

Section 4

ICP (Interface Control Panel)

4.1 ICP operations

The Fre-energy ICP system utilises a colour touch screen to provide status information and enable the operational parameters to be changed. Behind the screen there is a fully functional Programmable Logic Controller (PLC). The PLC has remote access.

Monitoring and reporting features are arranged in pages; dedicated screens include *Loading* and *Un-Loading Settings Screens* and *Rotating Arm and Mixing Controls Screen*.

Navigation of screens is achieved using the Buttons at the base of the control screen.

System display Header on all PLC display pages



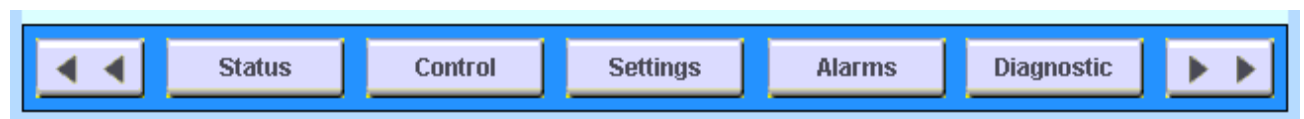
The top line of this display is a configurable line of text, normally set to the site name. However, this message can be changed on 'Settings Page 3' to enable messages to be left for operators.

The second line identifies the screen currently being shown.

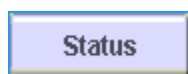
The time and date are the current system time.

Below the time and date is the current access level '0' and the box to the right enables a password to be entered, this facility allows certain screens to have password protected access and is available on request if there is an issue with 'button pushers'.

Screen Navigation BAR



The screens are configured in families:



For the system status screens these screens show what is going on in the control system



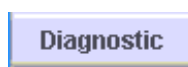
For the 'Control' screens for controlled elements within the process.



For the screens for system and operational settings.



For the screens giving information on current and Historic faults.

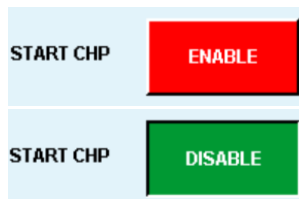


For Screens to directly access Raw PLC configuration & input / output data. We recommend that clients do not make any adjustments within these screens



The two arrow buttons can be used to navigate between the screens to move on to the next screen or return to the previous screen





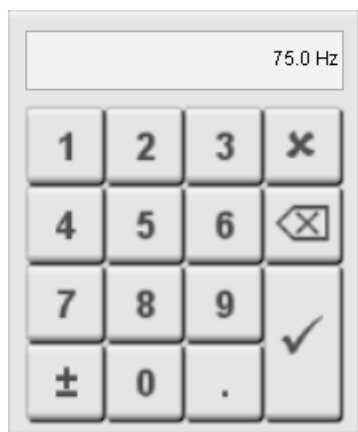
Button operation & methodology

The words inside give the Buttons function, the colour shows current state

Green is ON Red is OFF.

The CHP is OFF, Pressing the button will 'ENABLE' the CHP.

The CHP is ON, Pressing the button will 'DISSABLE' the CHP.



Changing of numeric values

To adjust values, press on the value to be changed, a dialogue box will pop up. The numbers in the top row show the current value and the type of parameter (in this case a frequency Hz). Type in the new value then pressing the  symbol will enter the new value, if the number is out of range (too high or low) the original value will be shown.

The  symbol deletes the right most digit

The  symbol reverts to the original value.

Option select TAB's

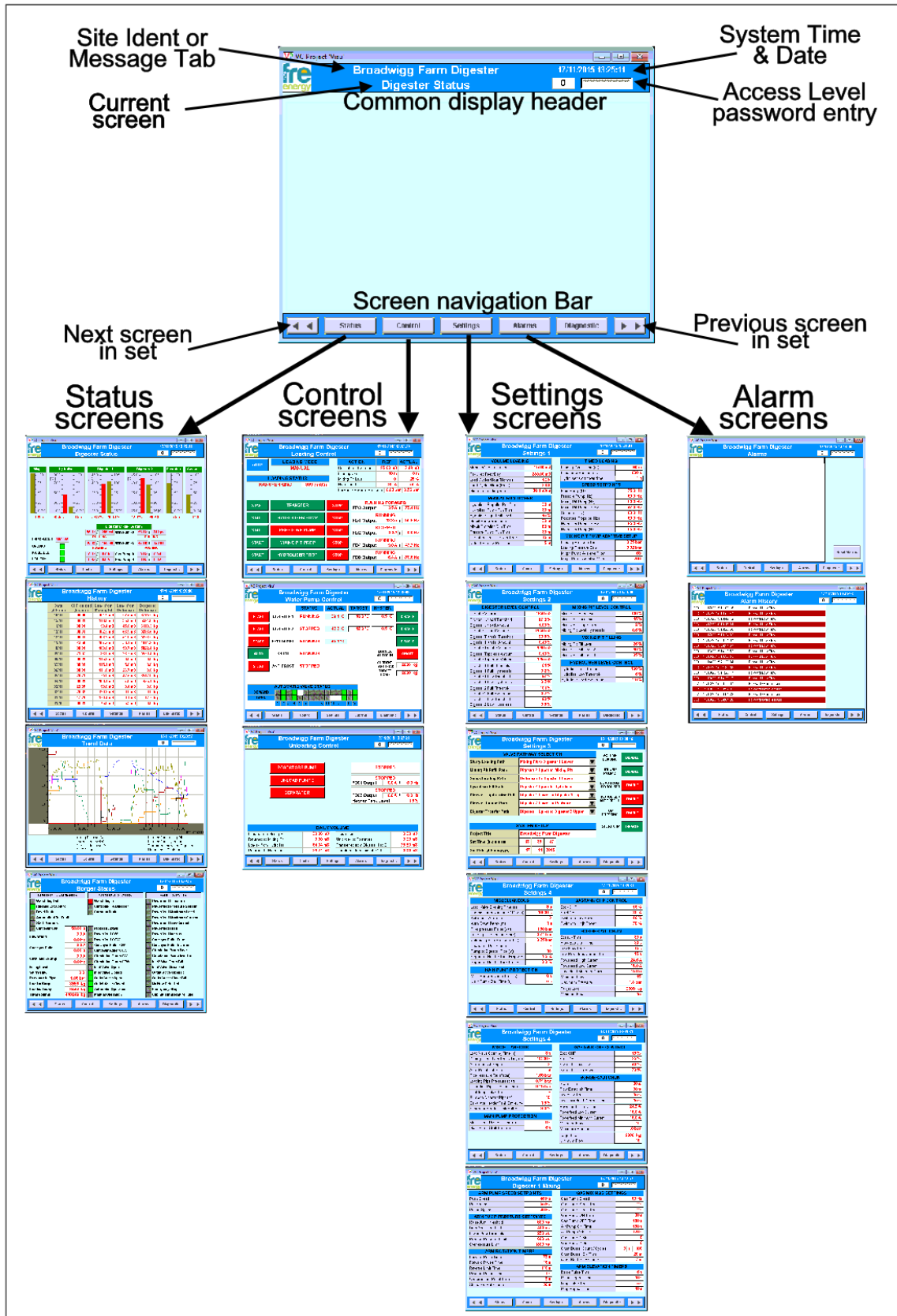
VALVE PATHWAY SELECTION		
Mixing Pit Refill Path	Poststore Lower to Mixing Pit	
Digester Unload Path	Digester 1 Lower to Mixing Pit Digester 1 Upper to Mixing Pit	
Digester Transfer Path	Poststore Lower to Mixing Pit Poststore Upper to Mixing Pit	

In some instances, there is a range of defined options available in this case clicking the selection opens a series of options

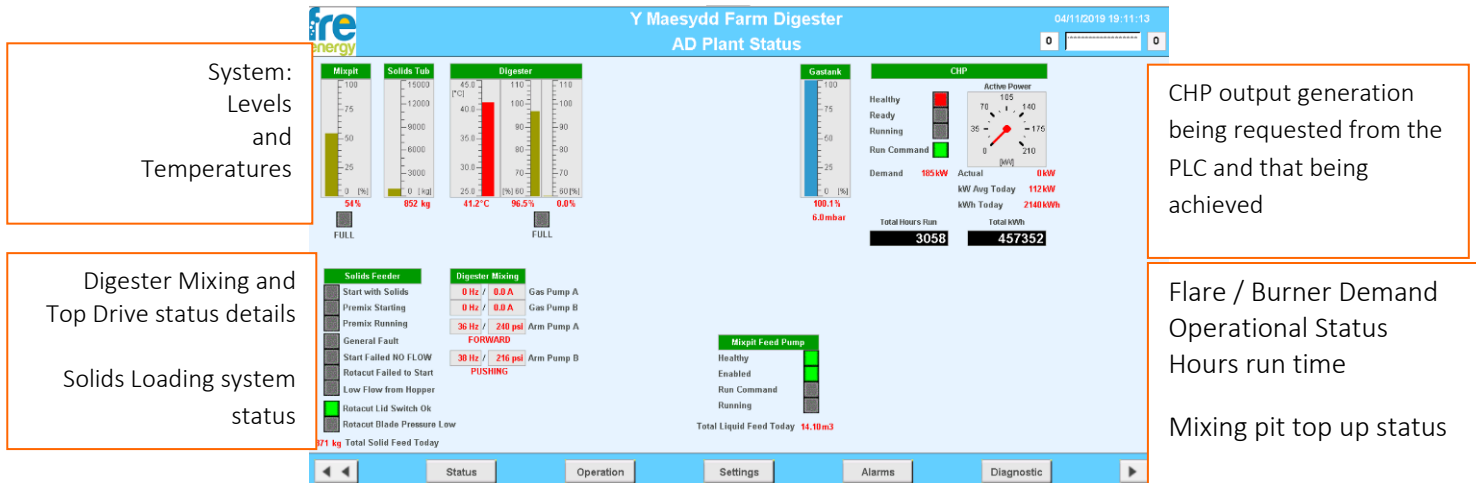
Mixing Pit Refill Path	Poststore Lower to Mixing Pit	
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The option (or in this case slurry Loading route) can be selected. Initially the current option is highlighted a new selection can then be selected. When pressed, it highlights and can then be confirmed as the selected option by a further press.

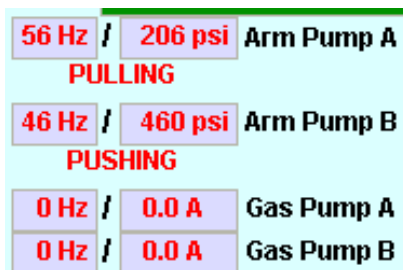
4.2 Control System Page Structure



4.3 Main Screen Status Screen 1 (Dashboard)



CHP DEMAND is sent from the Digester PLC to the CHP to request the output power. The three status indicators show the operational status of the CHP. The **ON LOAD** indicator comes on when the CHP has started, synchronised with the mains and is generating. The **AVAILABLE** signal indicates that the PLC can take control of the CHP, if it is OFF and Healthy is ON the most likely reason is the CHP is on Local control. The **HEALTHY** indicator tells the plc that the CHP does not have a fault.



