Water Licence: 3BM-KUG 1520 **WTP O&M manual**

September 18, 2020

Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU X0B 1L0

Attention: Richard Dwer, Manager of Licensing

RE: **Water Treatment Plant O&M manual**
Ref: **NWB Letter December 08, 2015**

Dear Richard,

The Hamlet of Kugluktuk is pleased to submit to Nunavut Water Board the attached file of new Water Treatment O&M manual required to the Water Licence 3BM-KUG 1520 as requested.

We hope that Nunavut Water Board will find the O&M manual effective in practicing the water License for water, sewage, and solid waste management programs.

GN-CGS is submitting this plan on behalf of the Hamlet of Kugluktuk.

Best Regards,

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OPERATIONS & MAINTENANCE MANUAL

Water Treatment System

Kugluktuk, NU

Project #2516

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REVISION AND APPROVAL RECORD

Revision	Description	Approved By	Date
00	Draft Release	Deanne Mould	10/25/2017
01	Reviewed	Paul Anderson, P.Eng.	11/1/2017

1 General specifications

1.0 Safety

It is very important that installers, operators and maintenance personnel read this manual and become thoroughly familiar with the modules. Pay close attention to applicable warnings, cautions and notes to protect your safety and maintain the proper functioning of the units.

(1) When installing the modules, follow the manufacturer's procedures to protect the integrity of the water treatment system.

(2) If any questions arise with respect to any portion of this manual, or if any error or discrepancy is found, please contact the manufacturer.

IMPORTANT – READ THIS MANUAL

This document contains important start-up, operational, and maintenance procedures, that must be followed in order to keep the water treatment plant and its individual components operating at the design level.

Failure to follow these procedures can result in damage to equipment and/or decreased water treatment function.

1.1 Security

As this module treats water for human consumption, the system should be secured. Entry should be restricted to authorized and qualified persons only. Unauthorized and unqualified persons should be escorted and supervised by an authorized person.

In the event of a break-in, vandalism, or other suspect activity that may have compromised the safety of the water, the appropriate section of the Emergency Response Plan should be activated. The Emergency Response Plan should be developed by the owners, operators, and community officials to deal effectively with issues that may constitute an emergency with respect to the water safety and water treatment plant operations.

Fig. 1: Water supply pond

1.2 General Description – Kugluktuk water treatment plant upgrade

The purpose of the water treatment upgrade is to provide additional supply and a system to address turbidity in the existing water supply which is above the allowable limit. Raw water is gravity fed from the existing sump which is supplied from the nearby Coppermine River. The new water treatment building is piped from the older plant. Raw water enters the new treatment plant at up to 152.7 GPM to fill the treated water tank TWS-3 as required. The raw water feeding the new treatment plant is continuously monitored for salinity. Upon detection of salt in the incoming water the motorized valve MCV01 will drive closed and an alarm condition will be reported through the PLC.

PROCESS DESCRIPTION

The purpose of the water treatment system is to fill the treated water storage tanks. As such the primary start/stop control for the system is the level transmitter (LT02) for tank TWS3. Other secondary controls include the level transmitter (LT01) for tank FF1, the Filter Feed tank; and the float switches for the Buffer Tank (T01).

NOTE: All pumps are duty / standby and will automatically switch to the standby pump if a duty pump fault is detected.

When the fill process is started AND LT-01 in the filter feed tank is below the start level AND the level in the buffer tank T01 is below HH level (LS04) then modulating valve MCV01 will open a fixed percentage as set on the HMI to allow the flow of water.

The raw water is measured by flow meter FT01, turbidity analyzer TU01, and pH analyzer PH01. If the raw water turbidity is below the recommended NTU, the Coagulation-Flocculation system (CFS skid 150) is not needed and can be bypassed from the HMI.

When the turbidity goes above the recommended limit, then valves to the CFS skid 150 - or clarifier – will be opened.

Water entering the CFS Skid first enters the flash mixing tank. The mixers MX01 and MX02 are started at the same time as MC01 as well as one of the Coagulant dosing pumps P21A or P21B. A dose of coagulant enters the flash mixing tank. Coagulants neutralize the negative electrical charge on particles, which destabilizes the forces keeping colloids apart. Coagulants include aluminum salts, iron salts, and polyelectrolytes specially formulated for drinking water (NSF).

Water then enters the flocculant tank which is dosed with a floc agent by one of the Floc dosing pumps P22A or P22B. Flocculants gather the destabilized particles together and cause them to agglomerate and drop out of solution. Examples of flocculants include low, medium, and high molecular weight polymers.

Clarified water enters one of the 2 CFS holding tanks plumbed in parallel. These tanks can be drained of accumulated sediment when the discharge hose is hooked up manually to V-06 or V-07.

The buffer tank T01 is filled with water from the pre-treatment system. The float switches for the Buffer Tank (T01) will start and stop the system if there is too much water or not enough. If the buffer tank level is too low (LS02) or too high it will stop the system to prevent the pumps P09A and P09B from running dry.

Raw water pumps P09A or P09B will transfer 152.7 GPM from the buffer tank to Filter Feed Tank FF1. The level transmitter (LT01) for tank FF1 provides secondary control for the system.

The Treated Water System (TWS) recirculation system can run continuously, if required. The Filter feed tank is heated by a heat exchanger with pumps P07 A&B pumping heated water through the system at 23.4 gpm.

From the Filter Feed Tank FF1, the raw water is pumped through filter feed pumps P19 and P20 at 69.2 gpm to each of three roughing filters. Modulating control Valve MCV02 is controlled to close when the neither P19 or 20 are not operating, to prevent from leaving FF1 under gravity.

Water from the roughing filters flows by gravity to slow sand filters SSF1, SSF2 and SSF3. Slow sand filters provide enhanced filtration due to a bacterial reaction in the upper levels of media. Water passes through the slow sand filters by gravity to the standpipes where turbidity analyzers TU 03, 04 & 05 monitor the leaving water and level transmitters (LT03, 04, 05) monitor tank levels.

Filtered Water can be pumped by P11 A&B to the treated water storage tank TWS3 or back to FF1 through recirculation pumps P10A & B. TWS3 is heated by heat exchanger HX-3 and recirculation pumps P08 A&B which circulate water through the TWS3 to keep it from freezing. Treated water from the existing system TWS2 can also fill TWS3 when MCV-08 is opened. Flowmeter FT08 will measure the flow rate and total volume transferred from TWS2 to TWS3.

TWS3 also provides water for the backwash of the slow sand filters SSF1-3 through pump P-12.

The primary start/stop control for the system is the treated water tank TWS3 level transmitter (LT02). LT02 has 3 operation set points: Start Level, Stop Level, and Fire Level. There are also four alarm set points: HH Alarm (high-high), H Warning (high), L Warning (low), and LL (Low-low) Alarm. Unless the water level is too low (L) or high (H) in any of the tanks, the system will continue to fill the treated water tank.

The treated water tank TWS3 supplies the UV & recirculation system which pumps treated water to the existing treated water tank TWS1. Pumps P13 A&B draw water from TWS3 through the UV system to TWS1. There is a sample tap S-10 before the UV and S-11 after the UV. Pressure indicators PI 26 and PI 27 indicate pressure before the UV pumps (P13A/B) and PI28 indicates pressure after the pumps. Flowmeter FT05 measures the flow rate and total volume transferred from TWS3 to TWS1.

TWS3 also supplies the truck-fill Arms 2 and 3 and water for domestic use (potable water storage tank 500 Gal) T-02. Pumps P14 A&B at 246.2 GPM supply the truck-fill arms. Flow meters FT 06 and 07 measure the flow rate and total volume of water delivered.

Treated water intended for truck-fills and T02 is first disinfected with a sodium hypochlorite solution. This chlorine solution is transferred to the injection quills, BPV-01 & 02 on the truck fill pipes through double walled tubing from the dosing pumps in the chlorine room.

The domestic water tank T-02 can receive sodium hypochlorite directly from dosing pump P-17 in the chlorine room. At the end of each day, or following an interruption of truck filling, solenoid valves SV-01 and 02 will open for an adjustable pre-set length of time to drain the volume of water that is held in the exterior truck fill pipe. This will prevent possible freezing in the event of a failure of the electric heat trace.

1.3 System interfaces

1) Physical interface – the various system modules are piped on site – shut-off valves are provided for troubleshooting and servicing. Water enters the WTP building at TP 01 in the NW corner of the Pipe Gallery. Water exits the WTP system at TP 19, leading to TWS1 and TP 22 & 23, the truck fill arms feeding the water delivery trucks.

2) **Power interface:** Utility power connections are made on site by others. Electrical panels with Termination and common connection points have been provided.

3) **Operational interface:** Control panels with VFDs and motor starter protection are provided for control by others. Control panels also have local controls: manual ON/OFF switches for servicing or other.

2 Main components

ID #	Description	Make	Model #	Size
T-04, T-05	Chemical storage tank	Norwesco	Size A	22 Gal
T-03	Chemical storage tank (12% sodium hypochlorite)	Norwesco	Size B	50 Gal
T-01	Buffer Tank	Norwesco		1350 Gal Vertical
T-02	Domestic Water Tank	Norwesco	Size A	500 Gal Vertical, 48" dia.
P-07 A/B	Heat exchanger pumps	Grundfos	UPS-32-160/2	23. 4 GPM
P-08 A/B	Heat exchanger pumps	Grundfos	UPS-32-160/2	23. 4 GPM
P-09A/B	Clarified Raw Water Pumps	Grundfos	CRN32-1-1	152.7 USGPM, 232 psi, 7.5HP 208V 3PH W/BALDOR CEM3709T
P-11A/B	Filtered water to TWS3 Circulator pumps	Grundfos	UPS40-240/2	49.9 USGPM, 145 psi, 1.5HP 208V 3PH
P-10A/B	Recirculation pumps	Grundfos	UPS32-160/2	23.4 USGPM, 145psi, 3/4HP 208V 3PH
P-12	SSF backwash pump	Grundfos	CRN 90-1-1	540 USGPM, 232 psi, Vertical multistage centrifugal, W/BALDOR VM2394T
P-13A/B	UV & Recirculation Pumps		MONARCH ACE-75 208V 3PH	39 USGPM, 208V 3PH
P-14A/B	Truck-fill pumps	Grundfos	TP100-160/2	246 USGPM, 145 psi, 208V 3PH
P-19, P-20	RF feed pumps	Armstrong	4380-3x3x6-1hp	69.2 USGPM, 4380-3x3x6-1hp
P15, P16, P17 P21-A/B, P22 A/B	Peristaltic chemical injection pumps	Blue-White	A-100NF	100 psi, 5.17 GPH
UV-01, UV-02	UV	Viqua	Pro50, 660003-R	110 GPM
BPV-05	Floc Mixer	Dynamix	DMX 5000 series	
BPV-04	Flash Mixer	Dynamix	DMX 5000 series	
Various	Pressure gauge	Winters	PFQ121	2-1/2" dial, 1/4" NPT bottom mount, 160psi, glycerin filled
TU-01	Turbidity Analyzer	HF Scientific	MicroTol	
FT-01	Electromagnetic Flow meter	Walsn	Standard SC-SI INegral	3", NSF
Various	Pressure sensors	IFM	PA3227	145psi
Various	Temperature Gauges	Weksler		3" dial
pH01	pH Monitor	ATI	Q46P-1-1-1-1	Sensor p/n 07-0092
Various	Solenoid valve	Asco	2/2 series 8210	2-way
Various	Ball valves	Praher Valves	S6 true union PVC	ALL PVC Ball valves - 1/2" to 2" unless otherwise noted PTFE Ball Seats EPDM O-rings, except on chemical

				dosing skids Viton O-rings on chemical dosing skids
Various	Check valves	Praher Valves	150-CV-200, Single Union Spring check valves	ALL PVC Check valves 1 ½ - 2" unless otherwise noted
Various	Spring check valves	Praher Valves	S4 PVC	Size: 2" Body: PVC Oring: EPDM Spring: 304 Stainless Foot Valve - n/a
Various	Swing check valves	Praher Valves	K4	3", 4", 6"
Various	Butterfly Valves	Keystone	221, 222	
MCV-01?	Electric Actuator	Pentair	Keystone EPI-2	
Various	Back pressure valve	Griffco	PART#: BPM050PSV	050, ½", 10-150 psi, PVC, viton diaphragm
Various	Air release valves	A.R.I.	S-050 PN 16	¾"
	Control Panel HMI	Siemens Simatic	TP700 Comfort 6AV2124-0GC01-0AX0	
	UPS for Main Control Panel	Always On UPS Systems Canada	GES-152N	
	Touch sensor	IFM	KT5106	
	Motor Starter Protectors	Siemens Sirius	SRV10	

Consumables: hypochlorite

3 Plant Operation and Troubleshooting

Fig. 2: Treated water storage tank TWS3

3.0 Filling the TWS Tank

LT02 controls the level in the Treated Water Storage (TWS3) tank. LT02 has 3 operational set points and 4 alarm set points: Start Level; Stop Level; Fire level; HH Alarm; H Warning; L Warning; LL Alarm.

Operation

1. When LT02 is below the Start Level:
    - Check the level of the Filter Feed (FF1) Tank. If the level is too low (i.e. LT-01 LL alarm), do not start the TWS fill process.
    - Start the Filter Feed Pumps, P19 and P20. If only one FF pump is required, the operator should set the H-O-A switch to OFF for one of the pumps.
    - Start a Filtered Water Pump, P11A or P11B
    - Start a SSF Recycle Pump, P10A or P10B. If the SSF recycle is not required, the operator should set the H-O-A switches to OFF.
    - Open MCV02

2. Fill TWS until Stop Level is reached. At which point, stop the pumps and close the valve.

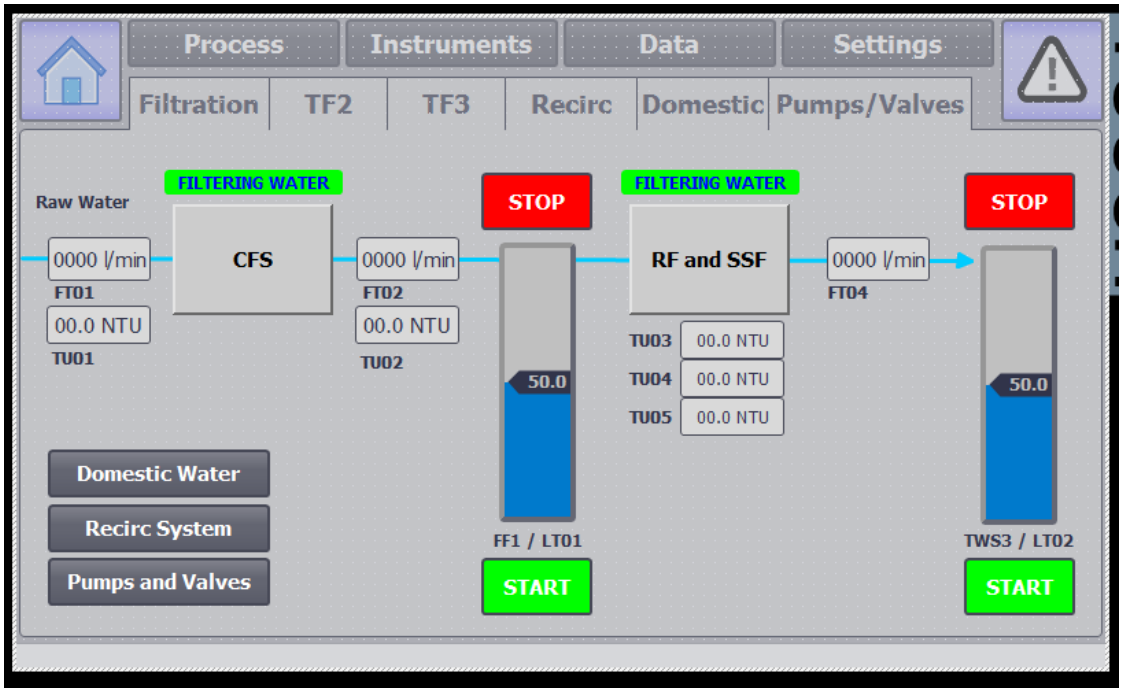


Fig. 3: Process/Filtration screen

Fig. 4: Filter feed tank FF1

3.1 Filling the Filter Feed Tank

LT01 controls the level in the Filter Feed (FF) tank. LT01 has 2 operational set points and 4 alarm set points: Start Level; Stop Level; HH Alarm; H Warning; L Warning; LL Alarm.

Operation

1. When LT01 is below the Start Level:
   - AND if the level in the Buffer Tank (T01) is below the HH level switch (LS04)
     - Open MCV01. MCV01 is a modulating valve and a fixed open % is set in the HMI. When the fill process is started the valve will open to this %.
     - Start the mixers, MX01 and MX02
     - Start one of the Coag dosing pumps, P21A or P21B
     - Start one of the Floc dosing pumps, P22A or P22B
     - Start a Raw Water Pump, P09A or P09B
     - Start the pump when the level in T01 is above LS03
     - Stop the pump when the level in T01 is below LS02 or LS01
2. Fill FF1 until Stop Level is reached. At which point, stop the fill process.

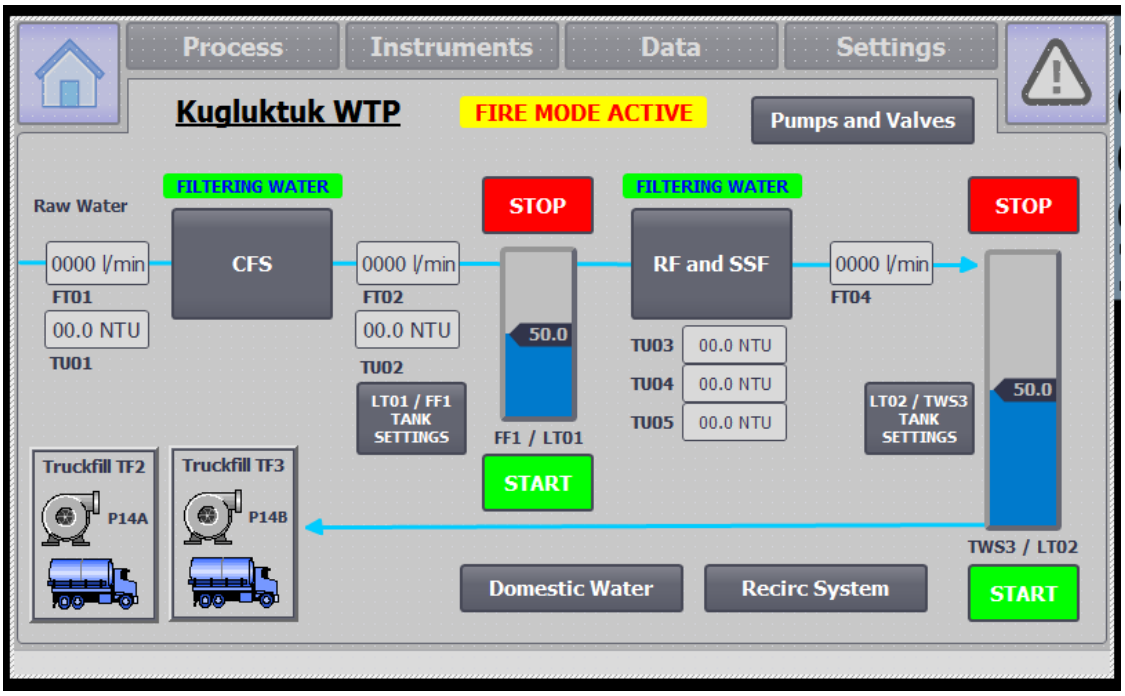


Fig. 5: Home screen

Fig. 6: Clarifier system for removing turbidity

3.2 Clarifier System:

If the raw water turbidity is below the recommended NTU as measured at TU01, the Clarifier system (CFS skid 150) is not needed and can be bypassed from the HMI to minimize the consumption of the coagulant and flocculent chemicals.

