



**Process Functional Analysis  
UK-309 Home Farm  
Engie UK**

**Revision Number: 01 / 17.10.2025**

**Date: 20.10.2025**

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## DESCRIPTION OF PROCESS FUNCTION

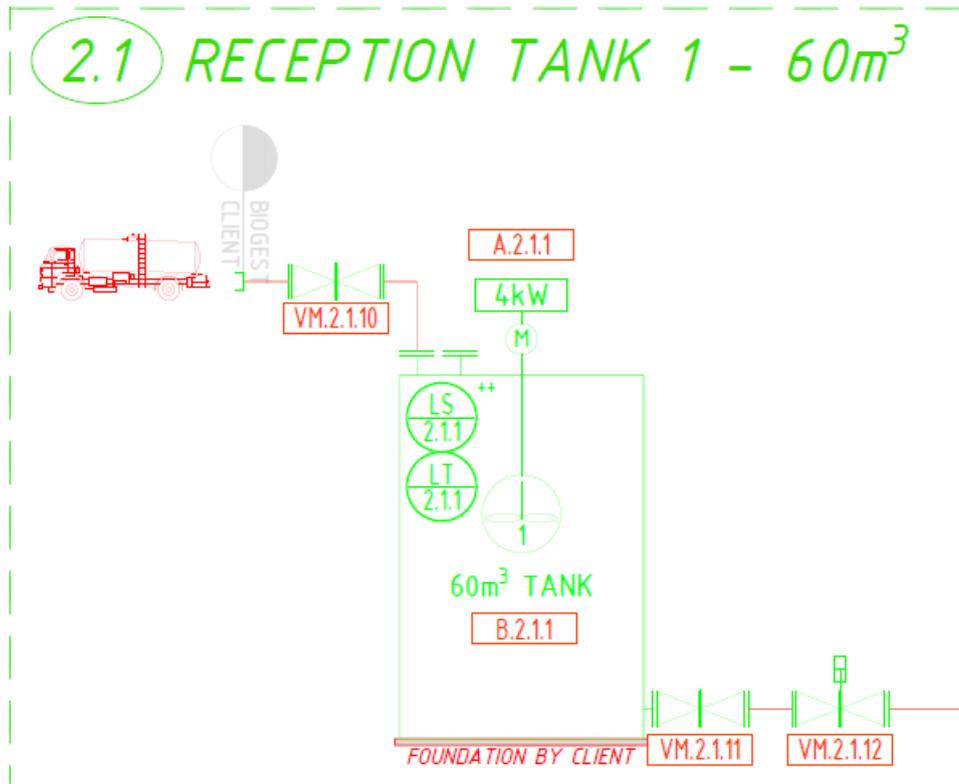
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Rev 01 / October 2025

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# 1. Description of the process functions

## 1.1. Reception Tank 1



Picture 1. Part of PFD related to the Reception tank 1

**Function:** The Reception tank 1 stores slurry unloaded from vacuum tankers and feeds it into the Power Ring digester as needed through pumps.

**Main Equipment:** Agitator A.2.1.1 – Ensures slurry homogeneity

**Instrumentation:**

Level transmitter – LT.2.1.1 – Monitors slurry level

Level switch – LS.2.1.1 – Detects high-level alarm

**Operating mode:**

**Mode A(Automatic):** Slurry feeding based on schedule, with control options by volume, time, or level

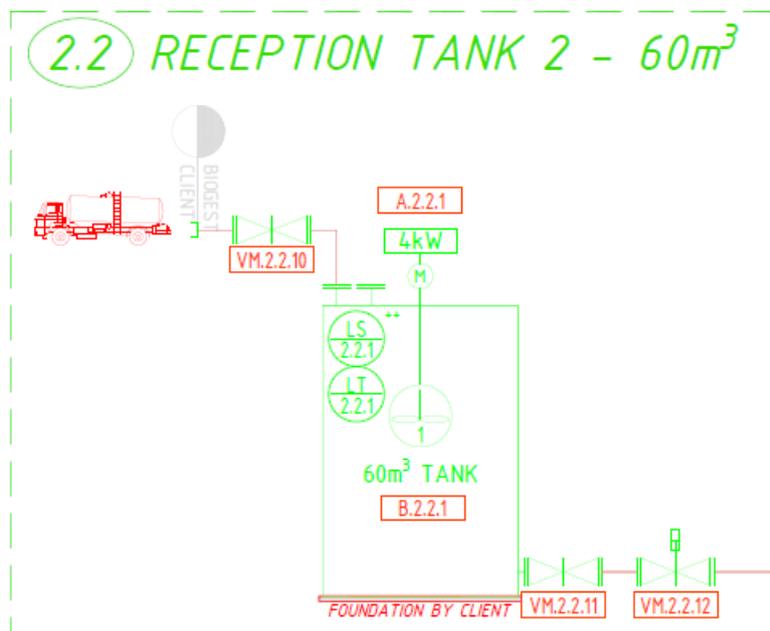
**Mode B(Manual):** Operator controls feeding by opening valves and starting pumps in Pumping station 2 and controls agitation

**Mode C:** Feeding stops when low or high level alarms trigger

### Key Interlocks/Protection:

- Low/High Level Alarms: Alerts and feeding stoppage if levels fall outside preset thresholds(LT.2.1.1)
- Max Level Alarm: High max level activates alarm, closes valves, and stops feeding(LS.2.1.1)
- Evacuation: Automatically triggered if the tank reaches a preset evacuation level(LT.2.1.1)
- Feeding Stop: Triggered when digester reaches preset stop levels(LT.4.1.1/LT.5.1.1)

## 1.2. Reception Tank 2



Picture 2. Part of PFD related to the Reception tank 2

Function: The Reception tank 2 stores slurry unloaded from vacuum tankers and feeds it into the Power Ring digester as needed through pumps.

Main Equipment: Agitator A.2.2.1 – Ensures slurry homogeneity

### Instrumentation:

Level transmitter – LT.2.2.1 – Monitors slurry level

Level switch – LS.2.2.1 – Detects high-level alarm

### Operating mode:

**Mode A(Automatic):** Slurry feeding based on schedule, with control options by volume, time, or level

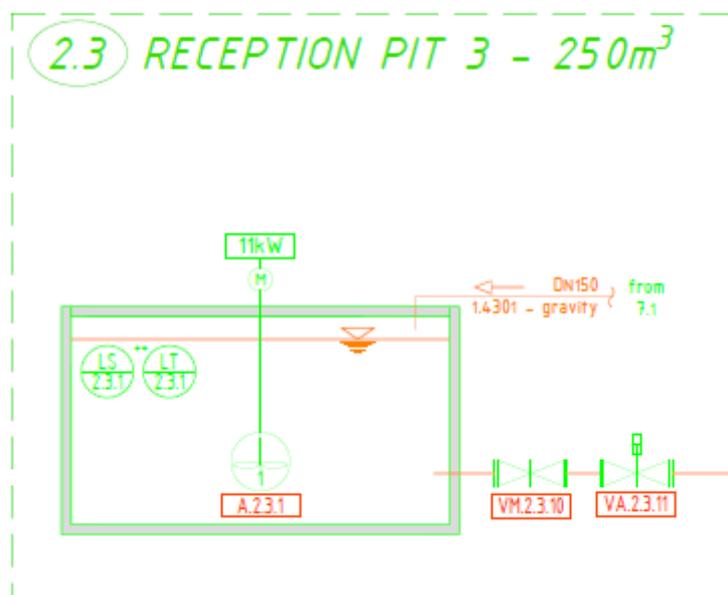
**Mode B(Manual):** Operator controls feeding by opening valves and starting pumps in Pumping station 2 and controls agitation