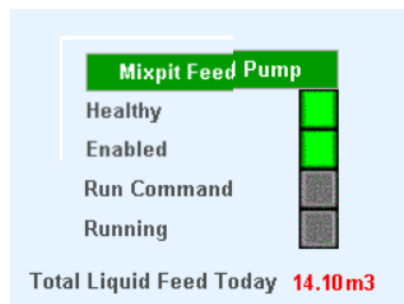
Status of Top Drive hydraulic system

Pump Speed & arm Pressure

Action, Pulling, Pushing, Pause Stopped

Gas Mixing Pump speed and Current

Mixing Pit Top up from sheds
Status of transfer pump
Pump enable signal
Run request from Panel
Transfer pump running
Total transferred today



Separator Status info NOT CURRENTLY IMPLEMENTED



Run Command from Controller

Running signal from Separator

Fault signal from Separator

Solids Feeding System Status information

Start solid feeding - Command
Premix is starting - Status
Premix is running – Status
Fault on Loading System – Status
Start Failed NO FLOW – STATUS
Rotacut Failed to Start – Status
Low Flow from Hopper – Status

Rotacut Lid Switch OK – SAFETY CCT
Rotacut Blade Pressure LOW – STATUS
Total Solids Loaded today

Solids Feeder

Start with Solids

Premix Starting

Premix Running

General Fault

Start Failed NO FLOW

Rotacut Failed to Start

Low Flow from Hopper

Rotacut Lid Switch Ok

Rotacut Blade Pressure Low

7871 kg

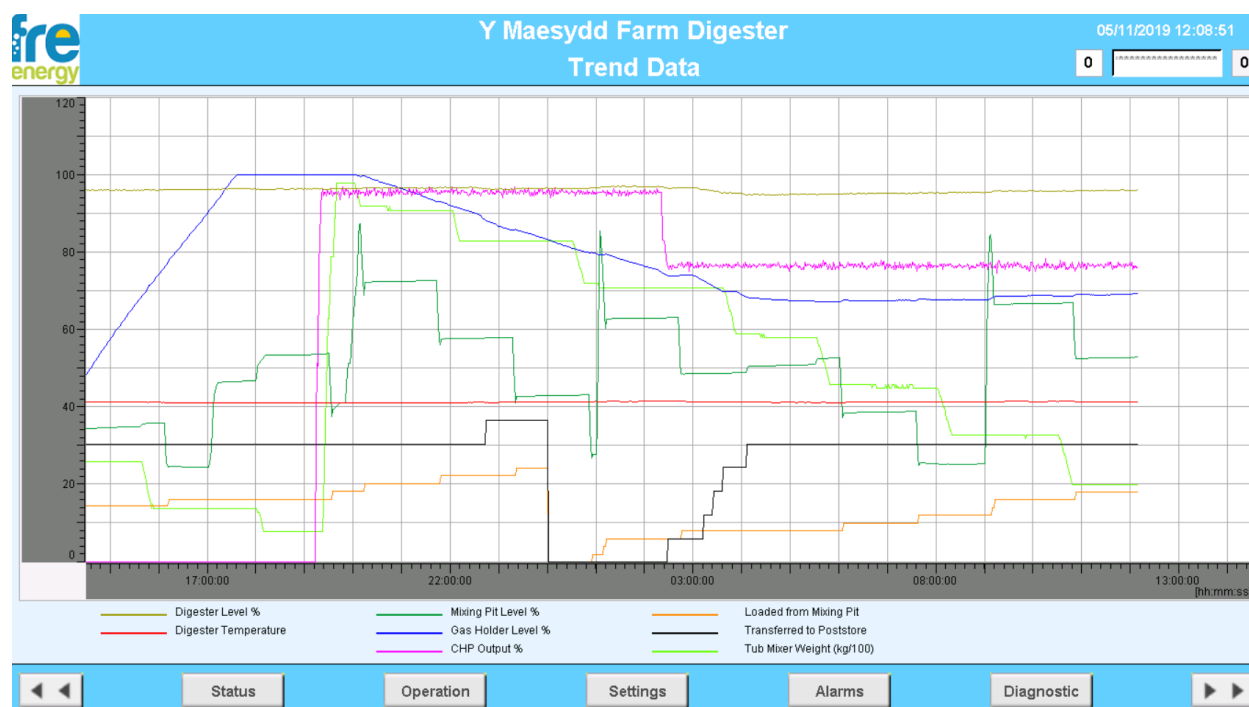
Total Solid Feed Today

Flare Control and Status not currently implemented

4.4 Status Screen 2 – Historic Data

Date (dd/mm)	CHP Onload	CHP Power Generation	Loaded from Mixing Pit	Returned to Mixing Pit	Solids Loaded	Unloaded From Digester	Digester Temperature	Digester Level
04/11	74.2 %	3093 kWh	22.2 m3	1.4 m3	9273 kg	36.7 m3	41.5 °C	96.6 %
03/11	100.0 %	4223 kWh	25.5 m3	1.4 m3	9927 kg	30.6 m3	41.6 °C	97.2 %
02/11	100.0 %	4382 kWh	39.1 m3	0.4 m3	10713 kg	61.2 m3	41.5 °C	97.0 %
01/11	100.0 %	4372 kWh	38.9 m3	1.4 m3	10823 kg	30.6 m3	41.2 °C	98.4 %
31/10	100.0 %	3942 kWh	39.1 m3	0.9 m3	11837 kg	24.5 m3	40.9 °C	97.1 %
30/10	100.0 %	3941 kWh	17.9 m3	0.9 m3	10898 kg	30.6 m3	40.9 °C	95.7 %
29/10	100.0 %	4108 kWh	20.0 m3	1.8 m3	11879 kg	30.6 m3	40.9 °C	95.6 %
28/10	100.0 %	3650 kWh	45.0 m3	1.5 m3	10287 kg	41.9 m3	40.9 °C	95.5 %
27/10	100.0 %	3565 kWh	1.9 m3	2.5 m3	9040 kg	18.4 m3	40.9 °C	95.0 %
26/10	100.0 %	4382 kWh	35.1 m3	0.9 m3	8862 kg	30.6 m3	41.0 °C	95.8 %
25/10	100.0 %	4380 kWh	15.1 m3	0.0 m3	11327 kg	12.3 m3	41.0 °C	95.6 %
24/10	100.0 %	4524 kWh	1.6 m3	0.5 m3	10208 kg	0.0 m3	41.0 °C	94.8 %
23/10	57.3 %	2673 kWh	1.0 m3	1.8 m3	7571 kg	22.8 m3	41.1 °C	94.0 %
22/10	100.0 %	4574 kWh	18.5 m3	0.9 m3	10545 kg	30.6 m3	41.1 °C	94.9 %
21/10	84.1 %	3369 kWh	22.5 m3	0.5 m3	8431 kg	26.9 m3	41.0 °C	95.0 %
20/10	95.3 %	3991 kWh	25.6 m3	0.9 m3	9680 kg	36.7 m3	41.0 °C	94.7 %
19/10	100.0 %	4450 kWh	30.0 m3	0.9 m3	9970 kg	49.0 m3	41.1 °C	94.8 %

4.5 Status Screen 3 – Previous 24 Hours Trend Data



4.6 Status Screen 4 – Solids loading Status Screen

This shows the data being passed between the control system and the pre-mix control system.

Y Maesydd Farm Digester
Vogelsang Premix Status

05/11/2019 12:26:14

Control Word 1	Control Word 2	Status Word 1	Status Word 2	Status Word 3
Transmission Toggle In	General Fault	Transmission Toggle Out	Premix Level Ok	FP Output Overpressure
Discharge Pump Forward	Bladewear Warning	Discharge Pump Drive Ok	spare	FP Input Overpressure
Discharge Pump Reverse	Machines Running	Discharge Pump PTC	Rotacut Lid Switch Ok	DP Output Overpressure
Feeder Pump Forward	Automatic Ready	Feeder Pump Drive Ok	Rotacut Blade Pressure Low	Emergency Stop Ok
Feeder Pump Reverse	spare	Feeder Pump PTC	Solids Feeder Probe Ok	Reset Command
Rotacut Clockwise	spare	Rotacut Drive Ok	Automatic Mode	Premix Start with Solids
Rotacut Anti-clockwise	spare	Rotacut PTC	Gate Valve 1 Open (Inlet)	Premix Start without Solids
Rotacut Start	spare	Screw Conveyor Drive Ok	Gate Valve 1 Closed (Inlet)	Alternative Pumping Path
Screw Conveyor Forward	spare	Screw Conveyor PTC	Gate Valve 2 Open (Outlet)	DRS Start Pulse
Screw Conveyor Reverse	spare	Solids Feeder Drive Ok	Gate Valve 2 Closed (Outlet)	DRS Hydraulics Ok
Solids Feeder Start	spare	Discharge Pump Not Dry	Gate Valve 3 Open (not used)	DRS Hydraulics Overpressure
Open Gate Valve 1 (Inlet)	spare	Feeder Pump Not Dry	Gate Valve 3 Closed (not used)	DRS Hydraulics Safety Ok
Open Gate Valve 2 (Outlet)	spare	Rotacut Not Dry	Gate Valve 4 Open (not used)	DRS Gate Valve Fully Open
Open Gate Valve 3 (not used)	spare	DP Output Overpressure 2	Gate Valve 4 Closed (not used)	DRS Gate Valve Fully Closed
Open Gate Valve 4 (not used)	spare	spare	spare	DRS Removal Ram Middle
Feeding Start	spare	spare	spare	spare

Navigation buttons: Status, Operation, Settings, Alarms, Diagnostic

The Operatin of the dedicated Pre-Mix control system can be accessed via the on-site PLC using the Microsoft Explorer to IP address 192.168.111.101

Vogelsang
ENGINEERED TO WORK

Pressure after DP: 0.7 bar
DP current: 0.0 A
RotaCut current: 0.0 A

FP OK
DP OK
RotaCut OK

13:32:48

PreMix PCU

0.0 m³/h, 0.5 bar, 0.5 bar, 10.0 Hz, 0.0 A, 6.7 m³/h, 15.0 Hz, 0.0 A, 0.0 m³/h

Ext. Doser

Auto

Remote with solids

Remote without solids

Alternatively pumping path

Reset

Alarm log: 25External SMF malfunction 15:03:22 03.11.2019 15:03:31 03.11.2019

Info log: 11START with Profibus 11:27:22 05.11.2019 11:44:58 05.11.2019

RESET

Waiting for next start

Settings

Please refer to the Vogelsang manual for details on the pre-mix internal settings

