Pall Aria™ AP
System Functional Description
For QUU WWTP Upgrades

Customer:	**Queensland Urban Utilities (QUU)**
Project Number:	**A090**
Document Number:	**A090-0321-001**
Document Revision:	**1**

PALL Water Processing

1

IMPORTANT – READ THIS FIRST

Before attempting to install the purchased Pall Aria™ AP system, Pall Corporation requires installation technicians and contractors read and understand the separate Installation manual. Before attempting to operate the purchased Pall Aria™ AP system, Pall Corporation requires all operators read and understand the separate Operation and Maintenance manual.

Attempting to install or operate any Pall Corporation equipment without first reading these manuals may result in personal injury and/or product damage and may void any and/or all warranties.

Direct all questions and/or inquiries to Pall Technology Services:

Telephone: +612 4340 8900

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*** The telephone number +612 4340 8900 from 9 A.M. to 4 P.M. Australian Eastern Standard Daylight Savings Time. After 4 P.M., there is a service charge unless the customer has an existing Pall service contract.**

Throughout this manual, the word "customer" refers to Queensland Urban Utilities (QUU)

Revision History

Revision	Date	Originator	Description
A	22/01/13	SDW	Document Release – For Approval
0	14/05/13	SB	For Construction
1	4/07/13	SB	Final (As-constructed incl. client comments)

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1 INTRODUCTION

The Pall Aria™ AP Water Treatment Systems are stand-alone water micro-filtration systems. The Pall Aria™ AP series systems are capable of removing particulate down to 0.1 micrometer (µm) to produce a filtrate flow of clean water for municipal or industrial applications.

Note: In this document**, bold lettering** indicates Operator Adjustable set points or operating parameters. For additional information on valves, devices, and equipment identified by tag number in the text of this document, please refer to Pall P&ID Drawings.

Please note that throughout this document, where applicable, Skid A (2211) tag numbers have been used, and site prefixes omitted for clarity. Relevant site or Skid B (2212) tag numbers can be inferred from the following tables, where x is equal to: 1 Boonah, 2 Kalbar, 3 Laidley, 4 Forest Hill

Table 1-1: Pall P&ID Drawings

Drawing Number	Title
A090x00-001	P&ID Legend
A090x00-003	AP MF System Overview P&ID
A090x00-210	MF System AP P&ID
A090x00-230	CHN system P&ID

Table 1-2: Equipment Tagging Convention

Tagging Convention	Skid
(*site tagging prefix*)-2211-(*unique identifier*)	AP Skid A

Tagging Convention	Skid
(*site tagging prefix*)-2212-(*unique identifier*)	AP Skid B

Table 1-3: Site Tagging Prefix

Description	Kalbar	Forest Hill	Boonah	Laidley
Site Tagging Prefix	ST059	ST052	ST056	ST053

IMPORTANT

Any water drained from the system into a common drain must meet the requirements/standards set by the governing authority for waste disposal in the affected community/area.

1.1 DOCUMENT IDENTIFICATION STANDARDS

Tables 1.4, 1.5, and 1.6 identify common acronyms, abbreviations, and text conventions used throughout this document for various Pall Aria™ Water Treatment System processes control programming.

Table 1-4: Process Acronym Identification

Process	Process Acronym
Forward Flow (Auto Filter)	FF
Air Scrub	AS
Reverse Filtration	RF
Forward Flush	FL
Integrity Test	IT
Clean-In-Place	CIP
Excess Recirculation	XR
Enhanced Flux Maintenance	EFM
Strainer Backwash	SBW

Process	Process Acronym
Transmembrane Pressure	TMP

Table 1-5: Common Text Abbreviations

Abbreviation	Description
AP	Pall Aria™ Package System
CHN	Chemical, Hot Water & Neutralisation
HMI	Human-Machine Interface
MF	Micro-Filtration
MLD	Mega Litres per Day
OIT	Operator Interface terminal
PLC	Programmable Logic Controller
P&ID	Process & Instrumentation Diagram
SCADA	Supervisory Control and Data Acquisition
TMP	Transmembrane Pressure
VFD	Variable Frequency Drive

Table 1-6: Visual Text Conventions

Type	Convention
Operator Adjustable Setpoints	**BOLD CAPS**
Engineer Adjustable Setpoints	***ITALIC BOLD CAPS***
Factory Adjustable Setpoints	***ITALIC BOLD CAPS*** (identified as Factory Setpoint)
HMI Screens	**Bold Underlined**
Control Types, Modes, and Processes	**Bold**
Selectable Screen Buttons	Framed

2 PALL ARIA™ AP SYSTEM SPECIFICATIONS

Pall Corporation recommends utilising the following information in conjunction with the Pall Aria™ Water Treatment System drawings. These drawings are submitted separately and not part of this document. Refer to the system drawings for the AP skid dimensions and battery limit connection types and sizes and other information not contained in this manual.

NOTE All flanged connections on Pall Aria™ Water Treatment Systems have bolt circle diameter and bolt hole sizes that correspond with ANSI 150# flanges.

2.1 PALL ARIA™ AP SYSTEM SUMMARY

Table 2-1: PALL ARIA™ AP SYSTEM SUMMARY

Description	Kalbar	Forest Hill	Boonah	Laidley
Site Tagging Prefix	ST059	ST052	ST056	ST053
System Flow (Net)	2 x AP2 Initial: 141 m³d Ultimate: 161 m³d	2 x AP2 Initial: 171 m³d	2 x AP3 Initial: 510 m³d Ultimate: 609 m³d	2 x AP3x Initial: 786 m³d
Rack Module Capacity Installed Modules/Skid Total Modules on System	8 4 8	8 4 8	13 11 22	20 17 34

2.2 MATERIALS OF CONSTRUCTION

Product	Types
Wetted Materials	Stainless Steel, Acrylic, Polypropylene, uPVC and EDPM (Elastomers)
System Electrical Enclosures	Painted Carbon Steel, Stainless Steel
System Tanks	High Density Polypropylene
System Piping	PVC, HDPE
System Fittings	PVC, HDPE

2.3 ENVIRONMENTAL REQUIREMENTS

Conditions	Range
Maximum Operating Pressure	310 kPa
Operating Temperature	5° - 40° C
Storage Temperature (without modules)	0.6° - 50° C
Operating Humidity (Non-Condensing)	10 – 90% Relative
Storage Humidity (Non-Condensing)	10 – 90% Relative

2.4 UTILITIES REQUIREMENTS

Utility	Requirements
Electrical Supply	415 VAC, 3 Phase + N, 50 Hz
Instrument Grade Air	827.4 kPa minimum delivery pressure, 0.09 scmm per module + 0.01 scmm continuously for automated valves. The air must be instrument grade, clean, dry, and oil-free.

2.5 PALL ARIA™ AP SKID TANK VOLUMES

On-Skid Tanks	AP2	AP3
Feed Tank (TK-2211-01)	265 liters	833 liters
RF Tank (TK-2211-02)	435 liters	1325 liters

2.6 PALL ARIA™ AP SKID PUMPS

Pump Style & Performance	AP2	AP3
Recirculation Pump (PU-2211-01) Flow: Head: kW: Speed:	Centrifugal 0 – 5.8 L/s 38 m 4kW 2900 RPM	Centrifugal 0 – 12.8 L/s 32 m 7.5kW 2900 RPM
RF Pump (PU-2211-02) Flow: Head: kW: Speed:	Centrifugal 0 – 6.7 L/s 30 m 4kW 2900 RPM	Centrifugal 0 – 22.8 L/s 21 m 7.5kW 2900 RPM

2.7 AUTOMATION HARDWARE

Hardware	Type
Off-Skid Operator Interface	Allen-Bradley® VersaView™

2.8 AUTOMATION SOFTWARE

Software	Type
System PLC Control	Allen-Bradley® CompactLogix™
Skid(s) Operator Interface	Allen-Bradley® Factory Talk View SE ™
Network	Ethernet
System Operation	Pall Corporation Proprietary Software
Customer Remote Access	pcAnywhere®
Data Reporting Software	Microsoft® SQL 2005/OPC System.Net Reporting

2.9 AIR COMPRESSOR SYSTEM

To ensure system functionality and efficiency, compressed air is provided that meets clean, oil-free, instrument grade air specifications. The compressed air system is composed of:

- A compressor including refrigerant dryer;
- A filtration system capable of particle removal of 1 micron and coalescer/hydrocarbon filtration of 0.01 micron;
- A receiver.

The system is sized to allow for 5 nm^3/hr./module to be available for the system every 15 minutes for a duration of one (1) minute for an Air Scrub, plus 1 nm^3/hr./skid continuously for automated valve operation.

Compressor Sizing	For 2 x AP2 System	For 2 x AP3 System
Compressor Model	Atlas Copco GX2-FF	Atlas Copco GX3-FF
Total Air Required	4 L/s @ 10 Bar	5.3 L/s @ 10 Bar
Receiver Size	565 L	1,000 L
Receiver Pressure Rating	1000 kPaG	1000 kPaG

2.10 CHEMICAL, HEATING & NEUTRALISATION (CHN) SYSTEM

Pall Corporation is providing a skid mounted Chemical, Heating and Neutralisation (CHN) system consisting of a CHN skid, a Filtrate tank, a CIP Batching & Neutralisation Tank including a water heater, four (4) chemical transfer pumps and valves to connect the CHN System to the Pall Aria™ AP skids, directly interfacing with the Pall Aria™ AP control system. The single CHN system provides water to both AP skids.

Pump Style & Performance	CHN Skid Pump
CHN Pump (PU-2250-01) Flow: Head: kW: Speed:	Centrifugal 3 L/s 4.6 m 0.37kW 1450 RPM

Off-Skid Pumps	Description
Chlorine Pump (PU-2511-90) Flowrate Air Pressure Required Air Consumption	Diaphragm 0 - 0.2 L/s 621 kPa 6.6 nm3/hr.
Acid Pump (PU-2532-91) Flowrate Air Pressure Required Air Consumption	Diaphragm 0 - 0.2 L/s 621 kPa 6.6 nm3/hr.
Caustic Pump (PU-2521-92) Flowrate Air Pressure Required Air Consumption	Diaphragm 0 - 0.2 L/s 621 kPa 6.6 nm3/hr.
SMBS Pump(PU-2513-93) Flowrate Air Pressure Required Air Consumption	Diaphragm 0 - 0.2 L/s 621 kPa 6.6 nm3/hr.

The CHN system includes a hot water system consisting of a Hot Water Tank (TK-2250-80) with heater and a Filtrate Tank (TK-2250-81).

Off-skid Tanks	For 2 x AP2	For 2 x AP3
Hot Water & Filtrate Tanks Style: Material: Volume:	 Vertical Round PE 2500 L (each)	 Vertical Round PE 5000 L (each)
Tank Heater	7.5 kW	10 kW

2.11 STORAGE AND PRESERVATION OF THE MICROZA® MICROFILTRATION MODULES

CAUTION

The Microza® microfiltration module membranes can dry out if left unattended. This adversely affects their performance. As a result, the modules are shipped containing a storage solution to preserve the membranes. This solution must be maintained in the modules until put into service. For that reason, after receiving the modules and before they are stored, the shipping containers must be opened and the modules inspected for leaks or damage of any kind. If any module leakage or damage is noticeable or suspected, contact Pall Technology Services immediately.

After inspection, reseal the modules in their containers and place them in an enclosed storage area that provides adequate protection from extreme heat (no exposure to direct sunlight) and cold (no temperatures below freezing). DO NOT STORE MODULES OUTSIDE.

FAILURE TO ADHERE TO THIS CAUTION RESULTS IN THE VOIDING OF ALL MODULE WARRANTIES!

DO NOT drop or expose either the modules or their shipping containers to shock or impact. There may be damage to the membrane even if no visible damage to the module case is evident.

After system installation, if the system is to be shut down for less than 24 hours, the Microza® modules membranes must be kept wet with clear water. If the system is to be shut down for more than 24 hours, refer to the "Long-Term Shutdown and System Lay-Up" procedure in the separate Operation and Maintenance manual for this system.

DO NOT move or in any way transport the Pall Aria™ Water Treatment System with the modules mounted on the skid. Any vibration or shock may damage the module membrane. Always dismount the modules and install dummy modules for system transportation

3 RAW WATER & FILTRATE SYSTEM SPECIFICATION

3.1 RAW WATER SYSTEM

Table 3-1: Raw Water Pumps

Pump Style & Performance	2x AP2	2x AP3
Raw Water Pump (PU-2220-01) Flow: Head: kW: Speed:	Centrifugal, self-priming with integral check valve 0 – 4.2 L/s 14 m 1.47 kW 2900 RPM	Centrifugal, self-priming with integral check valve 0 – 13.3 L/s 14 m 4 kW 2900 RPM

See "Raw Water & Filtrate System Functional Descriptions" in Section 5 for a detailed description of how these components operate.

Refer Section 6.7 "System Startup" for more information on selecting the Pall Aria™ Water Treatment System control types.

3.2 FILTRATE & FINISHED WATER SYSTEMS

Filtrate leaving the MF building flows onto site specific treatment, storage and/or discharge infrastructure outside of Pall Corporation's scope of supply. Refer to site-wide documentation for details.

See "Raw Water & Filtrate System Functional Descriptions" in Section 5 for a description of control interfaces between the Pall Aria™ AP System and Filtrate & Finished water systems.

4 PALL ARIA™ AP SKID PROCESS SUMMARY

4.1 INTRODUCTION

Parameters listed in the following descriptions are starting points for efficient system operation; however, these parameters may need to be modified due to changing system conditions. Contact Pall Technology Services for more information.

Detailed descriptions of the following processes appear in Section 6. Process and alarm set points appear in Section 7.

NOTE

Pall Aria™ AP Skid Lay-up

Pall Corporation recommends that if a single Pall Aria™ skid is going to be shut down for more than 24 hours, the customer must perform a system lay-up (chlorine soak and rinse, residual chlorine) as indicated in "Long Term Shutdown and System Lay-up" in Section 6 of the Pall Aria™ Operation and Maintenance manual.

This procedure involves the introduction of a sodium hypochlorite into the modules to prevent algae growth. For systems with short peak flow periods, it is desirable to prevent lay-up of a unit. The operator can do this by switching which skid is Lead or setting the **LEAD/LAG ROTATION INTERVAL** setpoint to 12 hours. Both setpoints are on the **Operator Lead/Lag Setpoints Screen**. Using elapsed time will prevent system lay-up but will not even out total filtrate produced by the units.

NOTE

Raw **Water Supply and the On-Skid Feed Tank**

Raw Water is pumped from the site effluent lagoon(s) directly into the Feed Tanks on the AP Skid(s). This is a continuous process initiated by the AP units which controls the Raw Water pump(s) and the on-skid Fill valve(s).

The Pall Aria™ AP Water Treatment System series packaged system design is as an independent entity and automates each of the following filtration process steps:

4.2 FILL

The system starts the **Fill** Process when the on-skid Feed tank (TK-2211-01) reaches the required operating level, as determined by the Feed Tank Level Indicating Transmitter (LIT-2211-01). This process pushes all air out of the feed side of the modules. When the **Fill** Process is complete, the system moves to **Forward Flow (FF)**, begins to produce filtrate, and fills the RF tank (TK-2211-02) as required.

4.3 FORWARD FLOW (FF)

This process produces filtrate (filtered water for end use). Raw Water feeds through an on-skid strainer that removes large solids before reaching the filter membranes. Solids collected on the feed strainer discharge to drain during strainer backwash (SBW) cycles. After the strainer, the water flows into the filter membranes, where it separates into filtrate and XR. The filtrate (treated water) discharges to downstream equipment. The XR flow discharges back to the on-skid Feed Tank (TK-2211-01).

4.4 FLUX MAINTENANCE (FM)

The modules undergo a programmed regimen consisting of a combination of processes that recovers the Trans-Membrane Pressure (TMP) and removes any solids fouling the membrane surface. **Flux Maintenance** cycles always begin with an **Air Scrub,** followed with either a **Feed Flush** or a **Reverse Filtration** (The operator can select which process follows the **Air Scrub)**. **Flux Maintenance** processes are started after either the filtration skid has processed a certain amount of filtrate volume or the filtration skid has been filtering for a certain amount of time.

4.4.1 AIR SCRUB (AS)

Air is introduced to the feed side of the membranes at a rate of 5 nm^3/hr./module The Reverse Filtration pump (PU-2211-02) starts at a rate of 0.5 L/s/module. This reverse flow pushes filtrate back through the membranes and, while air continues to agitate the fibre bundle, carries any solids to the drain. This lasts for about sixty (60) seconds.

The process is completed by the performance of either a **Feed Flush** (**FL**) using the Recirculation Pump (PU-2211-01) or a **Reverse Filtration** (**RF**) using the Reverse Filtration pump (PU-2211-02). This flushes the modules for about thirty (30) seconds. Any remaining solids are carried to the drain.

4.4.2 FEED FLUSH (FL)

If selected on the **Operator Flux Maintenance Setpoints Screen**, after completion of the **AS**, a **Feed Flush** to drain occurs for approximately thirty (30) seconds. The Recirculation Pump (PU-2211-01) sends water through the modules to flush to drain any remaining solids and air bubbles. The FL flow rate equals 1.1 L/s/module.

4.4.3 REVERSE FILTRATION (RF)

Under special circumstances (and if selected), after completion of the **AS**, a **Reverse Filtration** (**RF**) to drain occurs for approximately thirty (30) seconds. The RF Pump (PU-2211-02) sends water back through the modules to flush away any remaining solids and air bubbles to drain. The RF flow rate equals 0.88 L/s/module.

Typically, the **AS** and **FL/RF** interrupt the supply water feed flow rate (upstream) and the filtrate flow rate (down-stream) for two (2) minutes every twenty (20) minutes. The actual process settings vary between water sources and the volume of water being produced.

4.5 INTEGRITY TEST (IT)

The system undergoes an automatic five (5) minute **Integrity Test** based on a predetermined interval (runtime hours). This test checks for broken fibres in the modules. During the **IT**, interruption of **Feed Flow** and **Filtrate Flow** occurs. The customer can set the time of day to coincide with periods of low flow and has the option of performing an **IT** at any time the system is idle or in the **Forward Flow** process. The operator can set the system to "Warn on IT Failure" or "Warn and Shutdown." The operator always has the option of continuing to produce water if the modules fail the **IT**.