**Mode C:** Feeding stops when low or high level alarms trigger

### Key Interlocks/Protection:

- Low/High Level Alarms: Alerts and feeding stoppage if levels fall outside preset thresholds(LT.2.2.1)
- Max Level Alarm: High max level activates alarm, closes valves, and stops feeding(LS.2.2.1)
- Evacuation: Automatically triggered if the pit reaches a preset evacuation level(LT.2.2.1)
- Feeding Stop: Triggered when digester reaches preset stop levels(LT.4.1.1/LT.5.1.1)

### 1.3. Reception Pit 3



Picture 3. Part of PFD related to the Reception pit 3

Function: The Reception pit 3 stores liquid digestate brought by gravity overflow after separation process and feeds it into the Power Ring digester as needed through pumps.

Main Equipment: Agitator A.2.3.1 – Ensures liquid digestate homogeneity

#### Instrumentation:

Level transmitter – LT.2.3.1 – Monitors liquid digestate level

Level switch – LS.2.3.1 – Detects high-level alarm

#### Operating Modes:

**Mode A(Automatic):** Liquid digestate feeding based on schedule, with control options by volume, time, or level

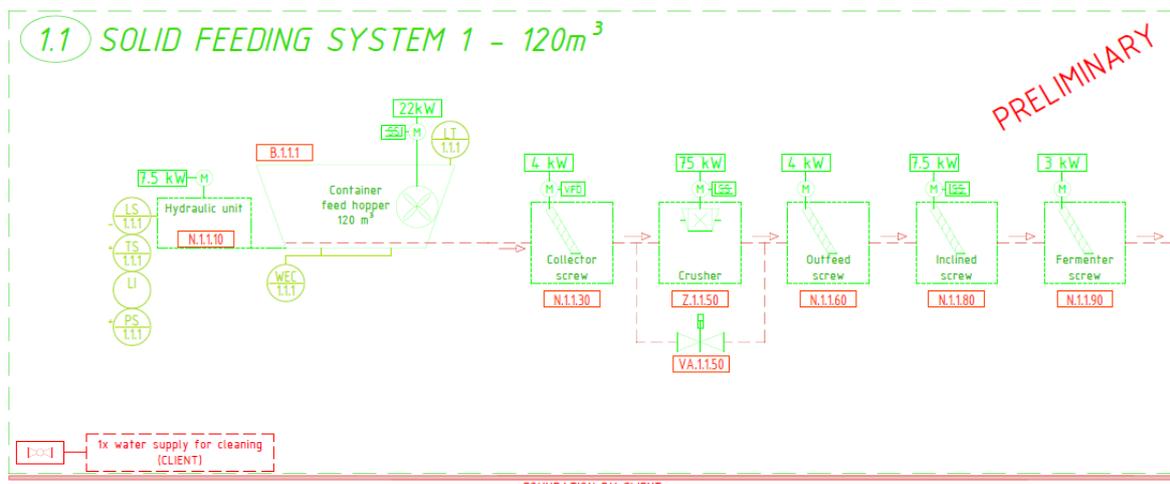
**Mode B(Manual):** Operator controls feeding by opening valves and starting pumps in Pumping station 2 and controls agitation

**Mode C:** Feeding stops when low or high level alarms trigger

Key Interlocks/Protection:

- Low/High Level Alarms: Alerts and feeding stoppage if levels fall outside preset thresholds(LT.2.3.1)
- Max Level Alarm: High max level activates alarm, closes valves, and stops feeding(LS.2.3.1)
- Evacuation: Automatically triggered if the pit reaches a preset evacuation level(LT.2.3.1)
- Feeding Stop: Triggered when digester reaches preset stop levels(LT.4.1.1/LT.5.1.1)

**1.4. Solid Feeding System 1**



Picture 4. Part of PFD related to the Solid feeding system 1

Function: The Solid feeding system transfers solid feedstock from the hopper to the primary digester via screws and crusher, ensuring consistent and controlled feeding of substrates.

Main equipment:

- Hopper – B.1.1.1 – Receives solid feedstock from wheel loader
- Hydraulic Unit – N.1.1.10 – Drives the moving floor for feedstock transport
- Mixing star – N.1.1.20 – Feeds substrate evenly to the collector screw
- Collector screw – N.1.1.30 – Transfers material to the common conveyor screw
- Impact crusher – Z.1.1.50 – Breaks down feedstock into particles
- Outfeed screw – N.1.1.60 - Convey crushed material
- Inclined screw – N.1.1.80 – Convey crushed material
- Fermenter screw – N.1.1.90 – Convey crushed material to the primary digester
- Bypass Valve – VA.1.1.50 - Allows rerouting of material flow when required

Instrumentation:

- Weight measurement – WEC.1.1.1 – Monitors hopper fill level
- Level switch – LS.1.1.1 – Protects hydraulic system
- Temperature switch – TS.1.1.1 – Protects hydraulic system
- Pressure switch – PS.1.1.1 – Controls front/end position of hydraulic floor
- Level transmitter – LT.1.1.1 – Monitors fill level in mixing area

Operating Modes:

**Mode A(Automatic):** Feeds solid substrate according to SCADA schedule and demand

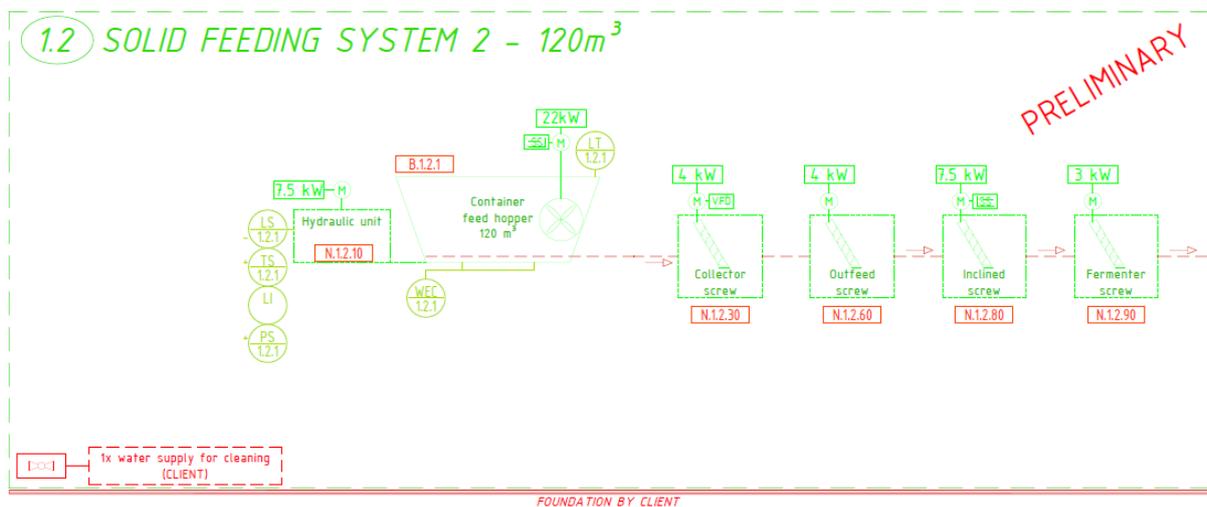
**Mode B(Manual):** Individual equipment can be operated for testing or maintenance

**Mode C(Stop):** Activated upon alarms or safety interlocks

Key Interlocks/Protection:

- Feeding stops automatically on high hopper weight, overcurrent of crusher or screws, or activation of hydraulic oil level/temperature alarms
- Level transmitter(LT.1.1.1) regulates movement of the conveying floor based on fill height in mixing area

**1.5. Solid Feeding System 2**



Picture 5. Part of PFD related to the Solid feeding system 2

Function: The Solid feeding system transfers solid feedstock from the hopper to the primary digester via screws and crusher, ensuring consistent and controlled feeding of substrates.

Main equipment:

Hopper – B.1.2.1 – Receives solid feedstock from wheel loader

Hydraulic Unit – N.1.2.10 – Drives the moving floor for feedstock transport

Mixing star – N.1.2.20 – Feeds substrate evenly to the collector screw

Collector screw – N.1.2.30 – Transfers material to the common conveyor screw

Impact crusher – Z.1.2.50 – Breaks down feedstock into particles

Outfeed screw – N.1.2.60 - Convey crushed material

Inclined screw – N.1.2.80 – Convey crushed material

Fermenter screw – N.1.2.90 – Convey crushed material to the primary digester

Bypass Valve – VA.1.2.50 - Allows rerouting of material flow when required

Instrumentation:

Weight measurement – WEC.1.2.1 – Monitors hopper fill level

Level switch – LS.1.2.1 – Protects hydraulic system

Temperature switch – TS.1.2.1 – Protects hydraulic system

Pressure switch – PS.1.2.1 – Controls front/end position of hydraulic floor

Level transmitter – LT.1.2.1 – Monitors fill level in mixing area

Operating Modes:

**Mode A(Automatic):** Feeds solid substrate according to SCADA schedule and demand

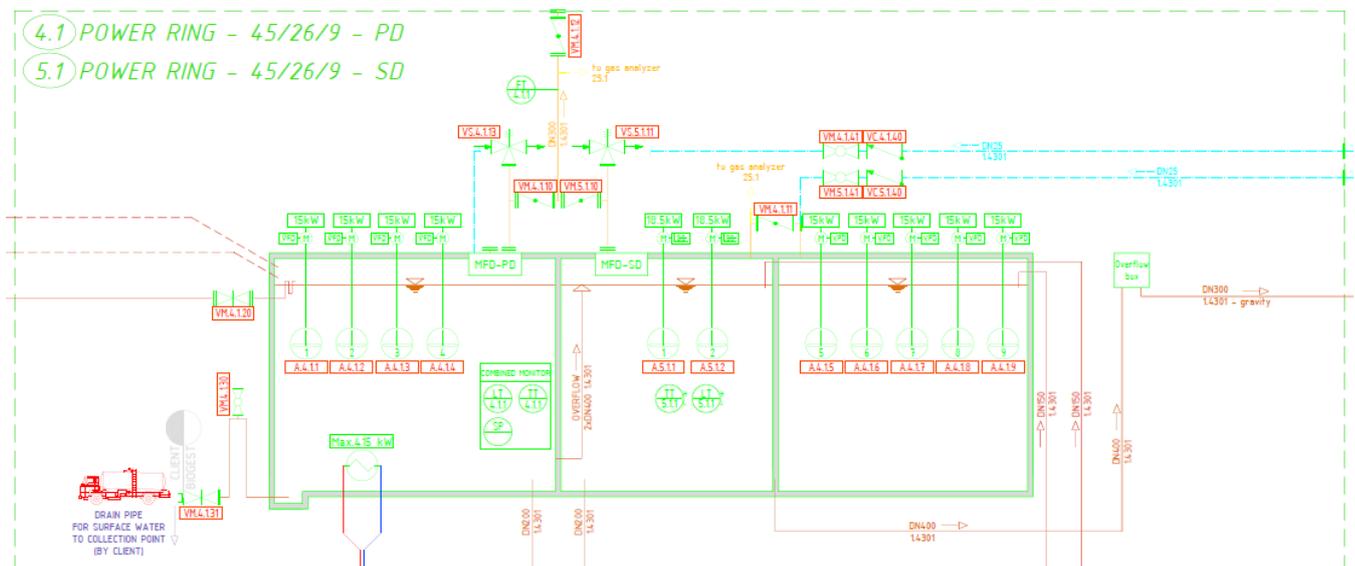
**Mode B(Manual):** Individual equipment can be operated for testing or maintenance

**Mode C(Stop):** Activated upon alarms or safety interlocks

Key Interlocks/Protection:

- Feeding stops automatically on high hopper weight, overcurrent of crusher or screws, or activation of hydraulic oil level/temperature alarms
- Level transmitter(LT.1.2.1) regulates movement of the conveying floor based on fill height in mixing area

**1.6. Power Ring Digester**



Picture 6. Part of PFD related to the Power Ring digester

Function: The Power Ring digester consists of Primary and Secondary digester that perform anaerobic digestion of liquid and solid feedstock. The system maintains optimal mixing, temperature, and level conditions for stable biogas production.

