# Application Guide XSeries G4 Plunger Application rev. AA

	Totalflow products	Doc name:	XSeries G4 Plunger Application
File name:	2104945MNAA.docx	Status of document:	Released
Issued by department:	Totalflow customer documentation	Distribution:	External public
Document No:	2104945-001	Creator name:	USHOSHE
Revision:	AA	Contact:	+1 918.338.4888 or 800.442.3097
Page:	1/36	Language:	En



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# 1.0 Overview

The ABB Totalflow Application within the XSeries Generation 4 hardware architecture allows the user to operate Plunger Lift Well site Hardware on Production Gas Well sites. It is intended to interface with plunger arrival switch, send on-off signals to production valve, and read well pressures and flow rate to determine optimum well plunger control conditions for well production. The Totalflow PCCU software is required to interface to the Totalflow G4 hardware for setup and configuration at the site.

The following diagram indicates the basic components of the system.



Figure 1 Basic System Components

### 1.1 How to use this guide

This document will instruct the user that is somewhat familiar with Plunger lift, how to setup and operate the ABB Totalflow Plunger Lift Application. We will go through basic start-up steps required to setup two (2) different Plunger Lift scenarios.

#### 1.2 Assumptions

This guide focuses on the initial configuration of Plunger lift. Physical and electrical installation instructions are included in separate documents. The following is assumed:

- All components have been installed correctly
- End Devices have been calibrated
- All components have been wired correctly
  - To provide/receive signals
- Power has been provided and all the devices are up

- Minimal verification has been performed to ensure the devices are drawing the correct power voltages for their operation.
- Proper grounding has been performed.
- PCCU Software has been installed on the machine you plan to use to setup and configure the plunger application with and is configured properly to communicate locally to the XSeries G4 hardware.

### 1.3 Prerequisites

The procedures described in this document apply to the following:

- PCCU software version 7.31 and later
- PCCU interface cable; can be serial ,USB or IP
- XRC (G4) Part# 2103329-001 software version 2103132-039 and later
- XFC (G4) Part# 2103328-001 software version 2102861-045 and later

# 1.4 Background

### 1.4.1 Plunger Lift Background

Before getting into the installation of the Plunger Lift, it can sometimes be helpful to understand the concept behind the device. The plunger works in a manner similar to a pneumatic piston wherein it is caused by gravity to fall to the bottom of a well. Acting as a seal between the liquid and gas, the plunger settles to the bottom of the production tubing and allows liquid to accumulate above it. This accumulation of liquid restricts the flow of gas, slowing it down. The production valve is closed to allow down-hole pressure to build in the casing. After the pressure has built, the production valve is opened, and the casing pressure lifts the plunger and accumulated liquids to the surface. At the surface, separators remove the liquids from the gas. Once the volume of the flowing gas drops, it becomes necessary to choose a time or method of closing the production valve. Once closed, the plunger drops to the bottom of the production tube. With the plunger deployed and the well shut-in, the down-hole pressure builds, and the cycle is repeated.

The entire operation takes place by the simple expediency of opening or closing a valve. There are many options available for determining when to open and close the valve, and these options can "tune" the plunger to optimize well production.



Figure 2 Plunger Site

### 1.4.2 Procedure Overview

The following general steps are needed from a system perspective for the Plunger Lift Application to be setup properly. The actual components required will depend on the specific scenario.

- Connect Components to Totalflow Device(wiring)
- Connect Totalflow Device using PCCU
- Add Applications to Device
- Program I/O setup (valve, arrival switch, etc.)
- Verify I/O operation
- Configure Plunger Application

# 2.0 Scenario 1- Plunger using "Timers" only

### 2.1 Timer Scenario Overview

In this scenario we will use only "Timers" within the Plunger Application to "Open" and "Close" the production valve. The ability to "Tune" the open and closed times of the valve for well optimization is not available in this "Timer" scenario. This is a very basic use of the Plunger Application and will not need information from the AGA-3 application such as Pressures and Flow rate to operate. We will however, need the "Plunger Arrival Switch" input (Pulse input) to sense plunger arrival and Digital Outputs 1 and 2 to "open" and "close" the production valve. The diagram listed shows the different "States" the Plunger Application will travel through in this scenario.



Figure 3 Plunger States

# 2.2 Assumptions

This particular example makes the following installation assumptions:

- A single upstream production valve (pneumatic/spring) is used.
- The production valve (pneumatic valve) will close on a system failure.(Failed State)= 4 consecutive non-arrivals of the plunger
- A Dual 12VDC 2-way solenoid valve is used to control the production valve. This is a control valve that uses a pressurized air supply to drive the production valve open and closed.
- An XFCG4 flow computer will interface to the 12VDC 2-way solenoid valve through the on-board Digital Outputs (DO1 > Open, DO2 > close) and use the on-board Pulse Input (PI1) for Plunger Arrival Switch (see Connect Components wiring section).
- An XFCG4 will be used to run the Plunger Application.
- This example will incorporate an arrival sensor and a plunger.

- The main production valve will *open* when following occurs; Plunger fall timer expires(25 min) + Closed timer expires(allows for bottom press to build,10min)
- The main production valve will *close* when the following occurs; Plunger arrival time (estimated 8 min) + Afterflow time (5 min) conditions have transpired.
- Well depth is 5,000 feet using 2% inch tubing (1.998 I.D.). It is estimated that the plunger will take approximately 25 minutes to fall under normal loading conditions. This estimated "fall time" can be determined by calculating the depth of the well divided by 200 (ft. /min). {5000/200=25}
- "Optimization" or "Tuning" will not be an option in this "Timer only" Scenario.



Figure 4 Plunger "Timer" site

# 2.3 Connect Components (wiring)



The wiring of the valve and plunger arrival switch depends on the X-Series device used and whether these are direct connections (onboard) or use extension modules. Wiring terminations should always be performed with the power off in the device.

- The example used in this basic configuration case and shown in Figure (2-3) illustrates the connections required to use an XFC to control a single 2way solenoid production valve with input from the plunger arrival switch. The diagram for this scenario shows direct connections to the board.
- 2) Connect the valve to the XFC's digital ouputs (DO1/DO2)
- 3) If deriving power from the XFC board connect the valve to J4- Pin2.
- 4) Connect the Plunger arrival switch on the XFC board on Pulse Input 1 (PI1)
- 5) After completing connections, turn on the power on the device
- 6) Verify power on sequence is correct, etc
- 7) Verify the arrival switch and valve I/O connections in the following procedures



Figure 5 Plunger I/O wiring

# 2.4 Connect using PCCU

Verify you are able to connect with the device using PCCU and change view to prepare for configuration.