4.6 FEED STRAINER BACKWASH (SBW)

The Feed Strainer (STR-2211-01) is a self-cleaning type that requires a backwash at regular intervals to avoid clogging. The strainer backwash cycle can be triggered on time and/or differential pressure. The operator can also manually initiate a backwash whenever the system is running in **Forward Flow (FF)**.

During a feed strainer backwash, the strainer flushes any debris collected on the strainer to drain. Typically, the **SBW** interrupt the supply water feed flow rate (upstream) and the filtrate flow rate (down-stream) for thirty five (35) seconds every twelve (12) hours. The actual process settings vary between water sources and the volume of water being produced.

4.7 ENHANCED FLUX MAINTENANCE (EFM)

The **AS** and **FL** Processes can be enhanced by a regular program of processing with NaOCl or other appropriate solution(s). This automatic process fills the system with the **EFM** additive and circulates the solution for forty five to sixty (45 to 60) minutes. The use of this process can increase the time interval between **CIP** functions. The frequency of this process depends on the incoming water quality and takes approximately one hour.

4.8 CLEAN-IN-PLACE (CIP)

Periodically, cleaning solutions must be used to return the membranes to their original TMP. Typical compounds are NaOCl, caustic solutions, and acid solutions. The required cleaning solution(s) are automatically delivered via the CHN skid and delivered to the AP unit feed tank (TK-2211-01) via the CHN skid pump (PU-2250-80). Automated pumping cycles and durations take place on the AP unit according to operator-entered setpoints. This process takes between two - five hours dependent on circulation times used.

5 RAW WATER & FILTRATE SYSTEM FUNCTIONAL DESCRIPTIONS

5.1 RAW WATER SYSTEM

The Raw Water System draws from the Site Effluent Lagoon(s) and delivers Raw Water to the AP units for treatment. The Raw Water System includes:

- Lagoon Level Indicating Transmitter(s), LIT-2220-01 (& LIT-2220-02);
- Raw water pump(s), PU-2220-01 (& PU-2220-02);
- Raw water rising main instrumentation, including:
    - Pressure Indicating Transmitter (PIT-2220-01);
    - Feed water Turbidity Sensor (AE-2220-01);

The Raw Water Pumps include flexible suction pipework and intake strainer(s) which, on the Boonah and Forest Hill sites, draws water from a single lagoon only. The Kalbar site includes a valving arrangements to select between two (2) effluent lagoons from which to draw Raw Water (with manual relocation of the suction hose and strainer) whilst the Laidley site includes a second Raw Water Pump and suction arrangement.

The Pall Aria™ AP Water Treatment System operates in either one of these modes:

- Effluent Lagoon **Level Control**;
- Constant **Filtrate Flow Control.**

Operation in Effluent Lagoon **Level Control** is the default control mode across all four sites.

5.1.1 RAW WATER PUMP CONTROL

The Raw Water Pump(s) is designed to deliver Raw Water to the on-skid Feed Tanks (TK-2211-01) whilst either AP unit is in forward filtration.

The Raw Water Pumps are started (DOL) if either on-skid Fill Valve (LCV-2211-01) position is greater than min. setpoint. Note open positions (**LCV Min. Position & LCV Open Position**) are an operator setpoint from 0 – 100% of valve output.

The on-skid Fill Valve modulates the feed flow so as to achieve a constant level within the on-skid Feed Tank (**T1 Target Level**) via a PID control loop. Fill Valve will close if the Feed tank reaches High High.

The MF system will pause if the level signal from the lagoon (LIT-2220-01) falls to the level of setpoint **MF PAUSE LEVEL**, after 10 seconds. Once the lagoon level rises to the level of setpoint **MF RESUME LEVEL** for 10 seconds, filtration will be resumed.

Raw Water Pump delivery has additional protection from the Raw Water Pressure Transmitter (PIT-2220-01) with system shutdown on high high pressure alarm and an operator warning will be raised for a low feed pressure.

5.2 FILTRATE SYSTEM

At the Boonah site only, MF System will pause if the level within the Filtrate Tank reaches high high set-point, as measured by the Filtrate Tank Level Transmitter. Once the tank level drops to the resume level for 10 seconds, filtration will be resumed. This Pause function will be overridden on High High within the Effluent Lagoon (i.e. controlled discharge from Filtrate Tank rather than overflowing the lagoon).

Downstream tank level signals are not available at Kalbar, Laidley and Forest Hill and this functionality is not included at these sites.

6 THE PALL ARIA™ AP WATER TREATMENT SYSTEM FUNCTIONAL DECRIPTION

6.1 INTRODUCTION

The Pall Aria™ AP Water Treatment System is at the heart of a complete water treatment process. It is important to consider each unit of operation of the process to ensure proper function of the Pall Aria™ AP Water Treatment System.

6.2 PALL ARIA™ AP STANDARD CONTROL TYPES

The Pall Aria™ AP Water Treatment System skid utilises custom-designed Pall Microza® Microfiltration System software to operate in either one of these modes:

- Constant **Filtrate Flow Control**
- Constant Lagoon **Level Control**

In **Filtrate Flow Control**, the Pall Aria™ AP system takes the operator setpoint of **CONSTANT FLOWRATE** from the **Operator Process Setpoints Screen**. The filtration skid takes this flow setpoint and adjusts the skid's Recirculation Pump VFD to maintain the flow demand.

Operation in **Level Control** is based on the raw water lagoon level (as measured by LIT-2220-01). In this control mode, the Pall Aria™ AP system takes the setpoint **TARGET LEVEL** from the **Raw Water Setpoints Screen** to generate a flow reference for the skid. A PID loop controls the flow

through the skid by varying the position of the feed Level Control Valve (LCV-2211-1) to maintain the level setpoint in the lagoon.

Refer to the Section 6.7 "System Startup" for more information on selecting the Pall Aria™ Water Treatment System control types.

6.3 SYSTEM CONTROL COMPONENTS

6.3.1 HARDWARE

This Pall Aria™ Water Treatment System uses the main control panel's (MCP) Allen-Bradley® VersaView™ operator interface terminal (OIT) mounted on the door for control. The skid control panels contain an Allen-Bradley® CompactLogix PLC.

Throughout this manual, OIT refers to the VersaView™ Software

The Pall Aria™ Water Treatment System application software uses a Human Machine Interface (HMI) that contains menus, functional screens, and a flow diagram to provide the information needed to monitor and operate the system.

Pall Corporation requires that individuals assigned to operate and maintain this equipment be trained technicians with basic skills. In making this requirement, Pall assumes these individuals possess some knowledge of computerised machinery. This software package **DOES NOT** include online Help menus.

CAUTION

All Pall Aria™ AP Water Treatment System operators must be trained by Pall Corporation or someone authorised by Pall Corporation. Any damage to the Pall Aria™ system or its components caused by an untrained operator voids all warranties.

6.4 PALL ARIA™ SKID CONTROL MODES

There are three (3) modes for the skid: **Auto**, **Manual**, and **Disable**. Operators can change modes from the **Skid Control Screen**. Access to this screen is by clicking the AP Skid Control button on any HMI screen it appears.

6.4.1 AUTO MODE

Auto Mode is the normal operating and preferred mode. It allows the skid to perform various processes automatically after the operator has selected them.

6.4.2 MANUAL MODE

In **Manual** Mode, the operator has control of all pumps and actuated valves. The operator can adjust speeds as required.

CAUTION

In Manual Mode, the operator has control of all pumps and actuated valves. The operator can adjust speeds as required if logged into the system with appropriate level password security.

Manual Mode operation presents a risk as it overrides all of the automatic equipment functions and can adversely alter the process and its results.

Only personnel trained by Pall Corporation or someone authorised by Pall Corporation may operate the Pall Aria™ Water Treatment System in Manual Mode. The operator assumes full responsibility for the result of all actions taken in Manual Mode.

6.4.3 DISABLE MODE

When the skid is disabled, the skid does not respond to any operator control. **Disable** Mode is not intended for use except as a safe condition for maintenance operations.

6.5 OIT DESIGN FEATURES AND CHARACTERISTICS

The Pall Aria™ Water Treatment System filtration skid OIT has an integrated keypad for operator input.

The various functional buttons displayed on each OIT HMI screen allow the operator to quickly move from one area of the software to another. In addition, the intuitively designed software allows the operator to understand what is happening within the system at any time. This includes color-coding so that the operator can easily observe the status of the valves, pumps, instruments, and other devices.

6.5.1 VIEWING THE PROCESS ON GRAPHICS SCREENS

From any Graphics Screen, the operator can observe the position of valves, the status of pumps and other devices, tank levels, and the flow of fluids.

Color-coding on the graphics screens are as follows:

- Green highlighting indicates when valves are open and pumps are running;
- Red indicates that the valves are closed and pumps stopped;
- Blinking Yellow/Red indicates active alarm condition is present.

6.5.2 MANUAL CONTROL AND SETPOINT SCREENS

The Pall Aria™ Water Treatment System HMI contains operator and engineer adjustable setpoints screens and a device manual control screen (only available when the Pall Aria™ AP system is in **Manual** Mode).

On the various **Setpoints Screens**, a valid security login determines an operator's ability to change operator or engineer setpoints. For example, operators are only able to change engineer setpoints if their login password is of the engineer security level.

The setpoints displayed on the screen examples in this document are for reference only. Actual system setpoints are described in Section 7.

CAUTION

Pall Corporation is not responsible for the consequences of operators altering system parameters without direct input from Pall Technology Services Engineers. Operators are solely responsible for results occurring from operating in Manual Mode and modifying system settings on their own initiative. For information or assistance, contact Pall Technology Services.

6.6 SELECTING THE PALL ARIA™ SKID MODES

Pall Corporation recommends that operators initially review this section while working live with the operator interface monitor/terminal and the system software.

Please note that the following SCADA screen shots are for a typical plant only, refer document "A090-0402-001: QUU Screen Shots" for project specific SCADA screens.

6.6.1 SELECTING AUTO MODE

On the OIT **AP Skid Control Screen** the operator clicks on the Skid Object to enable to the Rack Control popup.

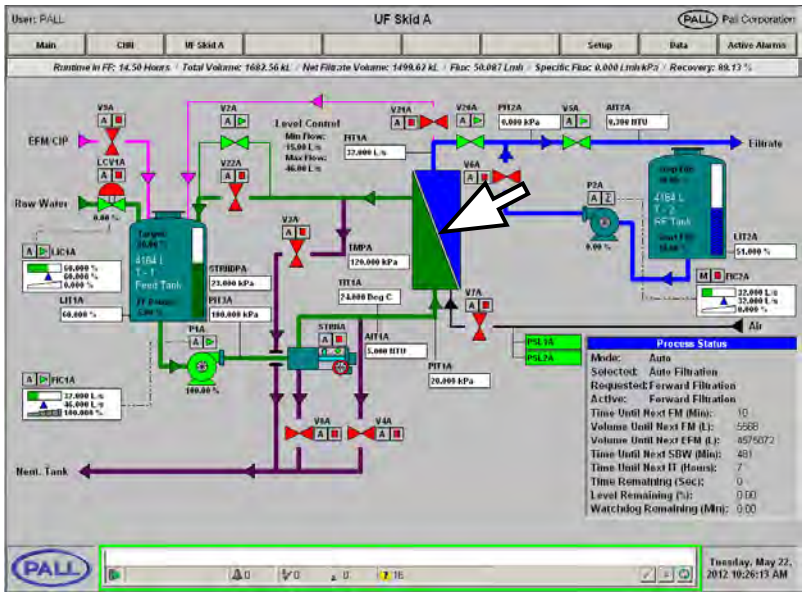


Figure 5.1 - SELECTING MF SKID A CONTROL SCREEN

To select automatic operation the Auto button (refer Figure 5.1) is selected. The Skid Mode displays "Skid Mode Auto".

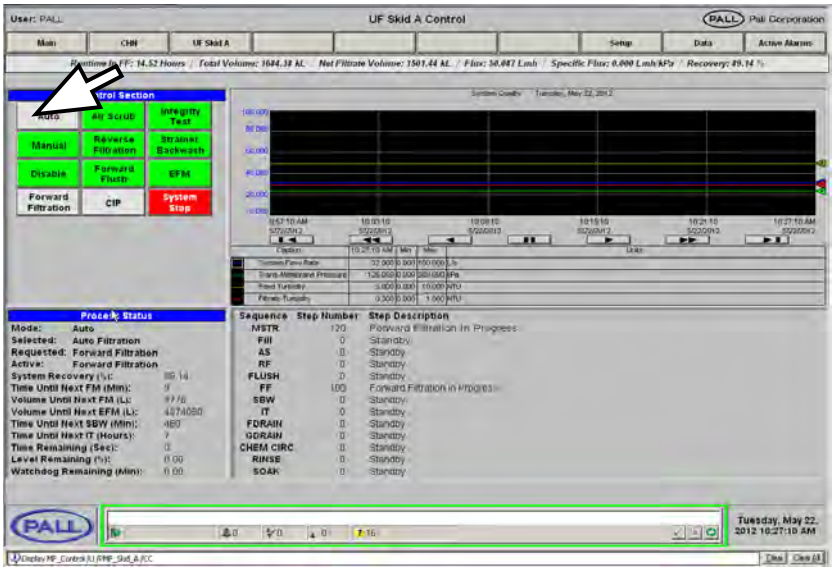


Figure 5.2 - MF SKID CONTROL SCREEN

There are three (3) modes for the CHN Skid: **Auto**, **Manual**, and **Disable**. Operators can change mode for the CHN Skid from the **CHN System Screen**. Access to this screen is by clicking the CHN button from any screen.

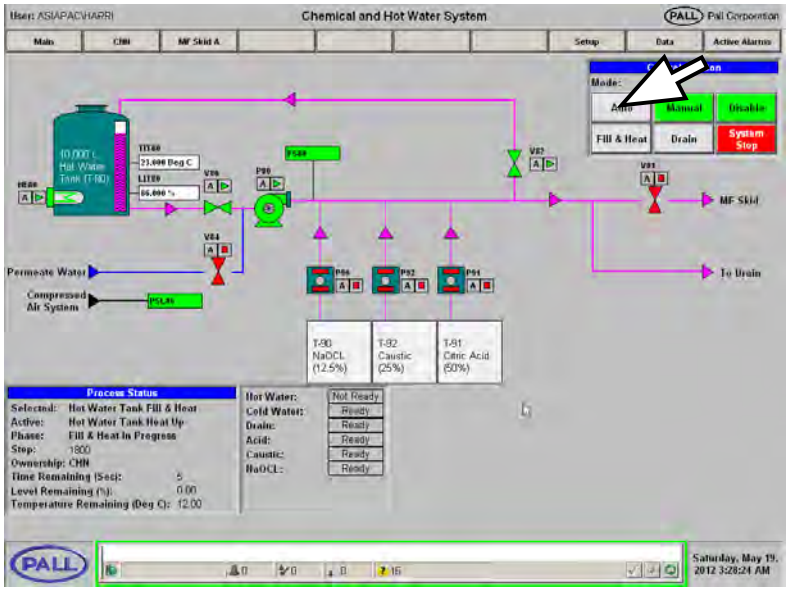


Figure 5.3 - SELECTING AUTO MODE ON THE CHN SCREEN

6.6.2 SELECTING MANUAL MODE

On the OIT **AP Skid Control Screen** the operator presses the Manual button (Figure 5.2). The Skid Mode displays "Skid Mode Manual".

When the system is in **Manual** Mode, the operator **MUST** control all of the system operations and automated components manually.

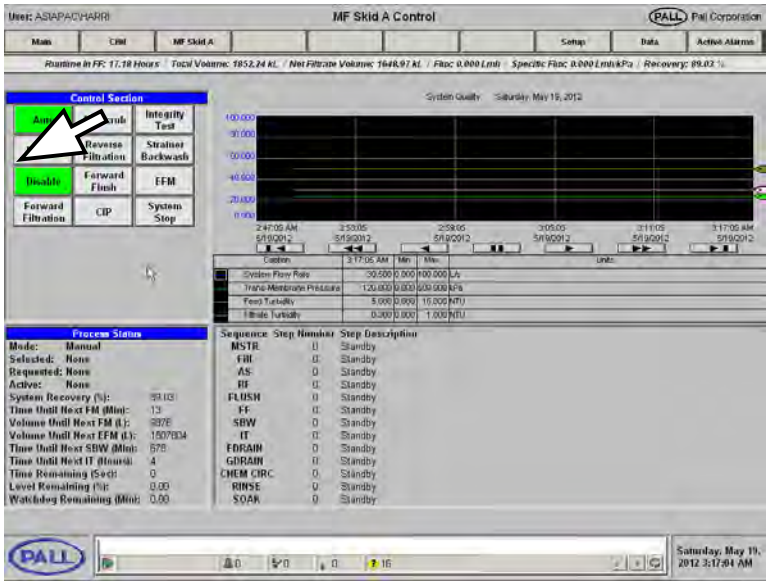


Figure 5.2 – Selecting Manual Mode On the OIT AP Skid Control or PC Skid Control Screen

CAUTION

In Manual Mode, the operator has control of all pumps and actuated valves. The operator can adjust speeds as required if logged into the system with appropriate level password security.

Only operators trained by Pall Corporation or someone authorised by Pall Corporation may operate the Pall Aria™ Water Treatment System in Manual Mode.

As Manual Mode overrides all of the automatic equipment functions and can adversely alter the process and its results, operators assume full responsibility for the consequence of all actions taken when operating in Manual Mode.

6.7 SYSTEM STARTUP

Using the on-skid OIT VersaView™ is the recommended method for setting up the Pall Aria™ AP system for operation, for that reason the descriptions in this section contain screen examples from the on-skid control panel mounted VersaView™ only.

6.7.1 SELECTING A SYSTEM CONTROL TYPE

System setpoints referred to in the following descriptions are located in charts in Section 7 of this document.