Main equipment:

Primary digester agitators A.4.1.1...A.4.1.9 – Ensure digestate homogeneity in primary digester

Secondary digester agitators A.5.1.1 and A.5.1.2 – Ensure digestate homogeneity in secondary digester

Instrumentation:

Level transmitter – LT.4.1.1 – Monitors digestate level in primary digester

Level transmitter – LT.5.1.1 – Monitors digestate level in secondary digester

Temperature transmitter – TT.4.1.1 – Monitors temperature in primary digester

Temperature transmitter – TT.5.1.1 – Monitors temperature in secondary digester

Gas flow transmitter – FT.4.1.1 – Monitors flow of produced biogas

Operating Modes:

**Mode A(Automatic):** Automatic control based on SCADA setpoints for feeding, agitation, heating, and level

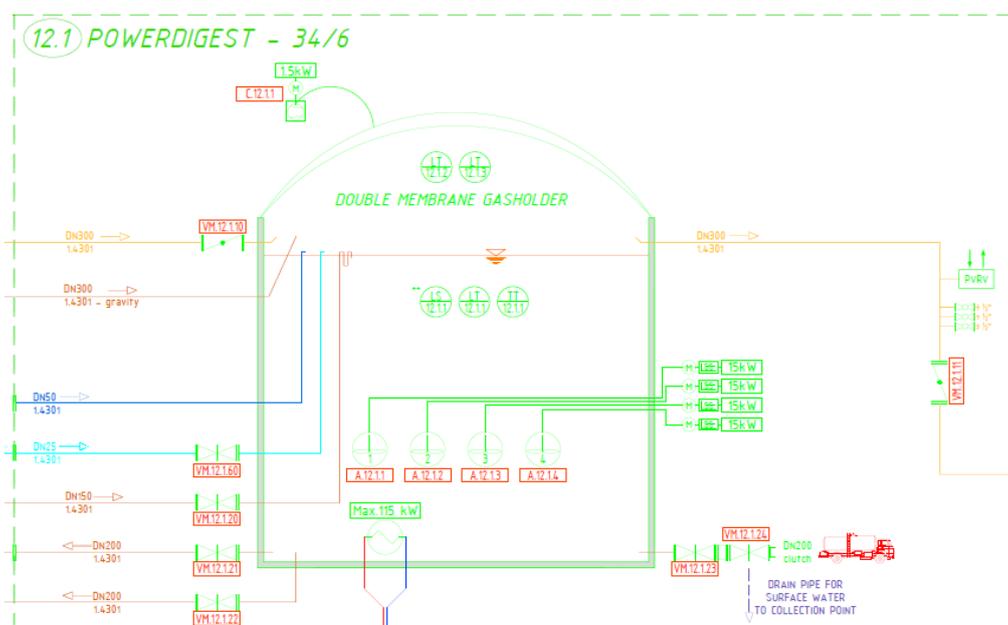
**Mode B(Manual):** Manual control for maintenance or testing

**Mode C(Stop):** Stop mode activated by alarms or protection events

Key Interlocks/Protections:

- Low/High Level Alarms: Alerts and feeding stoppage if levels fall outside preset thresholds(LT.4.1.1/LT.5.1.1)
- Feeding Stop Level: Stops liquid and solid feeding to prevent overflow(LT.4.1.1/LT.5.1.1)
- Evacuation: Automatic evacuation starts when level exceeds evacuation start point and stops at defined limit(LT.4.1.1/LT.5.1.1)
- Agitator Protection: Stop on high or low motor current(torque or mechanical failure)
- Heating System Protection: Alarm on low digestate temperature and stops heating on high temperature(TT.4.1.1/TT.5.1.1)

## 1.7. Power Digest



Picture 7. Part of PFD related to the Power Digest

Function: Power Digest serves as third stage of anaerobic digestion and provides biogas storage in the upper zone beneath the double membrane gas holder.

### Main equipment:

Agitators – A.12.1.1...A.12.1.4 – Maintain homogeneity of digestate

Air Blower – C.12.1.1 – Supplies air to the space between the double membranes of the gas holder

### Instrumentation:

Level transmitter – LT.12.1.1 – Monitors Digest level

Level switch – LS.12.1.1 – Detects high-level alarm

Gas holder level transmitters – LT 12.1.2,LT.12.1.3 - Monitor gas volume inside the double membrane

Temperature transmitter – TT.12.1.1 – Monitors Digest temperature for heating control

### Operating mode:

**Mode A(Automatic):** Normal operation managed by the SCADA system according to process parameters

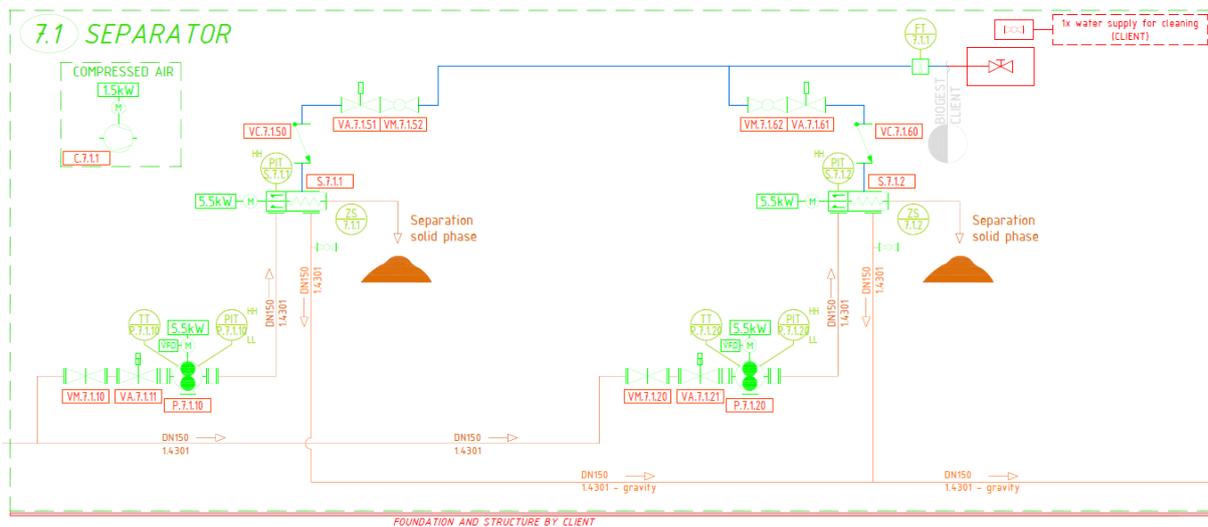
**Mode B(Manual):** Operator can manually control agitators for testing or maintenance

**Mode C(Stop):** All equipment stopped automatically on alarm or by operator command

### Key Interlocks/Protection:

- Agitators stop: If high/low motor current detected
- Temperature Control: Alarm generated when min/max temperature is detected(TT.12.1.1)
- Low/High Level Alarms: Alerts and feeding stoppage if levels fall outside preset thresholds(LT.12.1.1)
- Max Level Alarm: High max level activates alarm, closes valves, and stops feeding(LS.12.1.1)
- Gas Level: Max level activates flare, while min level stops gas consumers(LT.12.1.2/LT.12.1.3)
- Gas Pressure: Max pressure activates flare, min pressure stops gas consumers(PT.21.1.1)

## 1.8. Separator



Picture 8. Part of PFD related to the Separator

**Function:** The Separator system separates digestate from the Power Digest into solid and liquid fractions. After separation process, liquid digestate is brought to Reception pit 3 by gravity overflow.