4.7 Control Screen 1 – Loading Control Screen

Automatic Control Screen

Operating Mode is currently: **AUTOMATIC**

Pneumatic Valve controls & Status

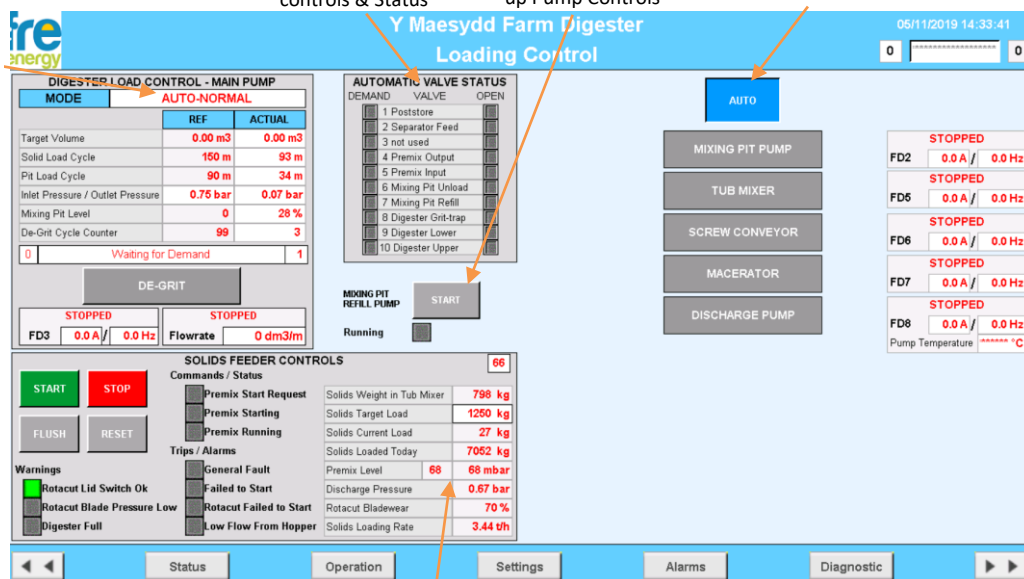
Manual Start & Running indicator for mixing pit top up Pump Controls

Press to Toggle Operating mode between Manual & Automatic

Loading Pump operational status information

Solid feeder controls

Solid Feeder Status & Alarms

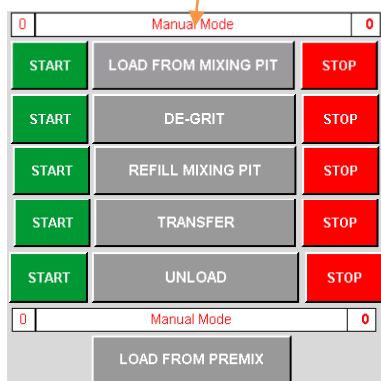
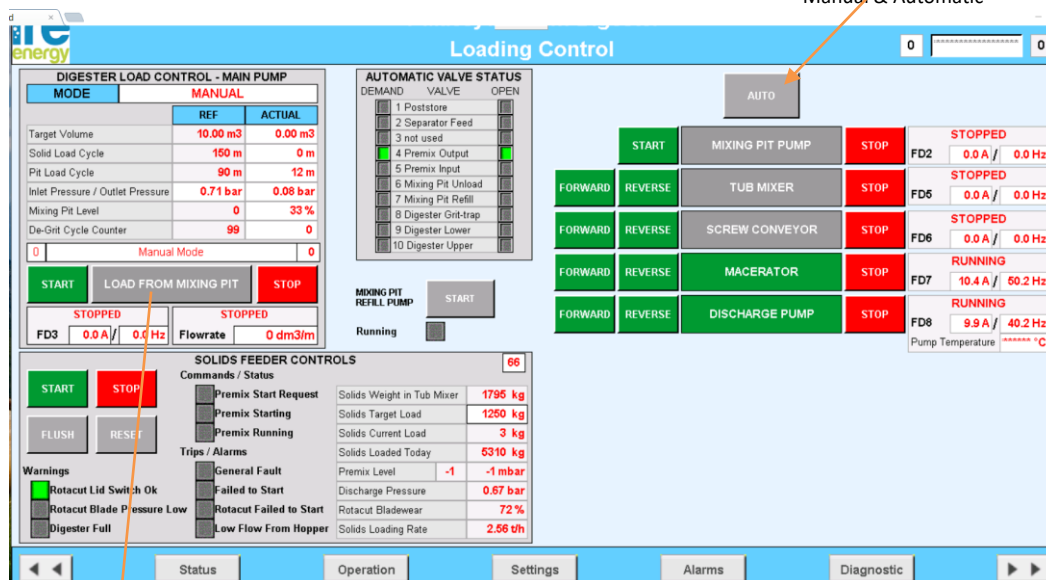


Pump Status, Speed and load

Manual Control Screen

Solid feeder operational status information

Press to Toggle Operating mode between Manual & Automatic



MANUAL MAIN PUMP FUNCTIONS

Load Digester from the mixing pit, this will start the Mixing Pit Pump as well

De-grit – Dumps from the Grit trap into the Sump area

Digester to Mixing pit, used to flush after a DE-grit function

Transfers or Un loads the digester into the post store

Unloads the Digester via the Separator (if fitted)

Run the Main pump to the Premix, needs the Premix enable set in SETTINGS 3

DIGESTER LOAD CONTROL - MAIN PUMP		
MODE	AUTO-NORMAL	
	REF	ACTUAL
Target Volume	0.00 m3	0.00 m3
Solid Load Cycle	150 m	93 m
Pit Load Cycle	90 m	34 m
Inlet Pressure / Outlet Pressure	0.75 bar	0.07 bar
Mixing Pit Level	0	28 %
De-Grit Cycle Counter	99	3
0 Waiting for Demand 1		
DE-GRIT		
FD3	STOPPED	STOPPED
0.0 A / 0.0 Hz	Flowrate	0 dm3/m

Main Pump Function information

Target and progress information on current action
Solid Load Cycle time and current time
Liquid feed Cycle time and current time
Feed pump Pressure on either side
Target (when filling) and actual mixing pit level
De-grit action cycle counter
Current Pump status
Last / current pump activity / Main Pump Function Select when in MANUAL operation.
Pump speed power and flow

The **START** button will kick off a feed from the solids loading unit, if pressed during a feed cycle the current load value is added to the daily load and the current load is cleared (i.e. it is restarting the sequence).

The **STOP** button will stop a solid feed that is in progress.

The **FLUSH** button is a toggle that runs the Premix without activating the solid feed input.

The **RESET** button will clear a fault on the Premix
A Premix fault is indicated by this being illuminated.

SOLIDS FEEDER CONTROLS		66
START STOP FLUSH RESET	Commands / Status	
	Premix Start Request	Solids Weight in Tub Mixer 798 kg
	Premix Starting	Solids Target Load 1250 kg
	Premix Running	Solids Current Load 27 kg
Warnings Rotacut Lid Switch Ok Rotacut Blade Pressure Low Digester Full	Trips / Alarms	
	General Fault	Solids Loaded Today 7052 kg
	Failed to Start	Premix Level 68 68 mbar
	Rotacut Failed to Start	Discharge Pressure 0.67 bar
	Low Flow From Hopper	Rotacut Bladewear 70 %
		Solids Loading Rate 3.44 t/h

Warnings	
	Rotacut Lid Switch Ok
	Rotacut Blade Pressure Low
	Digester Full

The Rotacut Door is not closed – Safety switch on Pre-mix it must be correctly aligned.
Check the hydraulic pressure pump on the Premix sets the blade pressure onto the screen.
Can not load if the digester is full.

Trips / Alarms	
	General Fault
	Failed to Start
	Rotacut Failed to Start
	Low Flow From Hopper

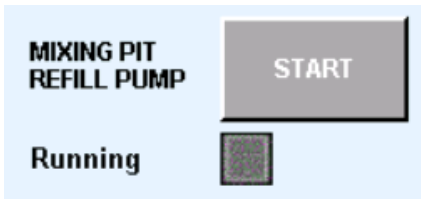
Fault from the Pre-mix Control, Check the Solids Load Status Screen or The Premix screen
The Liquid flow through the Premix has not established the Level has not risen.

The Rotacut has failed to start, this could be blocked.

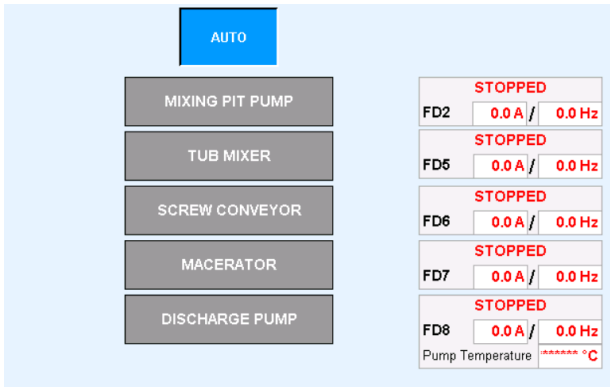
The load on the transfer auger has fallen below its minimum value indicating the auger is not full, this is generally due to the hopper level being too low, can be cleared by loading more into the hopper or the RESET button.

Remaining Material in Hopper
Target Feed Quantity
Total feed in current feed cycle, this is added to the Solids loaded today at the end of the Load
Total solids loaded since midnight
Level inside the mixing chamber of the PREMIX, should be > 50 and > 120
The Pressure in the discharge line between the Premix and the Digester
The Rotacut blade ware indicator.
Solids Loading rated calculated during load operation

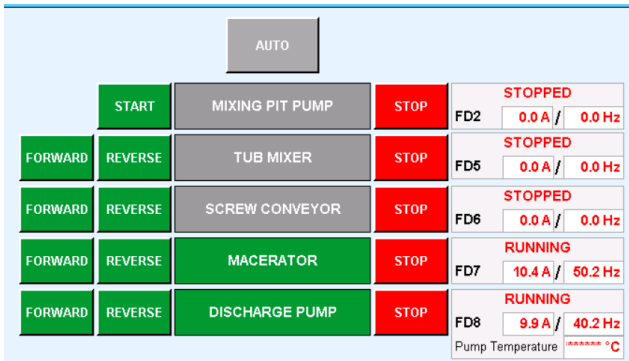
Solids Weight in Tub Mixer	798 kg
Solids Target Load	1250 kg
Solids Current Load	27 kg
Solids Loaded Today	7052 kg
Premix Level	68 68 mbar
Discharge Pressure	0.67 bar
Rotacut Bladewear	70 %
Solids Loading Rate	3.44 t/h



Manual button to trigger a Mixing Pit Refill, this function can be automatically called up to 3 times a day at times specified in the Settings Pages. When the pump is active the Running indicator illuminates – Refer to the Operation page for further information



Motor Running current, speed and status. While in Automatic operation.