6.7.1.1 SELECTING FEED LEVEL CONTROL

Firstly the operator navigates to the **Master Operator Setpoint Screen** (Figure 5.3) by clicking the Master Operator Setpoint button on the **Setup Screen**.

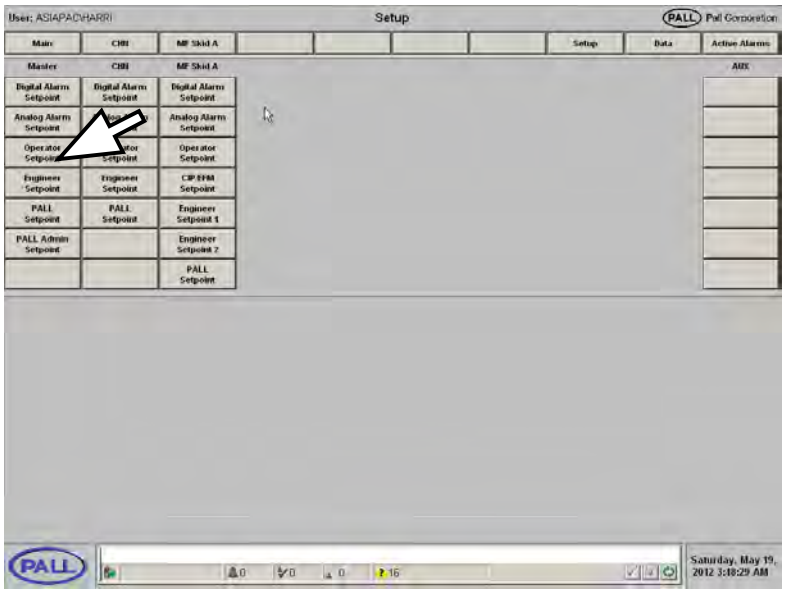


Figure 5.3 – Setup Screen

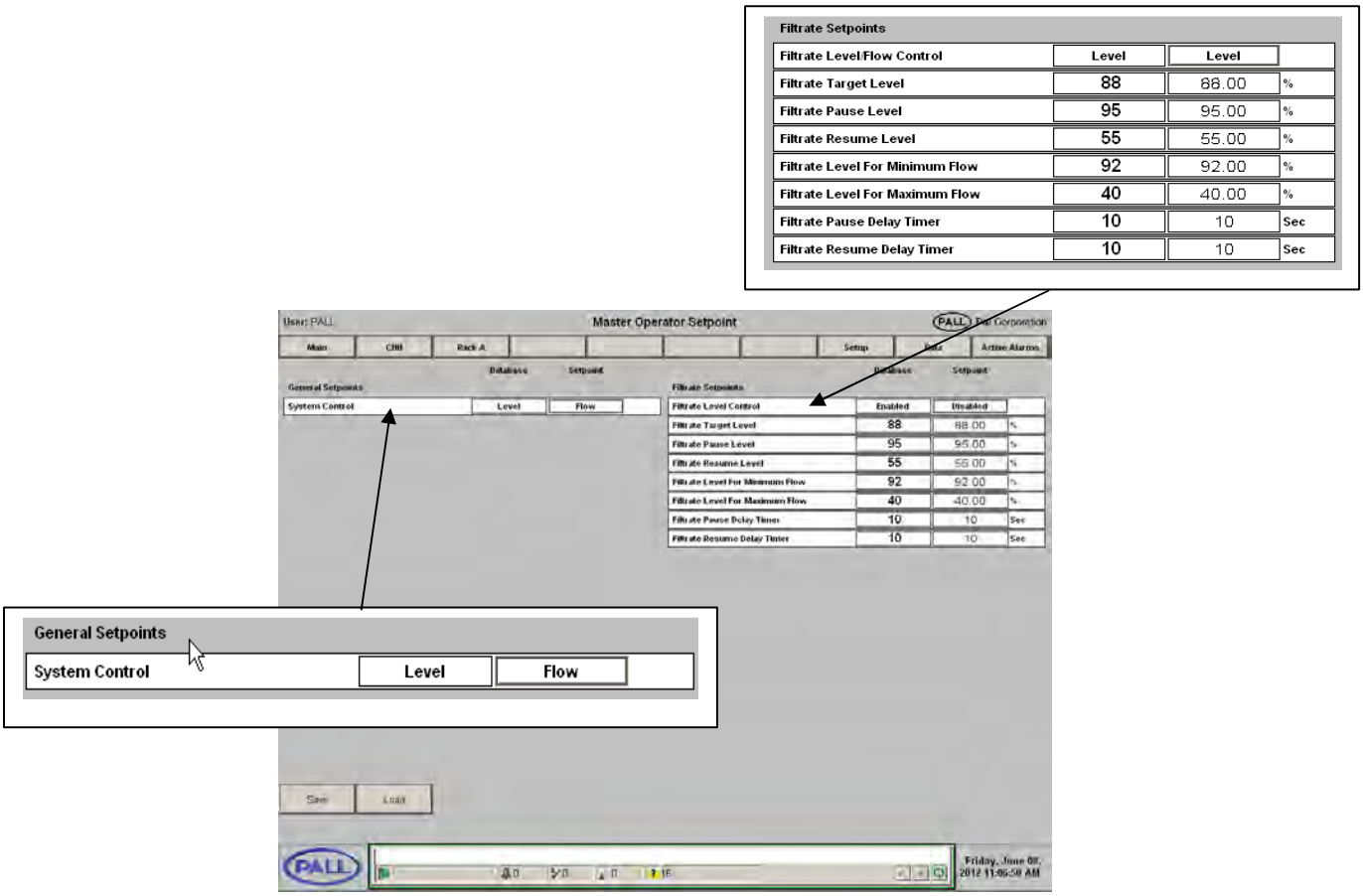


Figure 5.4 – Master Operator Setpoints Screen

If required the Feed Level Control setpoint should be clicked to toggle the selection from Disabled to Enabled.

If required the System Control setpoint should be clicked to toggle the selection from Flow to Level.

The operator can also change the other setpoints as required. Setpoints must be verified prior to initiating a filtration process in **Feed Level Control**.

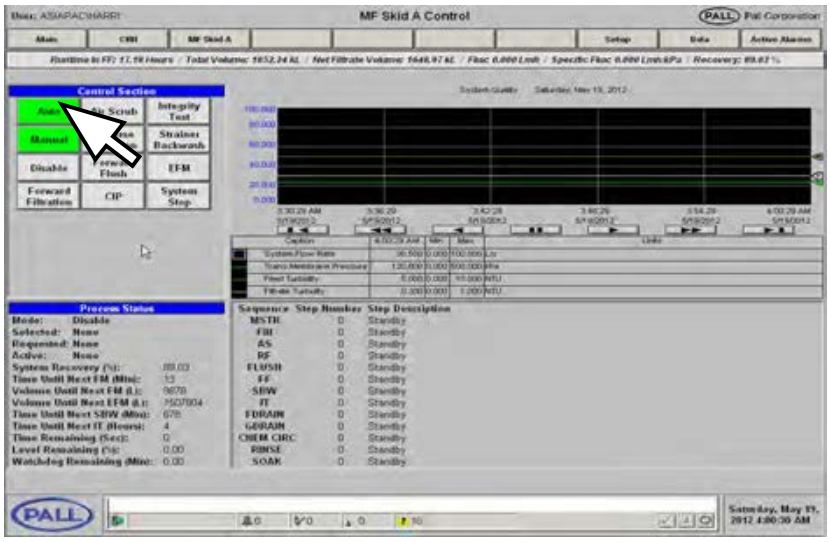
Once settings have been completed it is recommended the operator uses the Save button to store the setpoints to database.

6.7.1.2 INITIATING AUTO FILTER IN FEED LEVEL CONTROL

After placing the skid in **Feed Level Control** and inputting the required Setpoints:

1. The operator accesses the **Skid Control Screen** (Figure 5.6).

2. Select Auto Mode.



3. Press the Forward Filtration button.

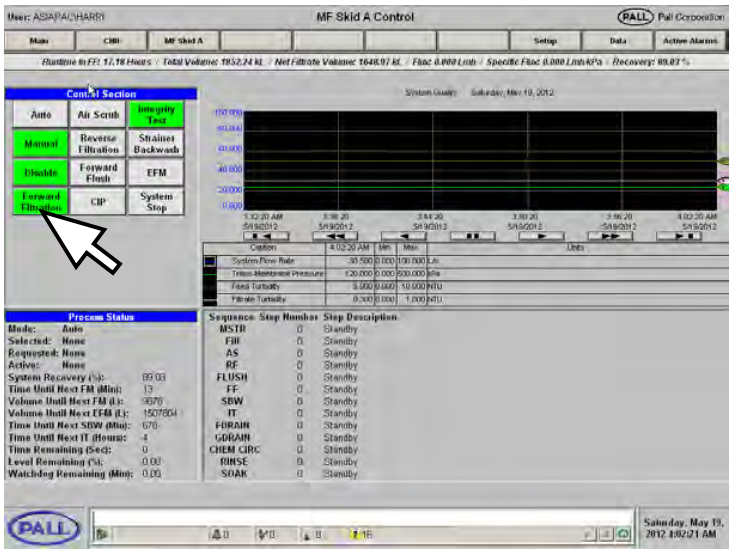


Figure 5.6 – AP Skid Control and Start Confirmation Screens

4. After pressing the Forward Filtration button, the start confirmation screen appears (Figure 5.6).

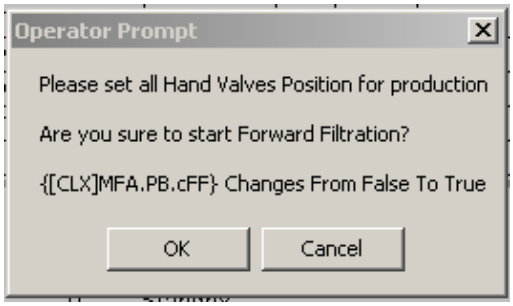


Figure 5.6 – AP Skid Control Start Confirmation Screens

Once the OK button is pressed, the skid will fill the feed tank to the Feed Tank Level Setpoint target. If the Feed Tank is not at that level already, the system proceeds to the **Fill** Process. The system then operates to maintain the lagoon at the **LAGOON TARGET LEVEL**.

6.7.1.3 SELECTING FILTRATE FLOW CONTROL

Firstly the operator navigates to the **Master Operator Setpoints Screen** (Figure 5.3) by clicking the Operator Setpoints button on the **Setup Screen**.

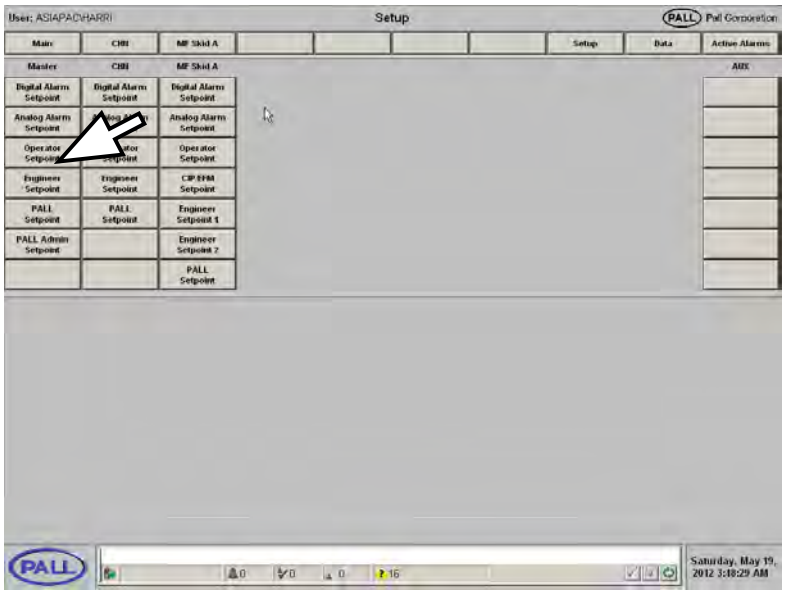


Figure 5.4 – Operator Setpoints Screen

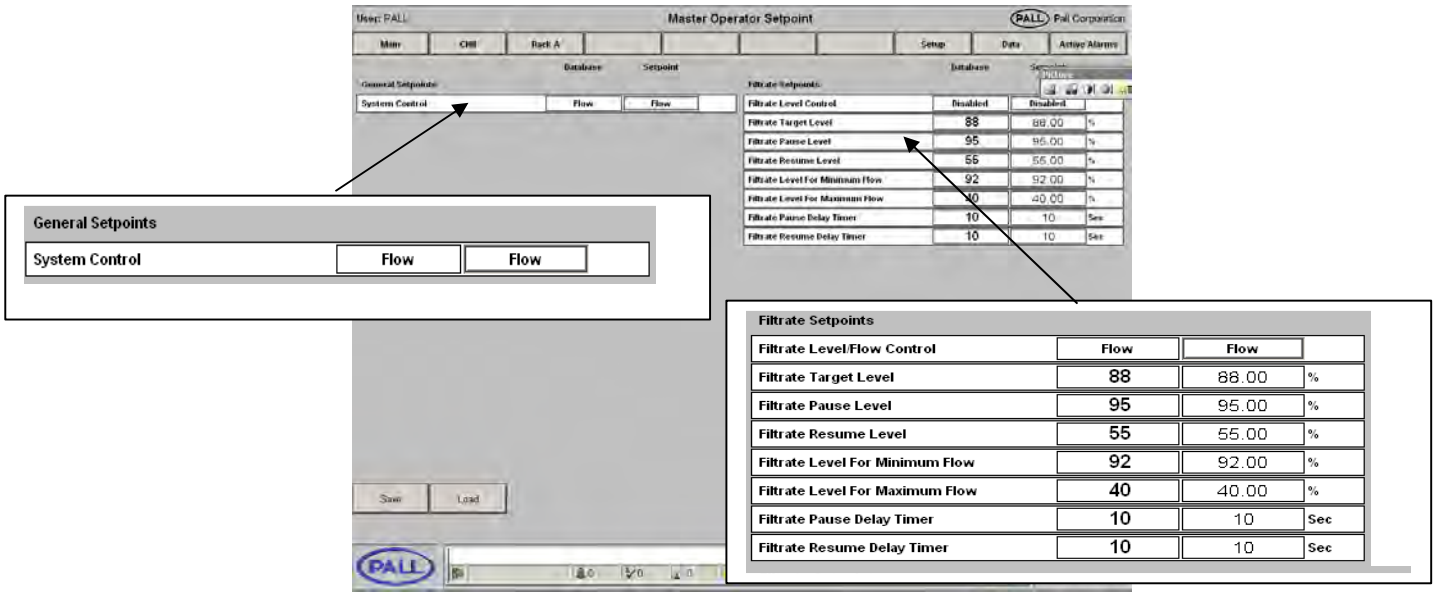


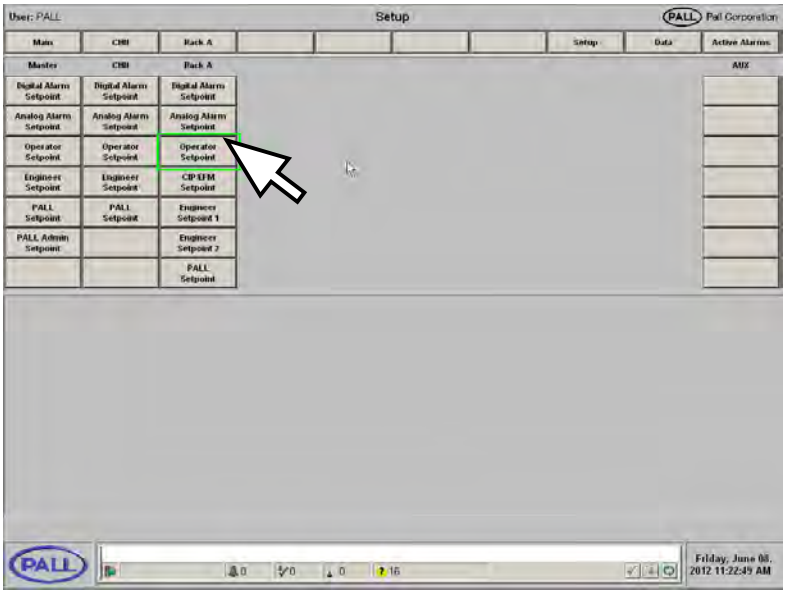
Figure 5.3 – Master Operator Setpoints Screen

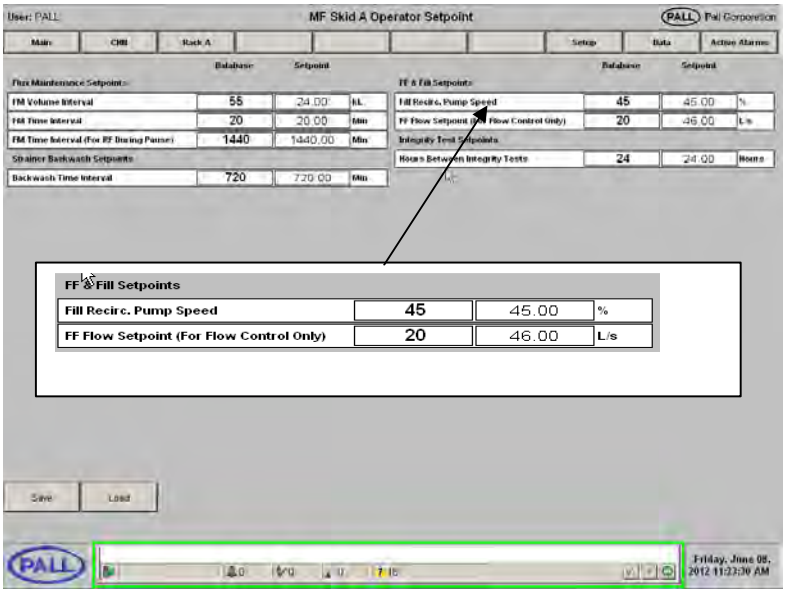
If required the Feed Level Control setpoint should be clicked to toggle the selection from Enabled to Disabled.

If required the System Control setpoint should be clicked to toggle the selection from Flow to Level.

Once settings have been completed the operator has the option of pressing the Save button to store the setpoints to database.