### Main Equipment:

- Separator units(S.7.1.1,S.7.1.2) – Mechanically separate digestate into solid and liquid fractions
- Separator feeding pumps(P.7.1.10,P.7.1.20) – feed Separator units with digestate
- Air compressor – C.7.1.1. - Provides compressed air for the pneumatic valves
- Pneumatic valves(VA.7.1.11,VA.7.1.21) - Direct digestate flow paths between Power Digest and Separator feeding pumps
- Valves – VA.7.1.51,VA.7.1.61 – for water distribution - spare

### Instrumentation:

- Pressure sensors – PIT.S.7.1.1,PIT.S.7.1.2 – Monitor digestate pressure at separator inlet
- Separator dry run detections – LS.7.1.1,LS.7.1.2 – Detect dry-run condition
- Limit switches – ZS.7.1.1,ZS.7.1.2 – Detect absence of solid plug(cake break) at the separator outlet
- Pressure indicators and transmitters – PIT.P.7.1.10,PIT.P.7.1.20 – Monitor pressure at the pump outlet
- Temperature transmitters – TT.P.7.1.10,TT.P.7.1.20 – Monitor temperature on pump housing
- Water flow transmitter – FT.7.1.1 – spare

### Operating mode:

**Mode A(Automatic):** Automatic digestate feeding and separation cycle based on Power digest level and inlet pressure control

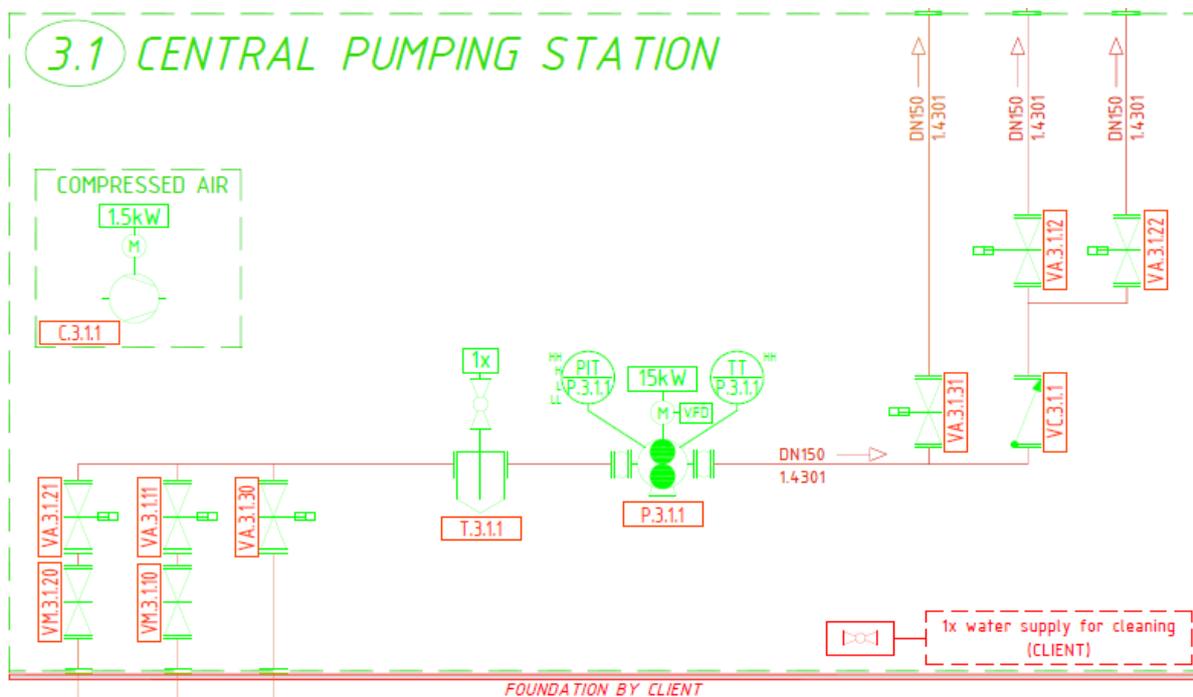
**Mode B(Manual):** Individual equipment can be operated for testing or maintenance

**Mode C(Stop):** All equipment stopped automatically on alarm, interlock, or by operator

Key Interlocks/Protection:

- Low/High Level Alarms: Alerts and feeding stoppage if level in Power Digest fall outside preset thresholds(LT.12.1.1)
- Max Level Alarm: High max level activates alarm and stops feeding(LS.12.1.1)
- Cake Break Detection: Separator stops immediately if no solid plug detected at outlet(ZS.7.1.1,ZS.7.1.2)
- Dry Run Detection: Prevents separator for running without material feed(LS.7.1.1,LS.7.1.2)
- High Pressure/Temperature: Stops pump automatically to prevent overload or overheating(PIT.P.7.1.10,PIT.P.7.1.20,TT.P.7.1.10,TT.P.7.1.20)

**1.9. Central Pumping Station**



Picture 9. Part of PFD to the Central Pumping station

Function: Central pump transfers liquid digestate between Power Ring digester and Power Digest. Depending on valve configuration, the pump can feed, recirculate, or evacuate liquid digestate between them.

Main Equipment:

Main pump – P.3.1.1 – Transfers liquid digestate between Power Ring and Power Digest  
 Air compressor – C.3.1.1 – Provides compressed air for the pneumatic valves  
 Pneumatic valves (VA.3.1.11, VA.3.1.12, VA.3.1.21, VA.3.1.22, VA.3.1.30, VA.3.1.31) – Direct liquid flow paths between Power ring digester and Power Digest, only one suction and one discharge valve can be open at any given time

### Instrumentation:

Pressure indicator and transmitter – PIT.P.3.1.1 – Monitors pressure at the pump outlet  
Temperature transmitter – TT.P.3.1.1 – Monitors temperature on the pump housing

### Operating mode:

**Mode A(Slurry feeding):** Transfers liquid feedstock from digester to Power Digest as part of the feeding cycle

**Mode B(Recirculation):** Circulates liquid between digester and Power digest, or within same tank to maintain homogeneity or temperature balance

**Mode C(Evacuation):** Removes excess liquid from digesters automatically when high-level setpoints are reached

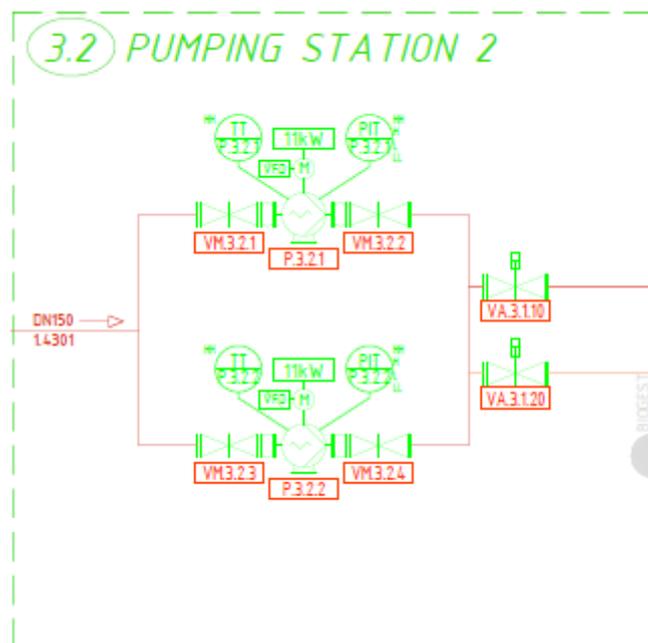
**Mode D(Manual):** Operator manually starts pump and selects valve configuration for maintenance or testing