Motor Running current, speed and status. While in Manual operation. An element running shows in GREEN.

Note to take control of the PREMIX related elements the Linked control need to be disabled on the SETTING SCREEN 3

NOTE! Great care must be taken in running the PREMIX Manually, as it can easially become blocked or damaged. The TUB Mixer can be run in reverse for short periods up to 3 seconds, beyond that it will be pushing upwards on the mixer, it is not designed to do this and may be damaged.

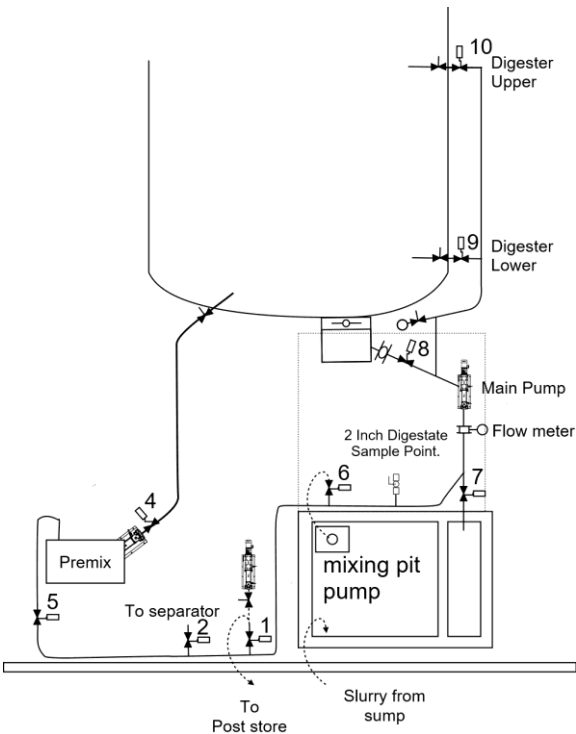
It is important to note that the Discharge Pump and Macerator will auto activate the Chamber level if ithe rises above the allowable level; this is to prevent the PRE-Mix control from alarming, requiring a local reset.

Pneumatic Valve Control and Status

AUTOMATIC VALVE STATUS		
DEMAND	VALVE	OPEN
☐	1 Poststore	☐
☐	2 Separator Feed	☐
☐	3 not used	☐
☒	4 Premix Output	☒
☐	5 Premix Input	☐
☐	6 Mixing Pit Unload	☐
☐	7 Mixing Pit Refill	☐
☐	8 Digester Grit-trap	☐
☐	9 Digester Lower	☐
☐	10 Digester Upper	☐

Green Indicates ACTIVE / NOT CLOSED.
The Valve between the PREMIX and the Digester is being called to Open and is NOT Closed

Valve Locations on site



Air Valve controls in the Control Room

Manifold Block In Control container			
Red		Yellow	Low air pressure switch
10	△	○	○ Digester Un-Load Upper → Pump
09	△	○	○ Digester Un-Load Lower → Pump
08	△	○	○ Grit Trap → Pump
06	△	○	○ Mixing Pit → Pump
05	△	○	○ Pump→ Vogelsang
04	△	○	○ Vogulsang → Digester Load
02	△	○	○ Pump → Separator
01	△	○	○ Pump → Post Store
07	△	○	○ Pump → Mixing Pit
	°	blank	○ Spare slot



4.8 Control Screen 2 – Temperature & Auxiliary

Y Maesydd Farm Digester Auxiliary Controls

06/11/2019 17:58:04

0 0

HEAT TRANSFER WATER PUMP STATUS: **RUNNING**

DIGESTER WATER PUMP STATUS: **RUNNING** ACTUAL: **41.3 °C** TARGET: **41.5 °C** HYSTER: **0.1 °C**

DIGESTER WATER VALVE ACTUAL: **62.2 °C** TARGET: **62.0 °C**

GAS HOLDER INFLATION PUMP STATUS: **RUNNING**

CONTROL CONTAINER FAN STATUS: **STOPPED**

ANTI-FROST HEATER STATUS: **STOPPED**

FLARE TEST STATUS: **FAULT** ON: **99 %** OFF STD: **99 %** OFF CHP: **99 %**

Hours Run: **00:00**

Healthy: **00:00**

Running: **00:00**

Run Demand: **00:00**

Premix Trim: **1.0**

Buttons: Status, Operation, Settings, Alarms, Diagnostic

Digester Heating Controls:

The digester temperature is monitored by the control system. The digester temperature is regulated by turning ON and OFF the hot water supply to the internal heat exchangers.

If the temperature rises above the set value + the hysteresis value, the hot water circulation pump is turned OFF (in this case if temperature > (41.5+ 0.1) 41.6°C).

If the temperature falls below the set value – the hysteresis value, the hot water circulation pump is turned ON (in this case if temperature < (41.5- 0.1) 41.4°C).

The temperature of the water in the heating circuit is regulated by a mixer valve, this set value can be adjusted. To prevent 'baking on' of digestate to the Heat Exchangers the Maximum value it can be set to is the Digester temperature + 25°C.

In this case the Set Temperature is set at 62.0°C

Hot Water Transfer Pump:

DISABLE **HEAT TRANSFER WATER PUMP** STATUS: **RUNNING**

Not Used in this System

This is the control signal for the Pump that circulates the hot water from the CHP water system to the heat exchanger in the Digester heating circuit. The pump can be disabled by selecting the button. **DISABLE**

Note! For this system, the pump is not used. The location of the heat exchanger is in the end of the CHP container rather than remotely in the control container. This allows the CHP circulation pump to be used for this function.

Digester Target temperature setting and Control:

DISABLE **START** **DIGESTER WATER PUMP** STATUS: **RUNNING** ACTUAL: **41.3 °C** TARGET: **41.5 °C** HYSTER: **0.1 °C**

Control of the digester temperature. The Circulation can be stopped using the button **DISABLE** the water circulation can also be forced to run continuously using the button, the **START** hot water circulation is disabled 5 minutes after the CHP (the Heat source) stops. This is to prevent the system 'stealing' heat from the digester.

Digester Water Valve Control:

DIGESTER WATER VALVE	ACTUAL	TARGET
	62.2 °C	62.0 °C

The temperature of the water entering the digester heating circuit is regulated. This hot water supply temperature is limited to be less than the digester temp +25°C to protect the heat exchangers from 'baking on of' digestate. There is a further command that will shut remotely shut off the hot water supply from the CHP / biogas boiler system. This is turned off if the CHP and the boilers are both off-line (to prevent the heat system 'robbing' heat from the Digester) or if the Digester Circulating Pump is turned off and the Frost Protection is not enabled. When the frost protection system is active and the digester is at temperature the Water temperature is set at the digester temp +2°C, this will keep warm water circulating to protect the pipe work.

Separator Control Signals**Not currently Used in this System**

For the Separator to run the Enable / Disable Button needs to be set to Green. This will then allow the Separator to Run. The control system will set the post store related valves to 'Unload to Lagoon'. The Separator can then either be allowed to run this will keep running until the post store level has fallen to that set in the SEPARATOR SETTINGS on the Device Configuration setting screen as 'Poststore Level Limit'. Or the 'Separator End Time' is reached. Under Auto control the Separator will automatically restart the next morning at the time set as 'Separator Start Time'. Should the dump valve to the lagoon be opened a high flow rate will be seen down this pipe and the Separator will be stopped and the Separator Enable Button will be cleared (back to RED) This will revert the valves to normal operation.

Gas Holder Inflator Status

GAS HOLDER INFLATION PUMP	STATUS
	RUNNING

This is the power feed to the gas dome inflator. It should remain permanently on. It cannot be turned off by the control system but will indicate if the overload trips. If it is turned off, the gas holder will deflate.

Control Container Ventilation.

DISABLE	START	CONTROL CONTAINER FAN	STATUS
			STOPPED

There is a vent fan in the control container that, this can either be forced ON using the  button on the screen or it will turn ON when the temperature inside the control cabinet triggers the cabin ventilation fan to activate, it will run on for a pre-set time after the cabinet ventilation fan turns OFF. This can be disabled using the  Enable / Disable button on the screen.

Frost Protection:

FROST	ANTI-FROST HEATER	STATUS
		STOPPED

There is a frost detecting thermostat installed under the control container. This is to protect the Foam Alleviation and the Condensation / Anti Implosion trap from freezing these both have ATEX heating elements installed. These are fed from the frost protection circuit. The system will activate from the thermostat or manually from the FROST  button. The circuit is monitored by the control system.

To test this system, press the FROST button and the STATUS will show RUNNING if OK or TRIPPED if there is a problem. If TRIPPED is shown the two devices should be protected with anti-freeze. If an extended period of cold weather is expected or the mains power is OFF Anti-Freeze needs to be employed.

Flare Controls:

FLARE TEST	FLARE	STATUS	ON	OFF STD	OFF CHP
		FAULT	99 %	98 %	98 %

These controls enable the gas holder level at which the flare is called to activate are set at. If the engine is running the Flare will turn off at the OFF STD level, there is the facility to set a lower level to run the gas holder down to should the CHP not be operating, this is to reduce the number of flare operations when we know it is going to be needed more often (when the CHP is not using any gas). The Flare can be activated for two minutes by pressing the FLARE TEST button.



Flare status:

Hours Run	00:00
Healthy	
Running	
Run Demand	

- Cumulative operational hours of the FLARE
- This is LIT Green if the Flare is available (No Fault).
- Illuminated when the FLARE is Burning
- Illuminated when the FLARE is being requested to run.

Premix – Level modify parameter:

Premix Trim	1.0
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This value is used to adjust the apparent level in the Premix chamber, it is useful when trying to use this when the stator on the Discharge Pump is worn or a particularly ‘sticky’ product is being processed. ONLY EVER CHANGE THIS FROM 1.0 under instruction of Fre-energy. If it is adjusted to get a few extra days out of worn pump stators it must be returned to 1.0 when a new stator is fitted.

