE Energy. Most sites are individually designed.	N/A	N/A
	10. Climate extremes - ice, snow & blizzards	Snow	Loading of gas bag leading to damage and release of flammable and toxic gas.	a) Gas bag stays warm and tends not to suffer from snow loading. b) No issues with ambient temperature range and gas bag design conditions. c) Rest of AD Plant is adequately designed for snow load conditions given the location of the plant in question.	N/A	N/A
	11. Lightning	Lightning strike direct to gas bag or process vessel. Enclosed flare provided - could be the highest point - this is the ultimate relief point for the process.	Known hazard with industry examples of explosions.	a) AD plant's gas bag and process vessels are surrounded by higher buildings / structures and should be unaffected.	R5. Lightning Risk Assessment (LRA) required for AD plant location and flare, if located at high level.	PDA / ADH Risk
					R6. Assess if the flare needs a propane or natural gas pilot flame. Account for this in HAZOP and DSEAR Risk Assessment.	PDA / FRE Energy
	12. Earthquakes	No hazards envisaged	N/A	N/A	N/A	N/A
	13. Erosion	Process materials of construction well proven in the application.	N/A	N/A	N/A	N/A

Hazard	Guideword	Causes	Consequences	Safeguards	Recommendations	Responsible Person / Organisation
	14. Subsidence	Old buildings with risk of subsidence / collapse due to partial demolition.	Damage to gas bag and / or process vessels and release of flammable and toxic gas.	a) Full structural assessments being carried out on existing structures. b) Reinforcing of remaining structures surrounding the new AD plant. c) New concrete base foundation being provided to ensure stability of installation, after excavation and full ground survey.	N/A	N/A
Created (Man-made) Hazards	15. Security hazards	Potential intruders out of hours because of multiple entry points to site.	Damage to equipment from malicious intent leading to loss of containment and environmental release / flammable / toxic.	a) CCTV across site. b) AD plant equipment will be in a bund to contain any release ≥ 110% of largest tank. c) E-stops local to each item of equipment inside locked gated palisade fence. d) Foul sewer would catch any release.	R7. Ensure that there is a secure palisade fence around the new installation. (Especially important for flare if located on roof). Control system to be inside a secure room, container or kiosk type enclosure.	FRE Energy
	16. Terrorist Activity / Malicious intent	Deliberate damage to gas bag - more likely if the biogas bag is located on roof due possibly projectile such as air rifle, crossbow, or drone strike for example. History of intruders on roof from adjacent buildings.	Loss of Containment (LoC) event leading to the release of flammable / toxic gas.	a) If the gas bag undergoes a LoC event on roof there is good natural ventilation at height. b) If the gas bag undergoes a LoC event at low level in bund, there is potentially restricted natural ventilation.	R8. CFD modelling required to model dispersion of gas bag releases at low level location.	PDA / ADH Risk
	17. Aircraft impact	Not on Leeds Bradford Airport (LBA) flight path.	N/A	N/A	N/A	N/A

Hazard	Guideword	Causes	Consequences	Safeguards	Recommendations	Responsible Person / Organisation
	18. Accidental flammable release	a) Releases from relief valves - spurious or overpressure. b) minor leak from gas bag. c) major leak or collapse of gas bag. d) liquid leak from digestor system. e) mechanical impact from moving vehicles - example Forklift Trucks (FLT).	a) Minor gas leaks or liquid leaks lead to toxic effects and / a fire. b) Major gas bag or collapse of gas bag could lead to delayed ignition / explosion, depending on congestion and confinement.	a) Personal gas detectors used by site people. b) Natural ventilation as AD plant is in outside area. c) Installation / commissioning leak tested on construction. d) Planned Preventative Maintenance (PPM) to Original Equipment Manufacturer (OEM) instructions. e) Low pressure operation. f) Hazardous Area Classification (HAC) with certified equipment in hazardous areas. g) Protection from mechanical impact by correctly design and installed concrete wall or ARMCO barriers. h) Gas piping made of stainless steel and mainly at high level in AD Plant. i) Overpressure protection from pressure / vacuum relief devices and liquid overflows as relevant for equipment protected.	See Recommendation R8.	PDA / ADH Risk
	19. Accidental Fire Originating from Outside and impacting AD Area	a) Wool is not combustible (but smoulders). b) Concrete floors not combustible.	Onset and spread of fire could endanger life, property, assets, cause business interruption and lead to environmental impact due to fire brigade response etc.	a) Building fabric is a low combustibility risk. b) Fire Risk Assessment (FRA) up to date. c) Warehouse fitted with extensive water sprinkler system. d) Local emergency services i.e. fire brigade literally across the road form Howarth Scouring's site.	N/A	N/A
	20. Accidental Toxic Release from Outside AD area.	N/A	N/A	N/A	N/A	N/A
Effect of the Facility on the Surroundings	21. Geographical infrastructure.	Vehicle movements in the area.	Potential impact on operations and personnel.	a) The inclusion of the AD plant on Howarth Scouring site will reduce local traffic in the vicinity.	N/A	N/A