**Mode E(Stop):** Used during maintenance or automatically triggered by interlocks

### Key Interlocks/Protections:

- Low/High Level Protection: Transfer of liquid digestate stops if levels fall outside preset thresholds(LT.4.1.1/LT.5.1.1/LT.12.1.1)
- Low/High Pressure: If outlet pressure is too high or low, alarm is generated and pump stops(PIT.P.3.1.1)
- High Temperature: Pump stops on over-temperature alarm(TT.P.3.1.1)
- Valve Interlock Logic: Pump start is possible only when valve is confirmed open

## 1.10 Pumping Station 2



Picture 10. Part of PFD related to the Pumping station 2

Function: Pumps transfer liquid digestate from Reception tanks to the primary digester or lagoon, depending on valve configuration.

## DESCRIPTION OF PROCESS FUNCTION

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### Main Equipment:

Pumps – P.3.2.1,P.3.2.2. – Transfer liquid digestate from Reception tanks to primary digester/lagoon

Pneumatic valves(VA.3.1.10, VA.3.1.20) – Direct liquid flow paths from Reception tanks to primary digester/lagoon, only one discharge valve can be open at any given time

### Instrumentation:

Pressure indicators and transmitter – PIT.P.3.2.1 – Monitors pressure at the pump outlet

Temperature transmitter – TT.P.3.2.1 – Monitors temperature on the pump housing

Pressure indicators and transmitter – PIT.P.3.2.2 – Monitors pressure at the pump outlet

Temperature transmitter – TT.P.3.2.2 – Monitors temperature on the pump housing

### Operating mode:

**Mode A(Slurry feeding):** Transfers liquid feedstock from Reception tanks to primary digester/lagoon as part of the feeding cycle

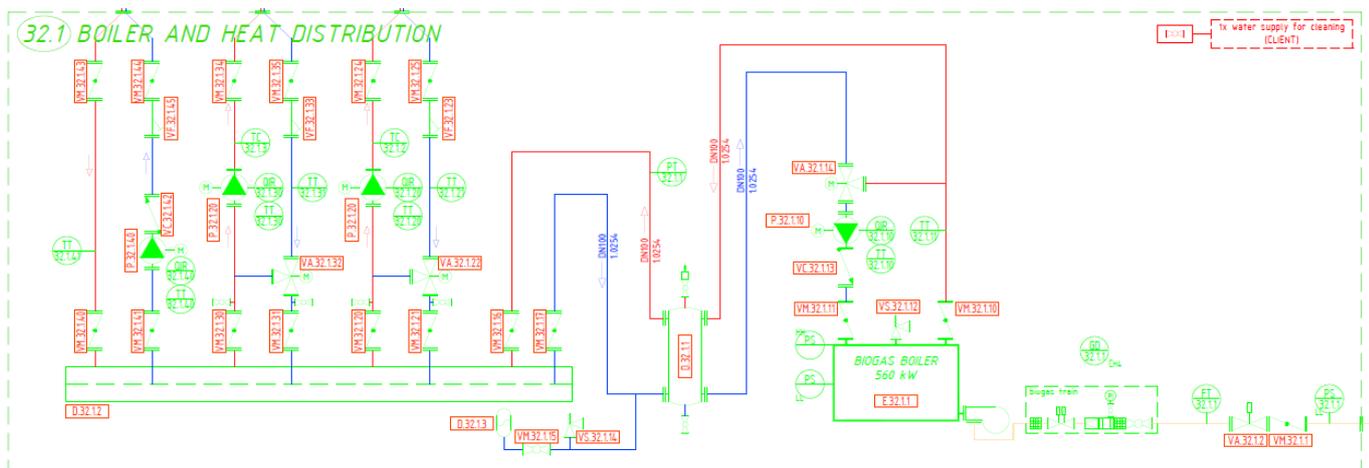
**Mode B(Manual):** Operator manually starts pump and selects valve configuration for maintenance or testing

**Mode C(Stop):** Used during maintenance or automatically triggered by interlocks

### Key Interlocks/Protections:

- Low/High Level Protection: Transfer of liquid digestate stops if levels fall outside preset thresholds(LT.4.1.1/LT.2.1.1/LT.2.2.1/LT.2.3.1)
- Low/High Pressure: If outlet pressure is too high or low, alarm is generated and pump stops(PIT.P.3.2.1/PIT.P.3.2.2)
- High Temperature: Pump stops on over-temperature alarm(TT.P.3.2.1/TT.P.3.2.2)
- Valve Interlock Logic: Pump start is possible only when valve is confirmed open

## 1.11. Boiler and Heat Distribution



Picture 11. Part of PFD related to the Boiler and heat distribution

**Function:** Boiler and Heat distribution system provides controlled hot water for heating of Power Ring and Power Digest to maintain optimal fermentation temperature. Heat is supplied from GUV unit and Biogas boiler.

### Main equipment:

Heat circulation pumps – P.32.1.10,P.32.1.40 – circulate hot water from GUU/Biogas boiler

Heat circulation pumps - P.32.1.20,P.32.1.30 – circulate hot water to Power Ring/Power Digest

Blending(Mixing) valves – VA.32.1.14,VA.32.1.22,VA.32.1.32 – Adjust flow and temperature of hot water to maintain setpoints in the digesters

Heat Exchanger/Heating Coil in Digester – transfers thermal energy from hot water to digester contents

### Instrumentation:

Temperature controllers – TC.32.1.2,TC.32.1.3 – Regulates pump and valve operation according to digesters temperature