4.9 Setting Screen 1

Y Maesydd Farm Digester Settings 1 08/11/2019 17:31:16 0 0

MAIN PUMP		VOGELSANG PREMIX OTHER SETTINGS		VOGELSANG PREMIX AUTORUN SETTINGS	
Manual Load/Unload Amount	10.00 m ³	Tub Mixer - Run Time on Refill	3 m	Premix Target Pressure	75 mbar
Automatic Solids Loading Cycle - Day	150 m	Tub Mixer - Minimum Weight	500 kg	Rotacut off delay after Feed Pump Stop	3 s
Automatic Solids Loading Cycle - Night	120 m	Tub Mixer - Manual Run Speed	45.0 Hz	Feed Pump Liquid Component Default	4.0 4.0
Solids Target Load	1300 kg	Tub Mixer - Manual Run Time	40 m	Feed pump OFF delay after Screw Conveyor Stop	10.0 s
Speed Setpoint	65.0 Hz	Screw Conveyor - Minimum Current	3.45 A	Stop Pressure after Discharge Pump	3.00 bar
Minimum Unloading Rate	175 dm ³ /m	Screw Conveyor - Min. Current Time	30 s	Control Pressure after Discharge Pump	2.00 bar
		Screw Conveyor - Manual Run Speed	20.0 Hz	Control Current for Rotacut	15.0 A
		Screw Conveyor - Manual Run Time	50 m	2nd Measurement for Discharge Pump Pressure	2.00 bar
		Rotacut Macerator - Manual Run Speed	50.0 Hz		
		Rotacut Macerator - Manual Run Time	75 m		
		Discharge Pump - Manual Run Speed	40.0 Hz		
		Discharge Pump - Manual Run Time	75 m		
		VOGELSANG CHAMBER PURGE SETTINGS			
		Purge Trigger Level	180 mbar		
		Purge Terminate Level	50 mbar		
		VOGELSANG LIQUID COMPONENT TRIM			
		Liquid Component - Step Up Trim Time	5 s		
		Liquid Component - Step Down Trim Time	45 s		
		Liquid Component - Step Up Size	0.5		
		Liquid Component - Step Down Size	0.2		
		Liquid Component - Maximum	9.2		
		Liquid Component - Minimum	3.0		
		Macerator High Current	15.70 A		
		Macerator Low Current	13.40 A		
		Start Gas Level for load trim	75.0 %		
		Maximum amount of load trim	50.0 %		

Navigation: << Status Operation Settings Alarms Diagnostic >>

MAIN PUMP	
Manual Load/Unload Amount	10.00 m ³
Automatic Solids Loading Cycle - Day	150 m
Automatic Solids Loading Cycle - Night	120 m
Solids Target Load	1250 kg
Speed Setpoint	65.0 Hz
Minimum Unloading Rate	175 dm ³ /m

Note: If the manual / Oneshot volume is set to 0 it will not manually load this is a common problem.

Target Load Value in Manual / One Shot
Time between Solid feeds – Day time
Time between Solid feeds – Night-time - see Setting Page2
Quantity of solids loaded in feed.
Main pump speed when not in regulated mode *note 1
Minimum Loading rate, *if the Pump does not load this volume in a minute the pump will shut down on low flow.*

Note 1: The Main pump speed / Liquid flow rate are regulated under some of the operations:

- Solid Loading – Speed controlled by Pre-mix
- Unload to Separator – Speed / flow regulated
- De-Gritting – Run at maximum speed

DE-GRITTING	
De-Gritting Volume / Cycle	0.25 m ³
De-Gritting Cycle Time	24.0 h
Number of Cycles (0=OFF, 99=ON)	99
Speed Setpoint	75.0 Hz

Volume to transfer for each De-Gritting cycle.
Time between De-Gritting cycles.
Number of De-Gritting cycles per day. 99 – continuous.
Dedicated pump speed for De-gritting (MAX).

The de-gritting function has a Re-Fill Mixing Pit from tank afterwards, this is to flush the pipe work between the tank and the mixing pit.

Notes on De-gritting. The Digester grit removal function flushes the grit from the grit trap. For this to operate, the grit trap slider needs to be open (fully open the slider and then re-close the slider by 500mm). With de-gritting, the grit collected in the trap is flushed out; too little de-gritting and the grit accumulates, too much de-gritting and significant proportions of the good bacteria lurking in the base area of the digester can be depleted which can degrade the biology of the digester. The system does recycle some of this via the liquid from the grit collection sump running over into the mixing pit. However, this is degraded – there is a balance to be struck.

Heat Exchanger Valve Setup

When the digester water system operates at high pressure (i.e. a system that is not vented to the atmosphere) to protect the heat exchangers in the digesters, which by their nature can not withstand a high pressure, they need to be on a separate water circuit that is vented to atmosphere. This digester heating system needs to be in an independent circuit with the heat brought across from the pressurised system via a heat exchanger. As pressurised systems generally operate at higher temperatures (in excess of 90°C) we have a temperature regulation valve to regulate the water temperature being sent to the heat exchangers in the digester. The control variables for this are in this section. We have a set Temperature and control parameters. The temperature in this circuit and the set temperature are repeated on the Second Control page if this system is in use.

HEAT EXCHANGER VALVE SETUP		The Hot Water temperature requested is set here, along with the band we would like it to remain within. The Gain sets the amount to vary the control by to correct the temperature and the Control Time is the time between adjustments. The Control time needs to be long enough to accommodate the lag in the response of the system, i.e. the time a change takes to be visible after the demand is adjusted.
Hot Water Demand Temperature	61.6 °C	
Temperature Deadband	0.5 °C	
Temperature Control Gain	100	
Temperature Control Time	5 s	
MISCELLANEOUS		Delay time to allow air valves to operate. Pressure at which to activate pipe pressure relief. Pre-store pump maximum / manual run speed. <i>When feeding the digester, the Mixing Pit pump speed is regulated to limit the pressure at the Main pump inlet - see SETTINGS page 2.</i>
Air Valve Opening Time (s)	5 s	
Valve Manifold Pressure Relief	1.60 bar	
Mixing Pit Pump Maximum Speed	50.0 Hz	

Air Valve Opening Time (s); There is a delay between the valves being asked to open and them fully opening. This time delay is to allow this action to complete before the next part of the process starts, i.e. starting to Pump, or recording a failure to OPEN.

Manifold Pressure Relief; During operation there can be a pressure build up in pipework due to gas being evolved. To protect the pipework from this, there is a protocol that pulses open a valve to relieve this pressure.

Note! This is not the pressure limit for operation. It is the pressure at which the system attempts to relieve a pressure build up. Increasing this level potentially above the pressure limits (these are hard set in the pressure transducers) will increase the shutting down of the pumps on overpressure.

Premix Motor Drive and Load weighing system settings:

VOGELSANG PREMIX OTHER SETTINGS

Setting related to the TUB MIXER		
Tub Mixer - Run Time on Refill	3 m	Auto loading start delay on material load. Note 1. Weight at which Solids loading is stopped. Run speed for the tub mixer. Maximum run time after a Manual Start.
Tub Mixer - Minimum Weight	500 kg	
Tub Mixer - Manual Run Speed	45.0 Hz	
Tub Mixer - Manual Run Time	40 m	

Note 1: While the Tub is being filled a 3 minute lockout timer is started, this will prevent the solids loading system from starting for 3 minutes and if the TUB level is at less than 3,000kg it will also run the TUB MIXER. This timer is restarted every time the weight lifts by 500kg.

Setting related to the SCREW CONVEYOR		
Screw Conveyor - Minimum Current	3.45 A	Transfers feed from the TUB to the Premix Current when Conveyor is empty – see note 2. Time delay on minimum Current before STOP Speed Conveyor runs at when in MANUAL. Maximum time conveyor will run when in MANUAL
Screw Conveyor - Min. Current Time	30 s	
Screw Conveyor - Manual Run Speed	20.0 Hz	
Screw Conveyor - Manual Run Time	50 m	

Note 2: If the Premix feed system is run with the conveyor empty the liquid will run back the conveyor channel, flooding back into the TUB MIXER. The low current detection acts to stop the system if a sustained period of low current is seen, this is generally an indication that the tub is empty. The weight at which this happens can vary dependent upon the ammount of material left balanced on top of the mixing rotor. This can also happen should the conveyor entry chanel be bridged in the TUB MIXER.

Setting related to the Rotacut Macerator		
Rotacut Macerator - Manual Run Speed	50.0 Hz	Macerator run speed when in MANUAL Maximum time Macerator will run when in MANUAL
Rotacut Macerator - Manual Run Time	75 m	

Setting related to the Discharge Pump		
Discharge Pump - Manual Run Speed	40.0 Hz	Discharge Pump speed when in MANUAL Maximum time Pump will run when in MANUAL
Discharge Pump - Manual Run Time	75 m	

NOTE! Great care should be taken when operating the PRE-MIX in manual, all the closed loop controls are dissabled and it is very easy to flood the hopper or block the macerator. This should only be done by experienced operators.

VOGELSANG CHAMBER PURGE SETTINGS

Within the Premix there is a chamber in which the solid feed stock is mixed. The level of liquid in this chamber is measured as a pressure; mbar 1mbar represents a height of approximately 1mm with the re-circulated digestate from the digester. This chamber can become over filled by liquid draining down from the pipework feeding the unit, draining back from a flooded conveyor channel or returning past worn stators in the discharge pumps. To deal with this, the control system will open the discharge valve and start the Macerator pump and the discharge valve.

Purge Trigger Level	180 mbar	Level at which purge sequence is triggered.
Purge Terminate Level	75 mbar	Level at which purge is shut down.

VOGELSANG PREMIX AUTORUN SETTINGS

These are control settings that are set in the dedicated Pre-mix control system. Parameters set here are passed across into the Premix control system.

Premix Target Pressure	75 mbar
------------------------	---------

The Liquid level in the mixing chamber of the Pre-mix is monitored to observe the pressure; the level is approximately 1mm per mbar. The target Level the system will try to maintain is set here 75mBar (75mm).

Rotacut off delay after Feed Pump Stop	3 s
--	-----

When the system completes its operation, the Macerator is run for a further 3 seconds after the feed pump has stopped, to allow residual material to drain through.

Feed Pump Liquid Component Default	4.0	4.0
------------------------------------	-----	-----

The two numbers are the default / starting value (left value) and the currently in use (right value). This value sets the ratio of Liquid to solids being fed.

- Lower Number: Less Liquid more Solid – material loaded is thicker – loads faster but can block the Macerator or the discharge Pump. Overloads on the macerator or over pressure stops the feed conveyor and can then slow the feeding rate down.
- Higher Number: More Liquid less Solid – material loaded is thinner – loads slower.

This value is dynamically adjusted by monitoring how hard the macerator is working. If it is hardly working, the ratio is dropped. If it is working hard, it increases the ratio, the details of this are in the section VOGELSANG LIQUID COMPONENT TRIM.

Feed pump OFF delay after Screw Conveyor Stop	10.0 s
---	--------

This is flush time operation that the system is run with only liquid feed at the end of a LOAD. This needs to be long enough to remove most of the fresh solid material from the body of the premix and the discharge pump.