- 1) Connect laptop with PCCU software to the device.
- 2) Click the "Entry" button on the top menu bar and verify PCCU establishes a connection with the device.

3) Click on "View" at the top menu, and then choose "Expert" from the drop down list.



Figure 6 Plunger View Setup

# 2.5 Add the Plunger Application

Add the plunger application to begin configuration. The application is added by completing the following steps.

- 1) Click on the station name (top node on the tree view on the left). If this is a new installation the name is "TOTALFLOW"
- 2) Go to the Applications tab
- 3) Click "Add Application"
- 4) Choose "Plunger Control" from the drop down menu (the slot number is chosen automatically, the Plunger slot # is 121).
- 5) Click send to save.
- 6) Click Re-read to verify the application has been added in the slot indicated

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- TOTALFLOW  - Communications	Station Setup Ap	oplications App Licensing Battery Information	n Resources	System L	.og Security Log Regist	ΣY.	
- Totalflow - TCP	App Number	Туре	Revision	Station	Directory	Restart	
MMI Serial + COM0	0	System	2103280-008		Dir = \		
TF Remote - COM1	1	Communications	2101348-004		Dir = \Comm-1		
Modbus - COM2	2	Communications	2101340-004		Dir = \Comm-2		
I/O Interface     Flow Measurement	3	Communications	2101340-004		Dir = \Comm-3		
Setup	4	Communications	2101341-004		Dir = \Comm-4	 [7]	
Analysis	5	Communications	2101344-004		Dir = \Comm-5		
Digital Outputs	7	I/O Interface XSeries	2103134-005		Dir = VOS		
- Adv Setup	8	Display XSeries	2403437 002		Dir = \Display		
Speed of Sound	9	Holding Regist Add New Application	_	×	Dir - Wolding		
Display     Helding Registers	10	Operations			Dir = \Operations	 [7]	
Operations	11	AGA-3 Measur	Application to ac	a	Dir = VAGA3-1		
Trend System	95	Trend System	er Control	-	Dir = \Trend		
⊡- Plunger	121	Plunger Contre	ns Slave	<u></u>	Dir = \Plunger-1	[7]	
E- CLOSED		AGA-	3 Measurement				
		AGA- Trend	/ Measurement I System				
- 2:Closed		Alarm	Accumulator		2 2		
- 3:Waiting		PID C Valve	ontroller Control				
5:Arrived		Shutd	lown System	- 11			
6:Afterflow		Pad C	ontroller	2			
E- Statistics		Pump Oli Cu	Interface istody Transfer	Vez 🚺			
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		IP Mu	e su Itiplexer				
Ready		Gas L API Li	ift iquid SU	-	#Pol	ls: 59 #Errors: 0 Connected to XFC-h	ioward Login: user

Figure 7 Add Plunger App

# 2.6 Plunger General Setup

The "General Setup" provides us a way to turn the Plunger App and Optimization on and off. The following steps are provided.

- 1) Go to Plunger>Setup>General Setup and "Disable" Plunger Control. We do not want the Plunger App to run until we have it set up completely.
- 2) Select "Disable" for Optimization. Until we have Plunger App and the associated Optimization (Tuning) parameters set up we need this feature disabled.



Figure 8 General Setup

### 2.7 Plunger Valve Setup

The "Valve Setup" will provide for necessary setup surrounding our production valve. The following steps are provided concerning the valve setup.

- Go to Plunger>Setup>Valve Setup and verify that the "Valve Position" value field is set for "Upstream". This implies that the valve is *upstream* from the point at which we are taking the "line pressure" reading on the measurement tube.
- 2) "Valve Time Limit" needs to have a value of "5" entered. This is the time in seconds that the Digital Output will energize while *manually* operating the valve.
- 3) "Main Valve Type" allows for the type of outputs used for the valve. Enter "Latch-Two output" for our scenario. This means that two Digital Outputs will be used to operate the valve and that those outputs will remain "latched" or "on" till command is given to turn off.
- 4) "Main Open DO" value field should be set as "7.2.4". This represents the Digital Output # 1. "Main Close DO" value field should be set as "7.2.5". This would represent assignment of Digital Output # 2.

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- TOTALFLOW  - Communications	General Setup Valve Setup Tube Setup Input Setup						
- Totalflow - TCP							
- Totalflow - USB	Description Value State Comment						
- MMI Serial - COM0	121.4.2 Closing Valve 00:00:07:51 00:00:000 State / Timer / Max Timer						
IF Remote - COM	ON/OFF CONTROL						
I/O Interface	121.1.2 Valve Position Upstream Valve position relative to meter. This is set from valve control screen when VCntrl Option is enable	led					
Flow Measurement	121.2 1 Valve Time Limit 5 Seconds Time to energize Digital Output's to control the valve manually(not valve control)						
Setup							
- Analysis	MAIN VALVE SETUP						
Digital Outputs	12112 Main Value Type Latch Two output Specifies the number and type of outputs used for the Main Value When Value Control is not used						
- Adv Setup	211.2 main varie Type Laterin to output appendix and type or output and the second of						
- Speed of Sound	121.3.1 Main Open 00 1.2.4 High Address or main valve Open Lingtal Output when valve Control is not used. Auto = IOS.LILUO.2						
Display	121.3.1 Main Close D0 7.2.5 Low Address of Main Valve Close Digital Output when Valve Control is not used. Auto = 105.DID0.3						
- Holding Registers	121.1.28 Main Valve Fail State Close Fail Main Valve Position						
Operations     Transf Sustain							
Plunger	121.1.30 Manual Main Valve Open NOW Auto						
- Setup	121.1.33 Manual Main Valve Close NOW Auto						
- CLOSED							
1:Falling	BLOW VALVE SETUP						
- OPEN	121.1.37 Blow Valve Type Disable Specifies the number and type of outputs used for the Blow Valve						
3:Waiting							
5:Arrived	CAPTURE VALVE SETUP						
- Otenternow	121.1.44 Capture Valve Type Disable Specifies the number and type of outputs used for the Capture Valve						
	Alter State Control or Control or Control of Contr						
	12.1.2.4 Valve Controller (Uption) Ulsabled Uptional - use valve control during now cycle(Prolinger Arriving and Atterritow)						
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	Reread Montor Print Screen Save Send Close Help XHel	ip 🧶					
Redr. #Polls 64 #Errors 0 Connected to XFC-boward Logic user							

Figure 9 Valve Setup

# 2.8 Plunger Input Setup

The "Input Setup" will provide the Plunger Application necessary information for register location of the plunger arrival switch. The following is provided concerning this setup.