Hazard	Guideword	Causes	Consequences	Safeguards	Recommendations	Responsible Person / Organisation
	22. Proximity to Population	Nearby housing.	Any flammable or toxic releases from the AD plant, if large enough, could disperse to nearby housing and affect associated people in the vicinity.	a) Housing should be unaffected - TBC by dispersion modelling.	R9. Confirm effects on nearby housing by CFD dispersion modelling (Please review with R8 & R10 in combination).	PDA / ADH Risk
	23. Adjacent land use	Industrial unts / scrap yards - no issues expected.	N/A	N/A	N/A	N/A
	24. Proximity to Transport Corridors - Railway	Railway line nearby.	It is believed that the adjacent railway line is used for passenger and goods traffic. However, it is unknow what type of goods traffic occurs on this line. Any flammable or toxic releases from the AD plant, if large enough, could disperse to the adjacent railway line and affect associated people in the vicinity.	a) Open location. b) Minimum 16m separation distance between potential AD pant and the railway line. c) No expected stoppage of rail traffic (constant moving from site observation – Howarth Scouring) due to distance away from stations and points.	R10. CFD dispersion modelling to take account of local rail track (Please review with R8 & R9 in combination).	PDA / ADH Risk
	25. Environmental issues	Covered by loss of containment	N/A	N/A	N/A	N/A
	26. Social issues	No odour issues identified from ad.	N/A	N/A	N/A	N/A
Infrastructure	27. Normal communications/ transportation links	No hazards identified apart from traffic movements and effect on railway – covered elsewhere.	N/A	N/A	N/A	N/A
	28. Communications for Contingency Planning	No hazards identified.	N/A	N/A	N/A	N/A
	29. Supply support	No hazards identified.	N/A	N/A	N/A	N/A

Hazard	Guideword	Causes	Consequences	Safeguards	Recommendations	Responsible Person / Organisation
Environmental Damage	30. Continuous Plant Discharges to Air.	a) H_2S fugitive releases. b) CO_2 fugitive releases.	Toxic and asphyxiation effects (including breathing reflux) to people.	a) Ferric chloride used in process which suppresses H_2S, where additional ferric chloride could be added to the process if needed. Due to Ferric chloride addition into the process, concentration of H_2S is dropped from approx. 2000ppm (fatal levels) to 100ppm in the biogas which is low and will readily disperse. NOTE: Biogas is approx. 71% CH_4 and 29% CO_2.	R11. H_2S and CO_2 releases to be modelled in CFD gas dispersion assessment.	PDA / ADH Risk
	31. Continuous Plant Discharges to Water	Rainwater covered above.	Digestate as part of the AD plant process.	a) Digestate will be routed to existing effluent plant and processed into a ~~to be concentrated to a~~ sludge with water removed to trade effluent. Sludge is used ~~land~~ as soil improver in the agricultural industry.	N/A	N/A
	32. Continuous Plant Discharges to Soil	None - fully hard standing bund.	N/A	N/A	N/A	N/A
	33. Emergency/upset discharges	Gas and liquid emergency upset discharges from the AD plant process.	Please see consequences associated with gas and liquid emergency upset discharges etc in this HAZID study.	a) Flare handles emergency gas releases. b) Bunding for emergency liquid releases. c) Sewer system for any releases not caught by bunding.	N/A	N/A
	34. Contaminated ground	None identified.	N/A	N/A	N/A	N/A
	35. Facility impact	Improved environmental impact	N/A	a) See Haworth Scouring Environmental, Social, Governance (ESG) presentation.	N/A	N/A
	36. Waste disposal options	Disposal of wastes to approved routes	N/A	a) Pollution, Prevention and Control (PPC) permit in place.	N/A	N/A
	37. Timing of Construction	No issues identified.	N/A	N/A	N/A	N/A
Control Methods	38. Manning / operational philosophy	Automated and remote monitoring.		a) Service contract with FRE Energy for major maintenance and ongoing support.	N/A	N/A

Hazard	Guideword	Causes	Consequences	Safeguards	Recommendations	Responsible Person / Organisation
				b) Minor maintenance will be covered directly by Haworth Scouring.		
Philosophy	39. Operational concepts	Plans in place for Waste Management Training & Advisory Board (WAMITAB) training	N/A	N/A	N/A	N/A
	40. Maintenance philosophy	Due to poor maintenance philosophy, LoC events could occur leading to releases of flammable, toxic and environmental damaging substances from the AD plant process.	Please see consequences associated with gas and liquid emergency upset discharges etc in this HAZID study.	a) Service contract with FRE Energy for major maintenance and ongoing support. b) Minor maintenance will be covered directly by Haworth Scouring. c) Spares held in site stores.	N/A	N/A
	41. Control philosophy	Automated and remote monitoring	N/A	N/A	N/A	N/A
	42. Manning levels	Adequate manning in place.	N/A	a) Dedicated manager selected and scheduled to be trained by FRE Energy during commissioning stage.	N/A	N/A
	43. Emergency	Due to poor emergency response philosophy, LoC events could occur leading to releases of flammable, toxic and environmental damaging substances from the AD plant process.	Please see consequences associated with gas and liquid emergency upset discharges etc in this HAZID study.	a) Site procedures will be incorporated into the new AD plant. b) FRE Energy operating manual has principles to be adapted into Howarth Scouring's emergency procedures.	N/A	N/A
	44. Response	Due to poor response philosophy, LoC events could occur leading to releases of flammable, toxic and environmental damaging substances from the AD plant process.	Please see consequences associated with gas and liquid emergency upset discharges etc in this HAZID study.	a) Remote monitoring / dialling for Howarth Scouring site key contacts as well as FRE Energy named contacts. b) Security visits site over weekends. c) CCTV on site.	N/A	N/A