Stop Pressure after Discharge Pump	3.00 bar
------------------------------------	----------

This is the pressure at which the PREMIX stops on an over-pressure fault. Reaching this pressure is an indication that there may be a valve that is not open correctly, either the Discharge valve near the Pump or the Manual valve near the pump. It could also be a blockage in the pipe between the Premix and the Digester. This value should not be increased above 3.00. The operation should be less than 2.0 Bar. Over-pressurising or packing a blockage makes it much more difficult to clear.

Control Pressure after Discharge Pump	2.00 bar
---------------------------------------	----------

This is the pressure at which the flowrate through the feeding system is slowed down. This can be activated if the mixture is getting too thick. The system will slow the Solid feed (via the screw conveyor) first as well as slowing the discharge pump.

Control Current for Rotacut	15.0 A
-----------------------------	--------

This is fundamentally the same function as the previous parameter but is looking at how hard the macerator is working.

2nd Measurement for Discharge Pump Pressure	2.00 bar
---	----------

This parameter is for a second Discharge path / pipe. Not present in this system.

VOGELSANG LIQUID COMPONENT TRIM

To allow for variations in the feedstock being fed, the ratio of the Solids to Liquid is adjusted. While the system is loading, the current to the macerator is monitored.

Macerator High Current	15.70 A
------------------------	---------

The ratio is increased by the

Liquid Component - Step Up Size	0.5
---------------------------------	-----

There is then a delay of

Liquid Component - Step Up Trim Time	5 s
--------------------------------------	-----

Before the ratio is adjusted again, if

The operation time needs to be long enough that the change in ratio has time to take effect and short enough that the system does not block.

The Ratio is reduced if the Macerator current remains below the

Macerator Low Current	13.40 A
-----------------------	---------

for the time set in the

Liquid Component - Step Down Trim Time	45 s
--	------

the Ratio is reduced by

Liquid Component - Step Down Size	0.2
-----------------------------------	-----

The Low current timer is then re-

started. The system should be configured such that the rate at which the Ratio is increased is significantly faster than the reduction rate. The benefit in a reduced ration is faster loading, which means less paracitic load, which means less wear on working parts. The effect of too low a rate is a blockage, which will require operator intervention to sort out.

Note! We recommend that you discuss any adjustments you wish to make to these parameters with Fre-energy before tweaking.

Feed rate adjustment values when at full gas.

The system has a feature to trim the amount to be loaded when the gas holder is Full. This will back-off the loading if the CHP has stopped and the gas holder is full. Care needs to be taken in using these parameters as the feed loaded today is providing some energy for today and also some over the following days; for a crop-fed plant this could be 60-days (in which case these parameters are of little benefit). Alternatively it may only be very short-term (e.g. food waste where the energy is released in a very short time). For plants feeding cattle slurry and chicken manure, the realistic digestion time is around 2- days. The release of initial gas from chicken manure can be very quick, i.e. a matter of hours and this can be a benefit.

Start Gas Level for load trim	75.0 %
-------------------------------	--------

This is the gas holder level at which the amount of solid feed starts to be adjusted. The amount it is trimmed by is calculated from the Gas holder level difference between the Trim level and the Actual level and then multiplying it by the

Maximum ammount of load trim	50.0 %
------------------------------	--------

So for example if the:

- Gas holder Level is 100% the Solids Load amount would be reduced by 50%.
- Gas holder level is at 87.5% (half way between 75 and 100%) Load amount would be reduced by 25% (half of 50 %).
- Gas holder level at 76% then the load amount would be reduced by $1/25^{\text{th}}$ of 50% - 2%.

4.10 Setting Screen 2: Tank / Pit Levels & Thresholds with CHP output control

Y Maesydd Farm Digester Settings 2 22/11/2019 12:57:21

DIGESTER LEVEL CONTROL		MIXING PIT LEVEL CONTROL		CHP SETUP	
Digester Volume	1220 m ³	Slurry Load Amount	2.00 m ³	Maximum Output	210 kW
Digester Full Threshold	100.0 %	Delay between Pit Loads (mins)	90 m	High Power Setpoint	200 kW
Digester Full Hysteresis	0.2 %	Mixing Pit Unload Threshold	77 %	Low Power Setpoint	165 kW
Digester Low Threshold	85.0 %	Mixing Pit High Level	85 %	Gas Level for High Power	90 %
Digester Low Hysteresis	0.2 %	Mixing Pit Low Level	25 %	Gas Level for Low Power	75 %
Digester Transfer Threshold	99.5 %	Mixing Pit Empty Level	24 %	Gas Level for Engine Stop	5 %
Digester Transfer Amount	0.50 %	Mixing Pit Level Hysteresis	2.5 %	Gas Level for Engine Re-start	42 %
Digester Transfer Volume	6.10 m ³				

MIXING PIT FILLING		CHP PEAK TIME SETUP	
Mixing Pit Fill Level 2	85 %	Pre-peak Gas Level for High Power	90 %
Mixing Pit Fill Level 3	80 %	Pre-peak Gas Level for Low Power	65 %
		In-peak Gas Level for High Power	25 %
		In-peak Gas Level for Low Power	8 %
		Pre-peak Duration	1 h
		In-peak Start Time	16 h
		In-peak Duration	3 h
		Night Hours Start	20 h
		Night Hours End	0 h

ADAPTIVE MIXING PIT PUMP SETUP		SEPARATOR SETUP	
Loading Pressure Target	0.88 bar	Separator Run Forward Time	120 s
Loading Pressure Band	0.02 bar	Separator Run Reverse Time	10 s
Mixpit Pump Adaptive Filter	50	Separator Speed Setpoint	50.0 Hz
Mixpit Pump Adaptive Gain	100	Poststore Pump Speed Setpoint	30.0 Hz

REMOTE PRESTORE PUMP	
Mixpit Level Test Time	1 m
Mixpit Level Test Percent/Min	1.00 %
Remote Transfer to Mixing Pit Time 1	17 h
Remote Transfer to Mixing Pit Time 2	9 h
Remote Transfer to Mixing Pit Time 3	1 h
Remote Transfer Volume	12 m ³
Remote Transfer Pump Time Limit	12 m

Navigation: ◀ ◀ Status Operation Settings Alarms Diagnostic ▶ ▶

Digester Level Control

DIGESTER LEVEL CONTROL	
Digester Volume	1220 m ³
Digester Full Threshold	100.0 %
Digester Full Hysteresis	0.2 %
Digester Low Threshold	85.0 %
Digester Low Hysteresis	0.2 %
Digester Transfer Threshold	99.5 %
Digester Transfer Amount	0.50 %
Digester Transfer Volume	6.10 m ³

The control system monitors the digester level via a pressure sensor. The digester level is checked immediately prior to loading. If it is greater than the **Transfer Threshold** a transfer sequence is initiated. This is the larger of either sufficient quantity to enable the next load to be completed, or the amount specified in the **Transfer Amount**. Transferring is inhibited if the digester level falls below the **Digester Low Threshold** or if the digester Level exceed the **Digester Full Threshold**.

The Full and Low threshold levels have a **Hysteresis** amount attached. This means that if the Digester is FULL the Level must fall to less than the (**Digester Full Threshold** – the **Hysteresis**) and if the Digester is LOW the Digester Level must rise above the (**Digester Low Threshold** + the **Hysteresis**).

The Amount to Transfer is defined as a percentage (%) of the Full Tank Value. For reference the calculated amount is shown Below as the Digester Transfer Volume.

Poststore Level Control NOT PRESENT IN THIS SYSTEM

This works on the same basis as the Digester Level Control; before a Transfer can be initiated, the Level in the Post Store is checked against the Post Store Transfer Level. If this is exceeded material is unloaded to the Lagoon.

MIXING PIT LEVEL CONTROL

Setting of values for the periodic Load from the Mixing Pit

Slurry Load Amount	2.00 m ³
Delay between Pit Loads (mins)	90 m

Under these settings the system will load 2.0m³ from the mixing pit into the digester every 90 minutes.

If the Mixing Pit Level exceeds the **Mixing Pit Unload Threshold** **77 %** Delay between loads time is ignored and the system triggers an immediate Load.

If the Mixing Pit Level exceeds the **Mixing Pit High Level** **85 %** 'STOP' Signal is forced in the remote line to the TOP up pump from the slats area in the cattle shed to prevent any further slurry being sent over. (Note: This can also be triggered by the FLOAT switch in the Mixing pit activates).

Mixing Pit Low Level **25 %** Is used to Stop a mixing propeller from running i.e. it should only be run if it is covered with Slurry. NOTE! NO MIXING PIT PROP IN THIS INSTALLATION.

Mixing Pit Empty Level **24 %** At this level the Mixing pit Load to the digester is Stopped; it is now too low for the mixing Pit pump to operate. There is a function to prevent this situation from bouncing. The Low state load inhibit is not removed until the the Pit level has increased by the **Mixing Pit Level Hysteresis** **2.5 %** amount.

MIXING PIT FILLING

There are two levels that can be used to autofill the mixing pit to pre-determined levels. This is implemented when solids are being added to the pit and then mixed in. On the first Mixing Pit Fill it is filled to the Lower of these levels, Solids can be added and mixed in. It can then be filled to the Next Level and further solids added and again mixed in. If a Third fill request is made, the Pit fill to the Mixing Pit High Level.

Mixing Pit Fill Level 2	85 %
Mixing Pit Fill Level 3	80 %

ADAPTIVE MIXING PIT PUMP SETUP

Loading Pressure Target	0.88 bar
Loading Pressure Band	0.02 bar
Mixpit Pump Adaptive Filter	50
Mixpit Pump Adaptive Gain	100

There can be an issue when the Mixing Pit pump is running and we are loading the system that the pressure can be pushed to a level where it triggers the Over pressure protection at the inut of the feed pump. To overcome this

REMOTE PRESTORE PUMP

problem the control system slows down the pump to limit the

pressure. The target pressure for the Pump can be set and a band implemented over which we do not make any further speed adjustment. There are two adjustments to control the Rate and scale of the adjustments. Note! We recommend that you do not vary these without first discussing with FRE-energy.

Setting the Controls for the remote pump installed under the slats in the cattle shed:

Transfers can be set for up to three times a day.

Remote Transfer to Mixing Pit Time 1	17 h
Remote Transfer to Mixing Pit Time 2	9 h
Remote Transfer to Mixing Pit Time 3	1 h

The system is protected against a burst pipe, the pump running dry or not running correctly, by the system monitoring the rate at which the level in the mixing pit rises. In this case if the mixing pit level has not increased by 1% in 1 minute the transfer will be stopped. The volume to be transferred is calculated by the change in mixing pit level.