- 1) Go to Plunger>Setup>Input Setup and verify that "Detection Type" is set up for "Plunger".
- Plunger arrival switch location needs to be established by entering "7.0.104" in the Register field in "Plunger Arrival PI". This will confirm use of Pulse Input # 1 for the arrival switch.

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- TOTALFLOW	Gener	ral Setup	Valve Setup Tube Setup Input Setu	p		
Totalflow - TCP						
Totalflow - USB			Description	Register	Value	Comment
MMI Serial - COM0	12	21.4.2	Closing Valve	00:00:14:21	00:00:25:00	State / Timer / Max Timer
Modbus - COM2						
⊕- I/O Interface			INPUT VALUE REGISTERS			
Flow Measurement	12	21.3.6	Casing Pressure Al	0.0.0	300	Address of Casing Pressure AI, normal = IOS.3.4 (AI5)
Setup	12	21.3.5	External Pressure Al	0.0.0		Address of External Pressure AI. Used for either tubing or line pressure depending on valve location
Digital Outputs	12	21.3.9	Hold Pressure Register	0.0.0	0	Address of Hold Pressure Al
No Flow	12	21.3.10	Open 1 Register	0.0.0	0	Address of Open 1
Adv Setup	12	21.3.11	Open 2 Register	0.0.0	0	Address of Open 2
Speed of Sound	12	21.3.12	Close 1 Register	0.0.0	0	Address of Close 1 (in1)
Holding Registers	12	21.3.13	Close 2 Register	0.0.0	0	Address of Close 2 (in2)
Operations	12	21.3.26	Hold External Register	0.0.0	Low	Address of Hold External
Trend System						
- Setup			MISC REGISTERS			
CLOSED	12	21.1.4	Detection Type	Plunger		Selects whether a plunger is being used or if the logic will act as an intermitter
1:Falling	12	21.3.0	Plunger Arrival Pl	7.0.104	0	Address of plunger arrival Pulse Input - Current
					2	
3:Waiting	12	21.3.27	Restart Button Register	0.0.0		Address of Restart Plunger DI
5:Arrived	12	21.3.28	Open button	0.0.0	Low	Address for valve open push button DI
Statistics	12	21.3.29	Close button	0.0.0	Low	Address for valve close push button DI
	< Re-	read	Montor	L		Print Screen Save Send Dose Help XHelp 10
Ready						#Polls: 67 #Errors: 0 Connected to XFC-howard Login: user

Figure 10 Input Setup

# 2.9 Verify (Test) I/O Operation

### 2.9.1 Test Arrival Switch

The true test of the Plunger arrival switch is confirmed by an indication by the plunger application that the plunger arrived during a normal plunger run. However, the user can perform a simple test to determine if the switch is working correctly prior to an actual plunger run by performing the following steps.

- 1) Verify that "Plunger Control" is in "Disable" mode in Plunger>General Setup.
- 2) Proceed to "I/O Interface" in the tree view and view the "Total Pulse Count" value field.
- 3) Using something metallic, a crescent wrench or valve handle, swipe up and down across the back of the switch to simulate a plunger arriving.
- 4) If the switch is good, "PI1" under "Total Pulse Count", should indicate an increase in pulse count.

### 2.9.2 Test valve output

In this scenario we will operate the Production valve from Digital Output 1 (open) and Digital output 2 (close) respectively. Use the following testing procedure to test the valve "open" and "closed".

- 1) Verify that "Plunger Control" is in "Manual" mode in Plunger>General Setup.
- 2) Go to Plunger>Setup>Valve Setup. One at a time select "Force OPEN" and then "Force CLOSE" and verify valve action.
- 3) Return Plunger mode to "Disable" upon completion of testing

### 2.10 Configure Plunger

The following steps will give the user specific instructions on setting up the Plunger "Timer" scenario using PCCU software.

#### 2.10.1 Configure Plunger "Closed" condition

Now we are ready to setup our "Closed" conditions (valve is closed) that need to be met in order for the valve to OPEN. To begin,

- 1) Go to Plunger>CLOSED>1: Falling, and "ENABLE" in the tree view window.
- 2) Enter the "Plunger Fall Delay" time in the "Fall Timer" location. Our fall time in this scenario is 25 minutes.

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E TOTALFLOW	1:Closing Val	/e				
Communications     Totalflow - TCP	_					
- Totalflow - USB		Description	Value	Limit	Comment	
MMI Serial - COM0	121.4.2	Closing Valve	00:00:00:18	00:00:25:00	State / Timer / Max Timer	
TF Remote - COM1		PLUNGER FALL DELAY				
Modbus - COM2	121.4.4	Fall Timer	00:00:00:18	00:00:25:00	Time to wait when closing valve before going to state 2	
Elow Measurement		VALVE CLOSE CHECK				
Setup	121.1.49	Valve Close Check (Option)	Disabled		Option - Use only flow to verify Valve Close	
Analysis						
Digital Outputs						
- No How						
Display						
Holding Registers						
- Operations						
TFWeb Server						
Trend System						
- Plunger Cature						
CLOSED						
- 1:Falling						
- OPEN						
3:Waiting						
5:Arrived						
6:Afterflow						
i - Statistics						
	-					
	Re-read	Monitor			Print Screen Save Send Close Help	X Help 💐
Ready					#Polls: 77 #Errors: 0 Connected to XFC-howard	Login: user

Figure 11 Fall Timer

- 3) Go to Plunger>CLOSED>2: Closed, and "Enable" the Closed Timer.
- 4) Enter 10 minutes in the "Closed Timer" field location. This will be the time we are allowing for the well to build pressure *after* plunger fall delay has occurred.