Pressure transmitter – PT.32.1.1 – Monitors heating pressure

Flow transmitter – FT.32.1.1 – Monitors biogas flow to the boiler

Pressure switch – PS.32.1.1 – Monitors pressure of biogas entering the boiler

Gas detector – GD.32.1.1 – Detects gas leakage

### Operating mode:

**Mode A(Automatic):** Heating managed by SCADA, maintaining digesters setpoint via PID loop

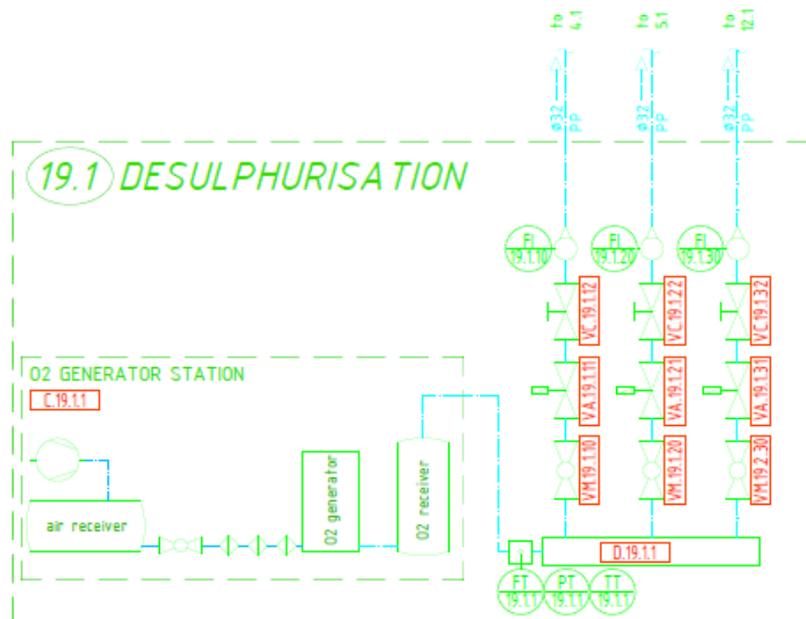
**Mode B(Manual):** Operator can start pump and open blending valve manually

**Mode C(Stop):** All heating components stopped automatically or by operator

### Key Interlocks/Protections:

- Min temperature: Alarm generated if digester temperature drops below setpoint(TT.4.1.1/TT.5.1.1)
- Max temperature: Alarm and automatic shutdown of heating system to prevent overheating(TT.4.1.1/TT.5.1.1)
- Gas leakage: If gas detector detects gas leakage, all equipment will be shut down, and Ex fan will be activated(GD.32.1.1)

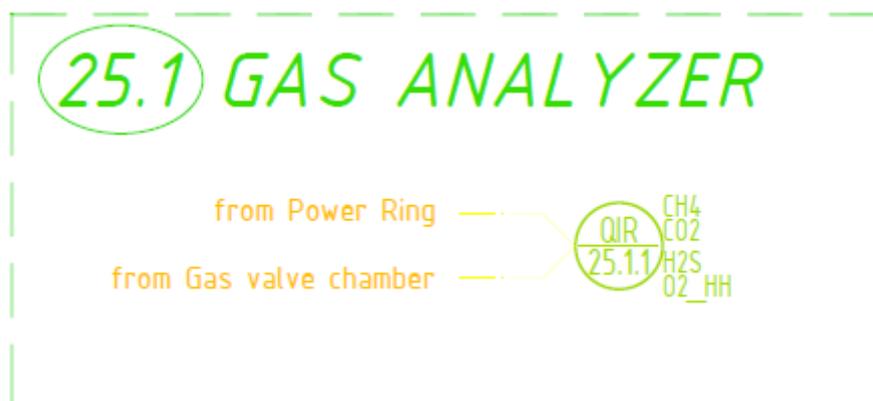
## 1.12. Desulphurisation



Picture 12a. Part of PFD related to the Desulphurization system

**Function:** By controlled injection, small amount of oxygen in Power Ring and Power Digest helps to reduce level of H<sub>2</sub>S in biogas.

The composition of produced biogas is known by measuring biogas in gas analyzer, which is shown on picture 12b., below:



Picture 12b. Part of PFD related to the Gas analyzer

### Main Equipment:

O<sub>2</sub> generator station – C.19.1.1 – supplies oxygen to digesters

Electromagnetic valves – VA.19.1.11,VA.19.1.21,VA.19.1.31 – control oxygen flow to digesters

### Instrumentation:

O<sub>2</sub> flow meter – FT.19.1.1 – Monitors flow,pressure and temperature of oxygen

### Operating mode:

**Mode A(Automatic):** Regulation of biologic desulphurisation is managed in line with H<sub>2</sub>S and O<sub>2</sub> concentration level in biogas inside digesters

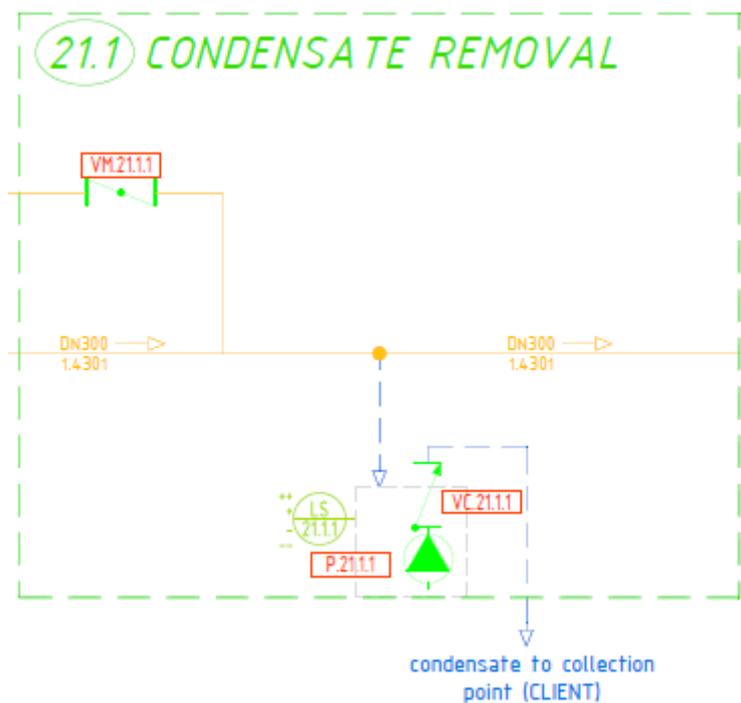
**Mode B(Manual):** Operator can release oxygen by opening electromagnetic valves remotely in manual regime from SCADA

**Mode C(Stop):** Stop of all O<sub>2</sub> equipment

### Key Interlocks/Protections:

- Max level O<sub>2</sub> content - if content of O<sub>2</sub> in biogas is above preset max value, alarm will be generated, and electromagnetic valves will be closed regardless of the operation mode(Gas analyzer 25.1)
- O<sub>2</sub> flow detection – In case when electromagnetic valves are closed if there is recognized some flow of O<sub>2</sub>, there will be generated alarm, O<sub>2</sub> concentrators will be stopped(FT.19.1.1)

## 1.13. Condensate Removal



Picture 13. Part of PFD related to the Condensate removal

Function: Removed condensate from biogas is collected and pumped by condensate pump to the drain system.