Mixpit Level Test Time	1 m
Mixpit Level Test Percent/Min	1.00 %

Using this calculation, the loading amount is limited to the

Remote Transfer Volume	12 m ³
------------------------	-------------------

There is also a further protection that will only allow the transfer pump to run for the [12 minutes].

Remote Transfer Pump Time Limit	12 m
---------------------------------	------

CHP Control variables

The CHP output power controls are set within this section; we have gas holder levels at which the engine is Started and Stopped, and its power switched to High or Low. On request, this function can be extended to use different switching levels at different times of day, and to Start and Stop multiple CHP's, including Load shearing where required.

CHP SETUP		
Maximum Output	210 kW	CHP – Maximum Power (<i>used for scaling</i>) High Power setting. Low Power setting. Gas holder Level to switch to High Power. Gas holder Level to switch to Low Power. Gas holder level at which CHP stops. Gas holder level at which CHP re-starts.
High Power Setpoint	200 kW	
Low Power Setpoint	185 kW	
Gas Level for High Power	90 %	
Gas Level for Low Power	75 %	
Gas Level for Engine Stop	5 %	
Gas Level for Engine Re-start	42 %	

To optimise the generation of the CHP, to for example, take full advantage of the potential for TRIAD payments, there is a feature built into the software that adjusts the power change levels to potentially slow the generation down prior to the potential peak time and then to run at full power when possible through the peak time. Along side the basic set values there is an indication of the current values in use.

Pre-peak Gas Level for High Power	90 %
Pre-peak Gas Level for Low Power	65 %
In-peak Gas Level for High Power	25 %
In-peak Gas Level for Low Power	8 %
Pre-peak Duration	1 h
In-peak Start Time	16 h
In-peak Duration	3 h

Actual
90 %
75 %
5 %
42 %

SEPARATOR SETUP

The separator unload can be selected either when in Manual or when the Unload to Separator Tab is set on SETTINGS Page 3.

For some separators there is a need to periodically reverse the separator for a set time to clean the screen. The timings for these are:

Separator Run Forward Time	120 s
Separator Run Reverse Time	10 s

The speed of the Separator

Separator Speed Setpoint	50.0 Hz
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 and the take-away pump can be adjusted. In general, the value should be approximately the same as for the Run operation of the feed pump.

4.11 Setting Screen 3 – Material pathways functions & System parameters



Y Maesydd Farm Digester
Settings 3

25/11/2019 18:01:13

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VALVE PATHWAY SELECTION

De-gritting Path	De-grit to Mixing Pit	▼
Mixing Pit Refill Path	Digester Upper to Mixing Pit	▼
Slurry Loading Path	Mixing Pit to Digester Lower	▼
Premix Feed Path	Digester Upper to Premix	▼
Digester Unload Path (Via Separator)	Digester Upper to Poststorage	▼
Digester Transfer Path (Direct to Poststore)	Digester Upper to Poststorage	▼

CHP DEMAND

DISABLE

MANUAL PREMIX

PREMIX CONTROL

UNLOAD VIA SEPARATOR

ENABLE

DISCHARGE PRESSURE

DISABLE

MIXING PIT REFILL PUMP

ENABLE

START

SYSTEM SETUP

Project Title	Y Maesydd Farm Digester		
Set Time (hh:mm:ss)	18	01	13
Set Date (dd/mm/yyyy)	25	11	2019

◀ ◀

Status

Operation

Settings

Alarms

Diagnostic

▶ ▶

VALVE PATHWAY SELECTION

De-gritting Path	De-grit to Mixing Pit	▼
Mixing Pit Refill Path	Digester Upper to Mixing Pit	▼
Slurry Loading Path	Mixing Pit to Digester Lower	▼
Premix Feed Path	Digester Upper to Premix	▼
Digester Unload Path (Via Separator)	Digester Upper to Poststorage	▼
Digester Transfer Path (Direct to Poststore)	Digester Upper to Poststorage	▼

The Options for the Routes for loading and unloading can be selected here. By Clicking the  symbol a table of options is opened, the required can be selected.

De-gritting Path	De-grit to Mixing Pit	▼
Mixing Pit Refill Path	Digester Upper to Mixing Pit	▲
Slurry Loading Path	Digester Lower to Mixing Pit Digester Upper to Mixing Pit	▼
Premix Feed Path	Digester Upper to Premix	▼

SYSTEM SETUP

The system definition area allows the Main Message at the Top of the Screen to be set. This can be edited to leave a message that is present on the top banner of each of the screens. The default is set to the Digester Name.

Project Title	Y Maesydd Farm Digester
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The Real time clock for the system can be adjusted in the same section.

Set Time (hh:mm:ss)	18	12	45
Set Date (dd/mm/yyyy)	25	11	2019

System Control selection Buttons.

This is telling you that the CHP is to run.

Pressing the button will turn it OFF.

This button enables the Manual controls for the Pre-mix Drives and Pumps. To select these, the main control needs to set to MANUAL and then selecting this button makes the controls available.

Note! Great care should be taken when operating the Pre-mix controls in Manual mode. It is recommended that this is only done in conjunction with instruction from Fre-energy.

When selected, this button will switch the Unload function from a direct transfer to the Post Store to unloading via the Separator.

This enables and disables the feed from the cattle sheds to the Mixing Pit. The Pump can be started using the START Button.



Setting Screen 4: Ancillary Functions Not present in this configuration

Device Configuration Screen

This setting screens allows the scaling of the sensors used to detect levels.

Note! The sensor calibration values should not be adjusted without discussion with Fre-energy.

DIGESTER LEVEL SENSOR	
Full Value	11750
Zero Value	240
Mounting Position %	65
Actual Reading	11825

DIGESTER RADAR LEVEL SENSOR	
Full Value	30600
Zero Value	0
Actual Reading	0

MIXPIT LEVEL SENSOR	
Full Value	10000
Zero Value	100
Actual Reading	4431

GASTANK LEVEL SENSOR	
Full Value	32750
Zero Value	500
Actual Reading	25280

SEPARATOR HEADER TANK SETUP	
Actual Level	9999 mm
Full Level	570 mm
Operating Target Level	350 mm
Separator Start Level	150 mm
Separator Stop Level	5 mm
Adaptive Speed Band Height	- mm
Feeder Pump Adaptive Filter	-
Feeder Pump Adaptive Gain	3
Feeder Pump Minimum Speed	7.0 Hz

This screen holds the calibration information for the level sensors and the parameters for the Separator control

Digester and Post Store (no Post Store in this system) level sensor calibration:

These two sensors are not installed at the absolute base of the digester. This allows the position to be offset corrected if required. There are 3 parameters used from which the system calculates the fill level of the digester and post store.

DIGESTER LEVEL SENSOR	
Full Value	11750
Zero Value	240
Mounting Position %	65
Actual Reading	11825

The Full Value is the reading when tank is full

The Zero Value is the 'free air reading'

The mounting position is the height up the tank of the sensor.

Note! This means that the sensor will not give a reading when the level is below the mounting position. The current raw value of the sensor is displayed below. As a rule of thumb the sensor should read 3,252 for each meter above the sensor.

These sensors are pressure operated. There is a correction applied to the level reading to compensate for the gas pressure in the system. The calculated digester level is fine-tuned using the reading from the gas pressure sensor. 1mBar = 1cm.

Mixing Pit and Gas Tank Level sensors

These two sensors read down to zero.

MIXPIT LEVEL SENSOR	
Full Value	14000
Zero Value	1000
Actual Reading	5150

The Full Value is the reading when tank is full

The Zero Value is the reading when the Mixing pit or Gas tank are at zero.

GASTANK LEVEL SENSOR	
Full Value	14750
Zero Value	3500
Actual Reading	11635

To aid the setting of these, the raw current value for the sensor is shown.

Separator Settings

These are the values used in the Separator unloading function. Further details on the operation of the separator can be found in the Status page section, and control Page 2 where the Separator control switch is located.

SEPARATOR HEADER TANK SETUP	
Actual Level	9999 mm
Full Level	570 mm
Operating Target Level	350 mm
Separator Start Level	150 mm
Separator Stop Level	5 mm
Adaptive Speed Band Height	- mm
Feeder Pump Adaptive Filter	-
Feeder Pump Adaptive Gain	3
Feeder Pump Minimum Speed	7.0 Hz

The Separator operates with a fixed head of digestate. This is achieved by having a header tank. The level of the header tank is measured using the Separator level sensor. The header tank also has an overflow sensor that will be triggered if the tank over flows.

At start up, the header tank should be empty. It is filled using this feed pump.

When the level exceeds the Separator Start Level 150 mm the separator and the take-away pump are started.

The feed pump is now run to attempt to maintain the Operating Target Level 350 mm

If the Level is Tank level is above this, the feed Pump slows down. If below, then the pump speeds up.

If the Level exceeds the Full Level 570 mm the feed pump is stopped.

There are some further parameters used in the control of the speed of the feed pump to maintain the desired level in the header tank.

The Feeder Pump Adaptive Gain 3 adjusts the amount of speed adjustment applied to the pump dependent upon the difference between the actual and target tank levels. If this value is set too high, the pump speed will fluctuate by large amounts and the tank level will move up and down, if too low, the tank will struggle to hold level when the Separator does a reversal of direction.

There is a minimum speed setting Feeder Pump Minimum Speed 7.0 Hz. If the request speed drops below this, the pump is stopped.

At the end of the separating unload operation, the feed pump is stopped and the separator continues to runs until the Tank Level reaches the

Separator Stop Level	5 mm
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 or for 2 minutes.

When the Separator stops, the Transfer Pump to the post store runs on for a further 30 seconds to clear any residual liquid within the system.

We also include a loss of plug detection system. When operating with plug type separators, the system requires a plug of separated material to be in the throat of the unit to squeeze the liquid out. If this plug fails, the liquid just runs out of the system making a mess! We include a function to accommodate if the unload pump runs at a flow in excess of that for an extended period and the pump is struggling to maintain level in the Header tank, the system is shut down on 'lost plug'.

Note! This feature needs to be set up during commissioning of the Separator.

The Separator can also be set to only operate in daylight hours, the times for this can be set On Settings 2 screen.