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- TOTALFLOW		osed-Setup	Closed HOLD 2: Close Timer				
Communications     Tatalilian TCD						-	
- Totalflow - USB			Description	Value	Limit	Comment	
MMI Serial - COM0		121.4.2	Closing Valve	00:00:11:28	00:00:25:00	State / Timer / Max Timer	
TF Remote - COM1		121.1.16	Hold / Open Reason	None	None		
Modbus - COM2			2:Open Valve Enables		1	Reasons To End Valve Closed	
- Flow Measurement		121.1.51	Closed Timer	ENABLED	00:00:10:00	Optional - Use timer to open main valve	
Setup		121.1.62	Tube-Line Open	Disabled	0.0000	Optional - Use tubing-line pressure to open main valve	
Digital Outputs		121.1.63	Case-Line Open	Disabled	160.0000	Optional - Use case-line pressure to open main valve	
No Flow		121.1.67	C-L & T-L Open	Disabled		Optional - Use Case-Line and Tube-Line to open main valve	
Adv Setup		121.1.64	Case-Tube Open	Disabled	0.0000	Optional - Use casing-tubing to open main valve	
Display		121.1.66	"C-T & T-L" Open	Disabled		Optional - Use casing-tubing AND Tube-Line to open main valve	
Holding Registers		121.1.68	Load Ratio Open	Disabled	0.0000	Optional - Use Load Ratio to open main valve	
Operations     Trand Surtam		121.1.124	Foss Gaul Open	Disabled	61.3768	Optional - Use Foss Gaul to open main valve, LR=C-T/C-L	
- Plunger		121.1.54	Tube Pressure Open	Disabled	0.0000	Optional - Use Tubing Pressure to open main valve	
Setup		121.1.52	Case Pressure Open	Disabled	0.0000	Optional - Use Casing Pressure to open main valve	
CLOSED		121.1.56	SP Open	Disabled	0.0000	Optional - Use Static Pressure to open main valve	
2:Closed		121.1.58	Open 1	Disabled	0.0000	Optional - Use Open 1 to open main valve	
- OPEN		121.1.60	Open 2	Disabled	0.0000	Optional - Use Open 2 to open main valve	
. Statistics							
	к. м.						
	Revead Monitor Print Screen Save Send Close Help X.Help (2000)						
Ready	p				#Polls: 18	81 #Errors: 0 Connected to XFC-howard Login: user	

Figure 12 Closed Timer

# 2.10.2 Configure Plunger "OPEN" condition

- 1) Go to Plunger>OPEN>6:Afterflow, and "Enable" the "AfterFlow Timer Close (Option).
- 2) Set the "AfterFlow Timer Close (Option)" to 5 minutes. After the plunger arrives and this timer expires, the valve will CLOSE.

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Image: Standard St	I Operate View Window He	elp						- 8
Commissions     Commissions     Consignations     Consignatio	10 🛅 🖫 💽 💽	ia 🗟	📰 🗣 📽 🚇	🔧 J 🤌	3			
Operations         Instantiations         Instentiations         Instantion	E TOTALFLOW	6:AF Setup	6:AF Timer					
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Mid Striat - COMU     121.4.2     Closing Value     0000-025.5     0000-205.0     0ptional - Use Afterflow Timer to close (Option)     10.1.8.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1	Totalflow - USB		Description	Value	Limit	Comment		
TP Remote - CONU     Moduse - CONU     Tophys     Tophys     Supprime     Tophys     Tophys     Supprime     Supprim     Supprime     Supprime     Supprim     Supprim     Supprim	MMI Serial - COM0	121.4.2	Closing Valve	00:00:20:55	00:00:25:00			
Modus - COA2     Modus     Modus - COA2     Modus - COA2     Modus - COA2     Modus -	TF Remote - COM1	121.1.85	AfterFlow Timer Close (Option)	ENABLED	00:00:05:00	Optional - Use AfterFlow timer to close main valve		
Provintional determinant       121138       Load Ratio Close (Option)       Disabled       0.0000       Optional - Use Load Ratio Close main valve       1	- Modbus - COM2	121.1.92	Turner FR Close (Option)	Disabled	0.0000	Optional - Use Turner Flow Rate to close valve		
Supp Analysis bigtal Outputs Ho Row Adv Step Digital Outputs Ho Row Adv Step Digital Outputs Ho Row Adv Step Digital Outputs Ho Row Adv Step Digital Outputs Holding Righters Dependent Disabled Coption Disabled	B-Flow Measurement	121.1.98	Load Ratio Close (Option)	Disabled	0.0000	Optional - Use Load Ratio to close main valve		
- Analysis     121.135     flow Rate Close (Option)     Disabled     0.0000     Optional - Use flow rate to close main valve       - Digital Outputs     - No Flow     - Advisis     - Close value for Casing Rise     - Close value for Casing Rise       - Digital Outputs     - No Flow     - Close value for Casing Rise     - Close value for Casing Rise     - Close value for Casing Rise       - Digital Outputs     - Close value for Casing Rise     - Close value for Casing Rise     - Close value for Casing Rise       - Digital Statistics     - Close value for Casing Rise     - Close value for Casing Rise     - Close value for Casing Rise       - Trively Steret     - Close Value for Casing Rise     - Close value for Casing Rise     - Close value for Casing Rise       - Trively Steret     - Close Value for Casing Rise     - Close value for Casing Rise     - Close value for Casing Rise       - Trively Steret     - Close Clopicin)     Disabled     0.0000     Optional - Use casing-Pressure to close main value     - Close       - Distaling     - Close     - Close     - Close Clopicin)     Disabled     0.0000     Optional - Use Stating Pressure to close main value     - Close       - Distaling     - Schoe     - Elsaling     - Schoe     - Close (Option)     Disabled     0.0000     Optional - Use Tubing pressure to close main value     - Close       - Stating     - Stating     -	Setup	121.1.91	DP Close (Option)	Disabled	0.0000	Optional - Use DP to close main valve		
Inder Down     Av Scrup     Casing Rise (Option)     Disabled     0.000     Optional - Clese valve for Casing Rise     Inder Down       Av Scrup     Casing Rise (Option)     Disabled     0.000     Optional - Clese valve for Casing Rise     Inder Down       Big Digsty     Holding Righters     Digsty     Disabled     0.000     Optional - Clese valve for Casing Rise     Inder Down       Big Digsty     Holding Righters     Disabled     0.000     Optional - Use tabling pressure to close main valve     Inder Down       Big Digsty     Case Close (Option)     Disabled     0.000     Optional - Use tabling pressure to close main valve     Inder Down       Strap     Close (Option)     Disabled     0.000     Optional - Use tabler pressure to close main valve     Inder Down       Close Option     Disabled     0.000     Optional - Use tabler pressure to close main valve     Inder Down       Stabled     Close Option     Disabled     0.000     Optional - Use tabler pressure to close main valve     Inder Down       Stabled     Close Option     Disabled     0.000     Optional - Use tabler pressure to close main valve     Inder Down       Stabled     Close Option     Disabled     0.000     Optional - Use Tabler pressure to close main valve     Inder Down       Stabled     Stabled     0.000     Optional - Use Tabler press	Analysis	121 1 95	Flow Rate Close (Option)	Disabled	0.0000	Optional - Use flow rate to close main valve		
Add Stop     Add Stop       Bigstor     District       Construct     Construct       Construct <t< td=""><td> Digital Outputs</td><td>121 1 129</td><td>Casing Rise (Ontion)</td><td>Disabled</td><td>0.0000</td><td>Ontional - Close value for Casing Rise</td><td></td><td></td></t<>	Digital Outputs	121 1 129	Casing Rise (Ontion)	Disabled	0.0000	Ontional - Close value for Casing Rise		
Diplay       Linits       Tube Linits       Upber Linits	- Adv Setup	121.1.120	Casing Slope (Option)	Disabled	0.0000	Optional - Close value for Casing Surav		
Indiag Registers     In Line Lune Lune (uppen)     Usable uppen)     Uppen)       Operations     Trud System     In Line Lune Lune (uppen)     Uppen)       In Trud System     In Line Lune Lune (uppen)     Uppen)     Uppen)       In Trud System     In Line Lune (uppen)     Uppen)     Uppen)       In Trud System     In Line Lune (uppen)     Uppen)     Uppen)       In Trud System     In Line Class (Option)     Uppen)     Uppen)       In Trud System     In Line Lune (uppen)     Uppen)     Uppen)       In Trud System     In Line Lune (uppen)     Uppen)     Uppen)       In Trud System     In Line Lune (uppen)     Uppen)     Uppen)       In Trud System     In Line Lune (uppen)     Uppen)     Uppen)       In Trud System     In Line Lune (uppen)     Uppen)     Uppen)       In Trud System     In Line Lune (uppen)     Uppen)     Uppen)       In Trud System     In Line Lune (uppen)     Uppen)     Uppen)       In Trud System     In Line Lune (uppen)     Uppen)     Uppen)       In Trud System     In Line Lune (uppen)     Uppen)     Uppen)       In Trud System     In Line Lune (uppen)     Uppen)     Uppen)       In Trud Lune (uppen)     In Line Lune (uppen)     Uppen)       In Trud Lune (uppen)	Display	121.1.100		Disabled	0.0000	Optional - Close valve for Casing Sway		
Cosetions     TriveSever     Tr	Holding Registers	121.1.90	Tube-Line Close (Option)	Disabled	0.0000	optional - use tubing-line pressure to close main valve		
Trad Splem       [21.18]       Case Close (Option)       Disabled       0.0000       Optional - Use Satis pressure to close main valve         Phong       ClosE       [21.18]       SP Close (Option)       Disabled       0.0000       Optional - Use Satis pressure to close main valve         CloSE	Operations     TEWeb Server	121.1.97	Case-Tube Close (Option)	Disabled	0.0000	Optional - Use casing-tubing to close main valve		
Planger     121.1.8     SP Close (Option)     Disabled     0.0000     Optional - Use Static Pressure to close valve       - Schup     - Close     - Schup     121.1.87     Tubing Close (Option)     Disabled     0.0000     Optional - Use Static Pressure to close valve       - Schored     - Schored     - Schored     - Schored     - Schored     - Schored       - Schored     - Schored     - Schored     - Schored     - Schored       - Schored     - Schored     - Schored     - Schored       - Schored     - Montor     - Pint     Screen Save     Send	Trend System	121.1.86	Case Close (Option)	Disabled	0.0000	Optional - Use casing pressure to close main valve		
- Sctup G. CLOSED - J-Folling - ZClosed G. OPEN - Striked - Strikertow @: Statistics - Reread Montor - Montor - Montor - Strikertow - Montor -	- Plunger	121.1.89	SP Close (Option)	Disabled	0.0000	Optional - Use Static Pressure to close valve		
COSEDLEAling LCosed OPUN SWating SW	Setup	121.1.87	Tubing Close (Option)	Disabled	0.0000	Optional - Use Tubing pressure to close main valve		
	CLOSED Lifalling 2.Closed 0 OFN 33Waiting 5.Antrived 6.Anterflow 10 Statistics	Reread	Montor			Perat Screen Sove) Send Cose Help	XHe	lo Q
							_	