Hazard	Guideword	Causes	Consequences	Safeguards	Recommendations	Responsible Person / Organisation
				d) Emergency services adjacent to Howarth Scouring's site.		
	45. Concurrent operations	None identified	N/A	N/A	N/A	N/A
	46. Start-up & Shutdown	As FRE Energy's Operating Manual.	N/A	N/A	N/A	N/A
Fire and Explosion Hazards	47. Stored, Transported and Transmitted Flammables	DSEAR Assessment	N/A	N/A	N/A	N/A
	48. Sources of Ignition - Electricity	DSEAR Assessment	N/A	N/A	N/A	N/A
	49. Sources of Ignition - Fuel	DSEAR Assessment	N/A	N/A	N/A	N/A
	50. Sources of Ignition - Oxidant	DSEAR Assessment	N/A	N/A	N/A	N/A
	51. Sources of Ignition - Static	DSEAR Assessment	N/A	N/A	N/A	N/A
		DSEAR Assessment	N/A	N/A	N/A	N/A
		DSEAR Assessment	N/A	N/A	N/A	N/A

Hazard	Guideword	Causes	Consequences	Safeguards	Recommendations	Responsible Person / Organisation
	52. Sources of Ignition - Hot Surface.	DSEAR Assessment	N/A	N/A	N/A	N/A
	53. Equipment Layout - hazardous area classification / separation distances	DSEAR Assessment	N/A	N/A	N/A	N/A
	54. Fire Protection and Response	DSEAR Assessment	N/A	N/A	N/A	N/A
	55. Explosion protection & response	DSEAR assessment	N/A	N/A	N/A	N/A
	56. Operator Protection - escape routes and refuge	FRA / Fire Strategy	Personnel (staff, contractors or visitors) can not escape during fire (or other emergency situation) easily and within specified distance, route and timescale. Therefore endangering life safety in fire or emergency situation.	None currently identified.	R12. Fire Strategy for new AD plant required for design input as well as for the rest of the Howarth Scouring's facility.	Howarth Scouring
Process Hazards	57. Inventory	Hazardous inventory of biogas – toxic and flammable hazards.	Please see consequences associated with gas and liquid emergency upset discharges etc in this HAZID study.	a) 250m^3 of gas in a flexible bag - smallest inventory that can be used with the size/capacity of CHP unit used. b) Otherwise, no increases of hazardous substances on site.	N/A	N/A
	58. Release of Inventory	See releases to air / water / land above.	N/A	N/A	N/A	N/A
	59. Over pressure	Overpressure events will be identified and assessed through the HAZOP process.	If over pressurisation causes LoC event, then there may be a release of liquid digestate, flammable/toxic gases in the vicinity. Thus having potential to hurt or significantly damage, depending on escalation path, people, the environment, assets and the business as outlined previously in this HAZID.	a) Biogas normally at 10mbarg in process. b) In biogas lines high pressure covered by lutes and PRV protection. c) In liquid lines pressure switches stop pumps if dead headed.	N/A	N/A

Hazard	Guideword	Causes	Consequences	Safeguards	Recommendations	Responsible Person / Organisation
	60. Under pressure	Under pressure events will be identified and assessed through the HAZOP process. However, draining the tanks or potential running the CHP for longer than required.	May lead to air ingress and flammable atmosphere in the system or vacuum and subsequent tank collapse.	a) Pressure relief devices defined above, such as PRV and Lutes.	N/A	N/A
	61. Over / under temperature	See low ambient above.	N/A	N/A	N/A	N/A
	62. Excess / zero level	Overfilling events will be identified and assessed through the HAZOP process..	If overfilling causes LoC event, then there may be a release of liquid digestate, flammable/toxic gas release in the vicinity. Thus having potential to hurt or significantly damage, depending on escalation path, people, the environment, assets and the business as outlined previously in this HAZID.	a) Protected by level transmitter and pressure switch. b) Overflow provided by lute. c) Antifoam protection by lute. d) Flare handles emergency gas releases. e) Bunding for emergency liquid releases. f) Sewer system for any releases not caught by bunding.	N/A	N/A
	63. Excess / zero level	Loss of containment / gravity draining tank	May lead to air ingress and flammable atmosphere in the system or vacuum and subsequent tank collapse.	a) Vacuum protection b) Software alarm on low level trip prevents extra low level - can empty tank by special procedure c) Gravity draining by special procedure. d) Protection against a major tank or piping leak from software low level trip. e) Gas systems connected - gives redundancy and high capacity relief.	N/A	N/A
	64. Wrong composition / phase	No issues identified.	N/A	a) Macerator processes all feeds. b) All effluent screened prior to processing.	N/A	N/A
	65. Reaction runaway - additions	None	N/A	N/A	N/A	N/A