Dosing pumps P21A or B pump coagulant into the flash mixing tank. Dosing pumps P22A or B draw flocculent from tank T-05 into the Floc tank. The amount of each chemical to be dosed is based upon raw water conditions and is best determined manually through jar testing, as shown in figure 6 above.

On the HMI:

- Raw water turbidity (TU01) is indicated on the left hand of the screen.
- To bypass the CFS:
  - Open V09
  - Close V03, V08
  - Turn off P21A and B
  - Turn off P22A and B

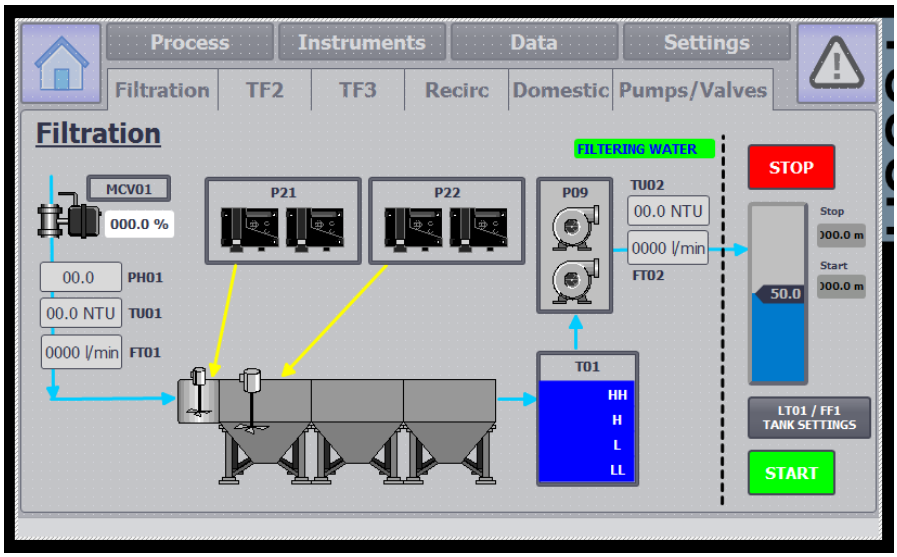


Fig. 7: Coag/Floc system on the HMI

Clarified water enters one of the 2 CFS holding tanks plumbed in parallel. CFS tanks can be drained of discharge/sand when the discharge tank is hooked up manually to V-06 or V-07.

3.2.1 Maintenance of Chemical Dosing systems

Location: Chemical pumps are located in the chemical room in the lower West side of the building.

1) The chemical tanks should be checked regularly and refilled as necessary.
2) Tubing on peristaltic dosing pumps needs to be inspected and replaced when wear is evident.
3) The pumps have a leak detection system that will trigger a pump fault.
4) Replace rollers if tubing flow is lower than expected with new tubing
5) Refer to the Blue-White pump manual for detailed information.

3.2.2 Troubleshooting a Chemical Dosing system

Check and clear any alarms on the HMI to return the system to functioning.

Symptom	**Cause / Remedy**
Pump is not running	• Check settings in HMI • Check for faults • Is there a leak in the peristaltic tubing or diaphragm? • Run pump in HAND mode
Pump is running all the time	• Check that pump is not in HAND mode • Check the display on the pump. Is it in Manual or 4-20mA mode? • Possible glitch in PLC
The chemical injection	• The chlorine in the dosing line is off-gassing and creating air pockets • The dosing line has lost prime • The backpressure valve close to the injector is not working properly

Symptom	Cause / Remedy
Consult the dosing pump manuals for further instruction	

3.2.3 Changing the Tubing on the Peristaltic

1) See the manual for the peristaltic pumps
2) Wear the required Protective face, eye and hand coverings.
2) Disable the pump.
3) Undo the chemical line connections
4) Remove the front cover protecting the tubing
5) Enable the pump and run in HAND mode
6) While the pump is running, remove the old tubing
7) If the pump is in fault and won't run, you can pull the tubing off. It's just easier to remove the tubing if the pump is running.
8) Clean any excess chemicals in the chamber and correct any faults.
9) Run the pump in HAND mode
10) Insert a new tube, suction (bottom) connection first, and feed the tube in as the pump is running.
11) Adjust tubing until the discharge (top) connection easily fits into its slot.
12) Disable the pump
13) Reattach the front cover
14) Reattach the chemical connections
15) Run the pump in HAND mode and check for leaks
16) Continue to run the pump in HAND mode until you are sure the line is primed.
17) Set the pump to AUTO.

Fig. 8: Pump Skid 405, UV lamps and recirc pumps

3.3 TWS Recirculation

The TWS recirculation system can be set to operate as long as TWS3 is not exhibiting a level alarm.

Operation

1. IF LT02 is not HH or LL alarm.
   - Start a Recirc Pump, P13A or P13B
   - Open MCV08

2. Turn on either UV01 or UV02. If they are in Fault a warning will be sent to the PLC.

Fig. 9: Heat exchangers

3.4 Storage Tank Heat Exchanger systems

There are 2 systems to warm and recirculate the water in the FF1 and TWS3 tanks. These systems consist of recirculation pumps and a heat exchanger. Refer to the mechanical system manual provided by the mechanical contractor for specific information on the boiler or heat exchanger operation.

Fig. 10: One of the recirculating pumps and flowmeter FT-03 showing the recycle flow.

Fig. 11: Pump Skid 408 showing the Heat exchange pumps P-07A/B and P-08A/B.

Operation, FF1 Tank

1. IF LT01 is not in LL alarm and the ambient temperature is below 5C.
    - Start a Heat Exchanger Pump, P07A or P07B
2. This recirculates water through HX2

Operation, TWS3 Tank

3. IF LT02 is not in LL alarm and the ambient temperature is below 5C..
    - Start a Heat Exchanger Pump, P08A or P08B
4. This recirculates water through HX2

Fig. 12: Truck-fill arms 2 & 3

3.5 Truck-fill

There are 2 truck-fills in the water treatment plant, TF2 and TF3. Both operate on the same logic.

Operation

1. The truck-fills are allowed to operate if:
    - The water level (LT02) in TWS3 is above the Fire Level
    - The FIRE Mode is activated and the water level (LT02) in TWS is above the LL alarm level

2. To start a truck-fill, the operator presses the START button at the pendant or on the HMI

3. TF2 will:
    - Start P14A
    - Open MCV06
    - Start dosing pump P15
4. TF3 will:
    - Start P14B
    - Open MCV07
    - Start dosing pump P16

5. When the truck is filled, the operator will press the STOP button at the pendant or the HMI. This will stop the respective pumps and close the valves.

6. If the truck-fill station is idle for more than a certain amount of time (e.g. 60 minutes), the truck-fill drain valve (SV01 or SV02) will open for 5 minutes. SV01 / SV02 will close immediately if the truck-fill is restarted.

7. The water within the exterior truck-fill pipe will drain under gravity into the domestic water tank (T02).

Fig. 13: Truck-fill arm prior to attachment of hose and sleeve.

Fig. 14: Skid 406 showing Truck-fill pumps P14A and P14B

Fig. 15: Skid 405 prior to installation on site.

3.6 UV system

The UV is a proven method of disinfecting potable water. Each Viqua Pro 50 unit is sized for 189 lpm (50 gpm). All of the water leaving the filter will pass through one of the UV units before entering the treated water tank.

Each UV unit has a controller which provides power to the UV lamp and indicates its status.

The UV transmissibility must be within acceptable limits for the UV lamps to be effective.

Consult the Viqua UV manual for lamp replacement, safety and detailed maintenance and operating instructions.

The UV will warm up for 3 minutes unless there is a UV fault.

Press the UV symbol from the main control panel's Home screen to access the UV monitoring. By default the UV lamp should be on Auto. The HMI will display whether there are any faults in the UV system. One UV unit at a time may also be turned off for servicing, or operated in Hand mode.

3.7 Slow Sand Filter (SSF) Backwash

Backwashing of the SSF should only be performed when starting the system or prior to re-building the "schmutzdecke".

Operation

1. Check that the valve to the discharge pond is opened for the respective filter
   - SSF1, manually open valve V40
   - SSF2, manually open valve V41
   - SSF3, manually open valve V42

2. A backwash is permitted if:
   - The water level (LT02) in TWS3 is above the Fire Level
   - Another filter is not already in backwash

3. The operator presses the backwash button on the HMI.

4. Open the MCV
   - For SSF1, MCV03 opens
   - For SSF2, MCV04 opens
   - For SSF3, MCV05 opens

5. Start the backwash pump, P12

6. Backwash the filters for a set duration, e.g. 10 minutes

7. Stop the backwash pump

8. Close the respective motorized valve

9. Manually close the respective discharge pond valve

3.8 Domestic Water Tank T-02

The Domestic Water Tank supplies water to the domestic water pump. It is filled from TWS3 tank or when the truck-fill arms drain. A separate line piped from Pump Skid 408 has been installed to deliver treated water from TWS3 to fill T-02 when required.

Operation

1. When the tank level in T02 is below LS02 or LS01, the fill process is started.
   - SV03 is opened
   - Chlorine pump P17 is started

2. When the tank level in T02 is above LS03 or LS04, the fill process is stopped.
   - SV03 is closed
   - Chlorine pump P17 is stopped

3. The truck-fills TF2 and TF3 drain into the tank T02. If there is excess water, the excess overflows into the floor drain.

3.8.1 Troubleshooting Tank Valves

Check and clear any alarms on the HMI

Symptom	Cause / Remedy
Valves aren't closing fully	• Isolate the problem valve • Open the valve • Check for debris in the valve and clean as required.

3.9 Filter Feed Pumps

P19 and P20 supply the roughing filters RF1 RF2, RF3 at 69.2 GPM. These pumps have isolating valves for service and pressure gauges before and after each pump.

3.10 Roughing filters

RF1, RF 2, RF3 are filled with raw water from FF1. Temperature gauges TI02, TI03, TI04 after each filter provide an indication of the water temperature and it flows under gravity from RF to SSF. Drain valves V34, 35 & 36 are provided at the tank for draining each tank to the discharge pond for servicing. Flow control valves FCV FV01, FCV02, FCV03 are manually adjusted to ensure balanced flow to each RF and SSF.

3.11 Slow Sand Filters

SSF1, SSF2, SSF3 are fed by gravity with water from the Roughing Filters. The upper level of the fine sand within each of the three SSFs will build up a bacterial level or “schmutzdecke” This bacterial level is slow to develop and can be damaged if exposed to chlorine, salt water or other contaminants. Periodic scraping of the top 1-2 cm will be required to maintain the integrity of the bacterial colony.

4 Control Panels

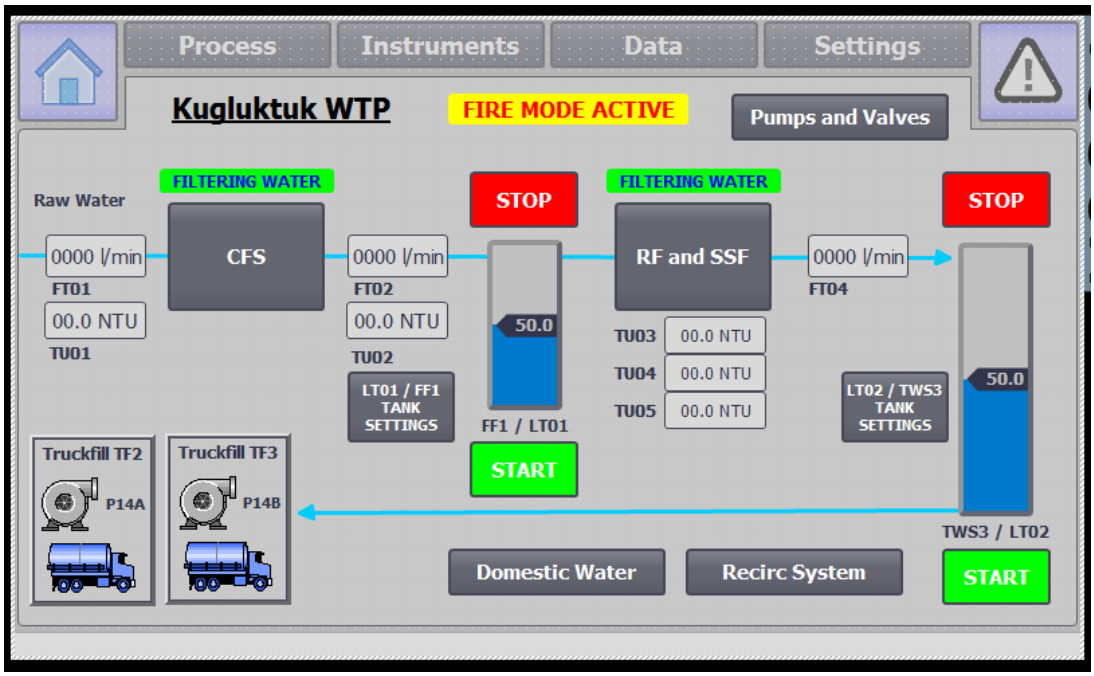
Fig. 16 Main Control Panel

LEFT CONTROL PANEL INDICATORS AND SWITCHES		
ID	**DESCRIPTION**	**TYPE**
-	E-STOP (ON-OFF)	BUTTON
Control Panel	COMMUNICATION WITH THE MAIN PLANT DCS (LOCAL-OFF-REMOTE)	SWITCH
Power Feed	POWER FEED INDICATOR	DISPLAY
Control Power	CONTROL POWER	DISPLAY
MCV02	FF1 OUTLET VALVE (HAND-OFF-AUTO)	SWITCH
MCV03	SSF1 BACKWASH VALVE (HAND-OFF-AUTO)	SWITCH
MCV04	SSF2 BACKWASH VALVE (HAND-OFF-AUTO)	SWITCH
MCV05	SSF3 BACKWASH VALVE (HAND-OFF-AUTO)	SWITCH
MCV06	TF2 CONTROL VALVE (HAND-OFF-AUTO)	SWITCH
MCV07	TF3 CONTROL VALVE (HAND-OFF-AUTO)	SWITCH
MCV08	RECIRC CONTROL VALVE (HAND-OFF-AUTO)	SWITCH
SV01	TF2 DRAIN VALVE (HAND-OFF-AUTO)	SWITCH
SV02	TF3 DRAIN VALVE (HAND-OFF-AUTO)	SWITCH
SV03	DOMESTIC WATER FILL VALVE (HAND-OFF-AUTO)	SWITCH
RIGHT CONTROL PANEL INDICATORS AND SWITCHES		

ID	DESCRIPTION	TYPE
-	E-STOP (ON-OFF)	BUTTON
Control Panel	COMMUNICATION WITH THE MAIN PLANT DCS (LOCAL-OFF-REMOTE)	SWITCH
Power Feed	POWER FEED INDICATOR	DISPLAY
Control Power	CONTROL POWER	DISPLAY
P07A	PUMP FOR THE HEATED WATER EXCHANGE 2 (HAND-OFF-AUTO)	SWITCH
P07B	PUMP FOR THE HEATED WATER EXCHANGE 2 (HAND-OFF-AUTO)	SWITCH
P08A	PUMP FOR THE HEATED WATER EXCHANGE 3 (HAND-OFF-AUTO)	SWITCH
P08B	PUMP FOR THE HEATED WATER EXCHANGE 3 (HAND-OFF-AUTO)	SWITCH
Power Feed	POWER FEED INDICATOR	DISPLAY
P21A	COAG PUMP (HAND-OFF-AUTO)	SWITCH
P21B	COAG PUMP (HAND-OFF-AUTO)	SWITCH
P22A	FLOC PUMP (HAND-OFF-AUTO)	SWITCH
P22B	FLOC PUMP (HAND-OFF-AUTO)	SWITCH
MX01	FLASH TANK MIXER (HAND-OFF-AUTO)	SWITCH
MX02	FLOC TANK MIXER (OFF-ON)	SWITCH
P09A	FF PUMP (HAND-OFF-AUTO)	SWITCH
P09B	FF PUMP (HAND-OFF-AUTO)	SWITCH
P10A	SSF RECYCLE (HAND-OFF-AUTO)	SWITCH
P10B	SSF RECYCLE (HAND-OFF-AUTO)	SWITCH
P11A	TW FEED PUMP (HAND-OFF-AUTO)	SWITCH
P11B	TW FEED PUMP (HAND-OFF-AUTO)	SWITCH
P12	BACKWASH PUMP (HAND-OFF-AUTO)	SWITCH
P13A	RECIRC PUMP (HAND-OFF-AUTO)	SWITCH
P13B	RECIRC PUMP (HAND-OFF-AUTO)	SWITCH
P19	RF FEED PUMP (HAND-OFF-AUTO)	SWITCH
P20	RF FEED PUMP (HAND-OFF-AUTO)	SWITCH
P14A	TF2 TRUCK-FILL PUMP (HAND-OFF-AUTO)	SWITCH
P14B	TF3 TRUCK-FILL PUMP (HAND-OFF-AUTO)	SWITCH
P15	TF2 CHLORINE PUMP (HAND-OFF-AUTO)	SWITCH
P16	TF3 CHLORINE PUMP (HAND-OFF-AUTO)	SWITCH
P17	DOMESTIC CHLORINE PUMP (HAND-OFF-AUTO)	SWITCH