Figure 13 Afterflow Timer

#### 2.10.3 Set the Plunger maximum arrival time

The "Max Arrival Time Limit" needs to be set in order for us to determine if a plunger fails to arrive, and therefore the plunger application will be in a "Failed" state which results in halting plunger control.

- 1) Go to Plunger > OPEN > 3:Waiting,
- 2) Set the time limit to a value greater than the longest expected plunger arrival time. In our sceneario, we will assume this value at 40 minutes.
- 3) Set the "Fail Limit" to a value of "3", which will then allow the plunger application to go into the "Failed" state after 4 continuous late arrivals.

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- TOTALFLOW	3:Waiting					
- Totalflow - TCP						1
Totalflow - USB		Description	Value	Limit	Fail Limit	Comment
MMI Serial - COM0	121.4.2	Closing Valve	00:00:17:19	00:00:25:00		State / Timer / Max Timer
TF Remote - COM1		CLOSE VALVE ENABLES				Reasons to end 3:Arriving/6:AfterFlow
I/O Interface	121.1.84	Flow Timer Close (Option)	Disabled	00:00:00:00		Optional - Use Flow timer to close main valve
- Flow Measurement	121.1.99	Close 1 (Option)	Disabled	0.0000		Optional - Use Close 1 to close valve
Setup	121.1.102	Close 2 (Option)	Disabled	0.0000		Optional - Use Close 2 to close valve
Analysis Digital Outputs						
No Flow	121.4.24	Arrival Timer / Last	00:00:00:00	00:00:00:00		Elapsed time since valve was commanded open and plunger i
Adv Setup						
⊞- Display	121.1.105	Mandatory Recovery Time	Disabled	00:00:00:00		Stay Closed Longer if plunger does not arrive
Holding Registers		ARRIVAL TIME LIMITS			V	
- TFWeb Server	121 2 12	Max Ary Count / Time / Fail	0	00:00:40:00	3	IF arrival time exceeds THEN tune, and Use: Mandatory Recove
In Trend System	121.2.9	Slow Ap; Count / Time	0	00.00.00.00		If plunger arrives slower than this then tune
⊟- Plunger	121.2.0	Normal Apr Count	244	00100100100		Normal Arrival De Not Tune
Secup	121.2.10		211			
1:Falling	121.2.8	Fast Arv Count / Time	6	00:00:07:00		If plunger arrives sooner than this then tune
2:Closed	121.2.11	Min Count / Time / Fail	4	00:00:00:30	0	If plunger arrives faster than this, don't tune
OPEN	121.1.7	Reset Plunger Counters	No		<u> </u>	Clear counters used to track plunger arrivals
6:Afterflow						
Statistics						
Events						
Cycles						
- Fail						
Flt Pt Time	•					F
	Re-read	Monitor			Print	Screen Save Send Close Help X Help 🧶
Ready					#Polls: 95	#Errors: 0 Connected to XFC-howard Login: user

Figure 14 Max Arrival Time

### 2.10.4 Enable the Plunger Application

The final task in completing this scenario is to "Enable " the plunger application. To accomplish this:

- Go to Plunger > Setup > General Setup, and select "Enabled" in the Plunger control value field. You should now see the plunger application begin in the "Closing Valve" state with timer counting up.
- 2) Select "Monitor" at the bottom left of your PCCU screen to have the screen update.