The operator can also change the FF Flow Setpoint. This setpoint must be set prior to initiating a filtration process in **Flow Control**. The FF Flow setpoint is set individually for each rack under the Operator Setpoints page.



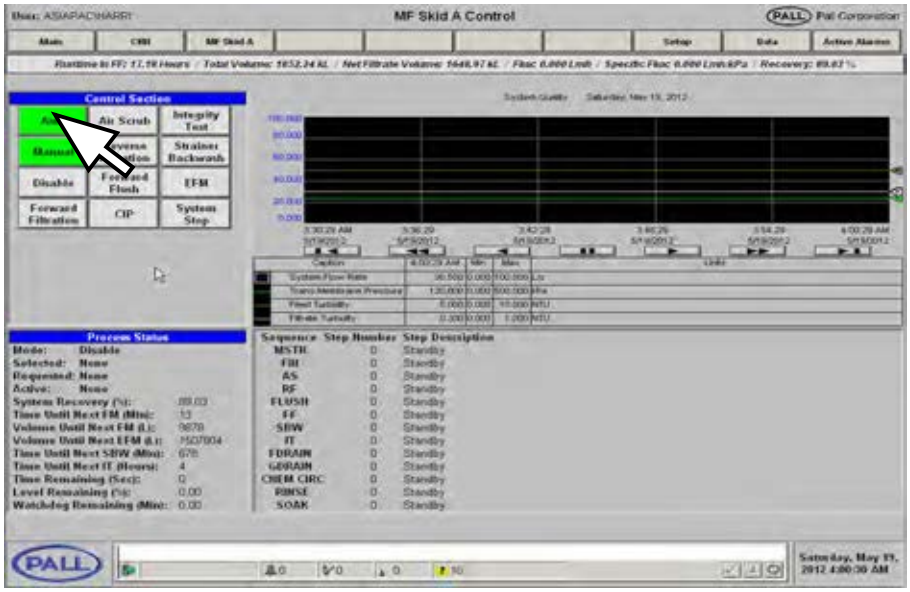


Once settings have been completed the operator has the option of pressing the Save button to store the setpoints to database.

6.7.1.4 INITIATING AN AUTO FILTER IN FILTRATE FLOW CONTROL

After placing the skid in **Feed Tank Flow Control** and inputting the required Setpoints:

1. The operator accesses the **Skid Control Screen**.
2. Select Auto Mode.



3. Press the Forward Filtration button.

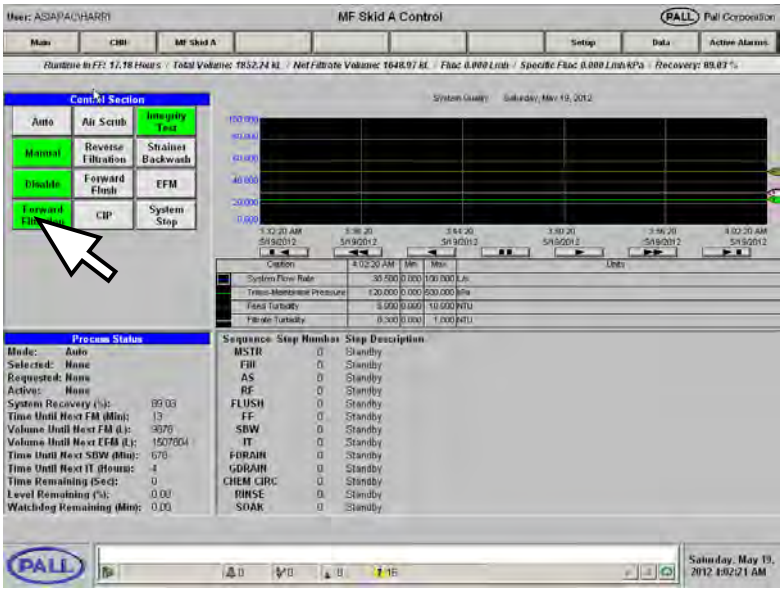


Figure 5.6 – AP Skid Control and Start Confirmation Screens

4. After pressing the Forward Filtration button, the start confirmation screen appears (Figure 5.6).

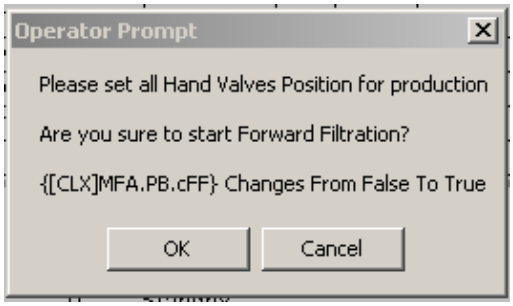


Figure 5.6 – AP Skid Control and Start Confirmation Screens

Once the Confirmed Valves button is pressed, the skid will fill feed tank TK-2211-01 to the Feed Tank Level Setpoint **TARGET**. If TK-2211-01 is not at that level already, the system proceeds to the **Fill** Process. The system then operates to maintain the **CONSTANT FLOWRATE** Setpoint.

6.8 FILL PROCESS

The **Fill** Process purges any air from the system on startup and after an **Integrity Test** (**IT**). If the Feed Tank (TK-2211-01) level is at or above the level governed by Feed Tank Level setpoint **TARGET**, VLV-2211-02 and VLV-2211-05 open and the Recirculation Pump (PU-2211-01) starts and runs at a speed governed by **PUMP PU-2211-01 FILL SPEED**. When FIT-2211-01 reads above the Skid Flowrate setpoint ***MINIMUM*** continuously for ten (10) seconds, the AP system assumes that the piping is full and the system proceeds to the **Forward Flow** Process. A watchdog timer on the **Fill** Process shuts down the Pall Aria™ Water Treatment System if FIT-2211-01 is not satisfied within ninety (90) seconds. This condition typically indicates that either a hand valve is in the wrong position (HV-2211-2,4 or 21) or the **PUMP PU-2211-01 FILL SPEED** is set too low.

6.9 FORWARD FLOW

When the **Fill** Process is complete, the system automatically initiates the **Forward Flow (FF)** Process. During **Forward Flow**, a PID controls the flow through the skid by varying the speed of PU-2211-01. VLV-2211-05 is open during **Forward Flow**.

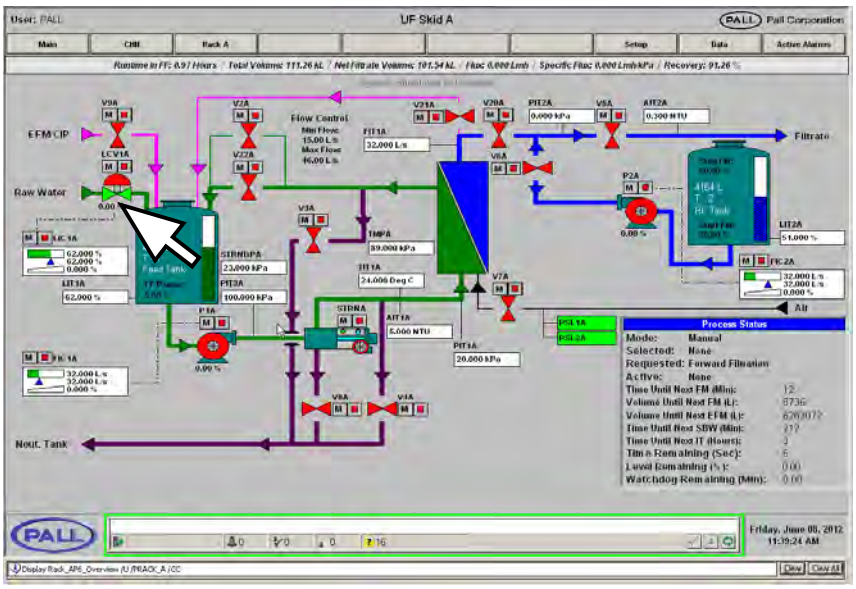
If feed turbidity levels are above **Feed Turbidity High,** the XR valve (VLV-2211-02) opens. This allows the feed flow to be recirculated through the MF module back to the feed tank. The designation for this flow is Excess Recirculation (XR). The constant flow fitting located on the XR line, which is factory set, controls this flow.

Table 5.4 – Typical XR Flow

AP System	Constant Flow Fitting (CFF)
AP2	0.3 L/s
AP3	1 L/s

6.10 ON-SKID FEED TANK LEVEL

When the level in TK-2211-01 is at or below a high tank level alarm setpoint and the operator has pressed the system Auto Filter button, the TK-2211-01 level control PID loop modulates the level control valve (LCV-2211-01) as required to maintain a tank level setpoint. When the system is not in **Auto Filter** or TK-2211-01 has a high level alarm, the level control valve closes. The operator can still operate the valve manually through the HMI **Skid Manual Control Screen** after switching to **Manual** Mode.



The valve position can be entered manually to desired location. Clicking on the Full Open or Full Close buttons will force the valve fully open or fully closed.

6.11 PAUSE

While operating in **Auto Filter** Mode, the system can be paused. **Pause** means that the actuated valves close, the Raw Water Pump(s) and the Recirculation Pump(s) PU-2211-01 are turned off. The Pall Aria™ AP system automatically restarts after the pause condition is lifted.

Flux Maintenance evolutions do not occur when the system is in **Pause**.

The following events trigger a skid pause:

- Feed tank TK-2211-01 level falls below the setpoint governed by **PU-2211-01 DISABLE LEVEL**.
- The Raw Water Lagoon level (LIT-2220-01) falls below the Raw Water Micro-Filtration setpoint **MF PAUSE LEVEL**

6.12 RF TANK LEVEL

While in the **Forward Flow (FF)** Process, a portion of the filtrate flow is directed through the RF automated valve, VLV-2211-06, into the reverse filtration tank TK-2211-02. When TK-2211-02 level reaches the RF Tank Setpoint ***STOP FILL LEVEL***, VLV-2211-06 closes and TK-2211-02 stops filling.

6.13 FLUX MAINTENANCE (FM)

The **Flux Maintenance (FM)** Processes are used to remove loose contaminants from the filter media to keep the transmembrane pressure (TMP) from rising too rapidly. During an FM all backwash waste is returned to the site effluent Lagoon via the RF/AS Drain valve VLV-2211-61.

- Boonah: lagoon 1
- Kalbar: lagoon 1
- Laidley: lagoon 1&2
- Forest Hill: lagoon 2

There are three (3) **Flux Maintenance** Processes:

- Air Scrub (AS)
- Feed Flush (FL)
- Reverse Filtration (RF)

Flux Maintenance evolutions are automatically initiated based on volume processed or skid filtering time, both of which are adjustable **FM** setpoints (**FM INTERVAL VOLUME** and **FM INTERVAL TIME**).

While in **Forward Flow,** the skid totalises volume produced and the time to determine when an **FM** evolution should occur. When either the skid has processed the FM interval volume or been filtering for a given period of time, an **FM** evolution occurs. Firstly, an **Air Scrub (AS)** is initiated, followed by either a **Reverse Filtration (RF)** or **Forward Flush (FL)**. An operator setpoint determines which process follows the **AS**.

Flux Maintenance evolutions can also be manually initiated by the operator while in **Forward Flow**.

6.13.1 AIR SCRUB (AS)

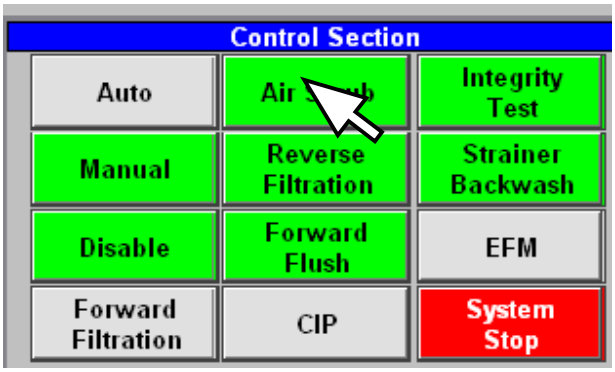
During the **AS** Process, valves VLV-2211-03, VLV-2211-06, VLV-1012-07A and VLV-2211-61A open and air is introduced into the feed side of the Microza® modules.

While air is introduced into the feed side of the modules, PU-2211-02 forces filtrate water from TK-2211-02 through the modules in the reverse direction. A PID loop controls the flow through the skid by varying the speed of PU-2211-02. The water flow rate for **Air Scrub** is governed by the setpoint **AIR SCRUB FLOWRATE**.

The **Air Scrub** Process time is governed by the setpoint **AIR SCRUB DURATION**.

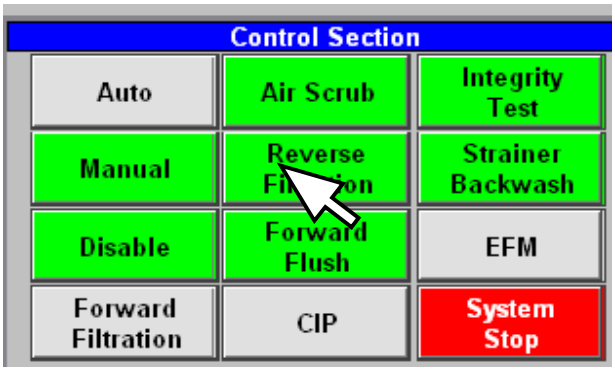
Refer to the Air Scrub Flowmeter Setting (FI-1012-2A) chart in Section 7.

The operator can initiate an **Air Scrub (AS)** Process any time the system is in the **Forward Flow (FF)** Process by pressing the Air Scrub button on the **Skid Control Screen**.



6.13.2 REVERSE FILTRATION (RF)

In special circumstances, the operator can initiate a **Reverse Filtration (RF)** any time the system is in the **Forward Flow** Process by pressing the Reverse Filtration button on the **Skid Control Screen**.



If selected, a **Reverse Filtration** (**RF**) process automatically occurs after an **Air Scrub** and always occurs after a **CIP** Process is completed.

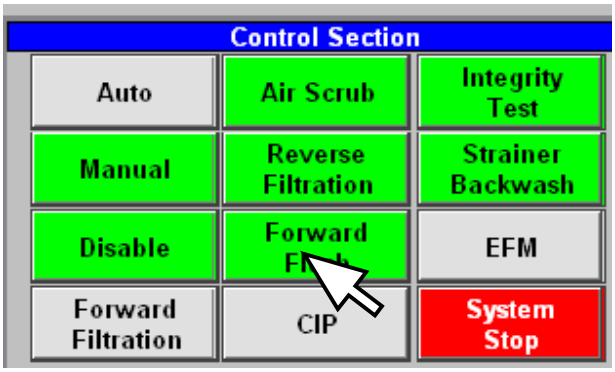
During **RF**, valves VLV-2211-03, VLV-2211-04 and VLV-2211-61 open and PU-2211-02 directs filtrate from through the modules in the reverse direction. A PID controls the flow through the skid by varying the speed of PU-2211-02. The flow rate for **Reverse Filtration** is governed by the setpoint **RF FLOWRATE**.

The **Reverse Filtration** Process time is governed by the setpoint **RF DURATION**.

If there is more than one MF skid operational, the Reverse Filtration Process will only occur on one of the AP skids at a time with a waiting period of 2 minutes in between the RF process for the next skid.

6.13.3 FORWARD FLUSH (FL)

The operator can initiate a **Forward Flush (FL)** any time the system is in the **Forward Flow** process by pressing the Flush button on the **Skid Control Screen**.



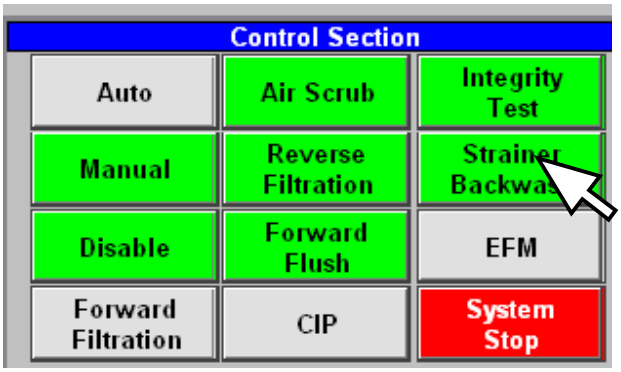
In place of an **RF** after an **AS**, a **Forward Flush** is used to rid the module of any air and debris remaining after the **AS** is complete.

During **Forward Flush** VLV-2211-03 and VLV-2211-61 opens and PU-2211-01 runs at a speed governed by the setpoint **FLUSH PUMP SPEED**.

The **Forward Flush** Process time is governed by the setpoint **FLUSH DURATION**.

6.14 FEED STRAINER BACKWASH (SBW)

The Feed Strainer, STR-2211-01, is a self-cleaning type that requires a backwash at regular intervals to avoid clogging. Determination of the timing for a strainer backwash is governed by the setpoint **STRAINER BACKWASH INTERVAL**. In addition, a high differential pressure **STRAINER BACKWASH DIF PRESS** will cause a backwash. The operator can also manually initiate a backwash whenever the system is running in **Forward Flow** by selecting the Strainer Backwash button on the **Skid Control Screen**.



During a **Feed Strainer Backwash** VLV-2211-05 closes and VLV-2211-02 opens. PU-2211-01 will run at a speed governed by the setpoint **STRAINER BACKWASH PUMP SPEED**. After a pressure build delay (**hardcoded setpoint**), SV-1 Closes and the strainer is backwashed for a set time. The number of strainer backwashes completed is compared to the setpoint **NO. OF CYCLES**. If the number of strainer backwashes completed is less than the setpoint of **NO. OF CYCLES**, then the skid performs another Strainer Backwash as described above. If the number of strainer backwashes completed is greater than or equal to the setpoint of **NO. OF CYCLES,** SV-1 opens and VLV-2211-05 opens and the skid returns to **Forward Flow.**

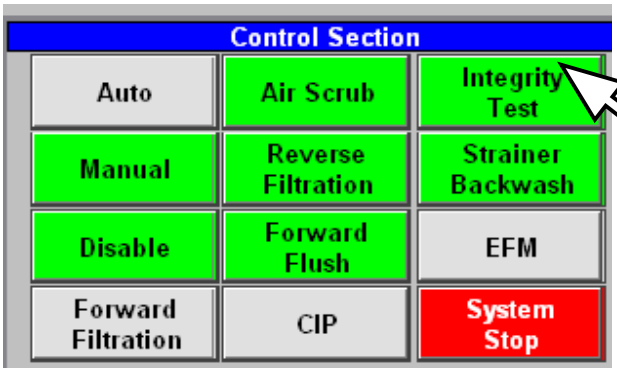
AP System	Rate	Total
AP2	2.52 L/s	75.7liters
AP3	4.2 L/s	42.1liters

TABLE 5.5 – TYPICAL FEED STRAINER BACKWASH VALUES

6.15 INTEGRITY TEST (IT)

The Pall Aria™ Water Treatment System initiates an **Integrity Test (IT)** automatically as governed by the **IT** setpoint **TIME BETWEEN INTEGRITY TESTS**.