Hazard	Guideword	Causes	Consequences	Safeguards	Recommendations	Responsible Person / Organisation
	66. Reaction runaway - conditions	None	N/A	N/A	N/A	N/A
	67. Operator / Maintenance Error (Mistreatment of process normally due to inadequate training or poorly written instructions)	Mistreatment or maloperation of process normally due to inadequate training or poorly written instructions.	May lead to LoC event potentially, which may hurt or significantly damage, depending on escalation path, people, the environment, assets and the business as outlined previously in this HAZID.	a) Software interlocks prevent maloperations. b) Operator training. c) Equipment operated successfully on farms with relatively unskilled supervision. d) Site is used to operating processes. e) Site has existing SCADA so is familiar with computerised and automated control systems.	N/A	N/A
	68. Mal-Operation of Openings - Equipment	Process substances are contained within piping and tanks. Connections, openings and hatches etc, associated with equipment, may be opened due to maloperation by personnel.	May lead to LoC event potentially, which may hurt or significantly damage, depending on escalation path, people, the environment, assets and the business as outlined previously in this HAZID.	a) Permit to work system in place – Lock Out Tag Out (LOTO) will be adapted for the AD plant system. b) Operator training.	R13. Consider a Procedural Deviation Analysis.	Howarth Scouring / FRE Energy
	69. Mal-Operation of Openings - Human Error	Process substances are contained within piping and tanks. Connections, openings and hatches etc, associated with equipment, may be opened due to human error by personnel.	May lead to LoC event potentially, which may hurt or significantly damage, depending on escalation path, people, the environment, assets and the business as outlined previously in this HAZID.	a) Gas sample points at high level where gas pipes are. b) Liquid sample and drain valves have blank flanges or screwed plugs as appropriate. c) On bottom of tanks there is always an actuated and manual valve.	Please see R13.	Howarth Scouring / FRE Energy
	70. Material problems-flammability	See DSEAR assessment.	N/A	N/A	N/A	N/A
	71. Material Problems-Thermal instability	No issues identified.	N/A	N/A	N/A	N/A
	72. Material Problems-Flash points	See DSEAR assessment.	N/A	N/A	N/A	N/A

Hazard	Guideword	Causes	Consequences	Safeguards	Recommendations	Responsible Person / Organisation
	73. Material Problems- Safe storage temperature	No issues with residence time / temperature in digesters. No issues with temperature for gas storage.	N/A	N/A	N/A	N/A
	74. Material Problems- Safe storage pressure	Incorrectly designed, manufactured or installed/commissions equipment that may not withstand design storage pressures anticipated with the AD plant system.	May lead to LoC event potentially, which may hurt or significantly damage, depending on escalation path, people, the environment, assets and the business as outlined previously in this HAZID.	a) Plastic pipe pressure rating derated for temperature. b) GRP tanks suitable for 70C - exceeds temperature of process. c) Protected by relief devices for over and under pressure. d) Designed, manufactured and installed/commissions by well trained personnel to acceptable industry standards, where the equipment in question will take in exceed of the process pressure anticipated at the temperatures envisaged for the new AD plant in question.	N/A	N/A
	75. Material problems- toxicity	H_2S / CO_2 to be assessed by dispersion study.	N/A	N/A	Please see R3, R8, R9, R10, R11 in combination.	PDA / ADH Risk
	76. Material problems- corrosivity	H_2S in system can create corrosivity with certain materials.	High H_2S would damage CHP engine.	a) Appropriate materials of construction in process. b) Ferric chloride added to process - supresses H_2S concentration to acceptable levels for toxic and corrosivity abatement.	N/A	N/A
	77. Material Problems - Twin Flow (Two liquids, Twin Phase).	No hazards identified	N/A	N/A	N/A	N/A
	78. Leak - Equipment Failure - Seal wear, corroded bolts, ductile failure bolts, vibration on pump / agitator.	Potential leak due to equipment failure such as seal wear, corroded bolts, ductile failure of bolts, vibration on pump / agitator for example.	May lead to LoC event potentially, which may hurt or significantly damage, depending on escalation path, people, the environment, assets and the business as outlined previously in this HAZID.	a) Planned Preventative Maintenance (PPM) b) Original Equipment Manufacturer (OEM) maintenance schedules. c) Anti vibration mounts where needed.	N/A	N/A