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E- TOTALFLOW	General Setup	Valve Setup Tube Setup	Input Setup				
- Totalflow - TCP							
Totalflow - USB		Description	Value	Units	Comment		
MMI Serial - COM0	121.45	Closing Valve	00:00:00:45	00:00:25:00	State / Timer / Max Timer		
TF Remote - COM1		COMMON SETUP	· · · · · ·		Other setup variables can be found in their specific State tabs		
Modbus - COM2	121.1.0	Plunger Control	Enabled		Enable plunger control state machine. Disable resets the controller.		
E-Flow Measurement	121.1.2	Cycle Start	Close-Close		Cycle runs from Open-Open or Close-Close		
Setup	121.0.10	Trand FileName					
Analysis	121.0.10	Trend Filenanie					
Digital Outputs							
No Flow		RESET OPTIONS					
Adv Setup	121.1.20	Startup Mode	1 Closing Valve		Startup state on Enable/Reset		
Holding Registers	121.1.3	Safety Reset Mode	Disable				
Operations							
TFWeb Server		TUNING					
Trend System	121.1.1	Optimization	Disabled		Enables or disables the continuous adjustment of all setpoints		
Setun	121.5.28	Plunger Fail Tune	1.5000		If plunger fails, multiply the next tuning by this factor		
CLOSED							
1:Falling							
		WELL GEOMETRY					
D-OPEN	121.5.26	Tubing Length	0.0000	Length	The length of tubing from the stop to the arrival sensor, used to calculate lift velocity		
	121.5.27	Tubing ID	0.0000	Inches	The inner diameter of the well tubing, used to calculate the Turner Flow Rate		
6:Afterflow	121.5.23	Fluid Gradient	0.4330		Slug Size Constant (0.433)		
- Statistics							
Events	121.2.0	Log Size	30		Size of Cycle, Blow and Fail Logs		
- Cycles	121.2.19	Event Log Size	100				
- Fail		1		J			
- Fit Pt Time	•				•		
	Reread Monitor Print Screen Save Send Close Help X Help (2)						
Ready	,				#Polls: 146 #Errors: 0 Connected to XFC-howard Login: user		

Figure 15 Enable Plunger App

# 2.10.5 View Plunger Application activity

To view activity of the Plunger application as it proceeds through the different states and to watch timers, use the "Summary View" tab. It can be located by selecting "Plunger" in the tree view.

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TOTALFLOW	Summary										
Totalflow - TCP											
- Totalflow - USB		Description	Value	Limit	Time Limit	Tune	Min	Max	Misc		
MMI Serial COM0	121.1.0	Enable	Enable								
TF Remote - COM1	121.1.8	Reset	non-reset								
Modbus - COM2	121.1.18	Current State	Closing Valve	00:00:22:18	00:00:25:00	1.5					
- Flow Measurement	121.1.134	Shutdown status	ok					•			
Setup		******* VALVES ******									
Analysis Digital Outputs	121.1.25	Main Valve	Closed	Auto Open	Auto Close				Latch-Two		
No Flow	6	········ CLOSE ·······									
Adv Setup		1: Falling/Closing Valve									
Display	121.4.4	Plunger Fall Delay	00:00:22:18		00:00:25:00						
Holding Registers		2: Closed									
TFWeb Server	121.4.9	Close Timer	00:00:06:52		00:00:10:00						
Trend System	121.1.16	2: Hold Close			None				Hold Close Reason		
Plunger     Setup	121.1.10	········· OPEN ·······			None				OPEN Reason		
- CLOSED	141.1.1	2: Plunger Arriving			none				or Lin Neuson		
1:Falling	121.4.24	Arrival Timer	00-00-00		00-00-00-20	00-00-07-00	00-00-00-00	00-00-40-00	Min/East/Slow/Max		
2:Closed	121.9.29	Arrival Timer	00.00.00.00		00.00.00.30	00.00.07.00	00.00.05.00	00.00.40.00	MINITASU SIOWIMAX		
- OPEN		6: Flowing									
5:Arrived	121.4.30	Flow Timer	00:00:08:02	00:00:00:00							
6:Afterflow	121.4.32	Atterflow Timer	00:00:05:01	00:00:05:00							
E- Statistics		FAIL MININ									
Cycles	121.1.15	0: Fail Reason	None						01/01/1900 00:00:00		
Plunger											
Fail											
t fine											
	Re-read	Monitor				Print Scre	en Save Se	nd Close	Help XHelp 🦄		
	J Beading Summary										

Figure 16 Summary View

# 3.0 Scenario 2- Plunger using "Casing-Line (Open) Flowrate

# (Close)

# 3.1 Casing-Line Scenario Overview

In this scenario we will use "Casing Pressure – Line Pressure" as the determining factor within the Plunger Application to "Open" and use "Flowrate" to determine when to "Close" the production valve. We will have the ability to "Tune" the open and closed times of the valve for well optimization in this scenario. The plunger application will also interface with the AGA-3 application which will provide Line Pressure and Flow rate values. In addition, we will need the "Plunger Arrival Switch" input (Pulse input) to sense plunger arrival, Digital Outputs 1 and 2 to "open" and "close" the production valve and a Casing Pressure transmitter to determine our casing pressure. The diagram listed shows the different "States" the Plunger Application will travel through in this scenario.



Figure 17 Plunger States

# 3.2 Assumptions

This particular example makes the following installation assumptions:

- A single upstream production valve (pneumatic/spring) is used.
- The production valve (pneumatic valve) will close on a system failure.(Failed State)= 4 consecutive non-arrivals of the plunger
- A Dual 12VDC 2-way solenoid valve is used to control the production valve. This is a control valve that uses a pressurized air supply to drive the production valve open and closed.
- An XFCG4 flow computer will interface to the 12VDC 2-way solenoid valve through the on-board Digital Outputs (DO1 > Open, DO2 > close) and use the

on-board Pulse Input (PI1) for Plunger Arrival Switch and use Analog Input # 1 for Casing Pressure (see Connect Components wiring section).