4.14 Setting Screen: Mixing Controls

Y Maesydd Farm Digester

Digester 1 Mixing

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ARM PUMP SPEED SETPOINTS		GAS PUMPS - COMMON SETTINGS	
Push Speed	37 Hz	Gas Pump Speed	50 Hz
Pull Speed	55 Hz	Gas Pump Accel Time	5 s
Pause Speed	45 Hz	Gas Pump Decel Time	5 s

ARM PUMP PRESSURE SETPOINTS		GAS MIXING - FIXED	
Raise Arm Threshold	1250 psi	Fixed Gas Pump ON Time	15 s
Drop Arm Threshold	650 psi	Fixed Gas Pump OFF Time	60 s
Lower Drop Threshold	400 psi	Fixed Gas Pump Mode	0
Reverse Pressure Limit	1300 psi		
Overpressure Limit	1600 psi		

ARM ROTATION TIMERS		GAS MIXING - SWITCHED	
Forward Pulse Time	88 s	Switched Gas Pump ON Time	15 s
Forward Pause Time	40 s	Switched Gas Pump OFF Time	60 s
Reverse Limit Time	110 s	Switched Gas Pump Mode	0
Reverse Pause Time	1 s		
Overpressure Relief Time	10 s		
Shutdown Retry Time	30 s		

ARM ELEVATION TIMERS		AIR PUMP SETTINGS	
Raise Pulse Time	2 s	Digester Air Pump ON %	100 %
Raise Repeat Time	15 s	Poststore Air Pump ON %	100 %
Drop Pulse Time	5 s		
Drop Repeat Time	10 s		

CRUST BUSTER SETTINGS	
Crust Buster Count / Cycles	0 / 100
Crust Buster ON Time	20 m
Crust Buster OFF Time	7 m

◀ ◀
Status
Operation
Settings
Alarms
Diagnostic
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ARM PUMP SPEED SETPOINTS	
Push Speed	45 Hz
Pull Speed	55 Hz
Pause Speed	30 Hz

Ram Speed control settings

Pump speed when ram is pushing forwards.

Pump speed during ram return stroke.

Pump Speed when ram is waiting.

ARM PUMP PRESSURE SETPOINTS	
Raise Arm Threshold	700 psi
Drop Arm Threshold	520 psi
Lower Drop Threshold	350 psi
Reverse Pressure Limit	1000 psi
Overpressure Limit	1800 psi

Arm lifting pressure settings

Arm lifts when push pressure is above this limit

Arm drops if pressure is below this but above

The lower push limit (Rams engaged pressure)

Pressure level to detect when ram fully is retracted

Over-pressure detection or lifting at top of travel

ARM ROTATION TIMERS	
Forward Pulse Time	75 s
Forward Pause Time	18 s
Reverse Limit Time	110 s
Reverse Pause Time	1 s
Overpressure Relief Time	5 s
Shutdown Retry Time	30 s
Gas Pumps Overload shutdown time	180 s

Arm rotating times

Time limit for forward push stroke.

Pause at end of forward stroke.

Ram return time limit – shuts down if exceeded.

Pause at end of return stroke.

Force Arm Drop on an over pressure trip.

Auto re-try time if system has shut down.

(The most common cause of a shutdown is low oil level in the hydraulic reservoirs.)

Mixing Pump Shut down time on over current.

ARM ELEVATION TIMERS	
Raise Pulse Time	5 s
Raise Repeat Time	10 s
Drop Pulse Time	5 s
Drop Repeat Time	10 s

Arm lifting and dropping timers

Arm raising pulse time.

Delay between lifting pulses

Arm dropping pulse time.

Delay between dropping pulses.

During a lifting or raising sequence the system is pulsed, the time and the repeat rate is defined here

GAS PUMPS - COMMON SETTINGS	
Gas Pump Speed	50 Hz
Gas Pump Accel Time	5 s
Gas Pump Decel Time	5 s

Gas mixing settings

Gas Pump run speed

Gas Pump ramp up time – extends belt life

Gas Pump ramp down time smooth stop.

GAS MIXING - FIXED	
Fixed Gas Pump ON Time	15 s
Fixed Gas Pump OFF Time	60 s
Fixed Gas Pump Mode	0

Fixed Gas Pump Run time (Pipe 7)

Fixed Gas Pump Off time (Pipe 7)

Fixed Gas Mixing Pump Operation Mode Selection

GAS MIXING - SWITCHED	
Switched Gas Pump ON Time	15 s
Switched Gas Pump OFF Time	60 s
Switched Gas Pump Mode	0

Switched Gas Pump Run time (Pipes 1 - 6)

Switched Gas Pump Off time (Pipes 1 - 6)

Switched Gas Mixing Pump Operation Mode Selection

Select Gas pump 1 Mode – See below

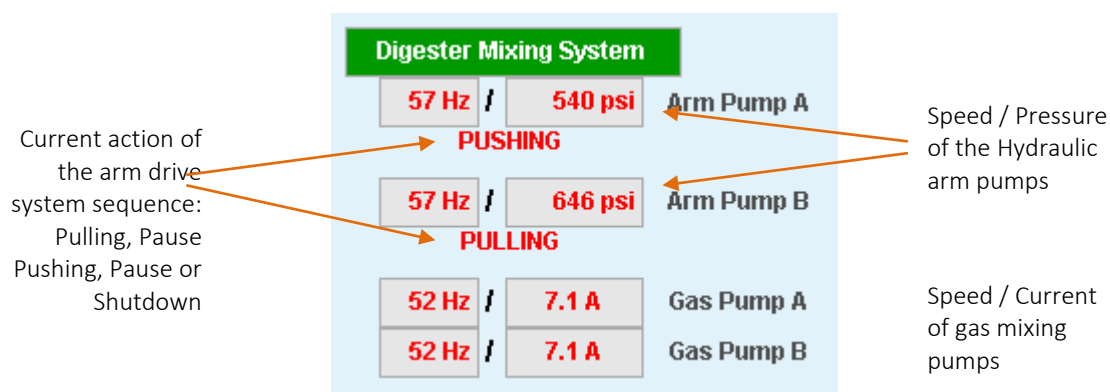
Select Gas pump 2 Mode

Number of cycles of crust busting

Freeze Time

Run Time

AIR PUMP SETTINGS	
Digester Air Pump ON %	100 %
Poststore Air Pump ON %	100 %

De-gritting arm and mixing pump operational status taken from Front Screen

The operational status of the Arm control and Gas mixing pump MODE or variable interlock to top drive.

The mode for the gas mixing pumps can be set manually in the gas mixing settings. The setting of the current mode is indicated in the gas status 'M' indicator. These modes are adjusted by the control system when it is in Crust Busting Mode:

- Mode 0: No intervention of top-drive hydraulics by the mixing pumps
- Mode 1: The hydraulics are suspended while the gas pump is running
- Mode 2: The hydraulics are suspended. Note! This can only run for 1 hour

The gas mixing control system monitors the performance of the gas pumps. The drive system can detect if the pump overheats or a mixing pipe is blocked.

If a fault condition is detected, the system shuts down for the waiting time and then re-starts. These features provide enhanced pump protection. Gas pump trips can be caused by several factors; firstly, a blocked pipe, although this could also show as an overload trip. Blocked inlet pipe, if there is insufficient gas flow through the pump it will overheat. If the gas pump detects such an incident it will wait for the normal OFF time and then try again. With the auto-indexing on gas pump starting the valve will move to the next pipe and carry on mixing as normal.

De-gritting arm protection

The rotating arm can drop into 'shut down mode' for two reasons:

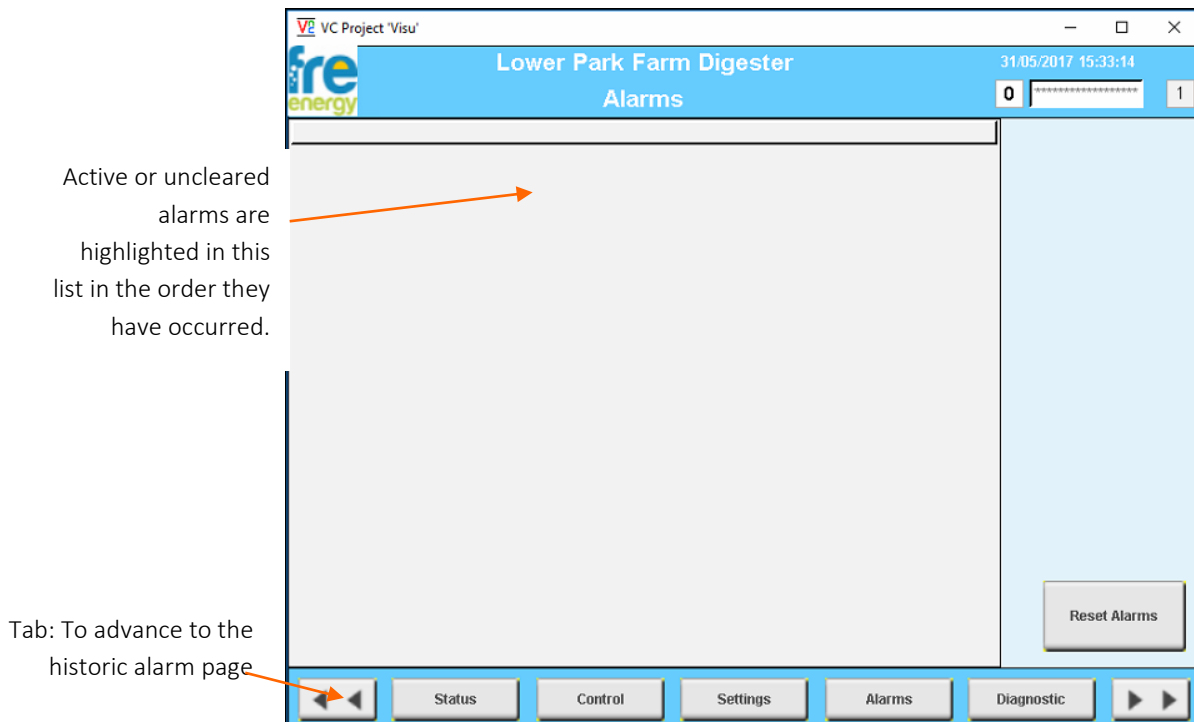
Firstly, if the arm should fail to reach the full 'back' position. This is generally caused by low oil in the pump reservoir. The cause of this can be general loss within the system, or an oil leak. The pumping hardware has been designed with dual pumps and a spilt-oil reservoir to accommodate the eventuality of the development of a leak in one of the hydraulic systems, then the other should keep operating.

Secondly, if a major over-pressure is observed, the system shuts down. This can be caused by either a major problem with a hydraulic ram or the lifting system having reached the top of its 'travel' which indicates the system is in desperate need of de-gritting.

Crust busting mode

The rotating arm control can be stopped and the mixing sequence allowed to run for a period, to allow intensive mixing in one area of the tank. The arm movement is frozen for the 'ON' time and then allowed to move for the 'OFF' time. This is carried out for a set number of cycles (shown on the count) before returning to normal operation. See the comments on the Gas Pump Mode control above 4.8

4.15 Alarms Page 1: Active Alarms



4.15 Alarms Page 2: Event History Screen

The alarm history screen identifies events and faults that have occurred, the time and date of occurrence and of the clearing of that event or fault.