Hazard	Guideword	Causes	Consequences	Safeguards	Recommendations	Responsible Person / Organisation
	79. Leaks - Human Error - Poor Assembly, wrong fabrication of material.	Human error associated with poor assembly, wrong fabrication of material etc, which may create leak of flammable, toxic or eco-toxic material.	May lead to LoC event potentially, which may hurt or significantly damage, depending on escalation path, people, the environment, assets and the business as outlined previously in this HAZID.	a) Experienced people assemble systems - proven on many applications. b) Coded welders where needed.	N/A	N/A
	80. Equipment instrument malfunction	Poor section of Instrumentation, service conditions, calibration, testing and maintenance activities may lead to instrument not working or reading correctly.	May lead to LoC event potentially, which may hurt or significantly damage, depending on escalation path, people, the environment, assets and the business as outlined previously in this HAZID.	a) Equipment monitored on PLC/SCADA system. b) Duplication of level measurement would show if one were in a failed condition.	*Comment - these failures will be covered in HAZOP.*	N/A
	81. Integrity Failure or Loss of Containment due to material failure.	Incorrect selection and design of material which could cause integrity failure leading to LoC event.	May lead to LoC event potentially, which may hurt or significantly damage, depending on escalation path, people, the environment, assets and the business as outlined previously in this HAZID.	a) Material Of Construction (MOC) selected by operating experience of many similar systems with no issues.	N/A	N/A
	82. Analytical or Sampling Errors (e.g. Failure to Obtain Critical Process Data or Injuries to Personnel).	No safety issues envisaged.	N/A	N/A	N/A	N/A
	83. Flow (Low or no flow occurs, high flows occurs, reverse flow occurs etc).	Cover in HAZOP.	N/A	N/A	N/A	N/A
	84. Abnormal Operations (Purging, Flushing, Emergency Shutdown, Start-up.)	Managed by FRE	N/A	N/A	Please see R13.	Howarth Scouring / FRE Energy
	85. Emergency operations	In an emergency situation, where blow down to flare is required in the new AD plant system, this may take up to 60 minutes due to flare capacity.	60 mins for blow down to flare of full AD plant system, including gas bag, maybe too long in emergency situation. This may have hurt or significantly damage, depending on escalation path, people, the environment, assets and the business as outline previously in this HAZID.	N/A	R14. Consider biogas dump valve to vent location in safe area, in parallel with flare.	Howarth Scouring / FRE Energy