The operator can manually initiate an **Integrity Test** at any time, so long as the system is in **Auto** Mode and the skid is not busy with other processes except for **Forward Flow**. To initiate an **IT,** access the **AP Skid Control Screen** and then press the Integrity Test button.



The operator can set the action to either return to **Forward Flow** or shutdown on an **IT** failure. QUU WWTP should be placed back into Forward Flow and alarm on IT failure.

Part One – Module Water Removal

The first part of the **Integrity Test** removes the water from the feed side of the modules. This is done by opening VLV-2211-05 and VLV-1012-07. Air is introduced into the feed side of the modules through valve VLV-1012-07. This action pushes the water to the filtrate manifold through valve VLV-2211-05. When the feed side of the modules has stayed above a pressure governed by **IT** setpoint ***MINIMUM TEST PRESSURE*** for a time, governed by a **hardcode setpoint of thirty (30) seconds,** VLV-2211-05 closes and VLV-2211-06 opens.

Part Two – Feed Pressure Stabilisation

The second part of the **Integrity Test** checks for feed pressure stabilisation. First, the feed side pressure is captured. After a time delay (**IT** setpoint ***STABLE TIME***), the current feed side pressure is compared to the captured value. If the differential of these two pressures is greater than the **Integrity Test** alarm setpoint of **IT DECAY HI**, the check will be performed again. If the differential is less than **IT DECAY HI**, the pressure has stabilised and VLV-1012-07 closes.

Part Three – Settling Time

The third part of the **Integrity Test** is a settling time. When VLV-1012-07 closes, the feed side pressure capture for the test is delayed for a time governed by a **hardcode setpoint of thirty (30) seconds**.

Part Four – Actual Membrane Test

The fourth part of the **Integrity Test** is the actual membrane test. At the beginning of the testing phase, the feed side pressure is captured to the **INTEGRITY TEST START PRESSURE**. During the testing phase, the current feed side pressure (**INTEGRITY TEST TEST PRESSURE**) is constantly subtracted from the **INTEGRITY TEST START PRESSURE** and stored as **INTEGRITY TEST PRESSURE CHANGE**.

The **Integrity Test** cycle time is governed by the **IT** setpoint ***CYCLE TIME***.

Part Five – Depressurisation Phase

The fifth part of the **Integrity Test** is the depressurisation phase. Valves VLV-2211-03, VLV-2211-04 and VLV-2211-61 open for a time governed by the **IT** setpoint of ***DEPRESSURISE TIME***. When this time expires, VLV-2211-03, VLV-2211-04 and VLV-2211-61 close. After a delay time

(**hardcoded setpoint of fifteen (15) seconds**), the feed pressure is compared to the **IT** setpoint ***DEPRESSURISE PRESSURE*** to see if the skid is depressurised.

If the feed side pressure is greater than this setpoint, the skid performs the depressurisation again. If the feed side pressure is less than or equal to the setpoint ***DEPRESSURISE PRESSURE***, the **INTEGRITY TEST PRESSURE CHANGE** value is compared to two (2) adjustable alarm setpoints. If the **INTEGRITY TEST PRESSURE CHANGE** value is greater than the **IT** alarm setpoint **IT DECAY HI**, that alarm is generated. If the **INTEGRITY TEST PRESSURE CHANGE** value is greater than the **IT** alarm setpoint **IT DECAY HIHI**, that alarm is generated.

When the **Integrity Test** is complete, the skid performs the **Fill** Process.

After the **Fill** Process is complete, the Pall Aria™ AP system shuts down if the skid is selected to shut down on IT Failure (a selection on **Engineer Setpoints Screen 1**). If the skid is not selected to shut down on IT failure, the skid moves to the **Forward Flow** Process.

6.15.1 INTEGRITY TEST FAILURE FOLLOW-UP

6.15.1.1 INITIAL CONDITIONS

- The Pall Aria™ Water Treatment System control is on and the HMI is active.
- The completion of an **Integrity Test** has taken place and the loss of test pressure was greater than the setpoint established for acceptable performance.

6.15.1.2 OPERATOR INSTRUCTIONS

1. In the event that a module may be removed from the rack during this procedure, confirm that either a spare microfiltration module or 2-inch (5.08-centimeter) grooved pipe clamp, caps and couplings are available.
2. Prepare to initiate another **Integrity Test**. From the **Skid Control** screen, press the Integrity Test button.
3. While the second **Integrity Test** is underway, closely observe the transparent TP joint coupling (see Figure 5.9) at the top of each module. If the integrity of a module has been lost, small bubbles appear in the clear coupling.
4. If the operator identifies a module in need of repair, the operator can perform either of the following steps:
    a. Fix the defective module while in place on the system.
    b. Remove and replace the defective module.

5. If repairing the module in place or its removal is necessary, follow the instructions in the Maintenance Section of the Pall Aria™ Operation and Maintenance manual.
6. If removal of the damaged module is necessary and no replacement is available, remove the module and tightly cap all rack fittings to the module. Leave the rack with one less module. Contact Pall Technology Services immediately for assistance.
7. When the repair or replacement of the damaged module is complete, follow the standard procedure for system restart on page 33.

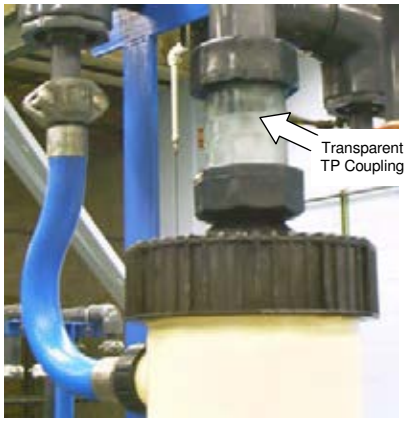


FIGURE 5.9 – THE TRANSPARENT TP JOINT COUPLING

6.16 DRAIN (DRN)

A **Drain** can be initiated by a **CIP** or **EFM** Process. This routine drains the AP skid back to the Effluent Lagoon:

- Boonah: lagoon 1
- Kalbar: lagoon 1
- Laidley: lagoon 1&2
- Forest Hill: lagoon 2

Valves VLV-2211-02, VLV-2211-03, VLV-2211-04 and VLV-2211-61 open. This allows the AP skid to drain to an external drainage network. The drain sequence commences with a forced drain using PU-2211-1 running at a fixed speed (**P1 SPEED DURING DRAIN).**

When TK-2211-01 reaches a level governed by the setpoint **PUMP DISABLE LEVEL,** PU-2211-1 continues to run for an additional forced drain time (**FORCED DRAIN TIME**) before stopping.

Valves VLV-2211-02, VLV-2211-03, VLV-2211-04 and VLV-2211-61 remain open for an additional drain time (**GRAVITY DRAIN TIME**) before closing.

6.17 NEUTRALISATION DRAIN (NEUT-DRN)

A **Neutralisation Drain** is generally initiated at the end of **CIP** or **EFM** Process. This routine drains the AP skid to the CIP/neutralisation tank (TK-2250-80) to allow chemical neutralisation.

Valves VLV-2211-02, VLV-2211-03, VLV-2211-04 and VLV-2211-60 open, and CIP skid valves VLV-2250-84 and VLV-2250-82 open. CHN Pump PU-2250-80 is started. The contents of TK-2211-01 on the rack and the membranes are transferred to TK-2250-80.

When loss of flow is detected by FS-2290-80 or Neutralisation Drain Time expires, PU-2250-80 stops and valves, VLV-2211-02, VLV-2211-03, VLV-2211-04, VLV-2211-60, VLV-2250-84 and VLV-2250-82 close.

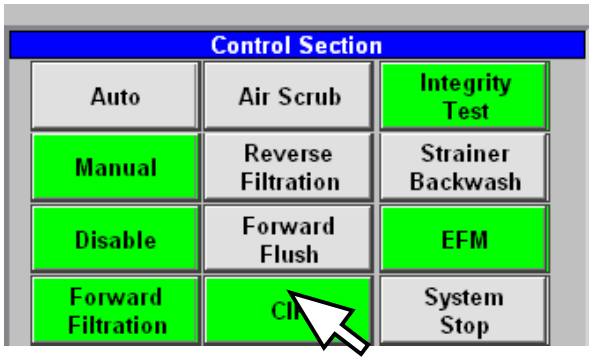
6.18 CLEAN IN PLACE

A **Clean-In-Place (CIP)** process is periodically required to clean deposits from the membranes that cannot be removed by **FM** processes. Typically, CIP occurs every three to twelve (3 to 12) weeks.

CAUTION

Any solution drained from the system into a common drain must meet the requirements/standards set by the governing authority for waste disposal in the affected community/area.

A **CIP** can only be initiated by operator selection (pressing the CIP button on the **Skid Control Screen**). The skid must be in **Auto** Mode and idle to start a **CIP** Process. Setpoints listed in the **CIP** Process description are from the **Operator CIP Setpoints Screen**. **CIP** Process buttons and screen prompts appear on the **CIP/EFM Message Center Screen** (Figure 5.10).



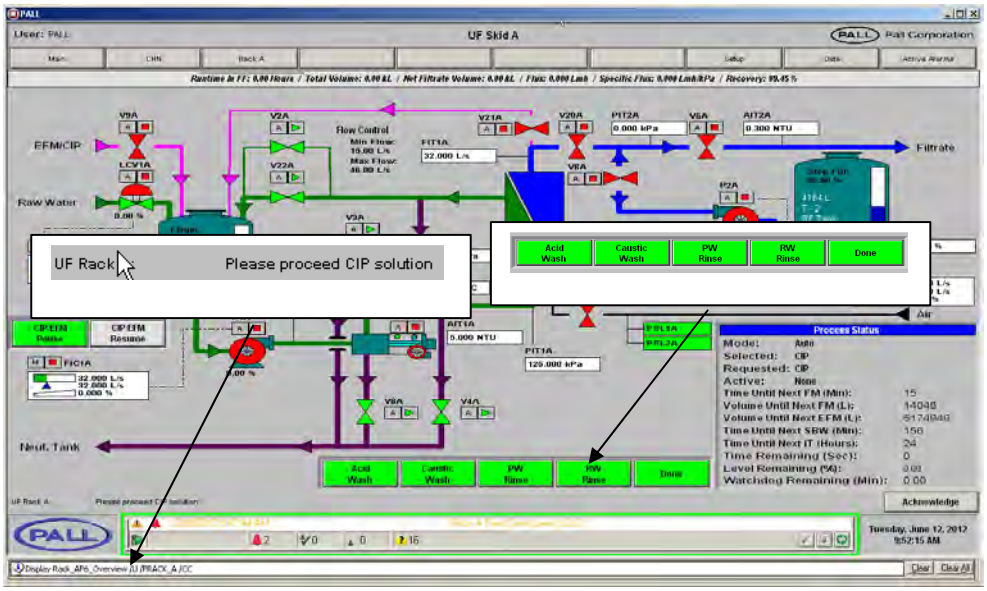


Figure 5.10 – The CIP/EFM Message Center Screen

1. The skid drains to remove the water from TK-2211-01 and the modules. (See the "Tank Waste Water Drain (WW-DRN)" Section for the procedure). After the operator has selected a CIP, the skid opens VLV-2211-02, VLV-2211-14 and closes VLV-2211-20.

2. When draining is complete, the operator is prompted to **"Choose Acid Wash, Caustic Wash, Filtrate Rinse, Raw Water Rinse, or Done."** The AP skid will automatically receive water and chemicals from the CHN System.

> **NOTE**
>
> The selection of caustic followed by acid or acid followed by caustic is application dependent. The procedure is the same for both with the exception of the target pH level checks.
>
> **A Rule of Thumb**
>
> Acid followed by caustic is used when metals are the dominant source for fouling the membrane. If organics are the dominant source, caustic followed by acid is typically used. Each filtration site/raw water is unique and requires the operator to determine the conditions to use which process based on history.

3. The volume of water to be delivered is governed by the setpoint **TK-2211-01 CIP/EFM LEVEL**. Which chemicals are delivered is based upon which wash the operator selects. If Acid Wash is selected Acid will be delivered to the skid with the quantity established by the setpoint **ACID QTY**. If Caustic Wash is selected caustic and chlorine will be delivered to

the skid with the quantity established by the setpoint **CAUSTIC QTY** and **CHLORINE QTY**. When TK-2211-01 level reaches the adjustable setpoint of **PU-2211-01 ENABLE LEVEL**, PU-2211-01 starts and runs at a speed governed by the setpoint **PU-2211-01 DRAIN SPEED**. When all of the hot water and chemicals have been transferred to the skid the skid enters the CIP Circulation Phase.

TABLE 5.6 –TYPICAL CHEMICAL CONCENTRATIONS (STORAGE)

Chemical	Concentration
Caustic	25%
Sodium Hypochlorite	12.50%
Acid	50%

NOTE

The default recipe for a CIP Process is 1% caustic and 1000 mg/l of sodium hypochlorite starting at 35 - 38° C. This solution is circulated for two (2) hours at 0.13 – 0.19 L/s per module, followed by a rinse and a 2% citric acid clean circulated for at least one hour, also at 0.13 – 0.19 L/s.

This recipe may change based on site feed water conditions, but should be the starting point.

Pall Corporation strongly recommends checking the chorine levels at the end of the caustic/chlorine **CIP**. The level should be about 50 - 100 mg/l at the end of the cycle. Adjust as necessary.

Refer to the CIP Chemical Charts in Section 7 for more information.

Chemical Circulation Phase

Once all of the hot water and chemicals have been added, the **CIP** enters the chemical circulation phase. VLV-2211-02 opens and PU-2211-01 runs at a speed governed by the setpoint **PU-2211-01 CIRC SPEED**, and the circulation timer starts to run. How long the circulation lasts is governed by the following setpoints **ACID WASH TIME** or **CAUSTIC WASH TIME**. (Acid Wash and Caustic Wash have different cycle times). Once the circulation time has expired PU-2211-01 stops and the skid enters the CHEMICAL SOLUTION/RINSE WATER DRAIN PHASE.

Chemical Solution/Rinse Water Drain Phase

(See the "CIP-Drain (DRN)" Section for the procedure).

When the chemical draining is complete, the operator is prompted to "**Choose Acid Wash, Caustic Wash, Filtrate Rinse, Raw Water Rinse, or Done.**" When the operator selects, the skid prompts the operator through the chosen process.

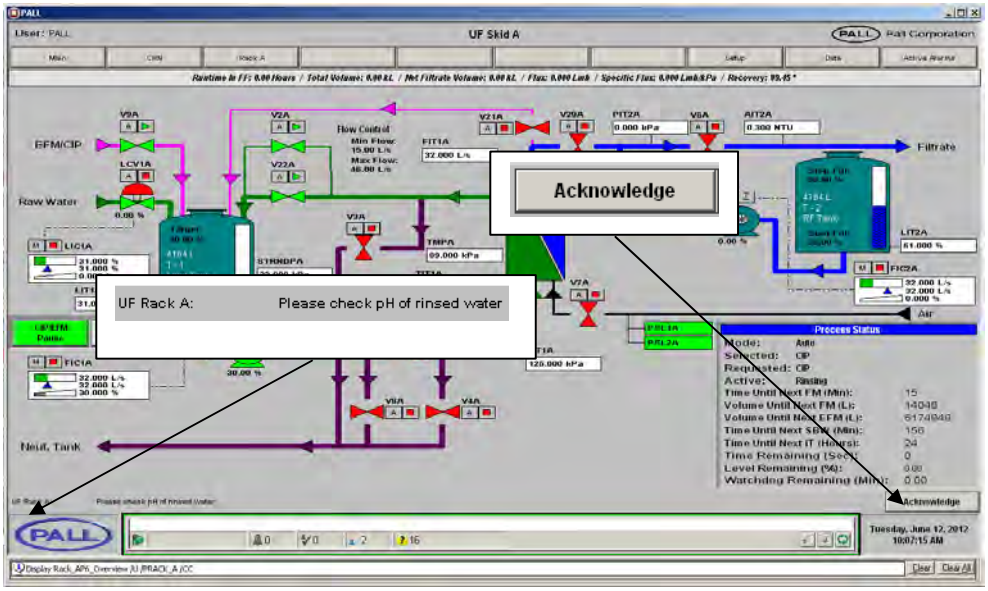
Selection Rinse

If Rinse is selected, cold water is automatically delivered to the skid from the **CHN** System. Once TK-2211-01 level reaches the setpoint governed by **TK-2211-01 CIP/EFM LEVEL**, the **CIP** Process enters the RINSE CIRCULATION PHASE.

Rinse Circulation Phase

When all of the cold water has been added, the **CIP** enters the rinse circulation phase. VLV-2211-02 opens and PU-2211-01 runs at a speed governed by the setpoint **P1 CIRCULATION SPEED**, and the circulation timer starts to run. How long the circulation lasts is governed by the setpoint **RINSE TIME**. Once the circulation time has expired the operator will be prompted to "**Check the pH of the Rinse Water, Press <ACKNOWLEDGE> when completed**".