- An XFCG4 will be used to run the Plunger Application and the AGA-3 application.
- The main production valve will *open* when following occurs; Plunger fall timer expires(25 min) then, Casing Pressure – Line Pressure set point is exceeded for a minimum of 1 minute.
- The main production valve will *close* when the following occurs; Plunger arrival time (estimated 8 min) then, Flowrate is below set point for a minimum of 1 minute.
- Well depth is assumed to be 5,000 feet using 2<sup>3</sup>/<sub>8</sub> inch tubing (1.998 I.D.). It is estimated that the plunger will take approximately 25 minutes to fall under normal loading conditions.
- "Optimization" or "Tuning" will be utilized in this Scenario.



Figure 18 Plunger Site

# 3.3 Connect Components (wiring)



The wiring of the valve and plunger arrival switch depends on the XSeries device used and whether these are direct connections (onboard) or use extension modules. Wiring terminations should always be performed with the power off in the device.

- The example used in this basic configuration case and shown in Figure (3-3) illustrates the connections required to use an XFC to control a single 2way solenoid production valve with input from the plunger arrival switch. The diagram for this scenario shows direct connections to the board.
- 2) Connect the valve to the XFC's digital ouputs (DO1/DO2)
- 3) If deriving power from the XFC board connect the valve to J4- Pin2.
- Connect the Plunger arrival switch on the XFC board on Pulse Input 1 ( PI1)
- 5) Connect Casing Pressure transmitter on the XFC Board on Analog Input # 1 (Al1).
- 6) After completing connections, turn on the power on the device
- 7) Verify power on sequence is correct, etc
- 8) Verify the arrival switch and valve I/O connections in the following procedures



Figure 19 Plunger I/O wiring

# 3.4 Connect using PCCU

Verify you are able to connect with the device using PCCU and change view to prepare for configuration.

1) Connect laptop with PCCU software to the device.

- 2) Click the "Entry" button on the top menu bar and verify PCCU establishes a connection with the device.
- 3) Click on "View" at the top menu, and then choose "Expert" from the drop down list.



Figure 20 Plunger View Setup

# 3.5 Add the Plunger Application

Add the plunger application to begin configuration. The application is added by completing the following steps.

- 1) Click on the station name (top node on the tree view on the left). If this is a new installation the name is "TOTALFLOW"
- 2) Go to the Applications tab
- 3) Click "Add Application"
- 4) Choose Plunger Lift from the drop down menu (the slot number is chosen automatically, the Plunger slot # is 121).
- 5) Click send to save.
- 6) Click Re-read to verify the application has been added in the slot indicated

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Image: Control USB     App 0     Type     Revision     Station     Directory     Restart       MMI Serial - COND     File Amountainations     2101348-044     Dir = 10 cmm.4     Image: Control	Communications	S	tation Setup Ap	plications App Licensing	Battery Informatio	on Resources	System L	.og Security Log Re	egistry				
Image: Second	Totalflow - ICP	Ш.	App Number	Туре		Revision	Station	Directory			Restart		
Image: Construction     1     Communications     220134.04     Dir = Comm.1       Image: Construction     2     Communications     220134.04     Dir = Comm.2       Image: Construction     3     Communications     220134.04     Dir = Comm.3       Image: Construction     3     Communications     220134.04     Dir = Comm.4       Image: Construction     3     Communications     220134.04     Dir = Construction       Image: Construction     3     <	- MMI Serial - COM0	Ш.	0	System		2103280-008		Dir = \					
Modus-COA2     VOI Interface     Pow Masurement     Stop	TF Remote - COM1	Ш.	1	Communications		2101348-004		Dir = \Comm-1					
Control And Assument     Communications     2013404     Communications     Control	Modbus - COM2	Ш.	2	Communications		2101340-004		Dir = \Comm-2					
Stup	- Flow Measurement	Ш.	3	Communications		2101340-004		Dir = \Comm-3					
Analysis - Digital Odqubs - No Flow - Ad-S Sclup - Speed of Sound - Digital - Digi	Setup	Ш.	4	Communications		2101341-004		Dir = \Comm-4					
Organization       7       10 Interface Starse       200314.065       0r - Uo S         Adv Schup	Analysis Dinital Outputs	Ш.	5	Communications		2101344-004		Dir = \Comm-5					
Adv Setup     Geod Sound     Diciply     Setup     Geod Sound     Diciply     Adv Rev Application     Operations     Term Gytem     Geod Sound     Diciply     Term Gytem     Term Gytem     Geod Sound     Diciply     Term Gytem     Geod Sound     Diciply     Term Gytem     Term Maste     Diciply     Control     Term Maste     Diciply     Term Gytem     Sound     Diciply     Sound     Sound     Diciply     Sound     Sound     Diciply     Sound     Sound     Diciply     Dicip	- No Flow	Ш.	7	I/O Interface XSeries		2103134-005		Dir = VOS					
Add free Application     Proceeding     Procee	Adv Setup	Ш.	8	Display XSeries	1 10 10	2403437 002	×	Dir = \Display					
10     Operations       11     AGA-3 Mean       14     AGA-3 Mean       14     AGA-3 Mean       15     Trend System       16     Overdations       17     AGA-3 Mean       18     Statistics	- Speed of Sound	Ш.	9	Holding Regist	w Application	-		Dir = \Holding					
Tend System     Tories Sy	Holding Registers	Ш.	10	Operations App n	number A	Application to ad	а	Dir = \Operations					
95     Trend System       90     Planger       - Stup     121       - Lif-alling     - Lif-alling       - Lif-alling     - Stup       - Statistics     - Statistics	Operations	Ш.	11	AGA-3 Measur	- Dhuno	er Control	-	Dir = \AGA3-1			<b>[</b> ]		
1 Statistics     721     Plunger Contol     Plunger Contol     Plunger Contol       2 Closed     2-Sixing     Plunger Contol     Plunger Contol     Plunger Contol       3 Statistics     Plunger Contol     Plunger Contol     Plunger Contol       9 Detter     Statistics     Plunger Contol     Plunger Contol       9 Statistics     Plunger Contol     Plunger Contol     Plunger Contol       9 Detter     Statistics     Plunger Contol     Plunger Contol       Plunger Contol     Plunger Contol     Plunger Contol     Plunger Contol <tr< th=""><th>Trend System     Diverger</th><th>Ш.</th><th>95</th><th>Trend System</th><th colspan="3">m Override rerom Therms Master</th><th>Dir = \Trend</th><th></th><th></th><th></th><th></th><th></th></tr<>	Trend System     Diverger	Ш.	95	Trend System	m Override rerom Therms Master			Dir = \Trend					
CLOSED     CLOSED     CLOSED     CA3-3 Measurement     ACA-3	- Setup	Ш.	121	Plunger Contro	Analy	ns Slave Isis Trend File		Dir = \Plunger-1					
ORN     Piles kömutar       3Maring     SMaring       3Maring     SMaring       SMaring     Biocontroler       Gatherliow     Piles Control       B. Statistics     Piles Control       Debits     Piles Control       Debits     Piles Control       Debits     Piles Control       Piles Control     Piles Control       Piles Control     Piles Control       Piles Control     Piles Control       Piles Control     Piles Control       Debits     Piles Control	CLOSED 1:Falling 2:Closed				AGA- AGA- Trend	3 Measurement 7 Measurement 1 System							
Statistics		L		_	Pulse PID C	Accumulator Controller							
Cold Inferior     Reread     Reread     Ref Cold Calculation     Ref Control     Ref Contro     Ref Control     Ref Control     Ref Contr	- 5:Arrived				Shutd	Jown System	_						
B) - Statistics     Parp Interface     C GLOUID (Treater Net     L     Corections     Holding Registers     Units Corrections     Holding Registers     Units Corrections     Corolis Interface     Exc Not Interface     Corolis Interface     Revned     Declary Science     V-Core Measurement     Corolis Interface     BRACK Interface     Declary Science     V-Core Measurement     Corolis Interface     Declary Science     V-Core Measurement     Corolis Interface     Disclinicities     did App     Declate App     Send     Cores     Help	6:Afterflow	Ш.			Pad C	Controller	2						
LeveNater Cycestage Degets Units Conreston Hest Interface Degets Corole SU Corole SU C		Ш.			Pump Oil Cu	Interface istody Transfer I	Mez						
Holding Registers Lines Conversion HEC Interface Deally Stores H-Care Negative H-Care		Ш.			Level Opera	Master ations	-						
Host Interface Doplay Stories N - Core Messarement Corole SU Corole Interface Corole Interface Corole Interface Debte App Send Close Help P Milliéer		Ш.			Holdin Units	ng Registers Conversion	_						
Decky Sories V-Cone Measurement Corole SU Corole Inferior DRAN Inferior PIP Mildower		Ш.			Host I	Interface							
Corde 52 Corde 54 Reveal DeAct Interface DeAct Interface DeAct Interface DeAct Interface DeAct Interface DeAct Interface DeAct Interface					Displa	y XSeries							
Re-read DROKI Inferiore tod App Delete App Send Close Help PROKINGENER					Coriol	is SU							
UP PLUDDexer			Re-read		ENRO Nozzk	N Interface SU	Add	d App Delete	Арр			Send	Close Help
Ready Gas Lift #Poils: 59 #Errors: 0 Connected to XFC-howard Login: user	Ready				IP Mu Gas Li	ittplexer ift iguid SU	÷	4	Polls: 59	#Errors: 0	Connected to	XFC-howard	Login: user