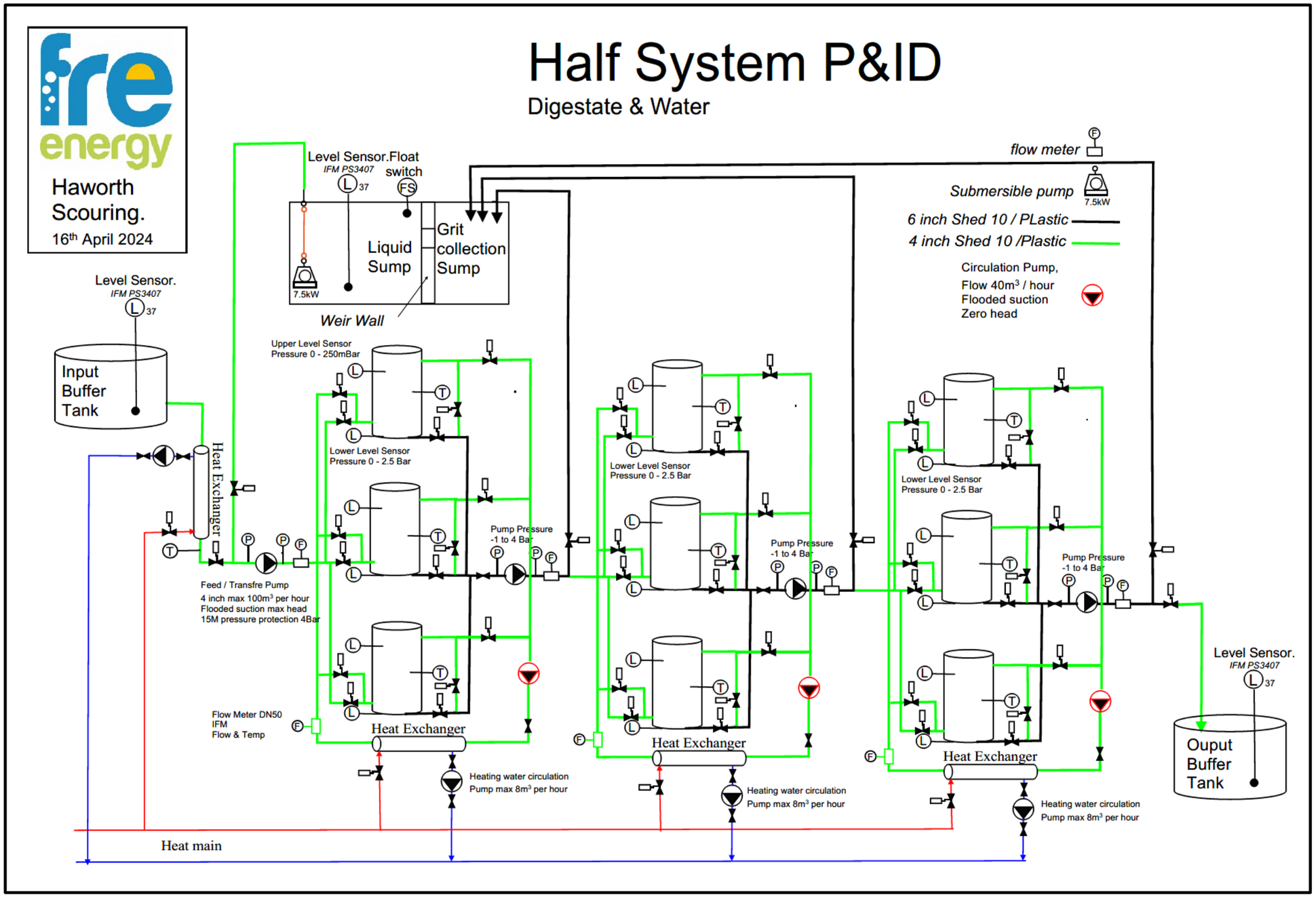
Hazard	Guideword	Causes	Consequences	Safeguards	Recommendations	Responsible Person / Organisation
	86. Environmental Releases (integrity failure, functioning vents, mechanical failures etc).	The AD plant has a potential to have releases which could affect the environment. These could occur due to integrity failures, functioning vents and mechanical failures.	May lead to LoC event potentially, which may hurt or significantly damage, depending on escalation path, the environment as outlined previously in this HAZID.	a) Existing procedures for stopping liquid flows, if needed. b) Pressure monitored in instrument air systems.	N/A	N/A
Failure of Utility Systems	87. Firewater systems	No fire water system on new AD plant system. However, water sprinkler system in main factory surrounding new AD plant.	Inability to quench a potential fire if it broke out in the new AD plant facility.	a) Small fires can be tackled by onsite trained resources. b) Actuated valves on inlet and outlet of biogas bag for isolation purposes. c) Local emergency services i.e. fire brigade literally across the road form Howarth Scouring's site.	R15. Consider isolations / flare operation in the event of an emergency in HAZOP.	Howarth Scouring / FRE Energy
	88. Fuel gas / natural gas	CHP has a gas blending unit to maintain calorific value if biogas needs it, no process hazards identified.	N/A	a) 2-G (external contractor who supplies and maintains CHP units with Howarth Scouring) covers this part of the process.	N/A	N/A
	89. Heating Medium - Water for Heating	No hazards identified	N/A	N/A	N/A	N/A
	90. Diesel fuel	None	N/A	N/A	N/A	N/A
	91. Power supply	Mains power failure affecting AD Plant only.	Lost of AD plant control system.	a) Uninterruptible Power Supply (UPS), which also provides a degree of lightning protection, provides power for up to 24v systems for up to 15 minutes to enable a safe shutdown.	N/A	N/A
	92. Steam	None	N/A	N/A	N/A	N/A
	93. Drains	Surface water and process drains separated. Bunding containing main inventories. All plant is on hardstanding.	N/A	N/A	N/A	N/A

Hazard	Guideword	Causes	Consequences	Safeguards	Recommendations	Responsible Person / Organisation
	94. Inert gas	None	N/A	N/A	N/A	N/A
	95. Chemical / fuel storage	Ferric chloride only.	Without Ferric Chloride, unable to reduce the H_2S concentration from potential lethal levels to more acceptable levels in the AD Plant.	a) Hazards known and understood by site and FRE Energy.	N/A	N/A
	96. Waste storage & treatment/sewerage	Wastes exported from site.	N/A	N/A	N/A	N/A
	97. Potable water/ cooling water	No hazards identified	N/A	N/A	N/A	N/A
	98. Refrigeration failure	None	N/A	N/A	N/A	N/A
	99. HVAC failure	None	N/A	N/A	N/A	N/A
	100. Air supply failure	Unable to control air operated control valves etc.	Without control of air operated air valves, the AD Plant may be difficult to control, which could result in AD plant being in an unsafe state or condition. May lead to LoC event as described previously in this HAZID.	a) Air pressure failure alarm. b) Local air reservoir. c) Valves fail to safe state.	N/A	N/A
	101. Communication systems fail	Comms fail- hacking	Hacking events may lead to LoC event potentially, which may hurt or significantly damage, depending on escalation path, people, the environment, assets and the business as outlined previously in this HAZID.	a) System operated locally and remotely. If comms lost local control would still be active. b) Unlikely that hacking could cause hazardous situations to arise. c) Hackers would need to have source code to access process values.	N/A	N/A
	102. Contamination of Air, N_2, Steam, Oil etc.	Filters dryers fail	Damage to actuated valves	a) Filter / dryers on Planned Preventative Maintenance (PPM). b) Receiver on dryer discharge has auto dump for condensate / oil accumulation/	N/A	N/A
Maintenance Hazard	103. Potential maintenance activities, preparing resources, carrying out work, failure to do work, injuries to workers.	General occupational and process safety type causes associated with maintenance work, specifically on the AD plant which could cause a range of consequences,	Has the potential to cause a fatality.	a) Original Equipment Manufacturer (OEM) Manual b) Permit to Work (PTW) System. c) Standard Operating Procedures (SOPs) d) Service contract with FRE Energy.	N/A	N/A