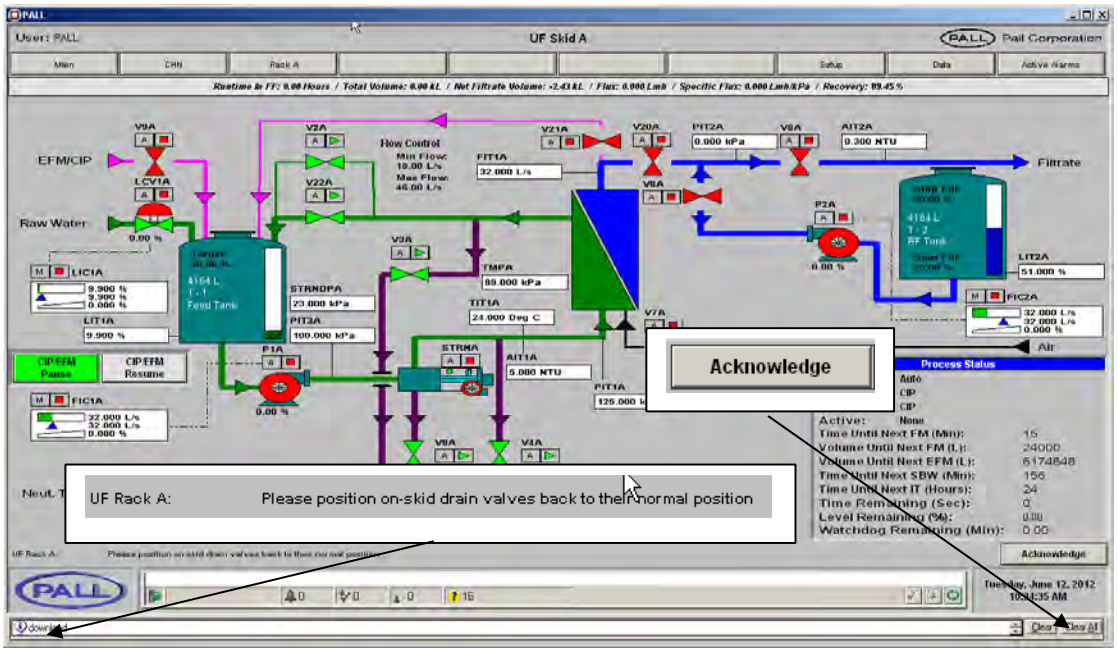
Sequence will pause until operator has pressed Acknowledge .



When the operator acknowledges this prompt, the skid enters the CHEMICAL SOLUTION/RINSE WATER DRAIN PHASE again. Refer to the description in the previous section for the details on this phase.

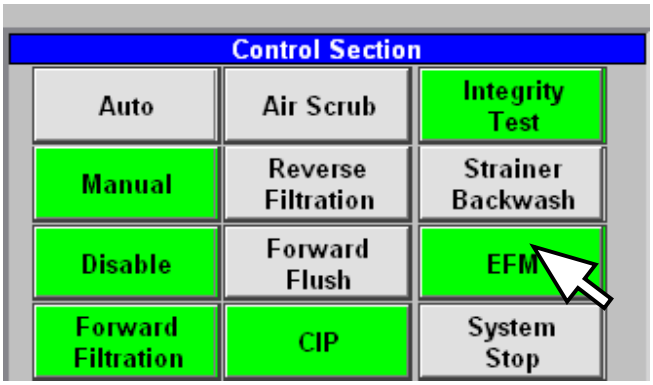
Selection of Done

After Done is selected, VLV-2211-02 and VLV-2211-14 close and VLV-2211-20 opens. The **CIP** Process ends and the skid performs a **Reverse Filtration**. See **Reverse Filtration** description above.


UF Skid A
Pall Corporation
EFM/CIP
Raw Water
Filtrate
Air
Flow Control
Min Flow: 10.00 L/s
Max Flow: 46.00 L/s
Acknowledge
UF Rack A:
Please position on-skid drain valves back to their normal position
Process Status
Auto
CIP
CIP
Active: None
Time Until Next FM (Min): 15
Volume Until Next FM (L): 24000
Volume Until Next EFM (L): 6174848
Time Until Next SBW (Min): 156
Time Until Next IT (Hours): 24
Time Remaining (Sec): 0
Level Remaining (%): 0.00
Watchdog Remaining (Min): 0.00
CIP EFM Pause
CIP EFM Resume
Tuesday, June 12, 2012
10:31:35 AM

6.19 ENHANCED FLUX MAINTENANCE (EFM)

An **Enhanced Flux Maintenance (EFM)** system extends the time interval between **Clean-In-Place (CIP)** events. An **EFM** can be initiated either by operator selection (press the EFM button on the **Skid Control Screen**) or automatically when the skid has processed a volume governed by the **EFM** setpoint **VOLUME INTERVAL.**

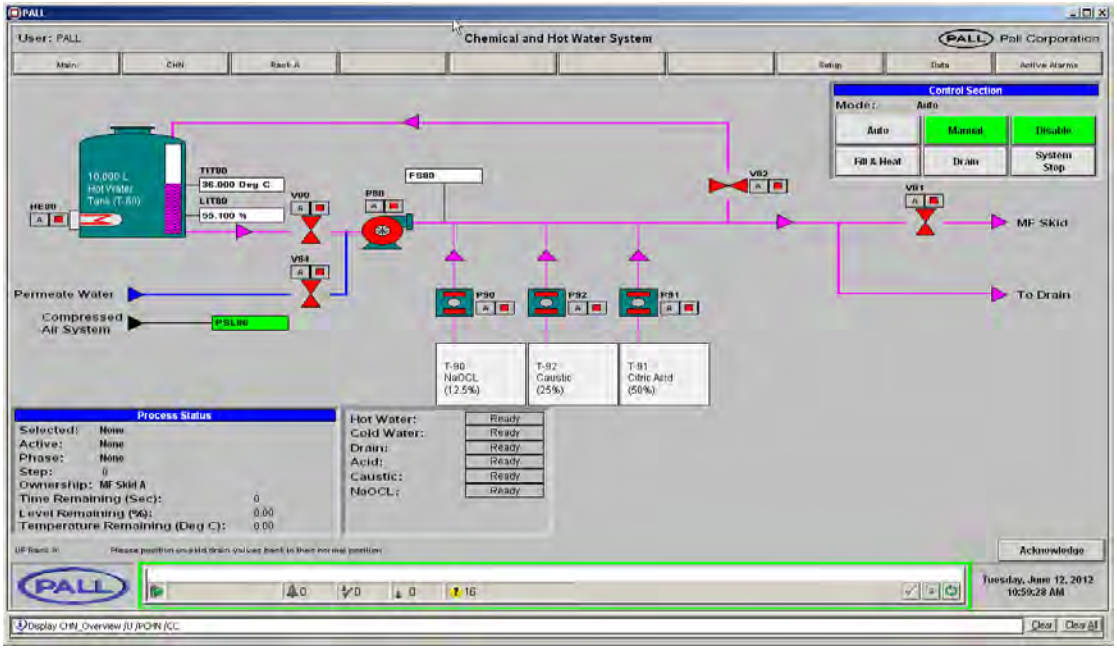


1. At the beginning of the **EFM** Process, VLV-2211-02 opens and the skid drains to remove the raw water from TK-2211-01 and the modules. Refer to the previous section "Waste Lagoon Drain (WW-DRN)" for the procedure.
2. When draining is complete, the skid requests EFM chemical and hot water from the CHN system. The amount of hot water and EFM chemical delivered is governed by **CIP** setpoint **TK-2211-01 CIP/EFM LEVEL** and **EFM** setpoints **ACID QTY**, **CAUSTIC QTY**, and **CHLORINE QTY**, respectively. As the CHN is delivering hot water and EFM chemical to the skid, the TK-2211-01 level starts to rise. Once TK-2211-01 level reaches the setpoint governed by **TK-2211-01 CIP/EFM LEVEL** the skid enters the Circulation Phase.
3. After delivery of the hot water and EFM chemical is complete, PU-2211-01 speed changes to a value governed by the **EFM** setpoint **PU-2211-01 SPEED** to circulate the EFM chemical. EFM circulation continues until reaching **EFM** setpoint **CIRCULATION TIME**.
4. When EFM circulation is complete, the skid performs another **Drain** routine. (Neutralisation Drain)
5. When the **Drain** is complete, the skid rinses the piping and modules. LCV-2211-01 opens to fill TK-2211-01 with raw water. When TK-2211-01 level reaches **CIP** setpoint **PU-2211-01 ENABLE LEVEL**, PU-2211-01 starts and runs at a speed governed by **CIP** setpoint **PU-2211-01 DRAIN SPEED.**
6. When enough raw water has been added to TK-2211-01 (**TK-2211-01 CIP/EFM LEVEL**), PU-2211-01 speed changes to a value governed by **EFM** setpoint **PU-2211-01 SPEED** to circulate the rinse water. The rinse continues until reaching **EFM** setpoint **RINSE TIME.**
7. When the rinse is complete, the skid performs another WW-**Drain** routine. (Normal Drain)

8. When the **Drain** is complete, the skid checks to see if the number of rinses is satisfied. The quantity of rinses is governed by the setpoint **NUMBER OF RINSES**. If the **NUMBER OF RINSES** is not satisfied, the skid rinses and drains again as previously described. When the number of rinses has been satisfied, the **EFM** procedure ends.
9. When the **EFM** procedure ends, TK-2211-01 will fill with raw water from LCV-2211-01. When T-1 level reaches the feed tank setpoint **TARGET**, the skid performs an **Air Scrub** followed by either a **Forward Flush** or **Reverse Filtration** Process.

6.20 THE CHEMICAL, HOT WATER, AND NEUTRALISATION (CHN) SYSTEM

The Chemical, Hot Water and Neutralisation (CHN) System has its own three (3) PLC Modes: **Auto**, **Manual**, and **Disable**. The operator can select the system mode by accessing the **CHN System Screen** and clicking on the appropriate button.



Auto Mode: In **Auto** Mode, the system keeps the water in the hot water tank hot, fills the hot water tank, and accepts various requests from the filtration skids. Refer to the various following sequences for this operation.

Manual Mode: In **Manual** Mode, the devices operate based on commands from the operator.

CAUTION

Manual Mode is not the preferred system operating mode. The system operator is solely and entirely responsible for the outcome of system functioning while in Manual Mode. Operators must not utilize Manual Mode unless trained to operate the Pall Aria™ Water Treatment System in Manual Mode.

Disable Mode: In **Disable** Mode, the devices in the CHN system do not respond to system or operator commands. **Disable** Mode is NOT intended for use as a safe condition for maintenance operations.

6.20.1 CIP/NEUTRALISATION SYSTEM

The CIP/Neutralisation system consists of a water tank (TK-2250-80) with an emersion heater (HE-2250-80). The system also has a temperature transmitter (TT-2250-80) and a level transmitter (LIT-2250-80). Refer to the Alarm Tables in Section 7 for the names and functionality of listed alarms.

6.20.1.1 FILLING & HEATING

As customer was not able to provide a potable water source, Pall will utilise an external storage tank for EFM/CIP processes which will be filled with MF Filtrate. Fill and heat sequence is described below.

IMPORTANT

Prior to commencing a CIP process, the "ENABLE RF ON SHUTDOWN" setpoint (Rack_A.SP.cRF_On_Shutdown) must be disabled.

This will prevent drawing down the RF tank level prior to the CIP requesting,

Following successful completion of the CIP, this setpoint may once again be enabled as required.

1. At the CIP/EFM request CHN skid will drain TK-2250-80 and TK-2240-81.
    a. Open VLV-2250-80 and V2250-83 and switch on pump PU-2250-80 until CIP/Neut tank level as observed on LIT-2250-80 reaches NEUT TANK PUMP DISABLE setpoint. When complete turn off the pump PU-2250-80 and close VLV-2250-80.
    b. Open VLV-2250-85 and switch on pump PU-2250-80 until tank level as observed on LIT-2250-80 reaches FILTRATE RINSE TANK PUMP DISABLE level setpoint. When complete turn off the pump PU-2250-80 and close VLV-2250-85.

2. Fill the Filtrate Rinse tank.
    a. With the AP system(s) in Forward Flow Open VLV-2240-51 and close VLV-2240-50 to allow filling of the Filtrate Rinse Tank. Travel stop on the valve VLV-2240-50 must be set at commissioning to allow controlled filling of the Filtrate Rinse Tank.
    b. Fill the Filtrate Rinse Tank to FILTRATE RINSE TANK EFM LEVEL or FILTRATE RINSE TANK CIP LEVEL setpoint depending on the request type.
    c. Once the desired tank level is reached, open valve VLV-2240-50 and close VLV-2240-51.
3. Fill and heat. Transfer the water from Filtrate Rinse tank to CIP / Neutralisation Tank if an EFM or Caustic CIP is requested.
    a. Open VLV-2250-85 and VLV-2250-82. Turn on pump PU-2250-80 and fill the CIP / Neut tank until CIP/EFM TANK LEVEL setpoint is reached.
    b. As the tank is being filled, add chlorine to disinfect the solution. Turn on the chlorine transfer pump PU-2250-80 for the duration of TANK DISINFECTION TIME setpoint. Ensure that water is flowing past the chlorine injection point whilst pumping chlorine.
    c. When CIP/Neut tank level has reached the setpoint, stop the pump PU-2250-80 and close the valve VLV-2250-85.
    d. Enable heat control. As the heater HE-2250-80 is turned on, circulate the solution by opening the valve VLV-2250-82 and turning on the pump PU-2250-80.
    e. When the EFM/CIP setpoint temperature is reached take the requesting skid offline to start the CIP/EFM.

NOTE: If Acid CIP is selected, above fill and heat step will not be executed.

6.20.1.2 HOT WATER TRANSFER TO THE SKID

With the CHN in **Auto** Mode, the CHN system sends hot water to the requesting AP skid. VLV-2250-80, VLV-2250-81, VLV-2211-60, VLV-2211-04, VLV-2211-14 and VLV-2211-02 open, VLV-2211-20 closes and Pump PU-2250-80 is turned on. The amount of hot water transferred is determined by the requesting skid. When the skid removes the request, pump PU-2250-80 turns off and VLV-2250-80, VLV-2250-81, VLV-2211-60, VLV-2211-04, VLV-2211-14 and VLV-2211-02 close, VLV-2211-20 opens.

6.20.1.3 COLD WATER TRANSFER TO THE SKID

With the CHN in **Auto** Mode, the CHN system sends cold water to the requesting AP skid. VLV-2250-85, VLV-2250-81, VLV-2211-60, VLV-2211-04, VLV-2211-14 and VLV-2211-02 open, VLV-2211-20 closes and Pump PU-2250-80 is turned on (following a permissive from Waste Lagoon).

The amount of cold (rinse) water transferred is determined by the requesting skid. When the skid removes the request, pump PU-2250-80 turns off and VLV-2250-85, VLV-2250-81, VLV-2211-60, VLV-2211-04, VLV-2211-14 and VLV-2211-02 close, VLV-2211-20 opens.

6.20.2 CHEMICAL TRANSFER SYSTEM

The **Chemical Transfer System** consists of four (4) chemical pumps: NaOCl Pump (PU-2511-90), Citric Acid Pump (PU-2532-91), Caustic Pump (PU-2521-92) and SMBS Pump (PU-2513-93).

- PU-2511-90 transfers NaOCl to the requesting skid for caustic wash evolutions.
- PU-2532-91 transfers citric acid to the requesting skid for acid wash evolutions.
- PU-2521-92 transfers caustic to the requesting skid for caustic wash evolutions.
- PU-2513-93 transfers SMBS to the neutralisation skid for chemical waste neutralisation

6.20.3 ACID SOLUTION TRANSFER TO SKID

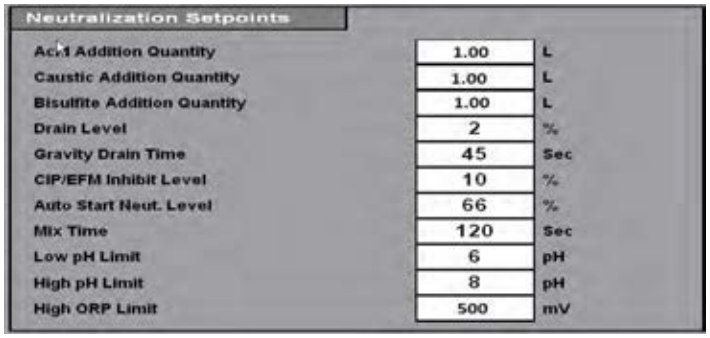
With the CHN in **Auto** Mode, the Chemical Transfer System sends acid solution to the requesting skid. First, cold water transfer is initiated (see section "Cold Water Transfer to the Skid" above). When water flow is established, PU-2521-91 starts and delivers acid to the water stream being transferred to the skid. The length of time PU-2521-91 runs is determined by the requesting skid. When the skid removes the request, PU-2521-91 and the cold water transfer stops.

6.20.3.1 CAUSTIC SOLUTION TRANSFER TO SKID

With the CHN in **Auto** mode, the chemical transfer system sends a caustic/chlorine solution to the requesting skid. First, hot water transfer is initiated (see Section "Hot Water Transfer to the Skid" above). When water flow is established, as measured by FS-2250-80, PU-2511-90 and/or PU-2521-92 start and delivering caustic and/or NaOCl to the water stream that is being transferred to the skid. The length of time PU-2511-90 and PU-2521-92 run is determined by the requesting skid. When the skid removes the request PU-2511-90, PU-2521-92, and the hot water transfer stops.

6.20.3.2 SOLUTION NEUTRALISATION

The CHN skid includes a Recirculation Valve (VLV-2250-82), Drain Valve (VLV-2250-83), recirc/drain pump (PU-2250-80) and ORP (AE-2250-81) and pH (AE-2250-81) instruments.



Neutralisation will commence automatically following completion of a EFM or CIP process. Alternately if the level in the Neutralisation tank reaches the Auto Start Neut. Level setpoint then any active CIP or EFM sequence will be paused and the neutralisation sequence will automatically commence.

The content of the MF rack is firstly drained using the NUTRALISATION DRAIN sequence. The first two rinses are captured in the Neut tank

The neutralisation sequence commences by opening VLV-2250-80 and VLV-2250-82 and starting the CHN pump (PU-2250-80). The pump recirculates the solution for Neut Recirc Time. After the neutralisation time is finished the pH (AE-2250-80) and ORP (AE-2250-81) are measured. The neutralisation sequence firstly corrects for pH (i.e. add acid if pH above High pH limit or add caustic if pH below Low pH limit). The neutralisation tank contents are recirculated for Neut Recirc Time to allow for complete mixing of the tank contents. After recirculation, the pH (AE-2250-80) is measured. If the solution is not within pH setpoints further addition occurs, as above, until the solution is within pH set points.