5 HMI Touch Screens

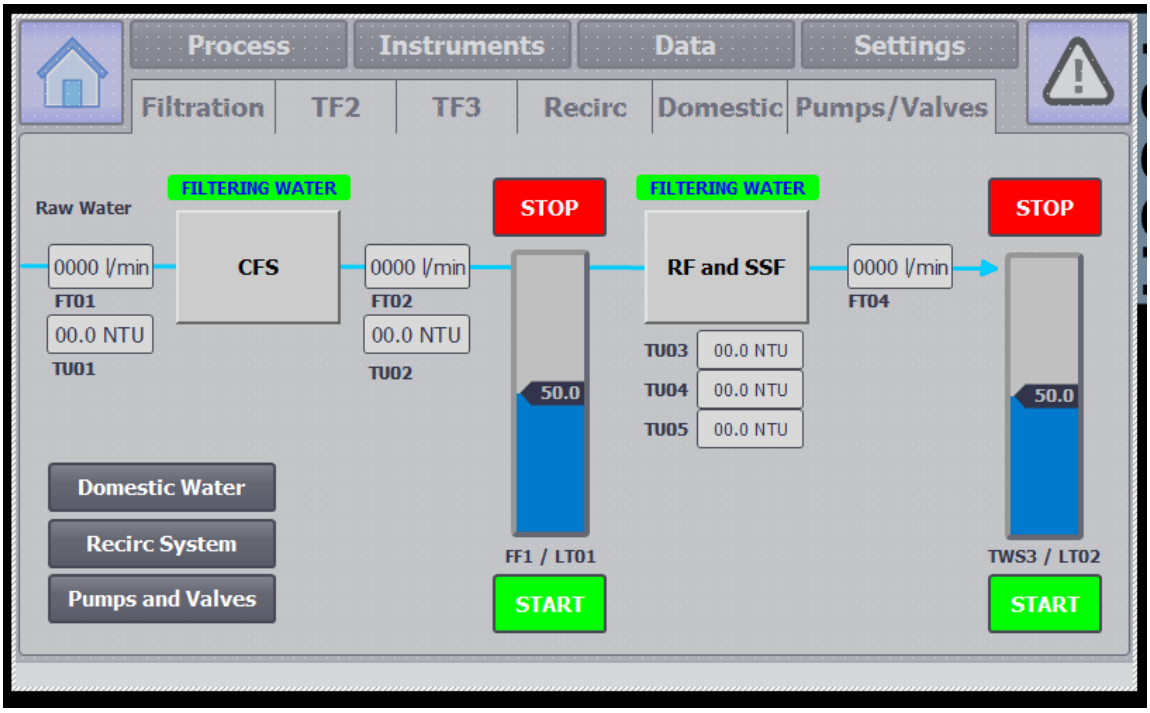
The control panel touch screen indicates system status and provides means for complete operator control as well as alarm indicators, alarm history, alarm delays and means for entering set points. Keep the home screen on as default to be updated on all system alerts.



Screen 1. Home: Main navigation screen

Notes:

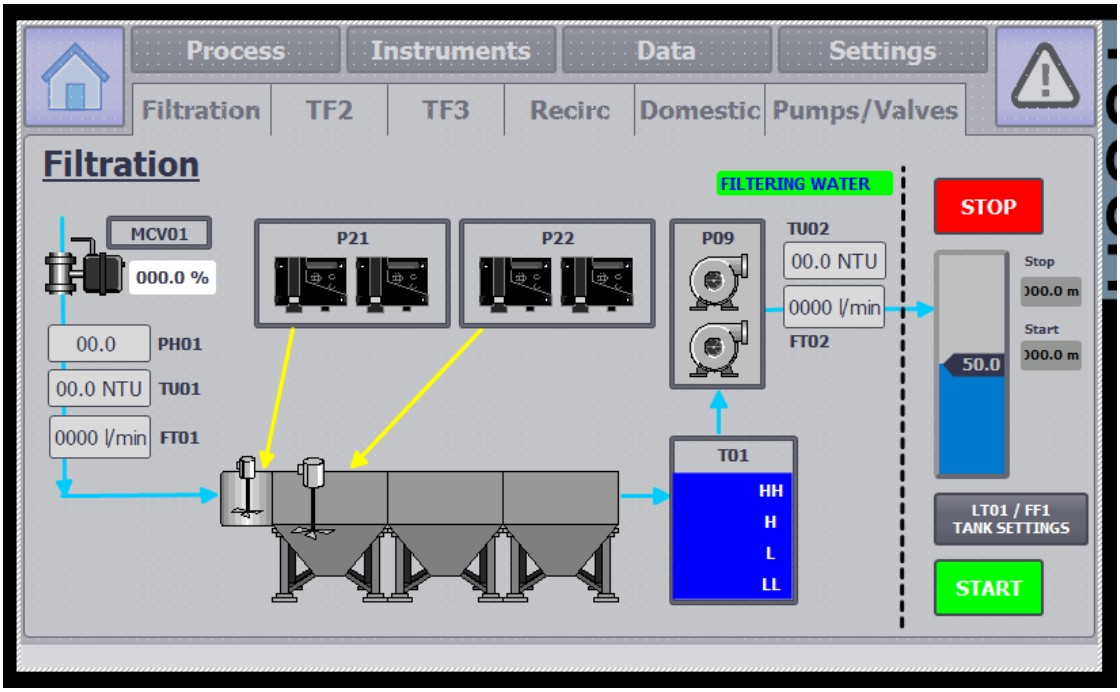
1. System overview with navigation to all other screens.
2. The tank fills can be Started and Stopped manually.
3. Start and Stop levels can be manually changed by clicking on the respective tank level number.
4. Various sub screens can be accessed by pressing the corresponding button or icon on the screen.



Screen 2. CFS screen

Notes:

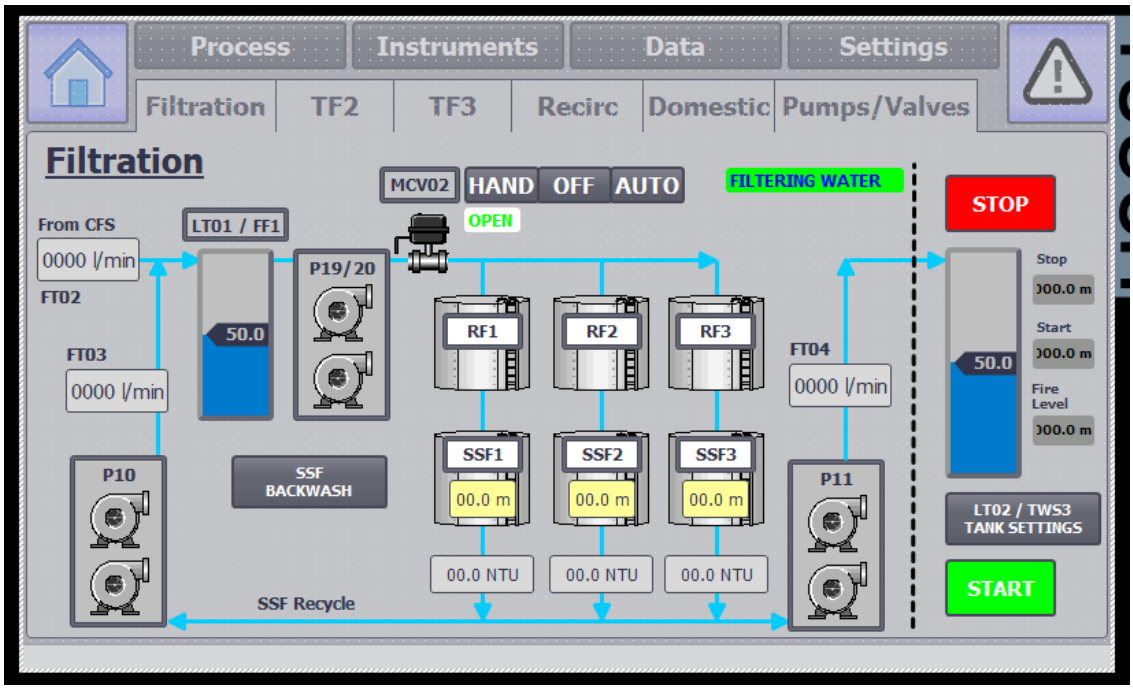
1. The performance of the Clarifier system can be monitored before/after as well as raw water flow and treated water flow.



Screen 3. Process: Filtration

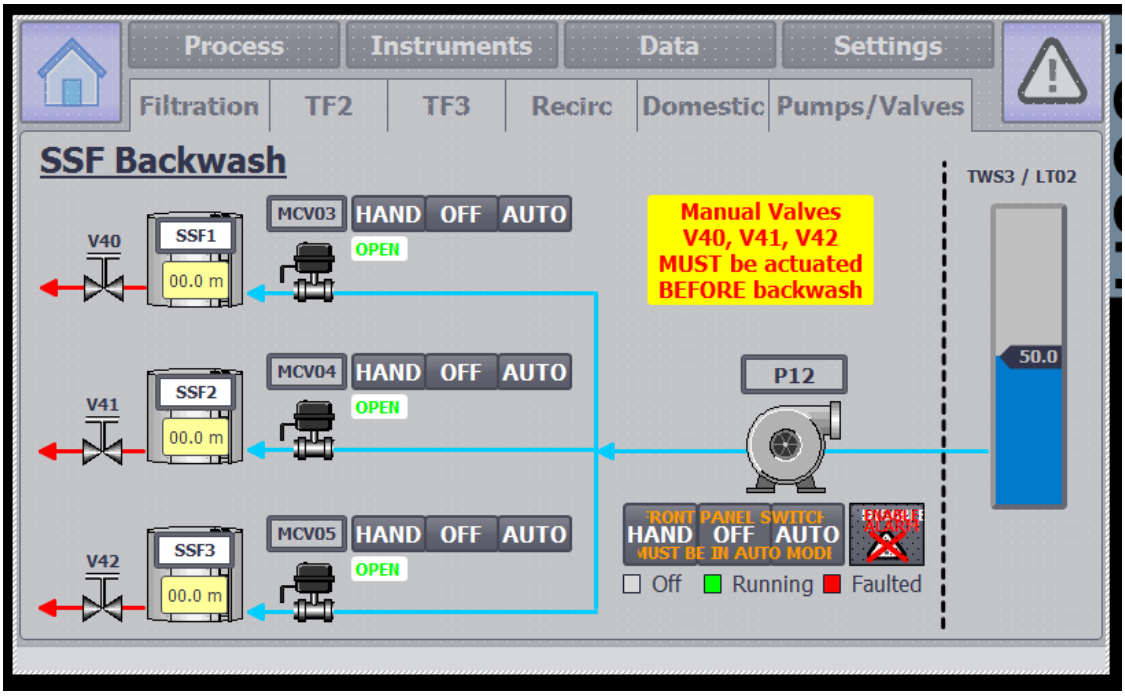
Notes:

1. Turbidity filtration/Clarifier system controls. Click the pump icons or Tank Settings for further controls.



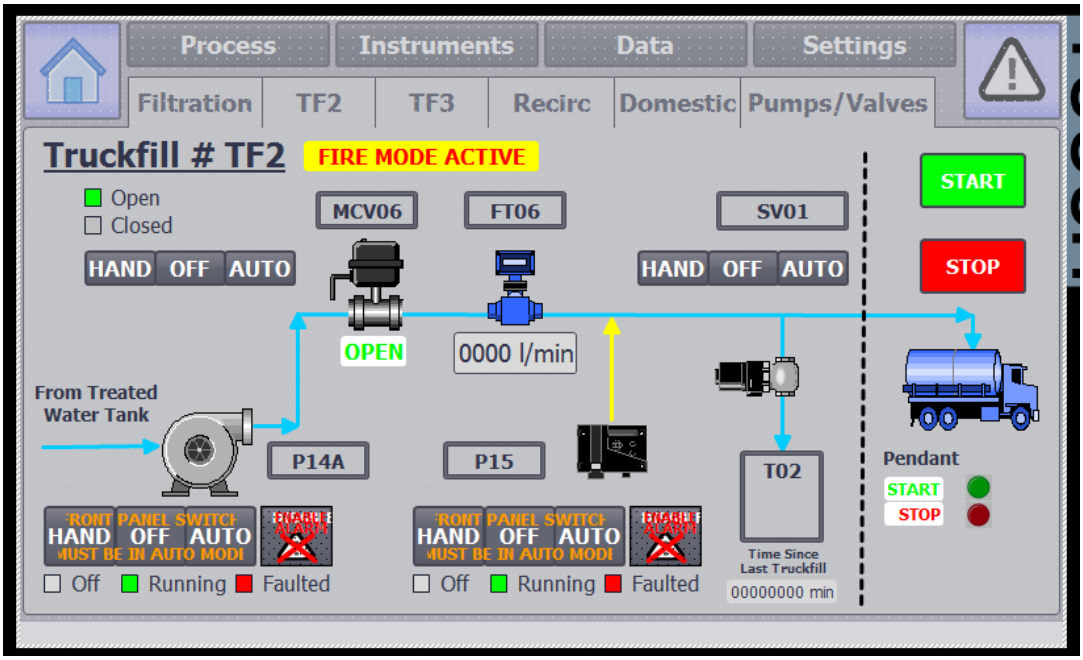
Screen 4. Process: RF and SSF screen

Notes:



Screen 5. Slow Sand Filter Backwash

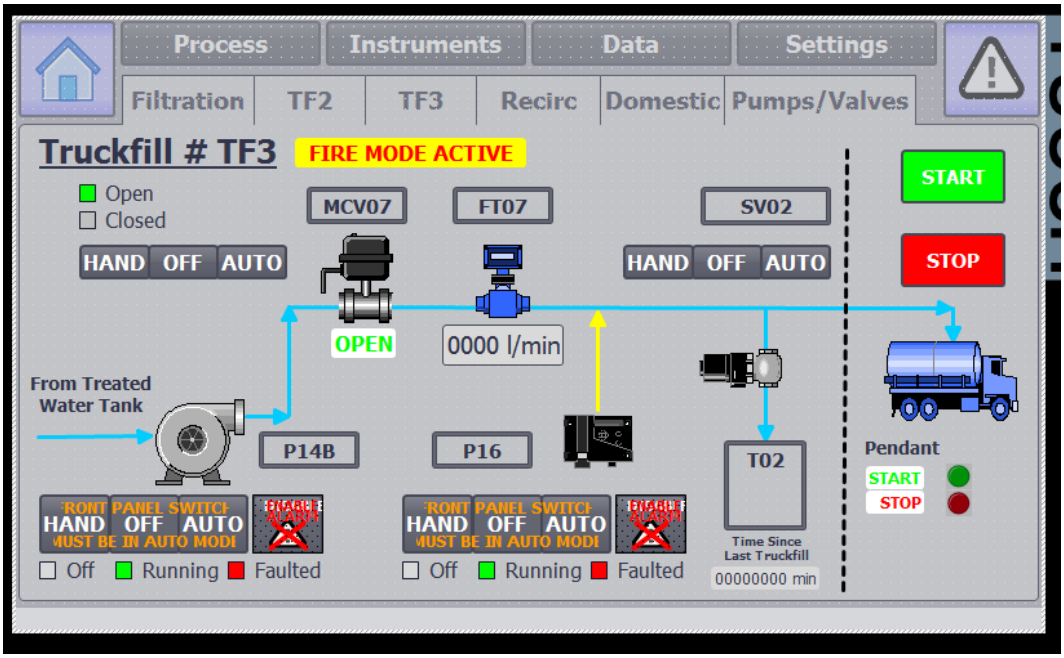
1. Manual valves to the discharge pond must be opened manually to perform a backwash of the particular filter. Motorized valves to the filter open automatically to allow a backwash of the slow sand filters. They may be operated in HAND mode to open manually, or OFF for servicing.



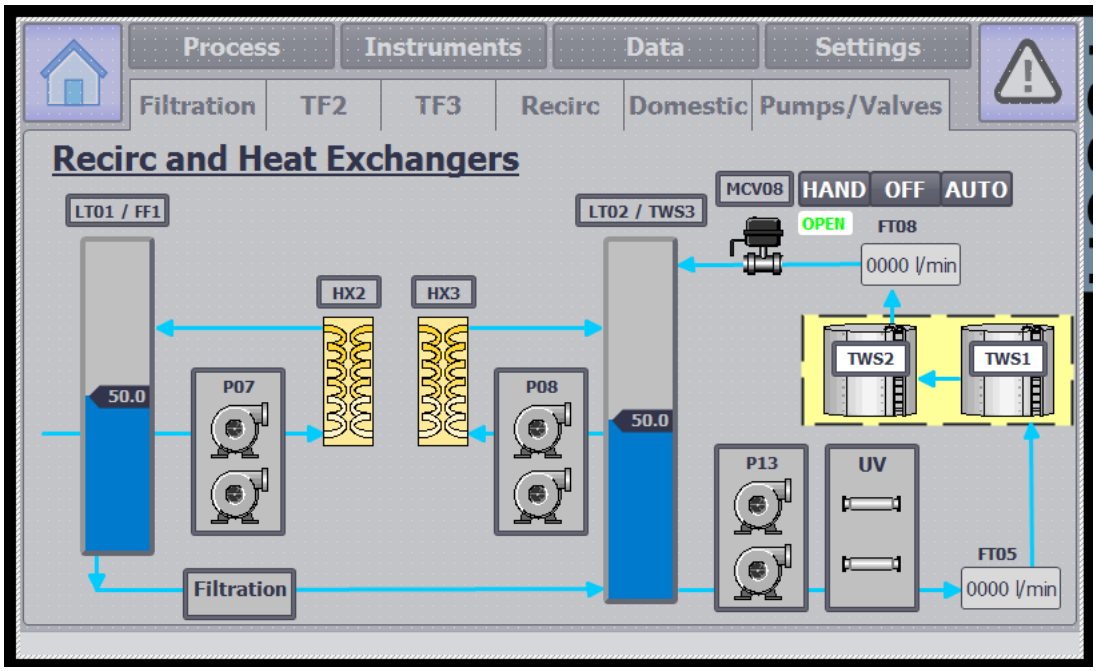
Screen 6. Truck-fill #2

Notes:

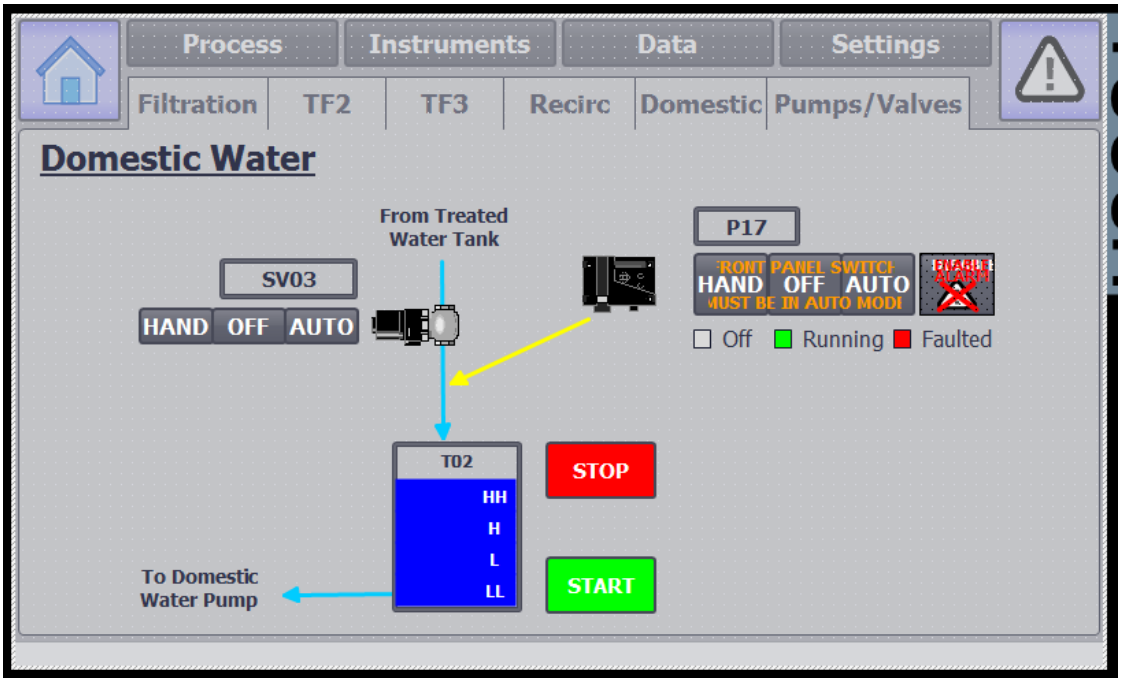
1. The truckfill #2 system: can be started with the HMI Start button (right). The truckfill feed pump P14 A or B will start, and the dosing pump P15 will automatically start. The Stop button needs to be pressed when the truck is filled.
2. Truckfill drain valve (SV01 or SV02) will open for 5 minutes when the truckfill has been stopped to drain of water.