Hazard	Guideword	Causes	Consequences	Safeguards	Recommendations	Responsible Person / Organisation
		depending on escalation paths. Some of these causes and consequence have been described in this HAZID, others will be described in more details in the HAZOP and through other assessment studies.		e) Site procedures to ensure operations are covered by SOPs. f) No new chemicals to site as a result of the AD process. g) Existing CoSHH assessments.		
Health Hazards	104. Disease hazards	Risk is no greater than those on site at present.	N/A	N/A	N/A	N/A
	105. Asphyxiation hazards	CO_2 / H_2S release as outlined earlier in this HAZID.	N/A	N/A	Please see R3, R8, R9, R10 and R11.	N/A
	106. Carcinogenic	None	N/A	N/A	N/A	N/A
	107. Toxic	H_2S releases as outlined earlier in this HAZID.	N/A	N/A	Please see R3, R8, R9, R10 and R11.	N/A
	108. Physical	Moving vehicles, such as forklift truck (FLT) crashes/collisions, imbalanced loads/falling objects etc.	Has the potential to cause a fatality.	a) Hazard exists on site with shared roads for people and traffic and many forklift truck movements.	N/A	N/A
	109. Mental	None	N/A	N/A	N/A	N/A
	110. Working hazards	Working at heights manual handling guarding / entanglement / trap and nip points slips trips and falls. Heat stress	Has the potential to cause a fatality.	Compliance with HSE regulations / PUWER etc. Safe system of work - hot work etc.	R16. Further studies required, such as DSEAR and PUWER assessments.	Howarth Scouring / FRE Energy
	111. Transport	None apart from vehicle movements hazardous to	N/A	N/A	N/A	N/A

Hazard	Guideword	Causes	Consequences	Safeguards	Recommendations	Responsible Person / Organisation
		pedestrians identified above.				