Once pH has been corrected to within the low and high limits the ORP (AE-2250-81) is checked. If the ORP is above the High ORP limit then SMBS is added. In each case chemical is batch added according to the Addition Quantity setpoint. The neutralisation tank contents are recirculated for Neut Recirc Time to allow for complete mixing of the tank contents. After recirculation the pH (AE-2250-80) and ORP (AE-2250-81) are measured. If the solution is not less than the ORP setpoints further addition occurs, as above, until the solution is under ORP set points.

Following successful neutralisation, the neutralisation tank contents are pumped to the Waste Lagoon. VLV-2250-80 and VLV-2250-83 open and pump PU-2250-80 turns on. Once the level in CIP Tank (LIT-2250-80) reaches the Drain level setpoint, pump PU-2250-80 stops. Once completed VLV-2250-80 and VLV-2250-83 close.

Note: During draining the pH and ORP are monitored. If the solution falls outside of drain consent parameters the drain step is stopped and the operator is notified that neutralisation is required.

7 APPENDICIES

7.1 CIP CALCULATIONS

Boonah - Aria AP3 CIP Estimated Chemical Usage

	Number Of Modules	11		
	Number Pulls on rack	13		
DOSAGE PUMP	**CIP Cycle Volume (gal)**	**225**	850.5	L
Air Diaphragm	AP3 Skid + 30% Tank (Low Level Limit)	66		
Wilden A 0.25	Interconnect to Rack	45		
3 gal/min @ 90psig	Rack Volume	20		
	Modules Volume (8 gallons/module)	88		

Acid rinse

Solid Acid Mixing

Dosing Solution concentration desired (by weight) =	50.0%		
Density of Acid (lbs/gal)	12.87		
Density of Water (lbs/gal)	8.35		
CIP Transfer System Tank volume (gal) =	50		
Quantity required (lbs) =	253.2		

Acid Qty per CIP

Dosing Solution concentration (by weight) =	50.0%		
CIP cycle concentration desired (by weight) =	2.0%		
CIP cycle volume (gal) =	225		
Qty of Dosing Solution required/rinse (gal)	7.11	26.97	L

Caustic & Bleach rinse

Solid Caustic Mixing

Dosing Solution concentration desired (by weight) =	25.0%		
Density of Caustic (lbs/gal)	17.77		
Density of Water (lbs/gal)	8.35		
CIP Transfer System Tank volume (gal) =	50		
Quantity of Caustic required (lbs) =	120.3		

Caustic Qty per CIP

Dosing Solution concentration (by weight) =	25.0%		
CIP cycle concentration desired (by weight) =	1.0%		
CIP cycle volume (gal) =	225		
Quantity of Dosing Solution required per CIP (gal)	7.14	26.97	L

NaOCl Qty per CIP

Dosing Solution concentration (by weight) =	12.5%		
CIP cycle concentration desired (by ppm) =	1000		
CIP cycle volume (gal) =	225		
Quantity of Dosing Solution required per CIP (gal)	1.80	6.8	L

Laidley - Aria AP3 CIP Estimated Chemical Usage

	Number Of Modules	17		
	Number Pulls on rack	20		
DOSAGE PUMP	**CIP Cycle Volume (gal)**	**272**	1028	L
Air Diaphragm	AP3 Skid + 30% Tank (Low Level Limit)	66		
Wilden A 0.25	Interconnect to Rack	30		
3 gal/min @ 90psig	Rack Volume	40		
	Modules Volume (8 gallons/module)	136		
	Acid rinse			
Solid Acid Mixing				
	Dosing Solution concentration desired (by weight) =	50.0%		
	Density of Acid (lbs/gal)	12.87		
	Density of Water (lbs/gal)	8.35		
	CIP Transfer System Tank volume (gal) =	50		
	Quantity required (lbs) =	253.2		
Acid Qty per CIP				
	Dosing Solution concentration (by weight) =	50.0%		
	CIP cycle concentration desired (by weight) =	2.0%		
	CIP cycle volume (gal) =	272		
	Qty of Dosing Solution required/rinse (gal)	8.59	32.5	L
	Caustic & Bleach rinse			
Solid Caustic Mixing				
	Dosing Solution concentration desired (by weight) =	25.0%		
	Density of Caustic (lbs/gal)	17.77		
	Density of Water (lbs/gal)	8.35		
	CIP Transfer System Tank volume (gal) =	50		
	Quantity of Caustic required (lbs) =	120.3		
Caustic Qty per CIP				
	Dosing Solution concentration (by weight) =	25.0%		
	CIP cycle concentration desired (by weight) =	1.0%		
	CIP cycle volume (gal) =	272		
	Quantity of Dosing Solution required per CIP (gal)	8.63	32.6	L
NaOCl Qty per CIP				
	Dosing Solution concentration (by weight) =	12.5%		
	CIP cycle concentration desired (by ppm) =	1000		
	CIP cycle volume (gal) =	272		
	Quantity of Dosing Solution required per CIP (gal)	2.18	8.23	L

Kalbar & Forest Hill - Aria AP2 CIP Estimated Chemical Usage (each)

	Number Of Modules	4		
	Number Pulls on rack	8		
DOSAGE PUMP	**CIP Cycle Volume (gal)**	**73**	276.3	L
Air Diaphragm	AP2 Skid + 30% Tank (Low Level Limit)	20		
Wilden A 0.25	Interconnect to Rack	5		
3 gal/min @ 90psig	Rack Volume	16		
	Modules Volume (8 gallons/module)	32		

Acid rinse

Solid Acid Mixing

Dosing Solution concentration desired (by weight) =	50.0%		
Density of Acid (lbs/gal)	12.87		
Density of Water (lbs/gal)	8.35		
CIP Transfer System Tank volume (gal) =	50		
Quantity required (lbs) =	253.2		

Acid Qty per CIP

Dosing Solution concentration (by weight) =	50.0%		
CIP cycle concentration desired (by weight) =	2.0%		
CIP cycle volume (gal) =	73		
Qty of Dosing Solution required/rinse (gal)	2.31	8.7	L

Caustic & Bleach rinse

Solid Caustic Mixing

Dosing Solution concentration desired (by weight) =	25.0%		
Density of Caustic (lbs/gal)	17.77		
Density of Water (lbs/gal)	8.35		
CIP Transfer System Tank volume (gal) =	50		
Quantity of Caustic required (lbs) =	120.3		

Caustic Qty per CIP

Dosing Solution concentration (by weight) =	25.0%		
CIP cycle concentration desired (by weight) =	1.0%		
CIP cycle volume (gal) =	73		
Quantity of Dosing Solution required per CIP (gal)	2.32	8.75	L

NaOCl Qty per CIP

Dosing Solution concentration (by weight) =	12.5%		
CIP cycle concentration desired (by ppm) =	1000		
CIP cycle volume (gal) =	73		
Quantity of Dosing Solution required per CIP (gal)	0.58	2.2	L

7.2 AP SKID PROCESS SETPOINTS

		Boonah	Kalbar	Laidley	Forrest Hill
Master Setpoints					
Analogue Setpoints					
	LIT_2220_01 - Raw Water Tank A Level Transmitter - High High Alarm	100.00	100.00	100.00	100.00
	LIT_2220_01 - Raw Water Tank A Level Transmitter - High Alarm	95.00	100.00	95.00	95.00
	LIT_2220_01 - Raw Water Tank A Level Transmitter - Low Alarm	40.00	40.00	5.00	40.00
	LIT_2220_01 - Raw Water Tank A Level Transmitter - Low Low Alarm	0.00	0.00	0.00	0.00
	LIT_2220_02 - Raw Water Tank B Level Transmitter - High High Alarm			99.00	
	LIT_2220_02 - Raw Water Tank B Level Transmitter - High Alarm			95.00	
	LIT_2220_02 - Raw Water Tank B Level Transmitter - Low Alarm			3.00	
	LIT_2220_02 - Raw Water Tank B Level Transmitter - Low Low Alarm			1.00	
	LIT_2240_50 - Filtrate Tank A Level Transmitter - High High Alarm	100.00			
	LIT_2240_50 - Filtrate Tank A Level Transmitter - High Alarm	99.00			
	LIT_2240_50 - Filtrate Tank A Level Transmitter - Low Alarm	10.00			
	LIT_2240_50 - Filtrate Tank A Level Transmitter - Low Low Alarm	4.00			
	LIT50B - Filtrate Tank B Level Transmitter - High High Alarm				
	LIT50B - Filtrate Tank B Level Transmitter - High Alarm				
	LIT50B - Filtrate Tank B Level Transmitter - Low Alarm				
	LIT50B - Filtrate Tank B Level Transmitter - Low Low Alarm				
Engineering Setpoints					
	MF System Flow Rate	5.00	4.00	12.00	3.00
	Air Release Delay Timer	60	20	60	30
Operator Setpoints					
	System Control	Flow	Flow	Flow	Flow
	Filtrate Level Control	Enabled	Enabled	0	Enabled
	Filtrate Target Level	100.00	88.00	0	88
	Filtrate Pause Level	100.00	98.00	98.00	98.00
	Filtrate Resume Level	96.00	96.00	96.00	96.00
	Filtrate Level for Minimum Flow	99.00	97.00		97.00
	Filtrate Level for Maximum Flow	85.00	85.00		85.00
	Filtrate Pause Delay Timer	10	10	10	10
	Filtrate Resume Delay Timer	10	10	10	10
Pall Setpoints					
	Peer PLC Installed	Yes	Yes	Yes	Yes
	SCADA Installed	Yes	Yes	Yes	Yes
	UPS Installed	Yes	Yes	Yes	Yes
	RW Tank A Level Transmitter Installed	Yes	Yes	Yes	Yes
	RW Tank B Level Transmitter Installed	No	No	Yes	No
	Filtrate Tank A Level Transmitter Installed	Yes	No	No	No
	Filtrate Tank B Level Transmitter Installed	No	No	No	No
Pall Admin Setpoints					
	Pump Runtime Delay Timer Setpoint	5	5	5	5
	Valve Close Delay Timer Setpoint	5	5	5	5
	Communication Alarm Delay Timer Setpoint	6	6	6	6
	Number of MF Skids	2	2	2	2

		Boonah	Kalbar	Laidley	Forrest Hill
Rack Setpoints					
Analogue Setpoints					
	LIT_2212_01-MF Rack ?? Feed Tank Level Transmitter - High High Alarm	99.00	99.00	99.00	99.00
	LIT_2212_01-MF Rack ?? Feed Tank Level Transmitter - High Alarm	95.00	90.00	90.00	90.00
	LIT_2212_01-MF Rack ?? Feed Tank Level Transmitter - Low Alarm	2.00	2.00	2.00	2.00
	LIT_2212_01-MF Rack ?? Feed Tank Level Transmitter - Low Low Alarm	1.00	0.00	0.00	0.00
	LIT_2212_02-MF Rack ?? RF Tank Level Transmitter - High High Alarm	99.00	99.00	99.00	99.00
	LIT_2212_02-MF Rack ?? RF Tank Level Transmitter - High Alarm	95.00	95.00	95.00	95.00
	LIT_2212_02-MF Rack ?? RF Tank Level Transmitter - Low Alarm	5.00	5.00	3.00	5.00
	LIT_2212_02-MF Rack ?? RF Tank Level Transmitter - Low Low Alarm	2.00	2.00	0.00	2.00
	TIT_2212_01-MF Rack ?? Feed Temperature Transmitter - High High Alarm	38.00	38.00	38.00	38.00
	TIT_2212_01-MF Rack ?? Feed Temperature Transmitter - High Alarm	35.00	35.00	35.00	35.00
	TIT_2212_01-MF Rack ?? Feed Temperature Transmitter - Low Alarm	10.00	5.00	5.00	5.00
	TIT_2212_01-MF Rack ?? Feed Temperature Transmitter -Low Low Alarm	0.00	0.00	0.00	0.00
	PIT_2212_01-MF Rack ?? Feed Pressure Transmitter - High High Alarm	344.00	344.00	300.00	344.00
	PIT_2212_01-MF Rack ?? Feed Pressure Transmitter - High Alarm	320.00	320.00	250.00	320.00
	PIT_2212_01-MF Rack ?? Feed Pressure Transmitter - Low Alarm	0.00	0.00	0.00	0.00
	PIT_2212_01-MF Rack ?? Feed Pressure Transmitter - Low Low Alarm	0.00	0.00	0.00	0.00
	PIT_2212_02-MF Rack ?? Filtrate Pressure Transmitter - High High Alarm	150.00	150.00	150.00	150.00
	PIT_2212_02-MF Rack ?? Filtrate Pressure Transmitter - High Alarm	120.00	120.00	120.00	120.00
	PIT_2212_02-MF Rack ?? Filtrate Pressure Transmitter - Low Alarm	25.00	25.00	25.00	25.00
	PIT_2212_02-MF Rack ?? Filtrate Pressure Transmitter - Low Low Alarm	0.00	0.00	0.00	0.00
	PIT_2212_03-MF Rack ?? Strainer Inlet Pressure Transmitter - High High Alarm	350.00	350.00	350.00	350.00
	PIT_2212_03-MF Rack ?? Strainer Inlet Pressure Transmitter - High Alarm	300.00	300.00	300.00	300.00
	PIT_2212_03-MF Rack ?? Strainer Inlet Pressure Transmitter - Low Alarm	0.00	0.00	0.00	0.00
	PIT_2212_03-MF Rack ?? Strainer Inlet Pressure Transmitter -Low Low Alarm	0.00	0.00	0.00	0.00
	FIT_2212_01-MF Rack ?? Filtrate Flow Transmitter - High High Alarm	15.00	15.00	18.00	15.00
	FIT_2212_01-MF Rack ?? Filtrate Flow Transmitter - High Alarm	12.00	12.00	16.00	12.00
	FIT_2212_01-MF Rack ?? Filtrate Flow Transmitter - Low Alarm	1.00	1.00	1.00	1.00
	FIT_2212_01-MF Rack ?? Filtrate Flow Transmitter - Low Low Alarm	0.50	0.50	0.50	0.50
	AIT_2212_01-MF Rack ?? Feed Turbidity Transmitter - High High Alarm	80.00	80.00	100.00	90.00
	AIT_2212_01-MF Rack ?? Feed Turbidity Transmitter - HighAlarm	75.00	75.00	75.00	75.00
	AIT_2212_01-MF Rack ?? Feed Turbidity Transmitter - Low Alarm	2.00	2.00	2.00	2.00
	AIT_2212_01-MF Rack ?? Feed Turbidity Transmitter - Low Low Alarm	0.00	0.00	0.00	0.00
	AIT_2212_02-MF Rack ?? Filtrate Turbidity Transmitter - High High Alarm	1.00	1.00	1.10	1.00
	AIT_2212_02-MF Rack ?? Filtrate Turbidity Transmitter - High Alarm	0.70	0.70	0.70	0.70
	AIT_2212_02-MF Rack ?? Filtrate Turbidity Transmitter - Low Alarm	0.00	0.00	0.00	0.00
	AIT_2212_02-MF Rack ?? Filtrate Turbidity Transmitter - Low Low Alarm	0.00	0.00	0.00	0.00
	TMP - MF Rack ?? Trans-Membrane Pressure - High High Alarm	225.00	225.00	225.00	225.00
	TMP - MF Rack ?? Trans-Membrane Pressure - High Alarm	200.00	200.00	200.00	200.00
	TMP - MF Rack ?? Trans-Membrane Pressure - Low Alarm	1.00	1.00	1.00	1.00
	TMP - MF Rack ?? Trans-Membrane Pressure - Low Low Alarm	0.50	0.50	0.50	0.50
	STRNDP - MF Rack ?? Strainer Differential Pressue - High High Alarm	199.00	199.00	199.00	199.00
	STRNDP - MF Rack ?? Strainer Differential Pressue - High Alarm	75.00	75.00	75.00	75.00
	STRNDP - MF Rack ?? Strainer Differential Pressue - Low Alarm	20.00	20.00	20.00	20.00
	STRNDP - MF Rack ?? Strainer Differential Pressue - Low Low Alarm	15.00	15.00	15.00	15.00
Engineering Setpoint 1					
	Air Scrub Cycle Time	60	45	60	60
	Air Scrub Reverse Flow Rate	5.50	3.00	8.50	3.00
	Air Scrub RF Pump Speed	40.00	35.00	40.00	35.00
	Air Scrub Auto PID Delay Time	5	5	5	5
	Air Scrub Air Pulse Off Time	0	0	0	0
	Air Scrub Air Pulse On Time	0	0	0	0
	Air Scrub Air Pulse Enable	Disabled	Disabled	Disabled	Disabled
	Air Scrub Ratio	0	0	0	0
	Reverse Filtration Cycle time	45	30	45	45
	Reverse Filtration Flow Rate	5.00	3.00	8.50	3.00
	Reverse Filtration Pump Speed	35.00	35.00	35.00	35.00
	Reverse Filtration Auto PID Delay Time	5	5	5	5
	RF During Pause	Enabled	Enabled	Enabled	Enabled
	RF On Shutdown	Enabled	Enabled	Disabled	Enabled