Screen 7. Truck-fill #3



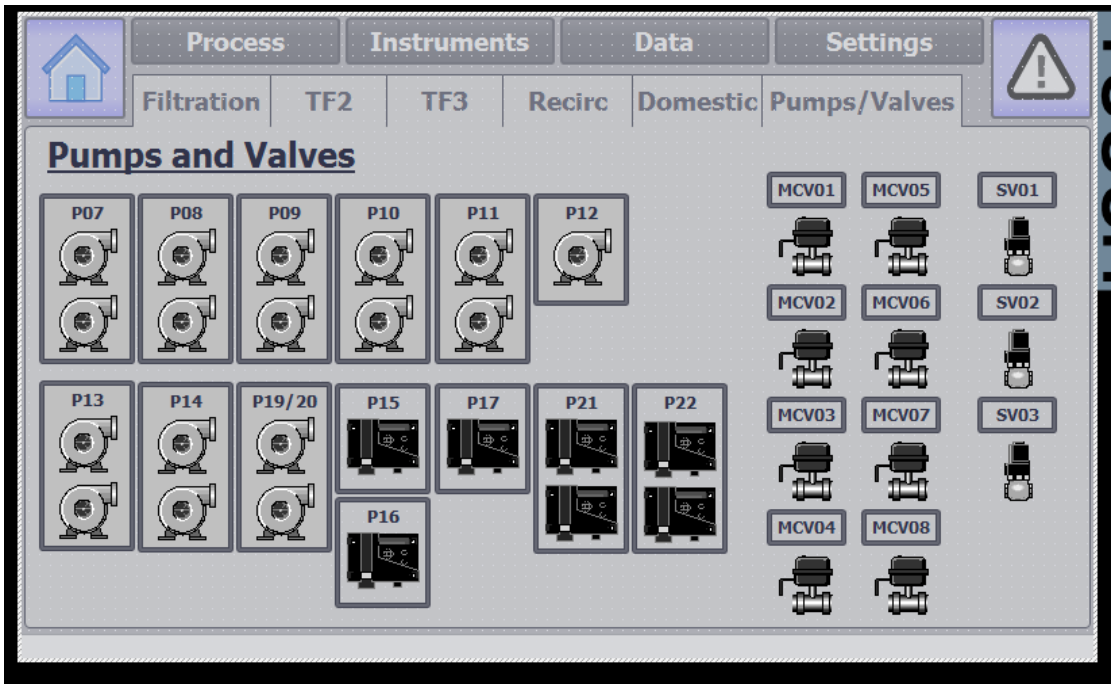
Screen 8. Process: Recirculation system



Screen 9. Process: Domestic Water

Notes:

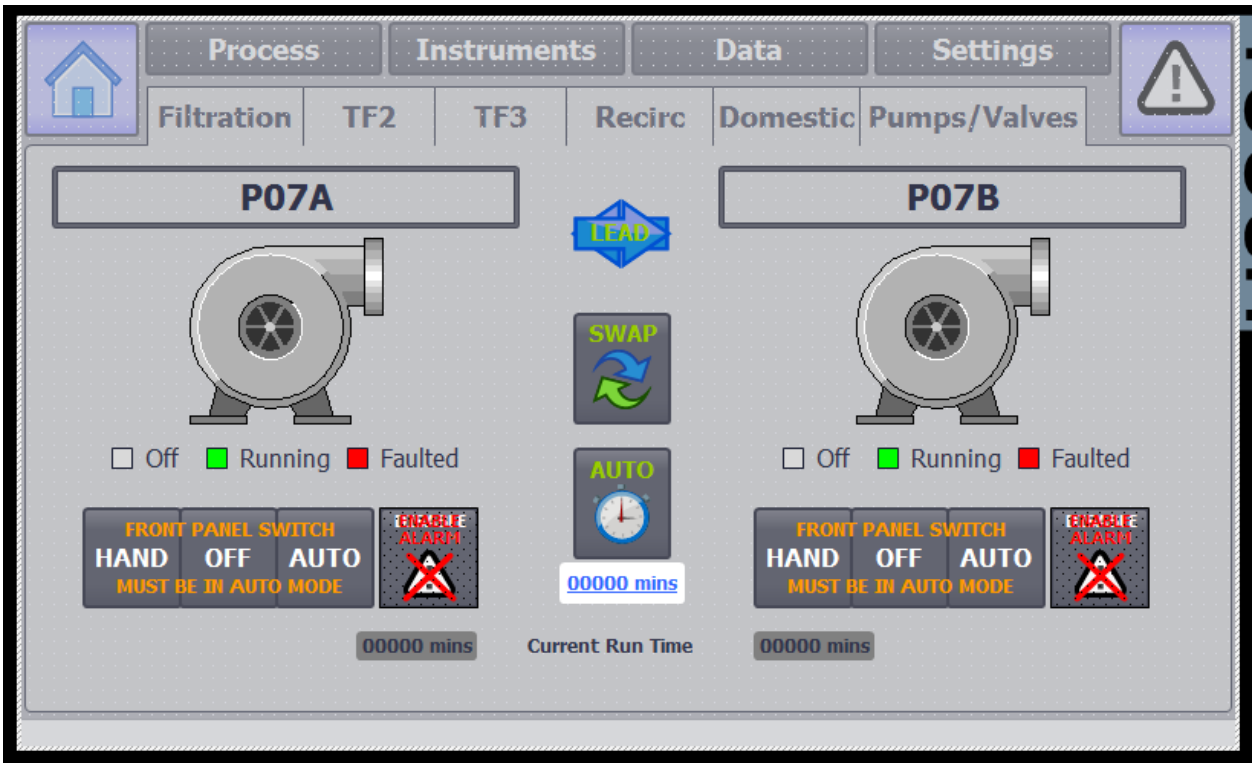
1. The chlorine pump P17 chlorinates the water going into T02 automatically or with Hand mode.SV03 oepns to allow flow into the tank T02.
2. Tank fill can be started or stopped.



Screen 10. Process: Pumps and Valves

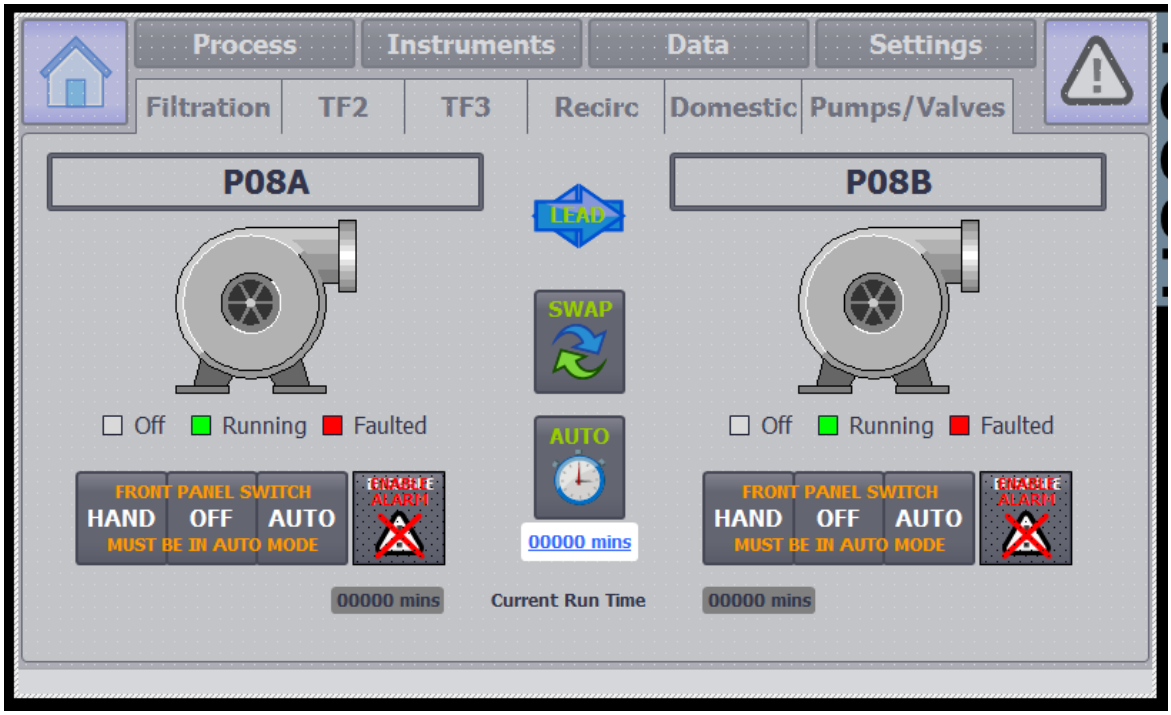
Notes:

1. Clicking on one of the pump or valve icons brings up individual controls.



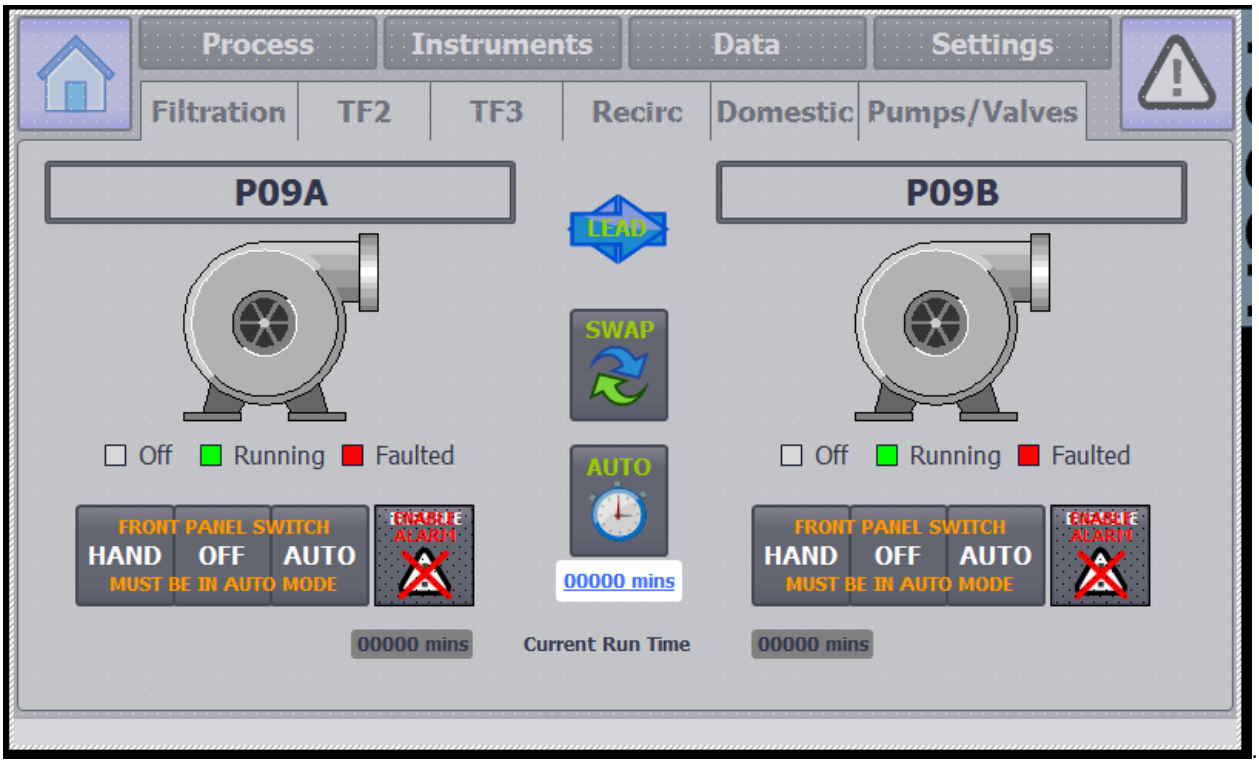
Screen 11. Process: Pumps: P07A and B

Notes:



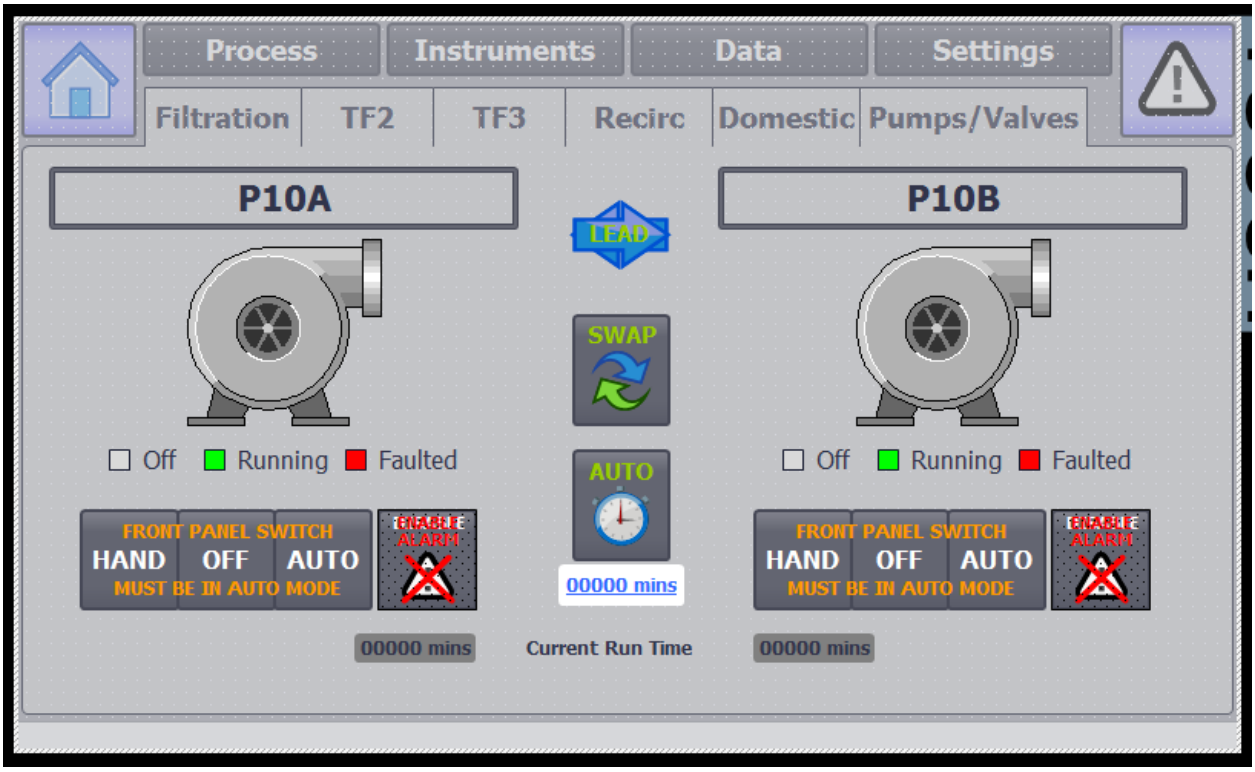
Screen 12. Process: Pumps: P08A and B

Notes:

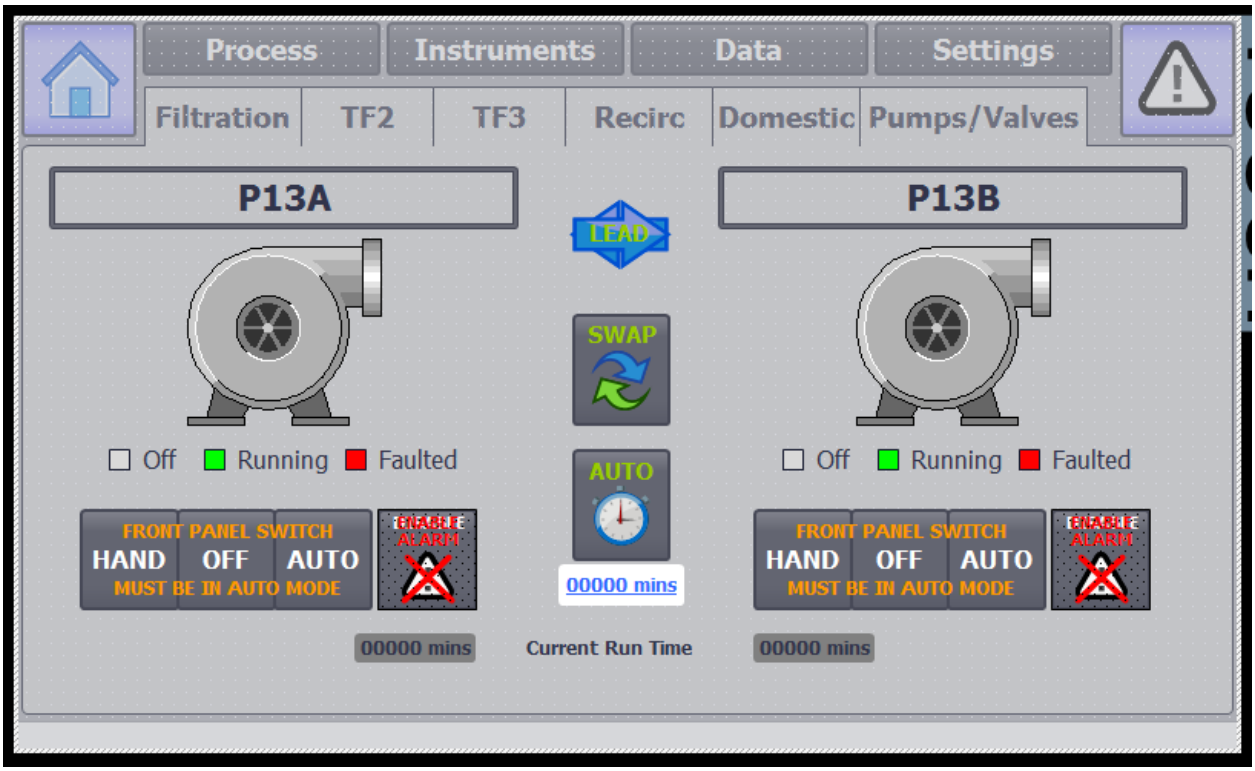


Screen 13. Process: Pumps: P09A and B

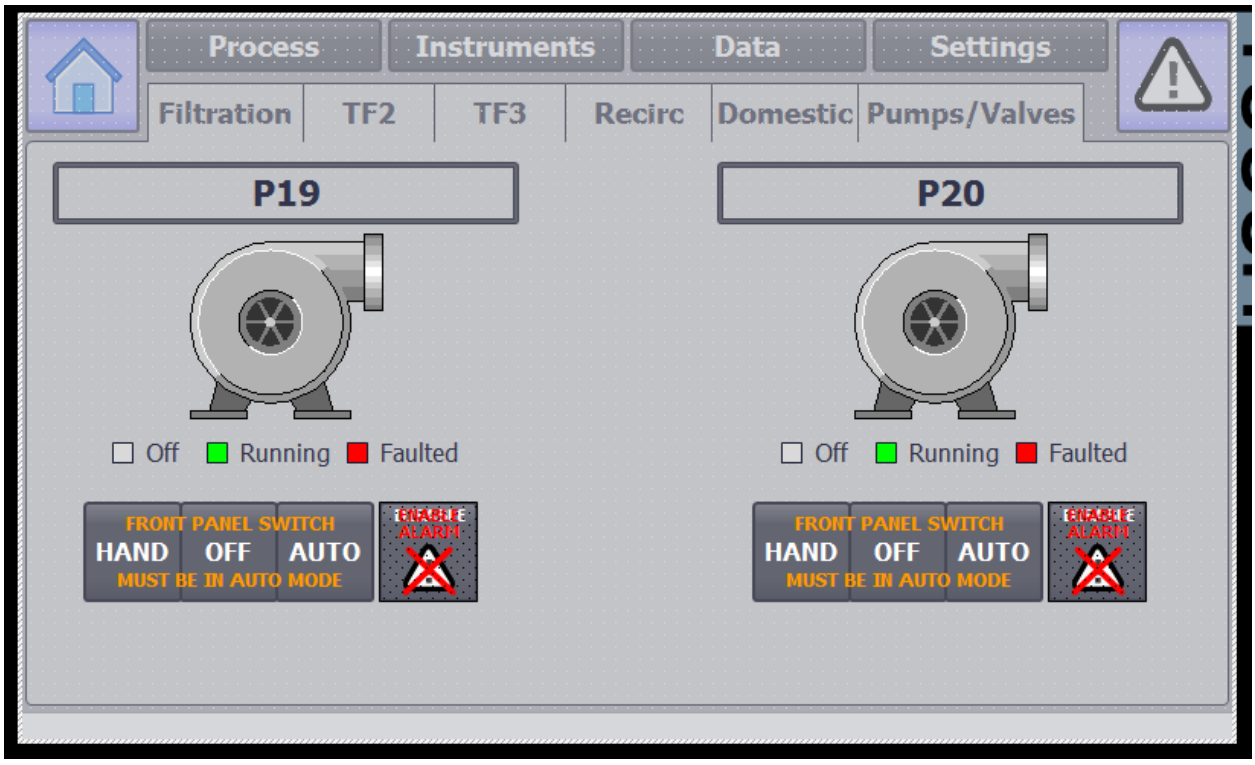
Notes:



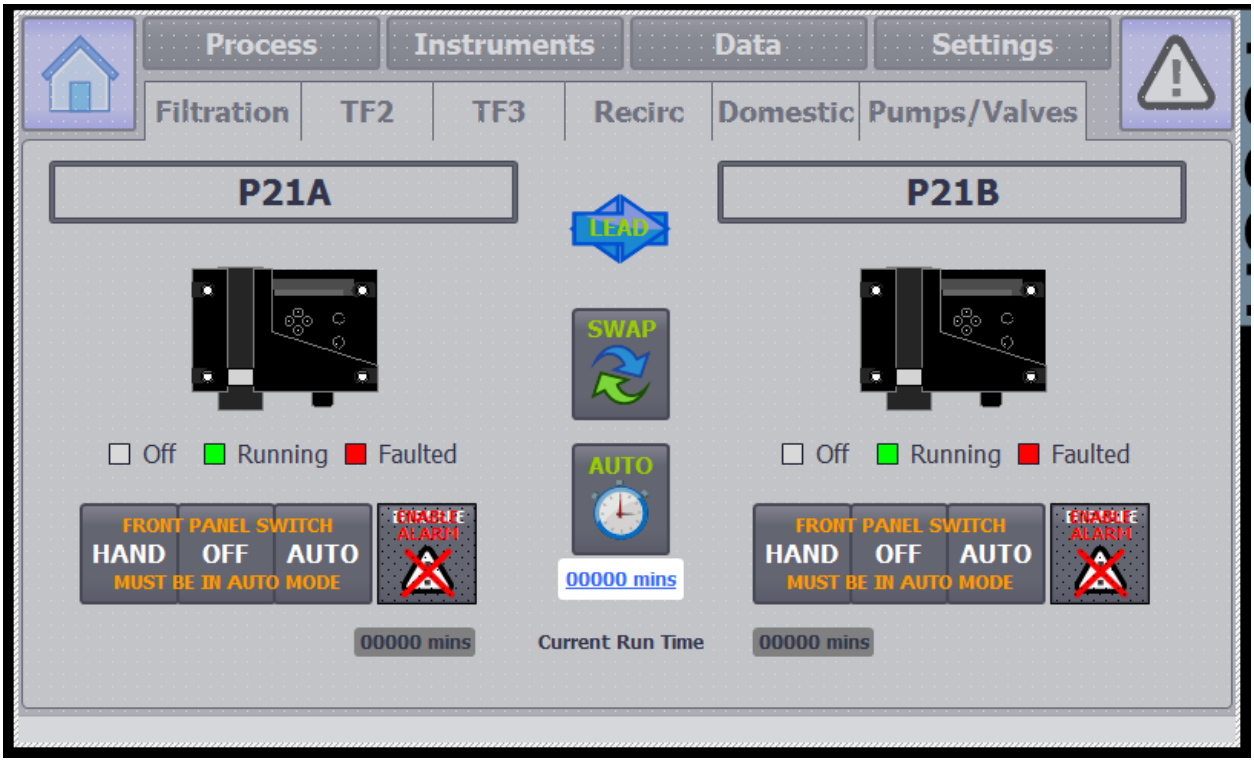
Screen 14. Process: Pumps: P10A and B



Screen 14. Process: Pumps: P13A and B



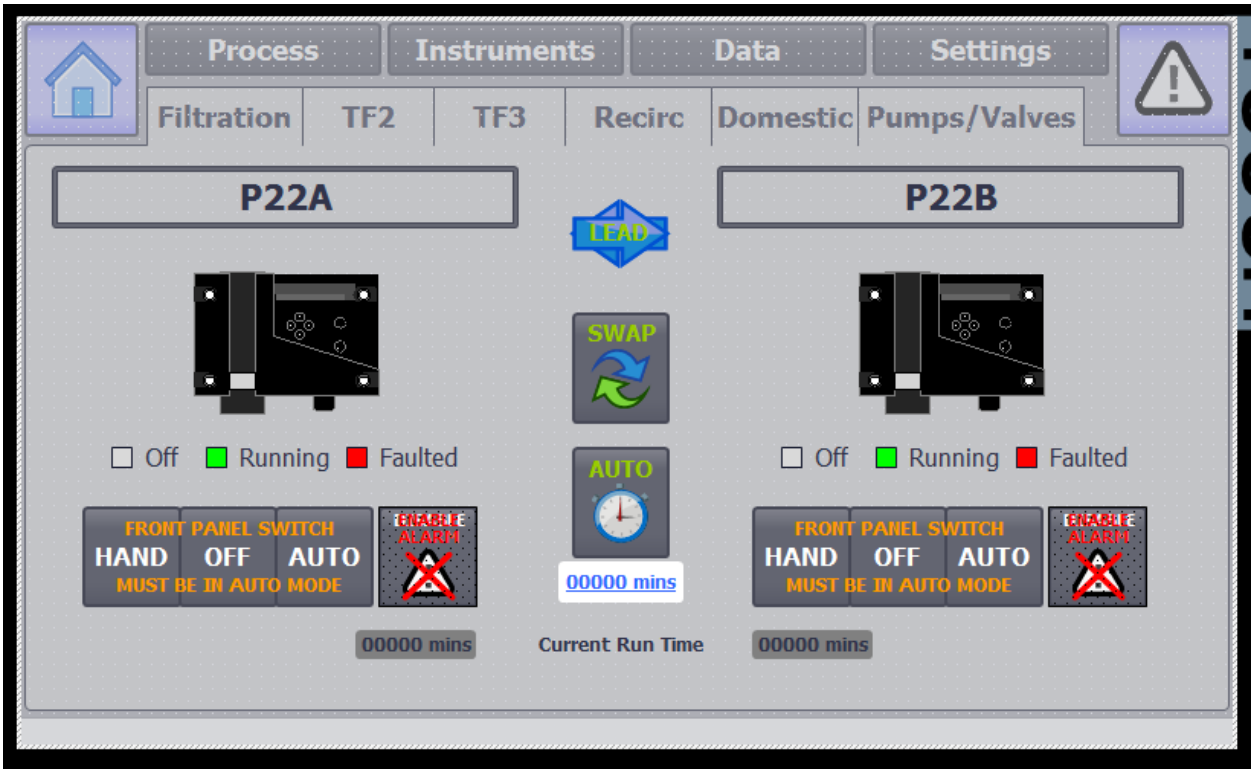
Screen 17. Process: Pumps: P19A and B



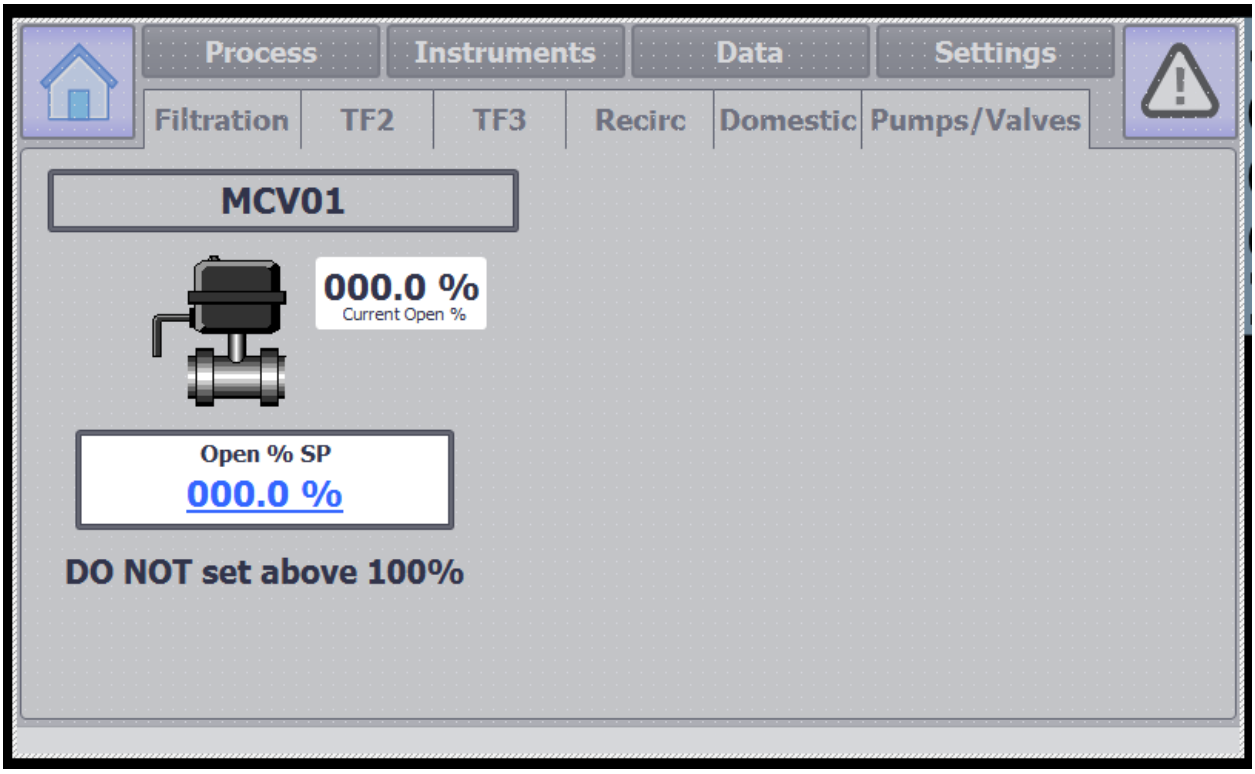
Screen 18. Process: Pumps: P21A and B

Notes:

1. A chemical dosing pump will typically operate flow-paced to a flow meter.
2. If the pump is placed in HAND mode, the pump will run either flow paced or manual speed as selected.

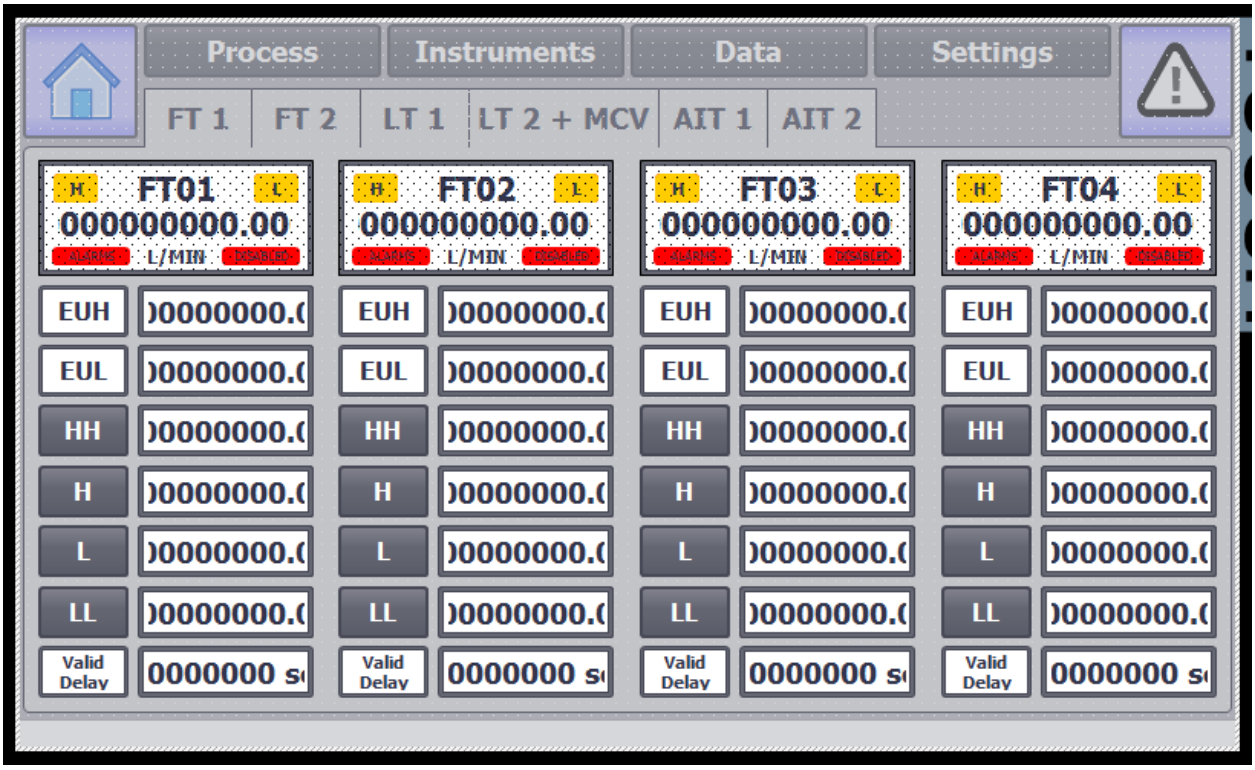


Screen 19. Process: Pumps: P22A and B



Screen 20. Process: MCV01

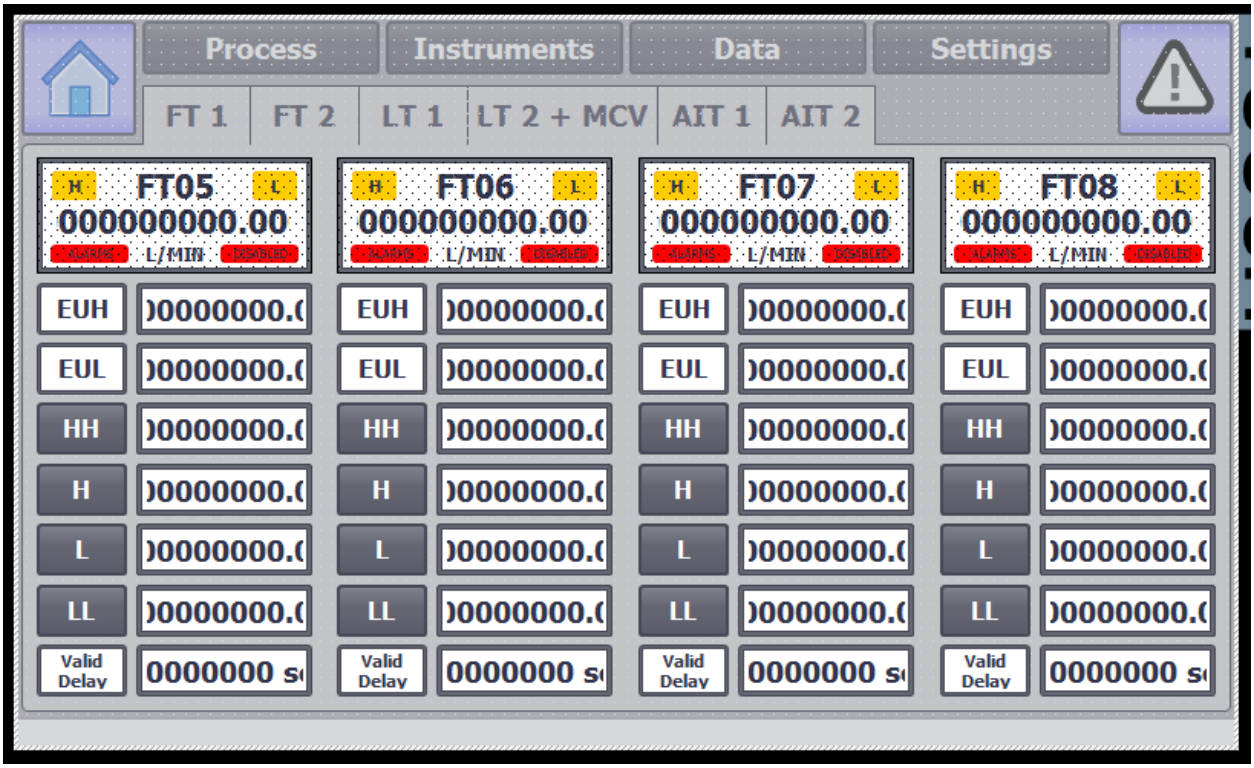
Notes:



Screen 21. Instruments: Flow transmitters

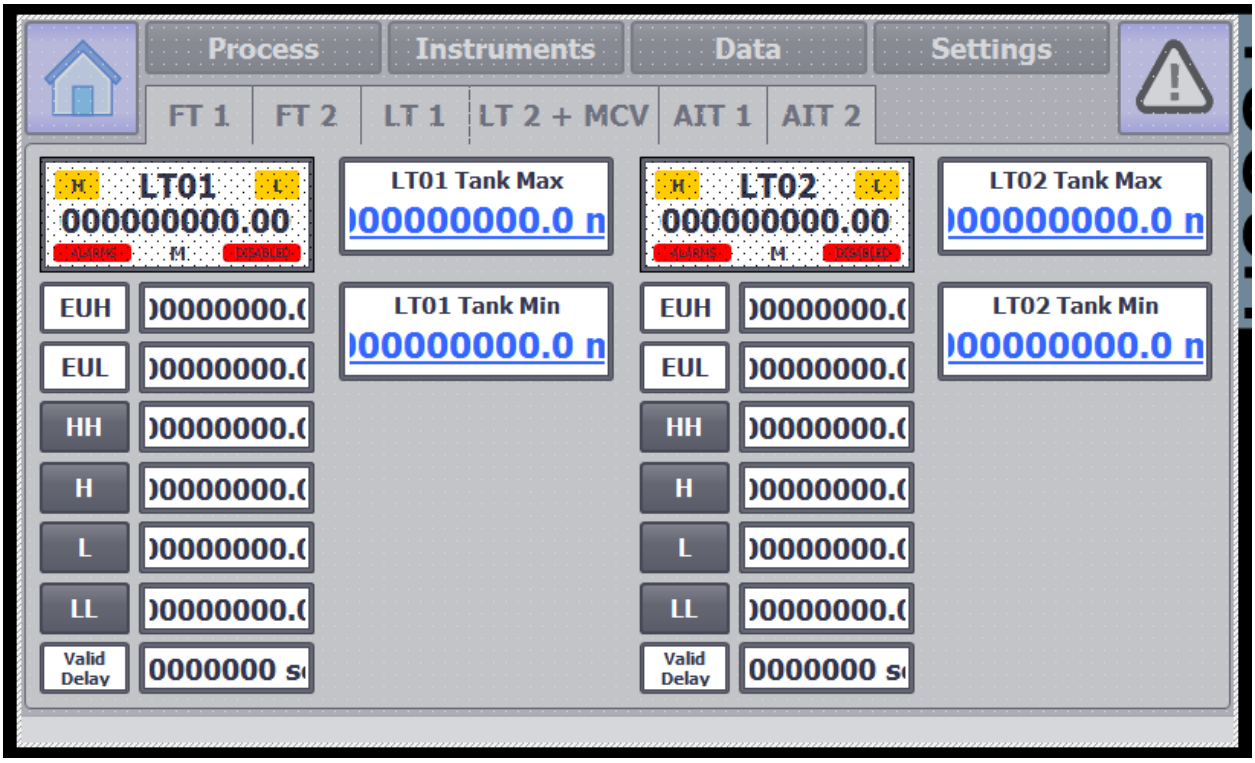
Notes:

1. These are the current measurements and optimum settings screens for each of the instruments.
2. There are two screens Flow settings.
3. The instrument settings are the signal ranges (EUH and EUL), and alarm settings for each instrument according to manufacturer's recommended.
4. Each HH, H, L, LL (low-low) can be enabled or disabled by clicking on. Press the instrument button (e.g. FT01) to disable all alarms for that instrument.



Screen 22. Instruments: Flow transmitters

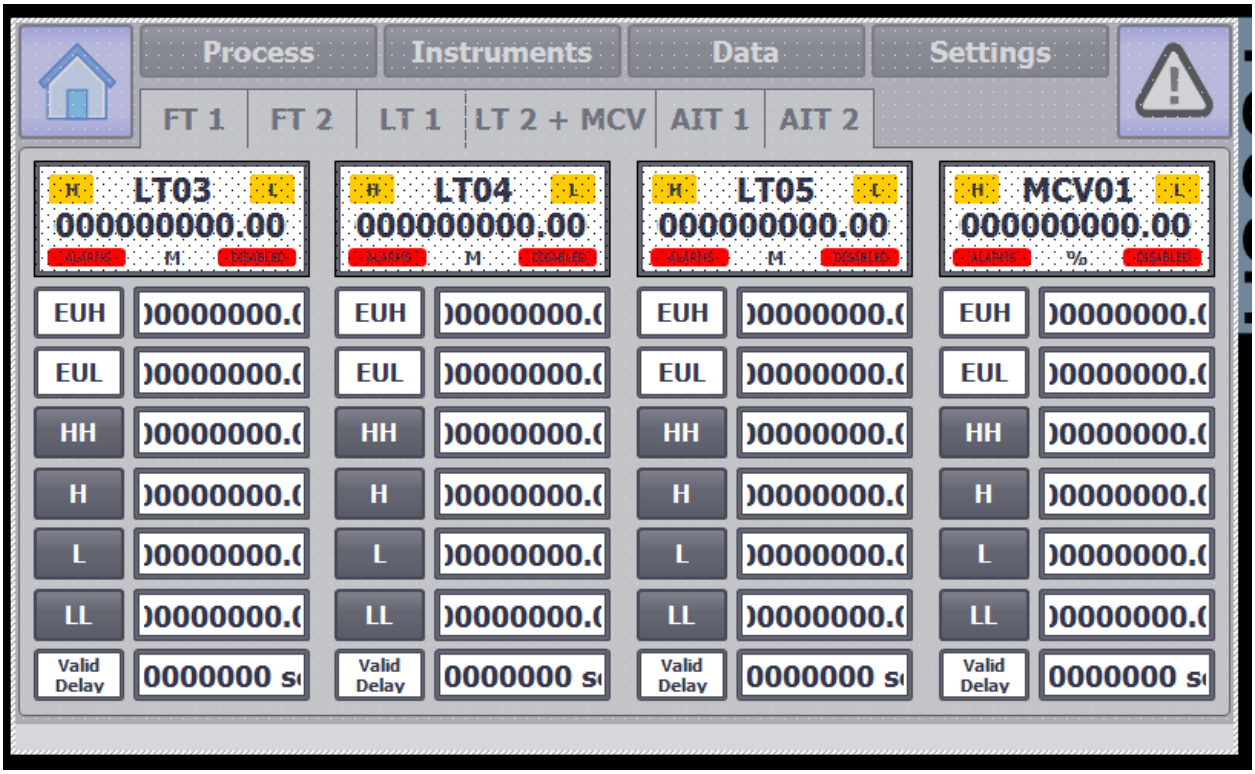
Notes:



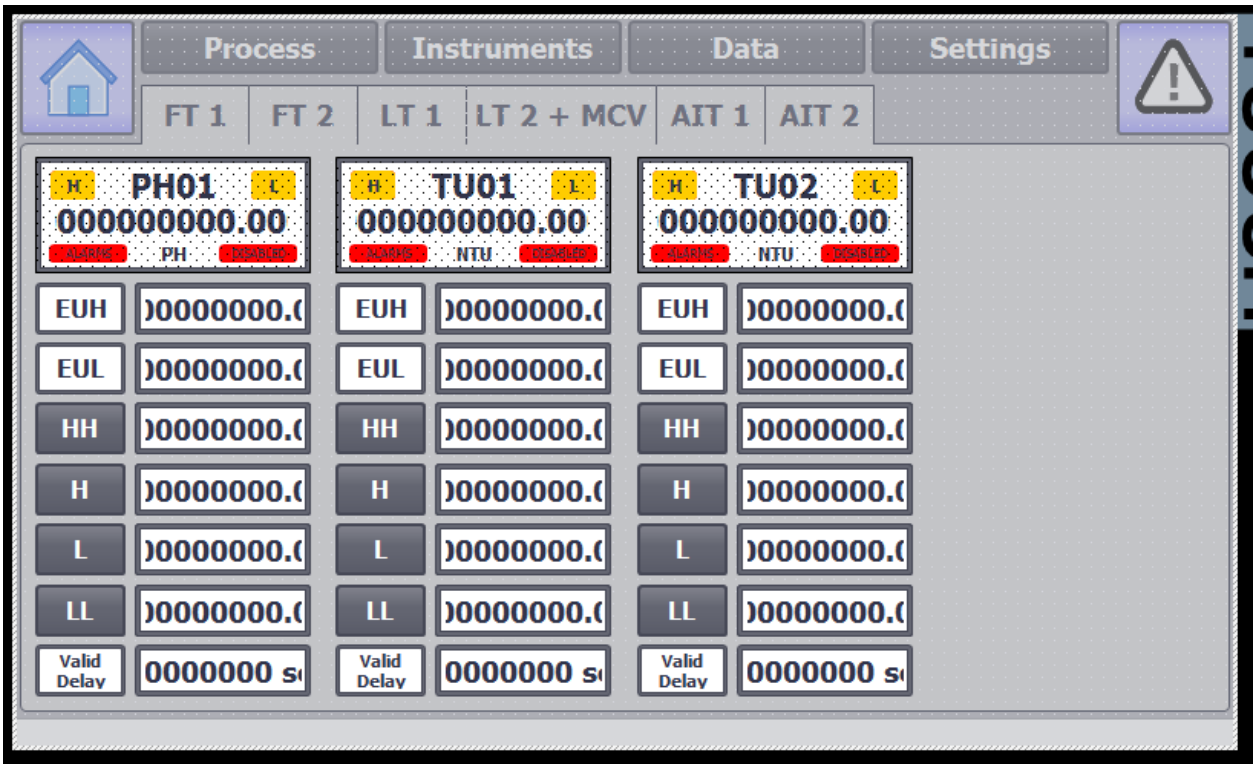
Screen 23. Instruments: Tank level transmitters and settings

Notes:

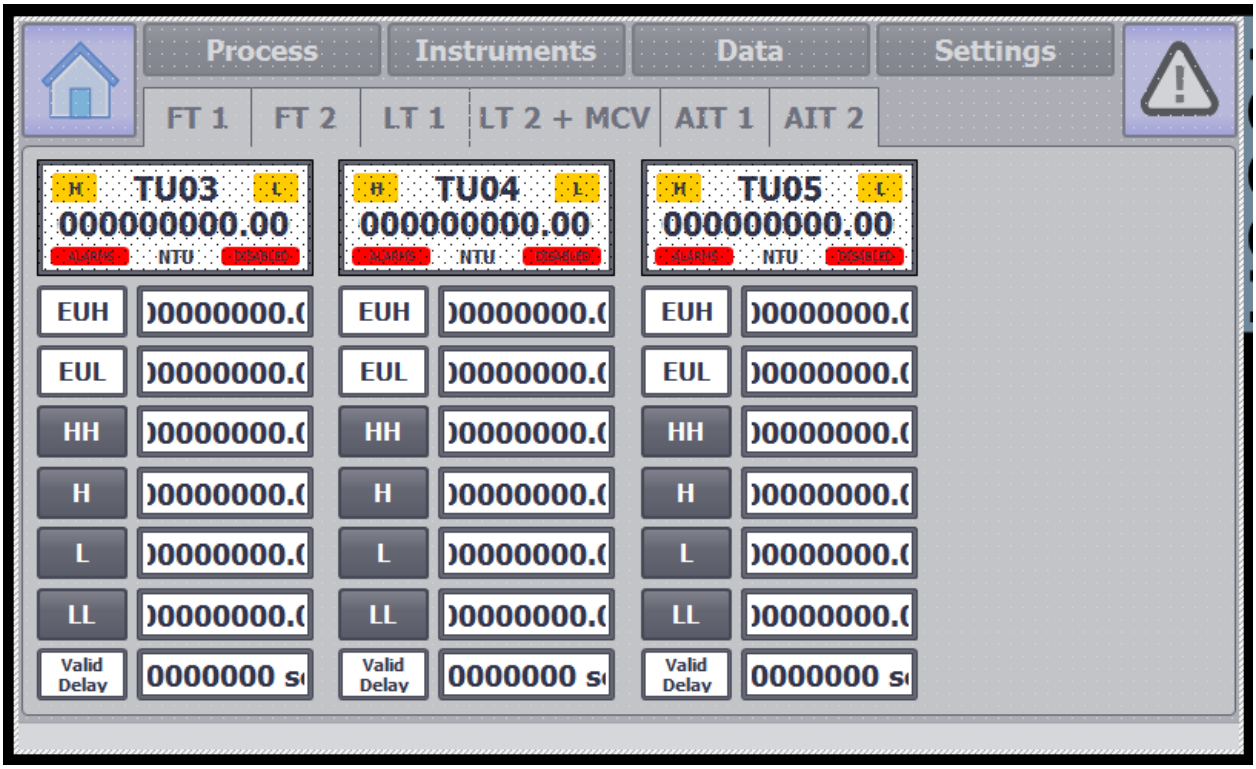
1. Some digital alarms can be disabled from the Alarm Screens in case of instrument failure or a bypass is required.



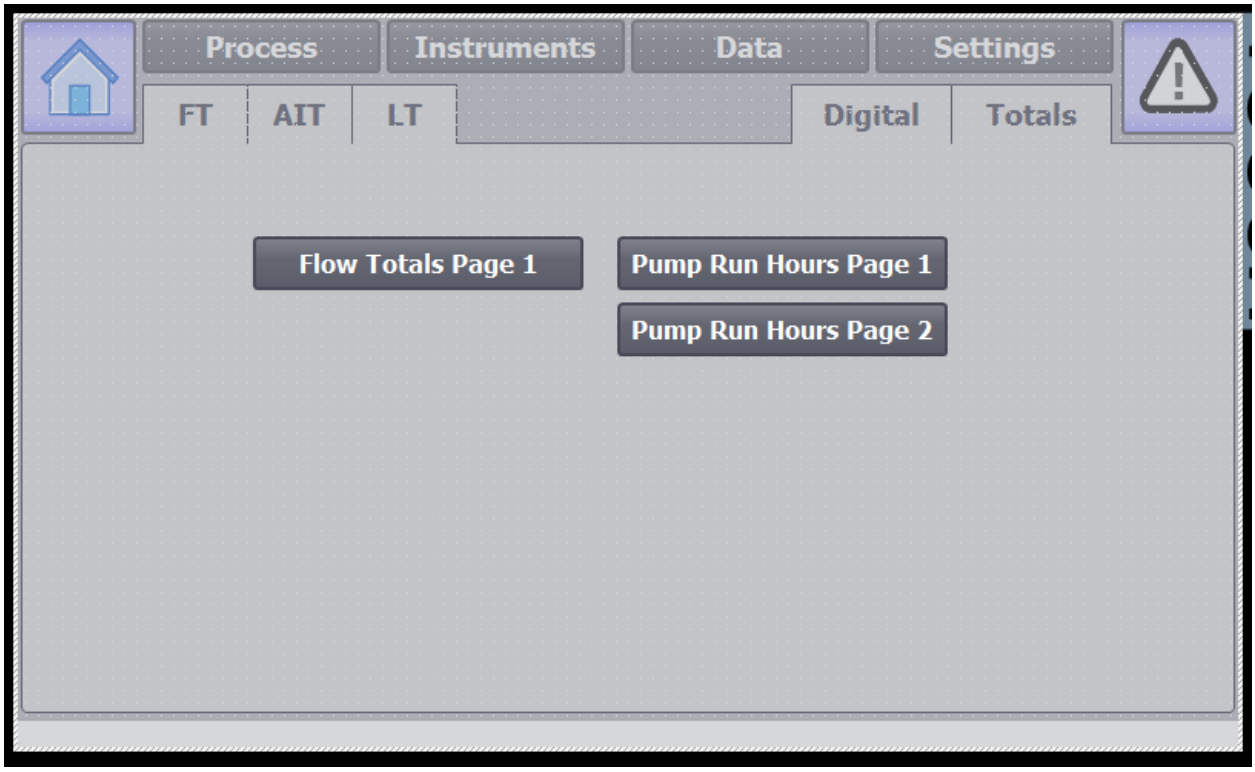
Screen 24. Instruments and tank level settings, Motor control valve