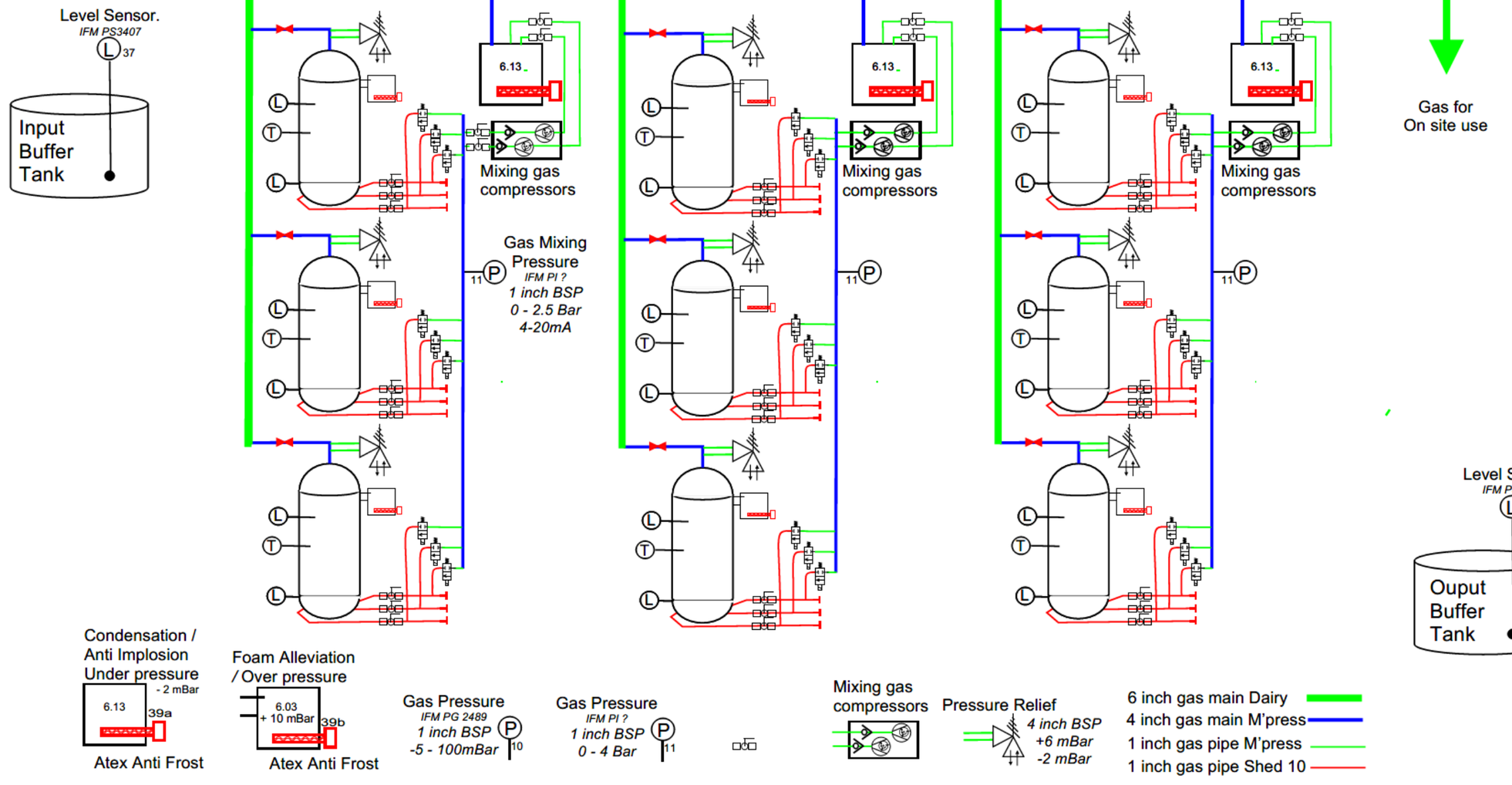
APPENDIX ONE: FLOWSHEET USED IN HAZID

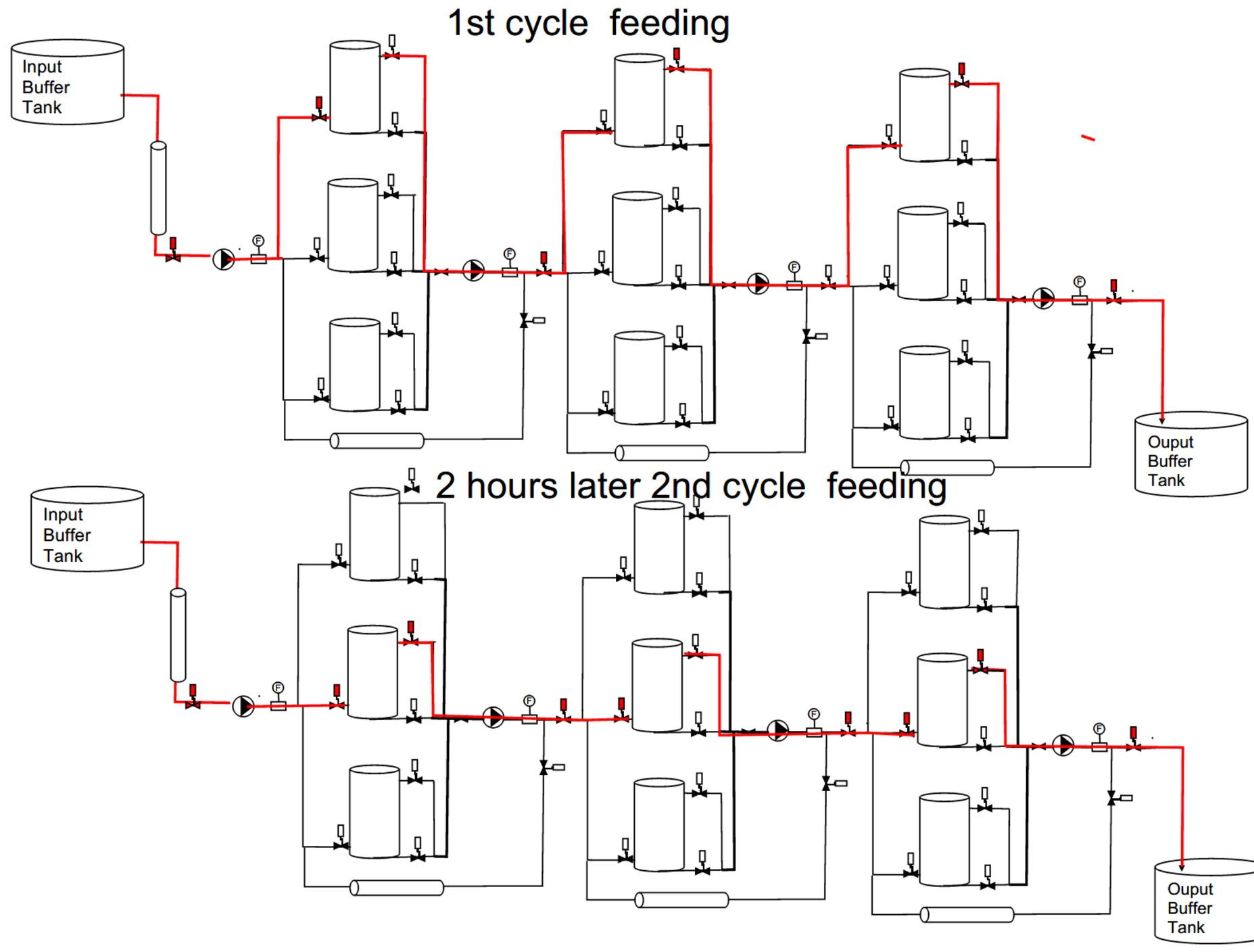


Half System P&ID

Gas,Tank protection and mixing

fre energy
Haworth Scouring.
16 April 2024

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