		Boonah	Kalbar	Laidley	Forrest Hill
	Feed Flush Cycle Time	30	30	30	30
	Feed Flush Pump Speed	60.00	60.00	60.00	60.00
	RF / FL After Air Scrub	FL	FL	FL	FL
	FM TMP Trigger Mode	Enabled	Enabled	Enabled	Enabled
	FM TMP Trigger	175.00	150.00	190.00	190.00
	SBW Differential Pressure Trigger	50.00	50.00	50.00	50.00
	SBW DP Trigger Delay Time	20	20	20	20
	SBW Pressure Build Up Time	10	10	10	10
	SBW Pump Speed	70.00	60.00	70.00	60.00
	SBW Cycles	3	2	3	3
	SBW Auto Counts	1	1	1	1
	SBW SV Stroke Time (for AP 2, 3, 4)	30	25	30	25
	Fill Watchdog	5.00	5.00	5.00	5.00
	Integrity Test Watchdog	15.00	15.00	15.00	15.00
	EFM Cycle Watchdog	120.00	160.00	90.00	90.00
Engineering Setpoint 2					
	Forward Flow Pump Speed	30.00	30.00	30.00	25.00
	Forward Flow Auto PID Delay Time	5	5	5	5
	Forward Flow Minimum Flow Rate	2.00	1.00	3.00	1.00
	Forward Flow Maximum Flow Rate	2.50	2.50	4.00	1.50
	Feed Tank Target Level	60.00	60.00	55.00	60.00
	Feed Tank Forward Flow Pause Level	10.00	10.00	10.00	10.00
	Feed Tank Control Valve Close Lvel	80.00	75.00	55.00	75.00
	RF Tank Minimum Level for RF	75.00	50.00	70.00	50.00
	RF Tank Stop Fill Level	75.00	80.00	80.00	80.00
	RF Tank Start Fill Level	55.00	65.00	65.00	65.00
	Level Control Valve Maximum Position	55.00	80.00	75.00	75.00
	Level Control Valve Minimum Position	30.00	35.00	30.00	30.00
	IT Auto Start Hour	4	4	4	4
	IT Auto Stop Hour	7	7	6	7
	IT Minimum Test Pressure	180.00	180.00	180.00	180.00
	IT Water Remove Delay Time	10	10	10	10
	IT Stabilsation Time	60	10	30	10
	IT Pressure Settle Time	60	60	60	60
	IT Cycle Time	300	300	300	300
	IT Depressurise Time	5	5	5	5
	IT Depressurise Stabilisation Time	10	10	10	10
	IT Depressurise Pressure	25.00	25.00	25.00	25.00
	IT Decay High Pressure	3.50	3.50	3.50	3.50
	IT Decay High High Pressure	6.80	6.80	6.80	6.80
	IT Auto Start	Enabled	Enabled	Enabled	Enabled
	IT Fail Action	Continue	Continue	Continue	Continue
CIP/EFM Setpoints					
	CIP Citric Acid Quantity	27.00	10.00	36.00	10.00
	CIP Caustic Quantity	26.00	9.00	32.00	10.00
	CIP Chlorine Quantity	7.50	4.00	9.00	4.00
	CIP Acid Circulation Time	60.00	45.00	60.00	45.00
	CIP Caustic Circulation Time	60.00	60.00	75.00	75.00
	CIP P1 Circulation Speed	55.00	40.00	50.00	45.00
	CIP / EFM P1 Run Level	30.00	30.00	35.00	30.00
	CIP / EFM P1 Stop Level	10.00	10.00	10.00	15.00
	CIP Rinse Circulation Time	5.00	5.00	5.00	5.00
	CIP Rinse LCV Position	50.00	50.00	50.00	50.00
	CIP / EFM Feed Tank Level	30.00	30.00	35.00	30.00
	Forced Drain Cycle Time	10	10	10	10
	Gavity Drain Cycle Time	300	200	300	240
	Drain to Neut. Cycle Time	120.00	120.00	300.00	120.00
	Feed Pump Drain Speed	35.00	30.00	35.00	35.00
	Drain Pump Stop Level	10.00	3.00	3.00	3.00
	EFM Drain to Neut	Exist	Exist	Exist	Exist
	EFM Auto Enable	Enabled	Enabled	Enabled	Enabled

		Boonah	Kalbar	Laidley	Forrest Hill
	EFM Auto Start Hour	8	8	8	8
	EFM Auto Stop Hour	20	17	18	17
	EFM Volume Interval	300.00	100.00	375.00	90.00
	EFM Circulation Pump Speed	30.00	30.00	35.00	35.00
	EFM Circulation Time	30.00	30.00	30.00	30.00
	EFM Soak Time	0.00	0.00	0.00	0.00
	EFM Rinse Time	5.00	5.00	5.00	5.00
	EFM Number of Rinses	2	2	2	2
	EFM Citric Acid Quantity	13.50	50.00	12.00	5.00
	EFM Caustic Quantity	10.70	4.00	12.00	5.00
	EFM Chlorine Quantity	7.00	2.00	6.00	2.00
	EFM Citric Acid Selection	Not Use	Not Use	Not Use	Not Use
	EFM Caustic Selection	Used	Used	Used	Used
	EFM Chlorine Selection	Used	Used	Used	Used
	EFM Type Selection (FEED / FILT)	Feed	Feed	Feed	Feed
	EFM Rinse Type Selection (PW / RW)	PW	RW	RW	RW
Operator Setpoints					
	FM Volume Interval	32.00	32.00	12.50	24.00
	FM Time Interval	15.00	20.00	10.00	15.00
	FM time Interval (for RF During Pause)	360.00	360.00	360.00	360.00
	Backwash Time Interval	60.00	60.00	90.00	45.00
	Fill Recirc. Pump Speed	55.00	45.00	60.00	45.00
	FF Flow Setpoint (for flow control only)	2.50	2.50	4.00	1.50
	Hours between Integrity Tests	24.00	24.00	24.00	24.00
Pall Setpoints					
	Design Temperature	23.00	23.00	23.00	20.00
	Number of Modules	11	4	17	4
	Feed Turbidity Installed	Yes	Yes	Yes	Yes
	Filtrate Turbidity Installed	Yes	Yes	Yes	Yes
	Filtrate Particle Counter Installed	No	No	No	No
	Filtrate ORP Installed	No	No	No	No
	Filtrate ph Installed	No	No	No	No
	Filtrate Chlorine Installed	No	No	No	No
	Feed pH Installed	No	No	No	No
	Backwash Drain Valve Installed	No	No	No	No
	Chemical Waste Drain Valve Installed	No	No	No	No
	AP2 Module Installed	No	Yes	No	Yes
	AP3 Module Installed	Yes	No	Yes	No
	AP4 Module Installed	No	No	No	No
	AP6 Module Installed	No	No	No	No
	LOV Module Installed	No	No	No	No
	UNA Module Installed	Yes	Yes	Yes	Yes
	USV Module Installed	No	No	No	No
	Feed Tank Level Control	Yes	Yes	Yes	Yes
	Shutdown Delay Time	20	20	20	20
	Forward Flow Speed Capture Delay Time	5	5	5	5
	Fill Mimimum Flow Detection Delay Time	20	20	20	20
	SBW Auto Counter Reset Delay Time	5	5	5	5
	IT Decay High Alarm Delay	1.00	1.00	1.00	1.00
	IT Decay High High Alarm Delay	1.00	1.00	1.00	1.00
	EFM Abnormal Shutdown Alarm Delay	1.00	1.00	1.00	1.00
	EFM Chemical Dosing Watchdog	1.00	1.00	1.00	1.00
	CHN Not Ready for EFM	1.00	1.00	1.00	1.00
	CIP Chemical Dosing Watchdog	1.00	1.00	1.00	1.00
	Feed Tank Pause Alarm Delay	1.00	1.00	1.00	1.00
	RF Tank Nor Ready Alarm Delay	1.00	1.00	1.00	1.00
	RF Tank Level Change Alarm Delay	3.00	3.00	3.00	3.00
	Strainer Backwash Failure Alarm Delay	1.00	1.00	1.00	1.00
	Flush Volume per Minute	58.00	58.00	58.00	58.00
	XR Enable	Enabled	Enabled	Enabled	Enabled

		Boonah	Kalbar	Laidley	Forrest Hill
CHN Setpoints					
Anologue Alarm Setpoints					
	LIT_2250_80 - CHN Skid Hot Water Tank Level - High High Alarm	100.00	100.00	100.00	100.00
	LIT_2250_80 - CHN Skid Hot Water Tank Level - High Alarm	95.00	95.00	95.00	95.00
	LIT_2250_80 - CHN Skid Hot Water Tank Level - Low Alarm	1.00	1.00	1.00	1.00
	LIT_2250_80 - CHN Skid Hot Water Tank Level - Low Low Alarm	0.00	0.00	0.00	0.00
	TIT_2250_80 - CHN Skid Hot Water Tank Temperature - High High Alarm	45.00	40.00	45.00	40.00
	TIT_2250_80 - CHN Skid Hot Water Tank Temperature - High Alarm	42.00	38.00	42.00	38.00
	TIT_2250_80 - CHN Skid Hot Water Tank Temperature - Low Alarm	0.00	0.00	0.00	0.00
	TIT_2250_80 - CHN Skid Hot Water Tank Temperature - Low Low Alarm	0.00	0.00	0.00	0.00
	LIT_2240_81 - Filtrate Rinse Water Tank Level - High High Alarm	100.00	100.00	100.00	100.00
	LIT_2240_81 - Filtrate Rinse Water Tank Level - High Alarm	90.00	90.00	90.00	90.00
	LIT_2240_81 - Filtrate Rinse Water Tank Level - Low Alarm	8.00	1.00	7.00	1.00
	LIT_2240_81 - Filtrate Rinse Water Tank Level - Low Low Alarm	2.00	0.00	6.00	0.00
	AIT_2250_80 - CIP pH Measurement - High High Alarm	14.10	14.00	14.00	14.00
	AIT_2250_80 - CIP pH Measurement - High Alarm	11.00	13.00	13.50	13.00
	AIT_2250_80 - CIP pH Measurement - Low Alarm	2.00	2.00	0.00	2.00
	AIT_2250_80 - CIP pH Measurement - Low Low Alarm	1.00	1.00	0.00	1.00
	AIT_2250_81 - CHN ORP Measurement - High High Alarm	1200.00	1200.00	1200.00	1200.00
	AIT_2250_81 - CHN ORP Measurement - High Alarm	1100.00	1100.00	1100.00	1100.00
	AIT_2250_81 - CHN ORP Measurement - Low Alarm	-100.00	-100.00	-150.00	-100.00
	AIT_2250_81 - CHN ORP Measurement - Low Low Alarm	-100.00	-400.00	-400.00	-400.00
Engineering Setpoint					
	Hot Water Tank Heater Enable Level	28.00	30.00	30.00	30.00
	Hot Water Tank Heater Disable Level	25.00	28.00	27.00	28.00
	pH Upper Discharge Limit	14.10	10	14.1	9
	ph Lower Discharge Limit	0.00	5.00	-1.00	6.00
	ORP Upper Discharge Limit	1400.00	1000.00	1550.00	1000.00
	Neutralisation Mixing Time	180.00	180.00	180.00	180.00
	Neut Acid Quantity	1.00	1.00	0.50	0.50
	Neut Caustic Quantity	1.00	0.50	0.50	0.50
	Neut SMBS Quantity	1.00	0.50	0.50	0.50
	Neut Auto Start Level	90.00	90.00	90.00	90.00
	NaOCL Dose Rate	300.00	300.00	300.00	300.00
	Citric Acid Dose Rate	300.00	300.00	300.00	300.00
	Caustic Dose Rate	300.00	300.00	300.00	300.00
Operator Setpoints					
	Hot Water Tank Gravity Fill	No	No	No	No
	Hot Water Tank Stop Fill Level	30.00	36.00	32.00	32.00
	Hot Water Tank Start Fill Level	6.00	6.00	6.00	6.00
	Hot Water Tank Heating Stop Temperature	27.00	27.00	32.00	32.00
	Hot Water Tank Heating Start Temperature	20.00	26.00	30.00	30.00
	Heater Enable	Yes	Yes	Yes	Yes
	Hot Water Tank Drain Level	6.00	4.00	6.00	10.00
	Hot Water Tank Gravity Drain Time	60	60	30	60
Pall Setpoints					
	EFM Exist	Yes	Yes	Yes	Yes
	Neutralisation Exist	Yes	Yes	Yes	Yes
	Hot Water Tank Exist	Yes	Yes	Yes	Yes
	Industrial Hot Water System Exist	No	No	No	No
	Solar Installed	No	No	No	No
	Acid Exist	Yes	Yes	Yes	Yes
	Caustic Exist	Yes	Yes	Yes	Yes
	Hupochlorite Exist	Yes	Yes	Yes	Yes
	HCL Exist	No	No	No	No

7.3 VALVE TABLE

The Value Truth Table provides the valve positions for each process of the Pall Aria™ Water Treatment System. The valve tag numbers shown correspond to the tag numbers shown on the P&ID drawings. The pneumatically actuated valves operate accordingly when the operator selects either a particular cycle or **AUTO** Mode.

Valve Description	Fill	Excess Recirculation	Upper Drain	Lower Drain	Filtrate Forward	Reverse Filtration Tank	Air Scrub	XR Bypass	Filtrate Forward	Module Rack Drain (To CIP)	Module Rack RF/AS Drain	Strainer Backwash Air Supply	Feed Tank Drain	RF Tank Drain	Filtrate Sample	Feed Turbidity	Air Supply Isolation	Air Flow Control	RF/AS Drain Sample	CIP Return
Valve P&ID Tag number ▶ / Process Description ▼	LCV-2211-01	VLV-2211-02(3)	VLV-2211-03	VLV-2211-04	VLV-2211-05	VLV-2211-06	VLV-1012-07A	VLV-2211-14	VLV-2211-20	VLV-2211-60	VLV-2211-61	SV-1	HV-2211-02	HV-2211-03	HV-2211-04	HV-2220-05	HV-1012-07	HV-1012-13	HV-2211-18	HV-2211-21
Fill	**M**	**O**	**X**	**X**	**O**	**X**	**X**	**X**	**O**	**X**	**X**	**O**	**X**	**X**	**S**	**O**	**O**	**O**	**X**	**X**
Forward Flow – Auto Filter (FF)	**M**	**O**	**X**	**X**	**O**	**O(2)**	**X**	**X**	**O**	**X**	**X**	**O**	**X**	**X**	**S**	**O**	**O**	**O**	**X**	**X**
Reverse Filtration (RF)	**X**	**X**	**O**	**O**	**X**	**O**	**X**	**X**	**O**	**X**	**O**	**O**	**X**	**X**	**X**	**O**	**O**	**O**	**S**	**X**
Air Scrub (AS)	**X**	**X**	**O**	**X**	**X**	**O**	**O(4)**	**X**	**O**	**X**	**O**	**O**	**X**	**X**	**X**	**O**	**O**	**O**	**S**	**X**
Forward Flush (FL)	**M**	**X**	**O**	**X**	**X**	**X**	**X**	**X**	**O**	**X**	**O**	**O**	**X**	**X**	**X**	**O**	**O**	**O**	**S**	**X**
CIP Circulation	**X**	**O**	**X**	**X**	**X**	**X**	**X**	**O**	**X**	**O**	**X**	**O**	**X**	**X**	**X**	**X**	**O**	**O**	**X**	**X**
EFM Circulation	**X**	**O**	**X**	**X**	**X**	**X**	**X**	**X**	**O**	**O**	**X**	**O**	**X**	**X**	**X**	**O**	**O**	**O**	**X**	**X**
EFM/CIP Forced Drain	**X**	**O**	**O**	**O**	**X**	**X**	**X**	**O**	**X**	**O**	**X**	**O**	**X**	**X**	**X**	**O**	**O**	**O**	**S**	**X**
EFM/CIP Gravity Drain	**X**	**O**	**O**	**O**	**X**	**X**	**X**	**O**	**X**	**O**	**X**	**O**	**X**	**X**	**X**	**O**	**O**	**O**	**S**	**X**
Integrity Test (IT)	**M(1)**	**X-O**	**X-O**	**X-O**	**O-X**	**X-O**	**O-X**	**X**	**O**	**X**	**X**	**O**	**X**	**X**	**X**	**O**	**O**	**O**	**X**	**X**
Feed Strainer Backwash (SBW)	**M**	**O**	**X**	**X**	**X**	**X**	**X**	**X**	**O**	**X**	**X**	**X**	**X**	**X**	**X**	**O**	**O**	**O**	**X**	**X**
CIP/EFM (Raw Water Rinse)	**M**	**O**	**O**	**X**	**X**	**X**	**X**	**O**	**X**	**X**	**O**	**O**	**X**	**X**	**X**	**O**	**O**	**O**	**S**	**X**
CIP/EFM (Filtrate Water Rinse)	**M(1)**	**O**	**O**	**O**	**X**	**X**	**X**	**O**	**X**	**X**	**O**	**O**	**X**	**X**	**X**	**O**	**O**	**O**	**S**	**X**

Legend: O = Open X = Closed O/X = Open and closed during cycle M = Modulating S = Open manual valve for sample during this process as required

Notes:

1. Will close on Feed Tank high level.
2. Will close on RF Tank high level.
3. V-2: Closed if XR not enabled via Pall Engineer Setpoint Screen.
4. Valve open unless pulsed A/S in enabled via Plant Engineer Screen (not typical operation).

7.4 AIR SCRUB FLOWMETER PRESSURE TABLE

HV-13 Controls Flowmeter. Pressure Read From PI2.

Number of Modules	Required SCFM	Flowmeter Reading (CFM) @					
		20PSIG	22PSIG	24PSIG	26PSIG	28PSIG	30PSIG
Correction Factor		1.54	1.58	1.62	1.66	1.70	1.74
1	3	2.0	1.9	1.8	1.8	1.8	1.7
2	6	3.9	3.8	3.7	3.6	3.5	3.4
3	9	5.9	5.7	5.5	5.4	5.3	5.2
4	12	7.8	7.6	7.4	7.2	7.0	6.9
5	15	10	9	9	9	9	9
6	18	12	11	11	11	11	10
7	21	14	13	13	13	12	12
8	24	16	15	15	14	14	14
9	27	18	17	17	16	16	15
10	30	20	19	18	18	18	17
11	33	21	21	20	20	19	19
12	36	23	23	22	22	21	21
13	39	25	25	24	23	23	22
14	42	27	27	26	25	25	24
15	45	29	28	28	27	26	26
16	48	31	30	30	29	28	28
17	51	33	32	31	31	30	29
18	54	35	34	33	32	32	31
19	57	37	36	35	34	33	33
20	60	39	38	37	36	35	34

PSI CORRECTION FACTOR = SQRT [(14.7 + WORKING PSIG) / 14.7]

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