Screen 25. Instruments: PH and Turbidity Analyzers

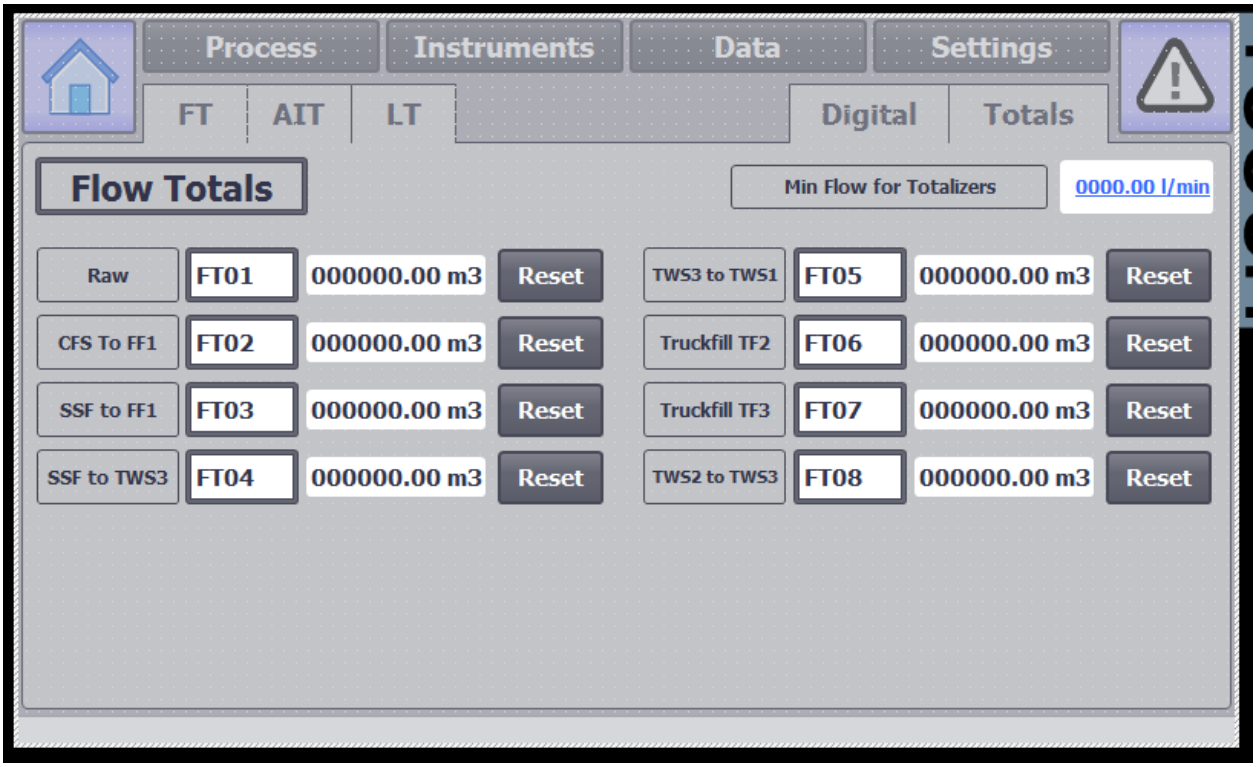


Screen 26. Instruments: More Turbidity Analyzers

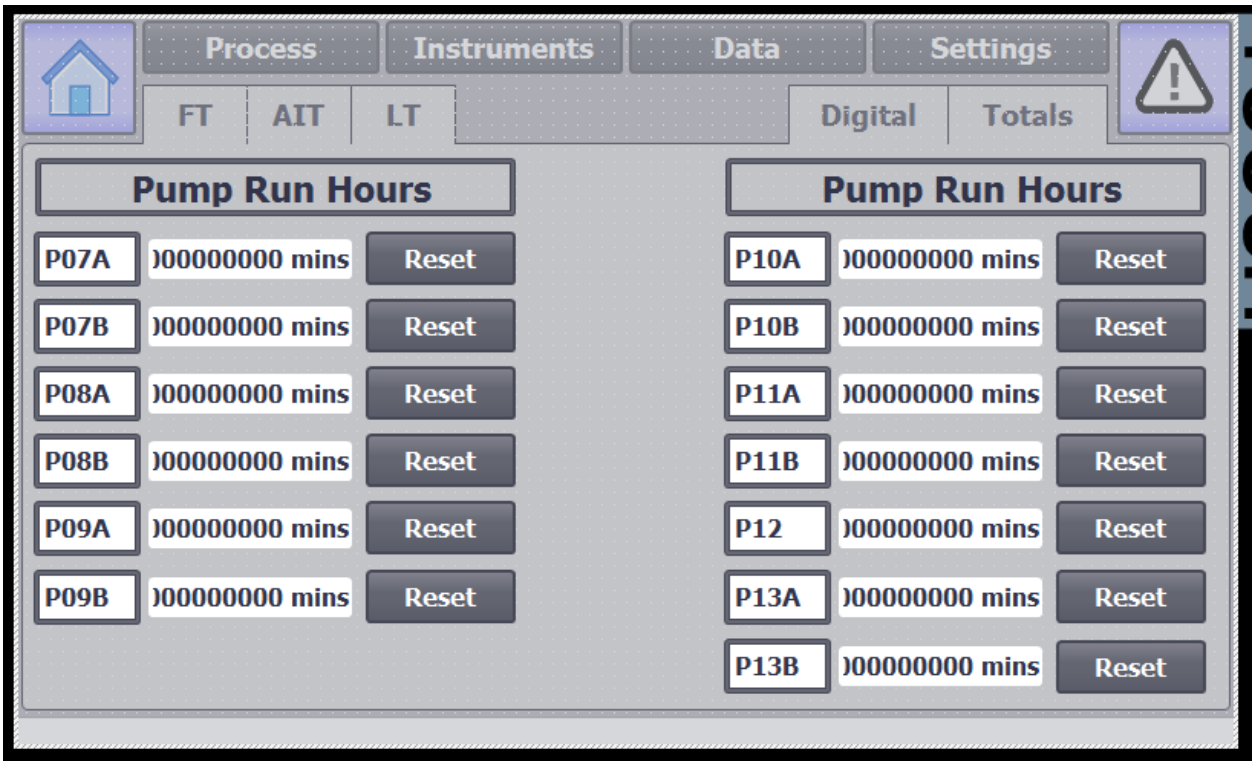


Screen 25. Data: Flow totals

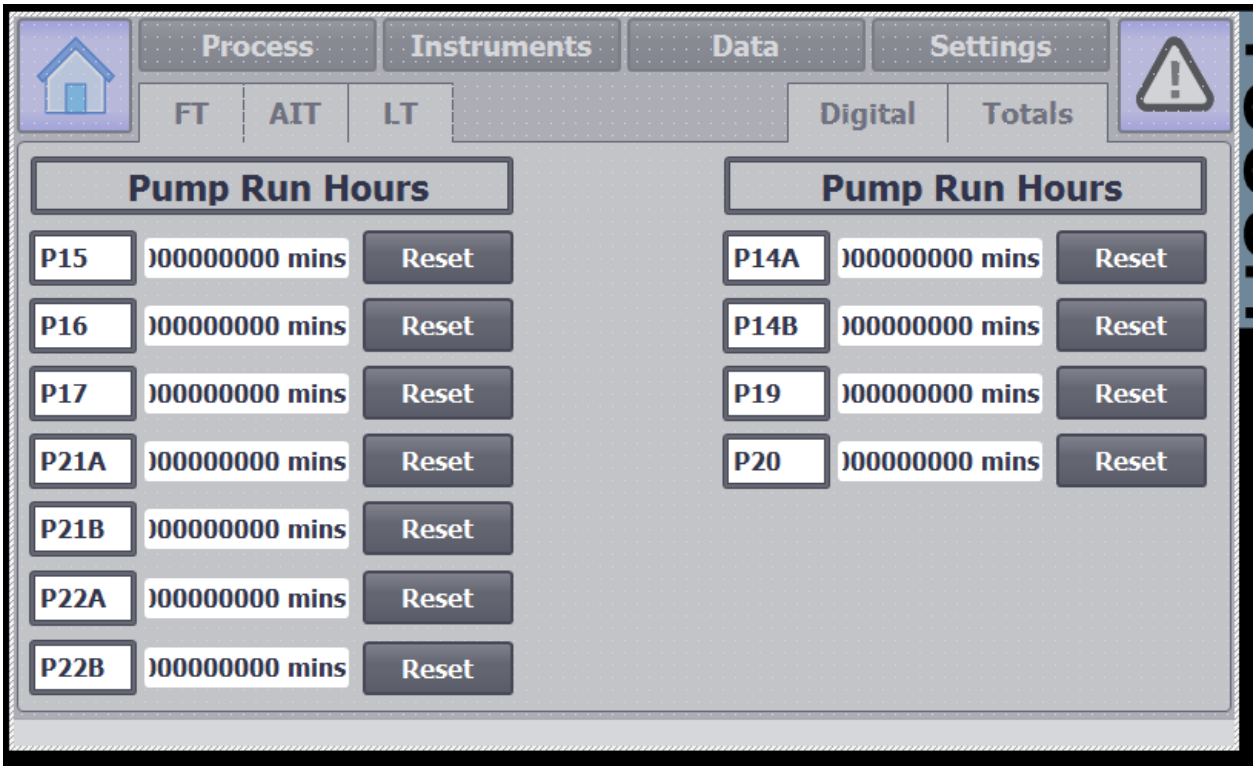
Notes:



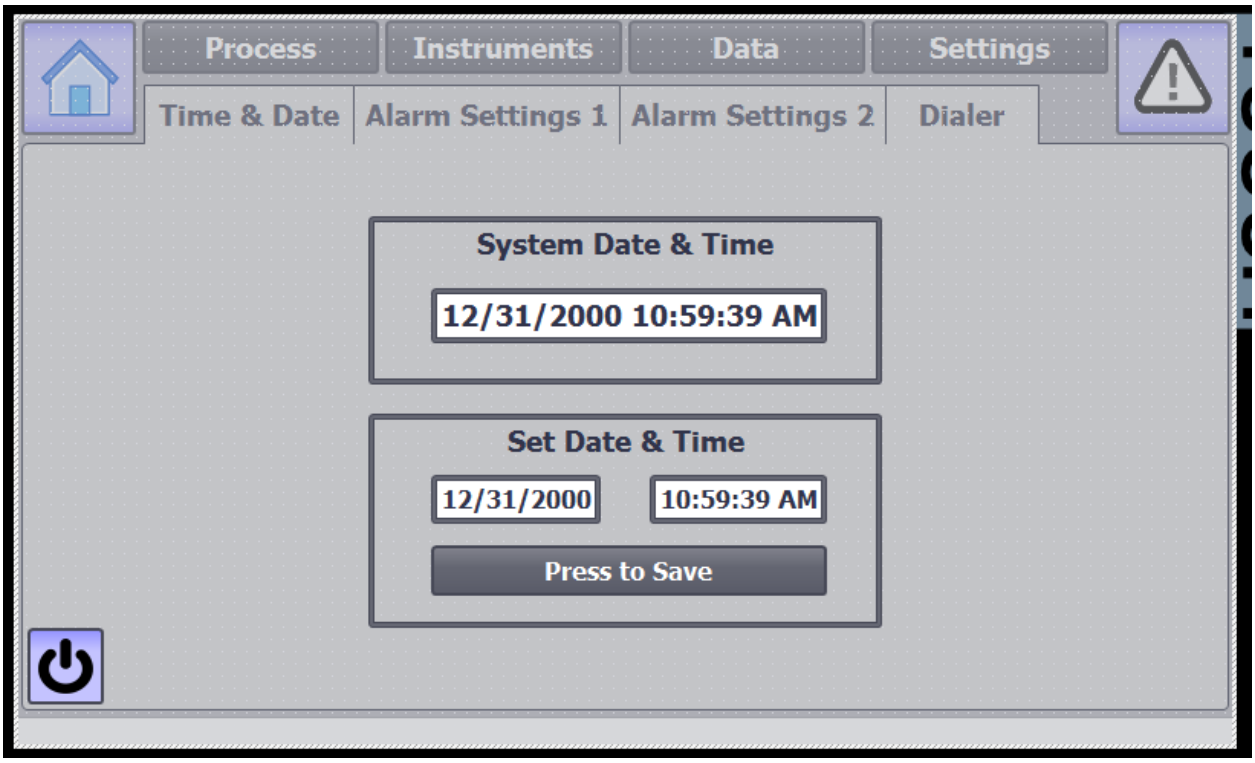
Screen 26. Data: Flow Totals Page 1



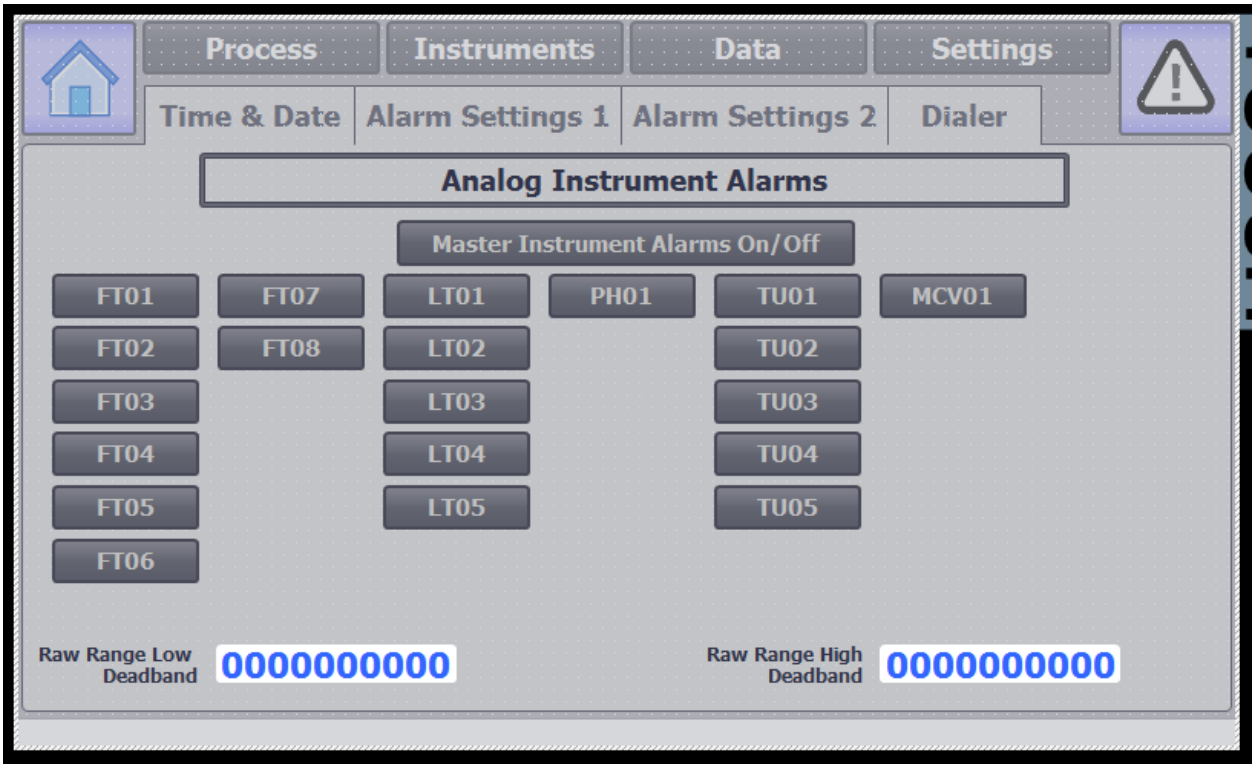
Screen 27. Data: Pump Run Hours Page 1



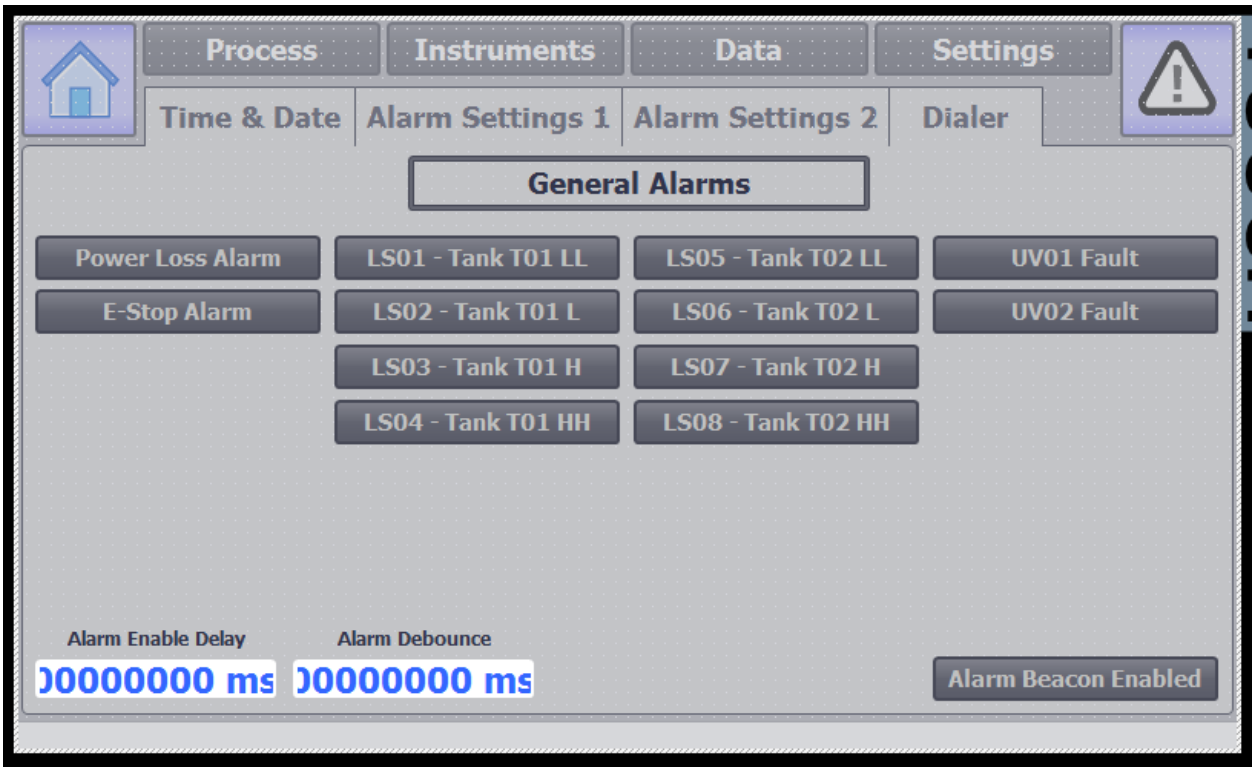
Screen 28. Data: Pump Run Hours Page 2



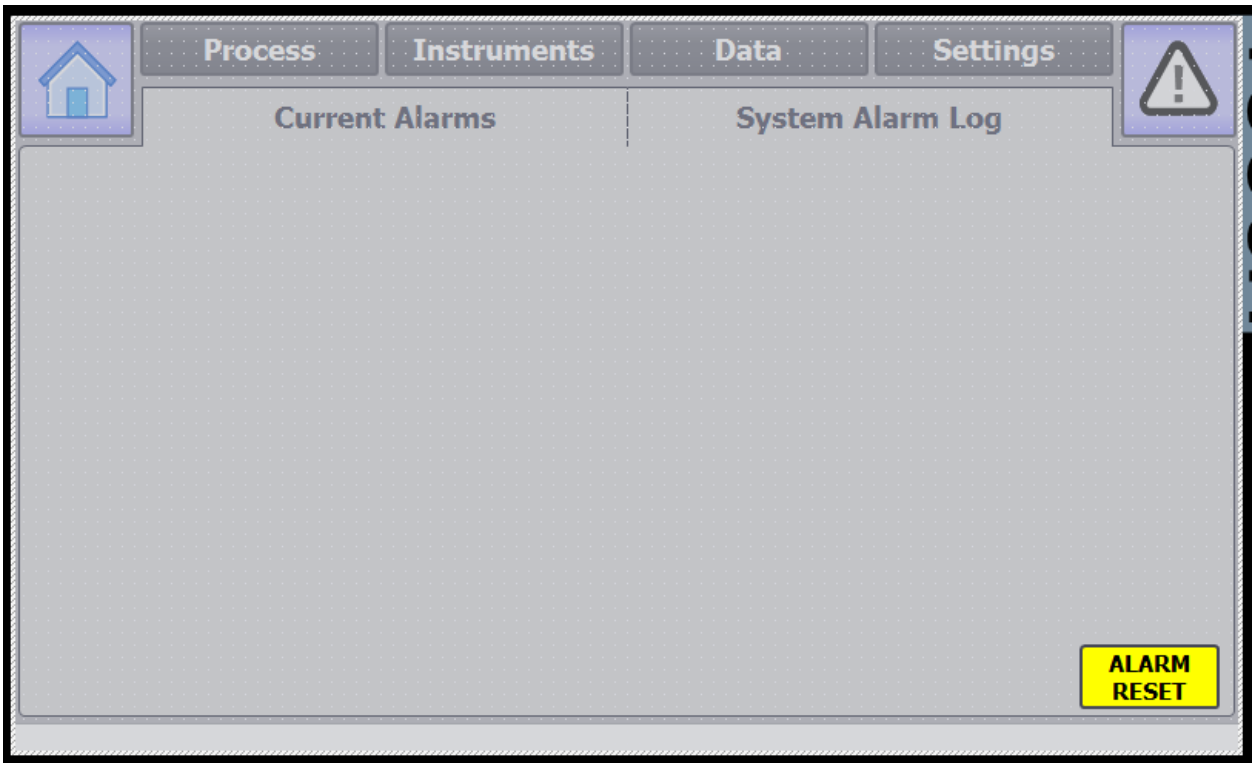
Screen 29. Settings: Date & Time of the PLC



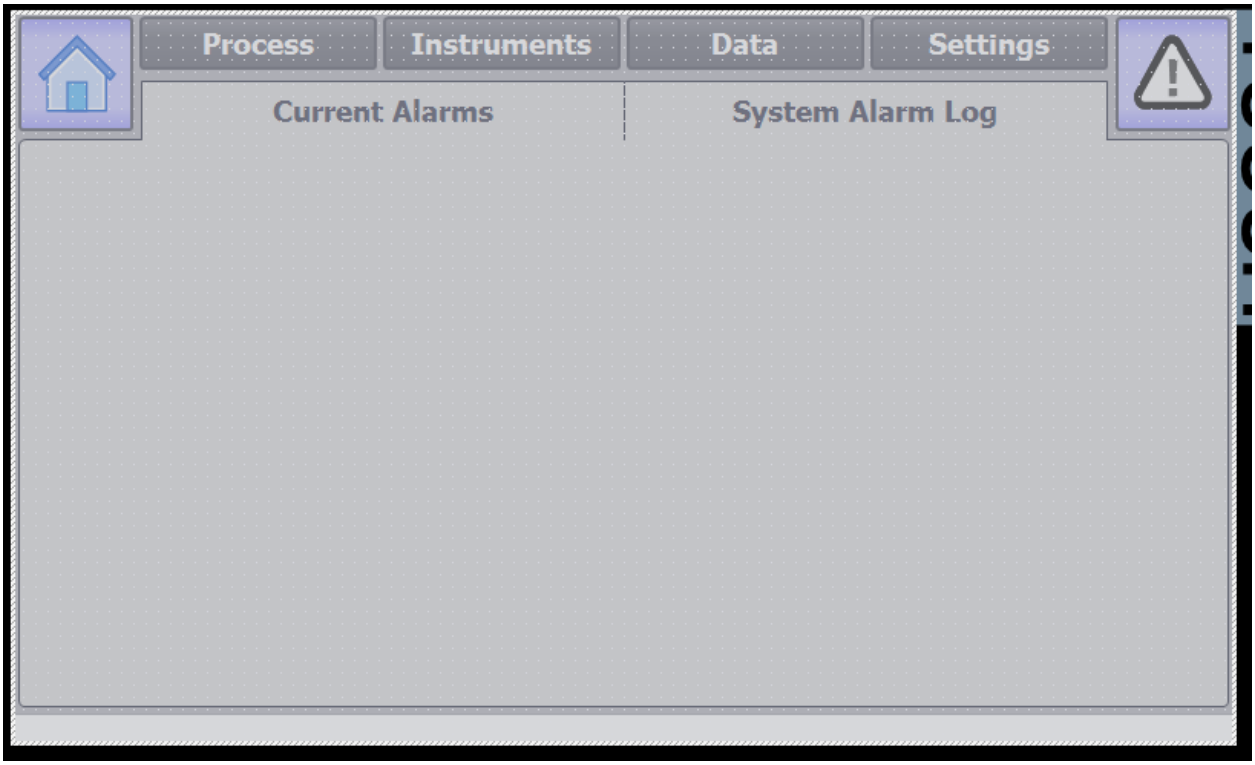
Screen 30. Settings: Alarm Settings 1



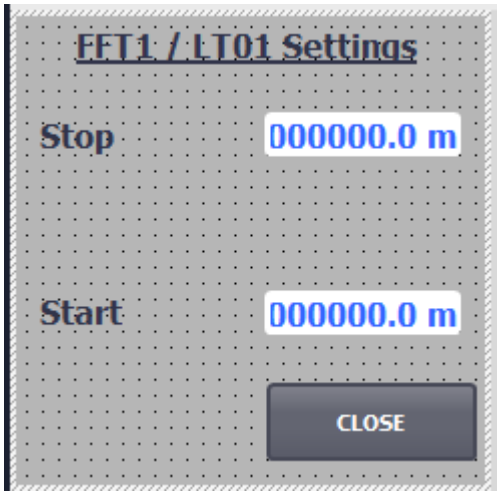
Screen 30. Settings: Alarm Settings 2



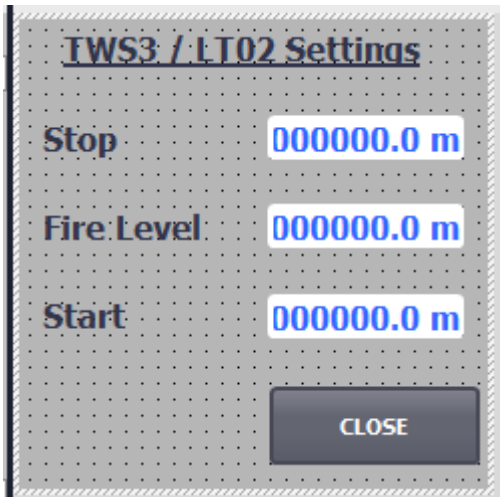
Screen 31. Settings: Alarm History



Screen 32. Settings: Alarm Log



Screen 33. Home: Tank FF1



Screen 34. Home: Tank TWS3

6 Maintenance Schedule Checklist

CHECK LIST 

Description	Task	Maintenance Frequency			
		Daily	Weekly	Monthly	Annually
Overall visual inspection	Complete overall visual inspection to be sure there are no alarms, all equipment is operating to design, there are no leaks, and safety systems are in place.	**X**			
Overall audio inspection	Complete overall audio inspection to be sure all equipment sounds normal when in operation.	**X**			
Record	Record pressure (TMP) and Flux daily. See “Instruments” screen on the HMI for values.	**X**			
Other tanks	Check the cleanliness of tanks and clean/disinfect if fouled.			**X**	
Ultraviolet units	Clean quartz sleeve and sensor quartz as required by the water quality.		**X or**	**X**	
Check lubrication	Assure that all bearings are lubricated per the manufacturer's recommendation.			**X**	
Check mountings	Check and secure all pump mountings.			**X or**	**X**
Motor condition	Check the condition of the pump motors’ temperature (hot?). Inspect bearings and drive belts for wear. Adjust, repair, or replace as req’d.			**X**	
Chemical tank level	Check level in the Chemical tanks and fill if necessary.	**X**			
Chemical Dosing Pumps	Check tubing and replace if necessary		**X**		
	Replace rollers if tubing flow is lower than expected with new tubing		**X**		
Turbidity and pH Analyzers – on-line	Cleaning and recommended re-calibration every 3 months				**3X**
Turbidity Analyzers – hand-held	Recommended re-calibration every 3 months				**3X**
Backwash Waste Pumps	Priming pots may need to be cleaned out.				

7 Standard Warranty

All the equipment delivered by BI Pure Water is warranted for a period of twelve **(12) months** from the date of commissioning, or eighteen months **(18)** from delivery, whichever is earlier.

The warranty covers the cost of any part of the unit that is proven defective in material or workmanship with the exception of parts outlined in "Conditional Terms."

CONDITIONAL TERMS

The warranty does not cover the cost of labor or service calls to examine, remove or replace a proven defective part. A part can only be determined to be defective by an authorized service representative or the manufacturer.

Except as agreed to in writing by BI Pure Water Canada Inc., packing and shipping costs for warranty inspection and/or repairs are not the responsibility of BI Pure Water Canada Inc.

The warranty does not apply to damage resulting from accidents, alteration, misuse, tampering, or abuse. Examples of the foregoing, without limitation, are:

1. Damage to the exterior or interior finish as a result of any of the above.
2. Use of inadequate or defective wiring or improper voltage; loose or blown fuses or open circuit breakers; or improper connections to electrical service.
3. Use with inadequate or defective plumbing, water supply or water pressure.
4. Improper use of controls.
5. Non-compliance with applicable plumbing or electrical codes, laws, ordinances, and regulations.
6. Disassembly or alteration service done by other than accredited BIPW Inc. service personnel.
7. Installation where the water supply flow rate is known to be beyond the capacity of the unit.
8. Damage as a result of flood, fire, frost, and Acts of God.
9. Failure to follow instructions for installation, operation or maintenance contained in the technical manual.

7.0.1 Authorized component policy

BIPW only authorizes the use of genuine BIPW spare parts, which meet stringent engineering design specifications and quality standards, and have traceability to having been procured and certified to these specifications by the BIPW Quality Assurance System.

The use of any non-BIPW authorized parts, or any parts not having been submitted to the BIPW Quality Assurance System will invalidate any and all factory warranties.

7.0.2 Factory service

To return the WTP components to an authorized service depot, perform the following steps:

1. Have the unit's serial number and service requirement details ready. BIPW can be reached by telephone at (604) 882-6650 or fax at (604) 882-6659.
2. A return authorization number is required before returning any components.
3. Securely package the unit in the foam covering and a box similar to the one it was shipped in.
4. Insure the package with your shipper.
5. Write the return authorization number on the package.
6. Unless otherwise instructed, ship to:

BI Pure Water (Canada) Inc.
#2, 9790 – 190th Street
Surrey, BC, V4N 3M9

8 Appendix A – Control Narrative

Water Treatment Overview

The purpose of the water treatment system is to fill the treated water storage tanks. As such the primary start/stop control for the system is the level transmitter (LT02) for tank # TWS3. Other secondary controls include the level transmitter (LT01) for tank # FF1, the Filter Feed tank; and the float switches for the Buffer Tank (T01).

NOTE: All pumps are duty / standby and will automatically switch to the standby pump if a duty pump fault is detected.

Filling the TWS Tanks

LT02 controls the level in the Treated Water Storage (TWS) tanks. LT02 has 3 operational set points and 4 alarm set points.

Start Level
Stop Level
Fire Level

HH Alarm
H Warning
L Warning
LL Alarm

Operation

1. When LT02 is below the Start Level:
   - Check the level of the Filter Feed (FF1) Tank. If the level is too low (i.e. LT-01 LL alarm), do not start the TWS fill process.
   - Start the Filter Feed Pumps, P19 and P20. If only one FF pump is required, the operator should set the H-O-A switch to OFF for one of the pumps.
   - Start a Filtered Water Pump, P11A or P11B
   - Start a SSF Recycle Pump, P10A or P10B. If the SSF recycle is not required, the operator should set the H-O-A switches to OFF.
   - Open MCV02
2. Fill TWS until Stop Level is reached. At which point, stop the pumps and close the valve.

Filling the Filter Feed Tank

LT01 controls the level in the Filter Feed (FF) tank. LT01 has 2 operational set points and 4 alarm set points.

Start Level

Stop Level

HH Alarm

H Warning

L Warning

LL Alarm

Operation

1. When LT01 is below the Start Level:
   - AND if the level in the Buffer Tank (T01) is below the HH level switch (LS04)
     - Open MCV01. MCV01 is a modulating valve and a fixed open % is set in the HMI. When the fill process is started the valve will open to this %.
     - Start the mixers, MX01 and MX02
     - Start one of the Coag dosing pumps, P21A or P21B
     - Start one of the Floc dosing pumps, P22A or P22B
   - If raw water turbidity (TU01) is below 3.0 NTU, bypass the CFS by doing the following:
     - Open V09
     - Close V03, V08
     - Turn off P21A and B
     - Turn off P22A and B
     - Reverse the process when turbidity goes above 3.0 NTU.
   - Start a Raw Water Pump, P09A or P09B
     - Start the pump when the level in T01 is above LS03
     - Stop the pump when the level in T01 is below LS02 or LS01
2. Fill FF1 until Stop Level is reached. At which point, stop the fill process.
3. STOP fill if a High Salinity Alarm is received. The salinity sensor alarm set points are on the salinity sensor controller. Included in the set points (SP) are the trigger SP and the dead band SP to reset the alarm.

Fig. 17: Various slow sand filters and water storage tanks

TWS Recirculation

The TWS recirculation system can operate continuously unless TWS3 has a HH or LL level alarm.

Operation

1. IF LT02 is not HH or LL alarm.
    - Start a Recirc Pump, P13A or P13B
    - Open MCV08
2. UV01 and UV02 are always on. If they are in Fault a warning will be sent to the PLC.

Storage Tank Heat Exchanger Systems

There are 2 systems to warm the water in the FF1 and TWS 3 tanks. These systems consist of recirculation pumps and a heat exchanger drawing hot water from the boiler system.

Operation, FF1 Tank

1. IF LT01 is not in LL alarm.
    - Start a Heat Exchanger Pump, P07A or P07B
2. This recirculates water through HX2

Operation, TWS3 Tank

1. IF LT02 is not in LL alarm.
    - Start a Heat Exchanger Pump, P08A or P08B
2. This recirculates water through HX2

Truck-fill

There are 2 truck-fills in the water treatment plant, TF2 and TF3. Both operate on the same logic.

Operation

1. The truck-fills are allowed to operate if:
    - The water level (LT02) in TWS3 is above the Fire Level
    - The FIRE Mode is activated and the water level (LT02) in TWS is above the LL alarm level
2. To start a truck-fill, the operator presses the START button at the pendant or on the HMI
3. TF2 will
    - Start P14A
    - Open MCV06
    - Start dosing pump P15
4. TF3 will
    - Start P14B
    - Open MCV07
    - Start dosing pump P16
5. When the truck is filled, the operator will press the STOP button at the pendant or the HMI. This will stop the respective pumps and close the valves.
6. If the truck-fill station is idle for more than a certain amount of time (e.g. 60 minutes), the truck-fill drain valve (SV01 or SV02) will open for 5 minutes. SV01 / SV02 will close immediately if the truck-fill is restarted.
7. The truck-fills drain into the domestic water tank (T02).

Slow Sand Filter (SSF) Backwash

Operation

1. Check that the valve to the discharge pond is opened for the respective filter
    - SSF1, manually open valve V40, RF-1 intake valve (V25) should be closed
    - SSF2, manually open valve V41, RF-2 intake valve (V26) should be closed
    - SSF3, manually open valve V42, RF-3 intake valve (V27) should be closed
2. A backwash is permitted if:
    - The water level (LT02) in TWS3 is above the Fire Level
    - Another filter is not already in backwash
3. The operator presses the backwash button on the HMI.
4. Open the MCV
    - For SSF1, MCV03 opens
    - For SSF2, MCV04 opens
    - For SSF3, MCV05 opens
5. Start the backwash pump, P12
6. Backwash the filters for a set duration, e.g. 10 minutes
7. Stop the backwash pump
8. Close the respective motorized valve
9. Manually close the respective discharge pond valve and RF Feed valve

Domestic Water Tank

The Domestic Water Tank supplies water to the domestic water pump. It is filled from TWS3 tank or when the truck-fill arms drain. A chlorine pump is provided to chlorinate the water when the tank is filled from TWS3.

Operation

1. When the tank level in T02 is below LS06 or LS05, the fill process is started.
    - SV03 is opened
    - Chlorine pump P17 is started
2. When the tank level in T02 is above LS07 or LS08, the fill process is stopped.
    - SV03 is closed
    - Chlorine pump P17 is stopped
3. The truck-fills TF2 and TF3 drain into the tank T02. If there is excess water, the excess overflows into the floor drain.

9 Appendix B – MSDS