### Main Equipment:

Condensate pump – P.21.1.1 – Pumps condensate water to the drain system

### Instrumentation:

Level detector – LS.21.1.1 – Controls condensate pump work based on condensate level

Pressure transmitter – PT.21.1.1 – Monitors biogas pressure

### Operating mode:

**Mode A(Automatic):** Condensate pump is maintained by start and stop level ensuring that is all time submersible and not in the contact with biogas

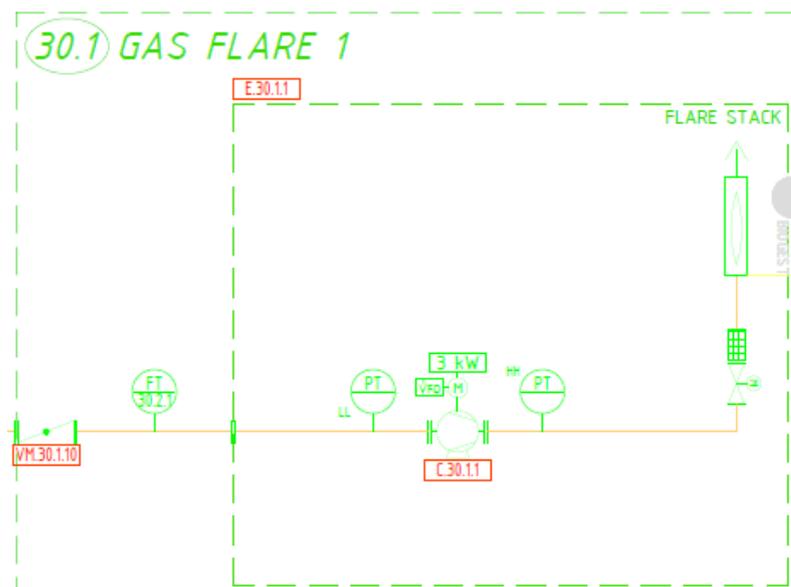
**Mode B(Manual):** Operator can start pump remotely from SCADA if level of water is above emptying level

**Mode C(Stop):** Stopping of all condensate removal equipment

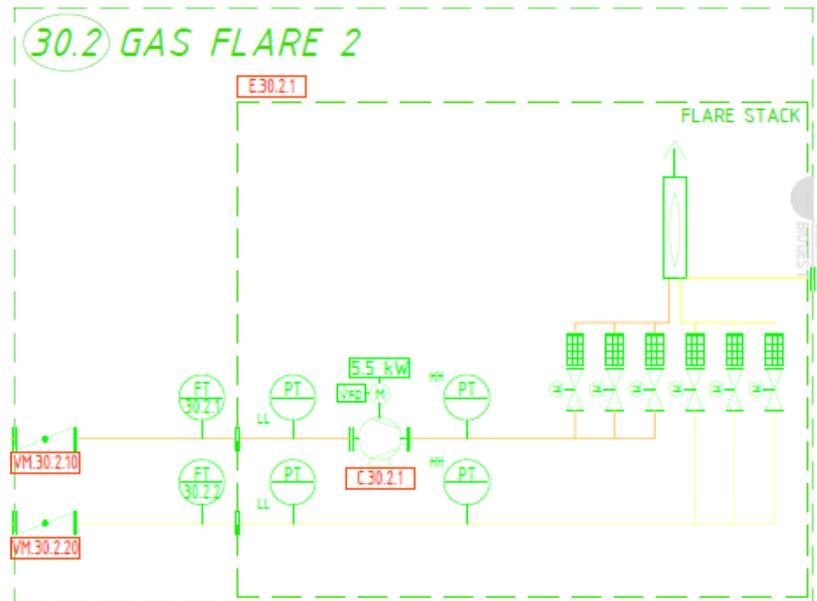
### Key Interlocks/Protections:

- Minimum level: If level of water in water pit is below min preset value, condensate pump will be stopped and de-energized(LS.21.1.1)
- Maximum level – If level of water in water pit is above max preset value, alarm will be generated in SCADA

## 1.14. Gas Flare



Picture 14a. Part of PFD related to the Gas flare 1



Picture 14b. Part of PFD related to the Gas flare 2

**Function:** Utilization of biogas in case when biogas storage is full and biogas production is higher than consumption of GUU and Boiler, or in case when biogas is not in satisfactory quality and has to be flared.

**Main Equipment:**

Gas flare units – E.30.1.1, E.30.2.1 – Ignition of excessive or unsatisfactory biogas  
Gas compressors – C.30.1.1, C.30.2.1 – Compressing biogas before entering the flare

**Instrumentation:**

Flow transmitters – FT.30.1.1, FT.30.2.1 – Monitor biogas flow to the flare

**Operating mode:**

**Mode A(Automatic):** Operation of the flare is in line with gas level and/or gas pressure in gas storage

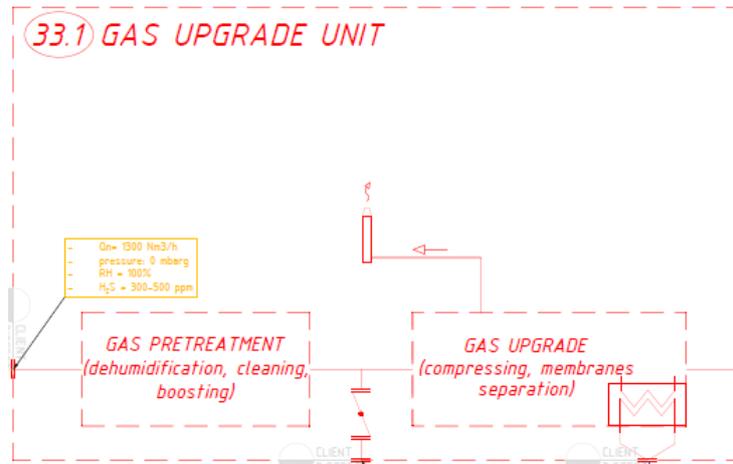
**Mode B(Manual):** Operator can start the flare on spot from control panel or remotely from SCADA

**Mode C(Stop):** Stopping of all gas flare equipment

**Key Interlocks/Protections:**

- Maximum level in gas storage: If level of gas in gas storage is above preset max value, flare will be started(LT.12.1.2/LT.12.1.3).
- Max gas pressure - If pressure of gas in gas storage is above preset max value, flare will be started(PT.21.1.1).
- If produced biogas is not in satisfaction quality, flare will be activated to burn unsatisfactory biogas(Gas analyzer 25.1).

## 1.15. Gas upgrade unit and Gas entry unit (client's scope)



Picture 15a. Part of PFD related to the Gas upgrade unit



Picture 15b. Part of PFD related to the Gas entry unit

### Interaction with master control system of AD site:

GUU is stand-alone unit with belonging control panel which ensure proper work of the biogas purification process. Here is ensured signal exchange with master control of AD site in the both ways via communication link.

Demand signal of GUU unit and belonging low pressure compressors comes in line with availability of the biogas in gas storage (LT 12.1.2; LT 12.1.3/PT 21.1.1). If level in gas holder is above set min level (LT 12.1.2; LT 12.1.3 – LL) and if pressure in gas system is above min value (PT 21 1.1 – LL) then demand signal to GUU will be active and GUU will be demanded. In case if any of these conditions is not fulfilled GUU will be stopped – under pressure/gas holder low level protection.