Figure 21 Add Plunger App

# 3.6 Add the AGA-3 Application

Add the AGA-3 application to the configuration. The application should be setup to indicate correct gas Flowrate at the plunger site.

- 1) Click on the station name (top node on the tree view on the left). If this is a new installation the name is "TOTALFLOW"
- 2) Go to the Applications tab
- 3) Click "Add Application"
- 4) Choose AGA-3 Measurement from the drop down menu (the slot number is chosen automatically, the AGA-3 slot # is 11).
- 5) Click send to save.
- 6) Click Re-read to verify the application has been added in the slot indicated
- 7) On the tree view, expand the station node (TOTALFLOW) and go to Flow Measurement >Setup>General Setup Tab
- 8) Verify that the setup is correct on all tabs within "Flow Measurement".

### 3.7 Plunger General Setup

The "General Setup" provides us a way to turn the Plunger App and Optimization on and off. The following steps are provided.

- 1) Go to Plunger>Setup>General Setup and "Disable" Plunger Control. We do not want the Plunger App to run until we have it set up completely.
- Select "Disable" for Optimization. Until we have Plunger App and the associated Optimization (Tuning) parameters set up we need this feature disabled.

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E TOTALFLOW	G	eneral Setup	Valve Setup	nout Setup		
Communications     Totalflow - TCP	I F					
- Totalflow - USB			Description	Value	Units	Comment
- MMI Serial - COM0		121.4.2	Closing Valve	00:00:07:51	00:00:00:00	State / Timer / Max Timer
TF Remote - COM1			COMMON SETUP			Other setup variables can be found in their specific State tabs
Modbus - COM2		121.1.0	Plunger Control	Disabled 🛌		Enable plunger control state machine. Disable resets the controller.
- Flow Measurement		121.1.2	Cycle Start	Close-Close		Cycle runs from Open-Open or Close-Close
Setup		121.0.10	Trend FileName			
Analysis						
Digital Outputs			DEPET ODTIONE			
- No Flow			RESET OF TIONS			
- Speed of Sound		121.1.20	Startup Mode	1 Closing Valve		Startup state on Enable/Reset
Display		121.1.3	Safety Reset Mode	Disable		
Holding Registers						
Operations     Trend System			TUNING			=
- Plunger		121.1.1	Optimization	Disabled		Enables or disables the continuous adjustment of all setpoints
Setup		121.5.28	Plunger Fail Tune	1.5000		If plunger fails, multiply the next tuning by this factor
CLOSED						
1:Falling			WELL GEOMETRY			
		121.5.26	Tubing Length	5000.0000	Length	The length of tubing from the stop to the arrival sensor, used to calculate lift velocity
3:Waiting		121.1.136	Tubing ID	2 3/8	Inches	The inner diameter of the well tubing, used to calculate the Turner Flow Rate
5:Arrived		121 5 27	Tubing ID	1 9980	Inches	The inner diameter of the well tubing used to calculate the Turner Flow Pate
		121 5 159	Tubing OD	2 3750	Inches	The outer diameter of the well tubing used to calculate the Turner Flow Pate
m- statistics		121.5.155	Casing ID	0.0000	Inches	The inner diameter of the well casing used to calculate the Turner Flow Rate
		121.0.100	Cuality to	0.0000	incirca.	
		121.5.23	riuld Gradient	0.4330		sig size constant (0.453)
		121.2.0	Log Size	30		Size of Cycle, Blow and Fail Logs
		100		1 466		۰ ۲
		Re-read	Monitor			Print Screen Save Send Close Help XHelp 🍬
Ready						#Polls: 63 #Errors: 0 Connected to XFC-howard Login: user

Figure 22 General Setup

# 3.8 Plunger Valve Setup

The "Valve Setup" will provide for necessary setup surrounding our production valve. The following steps are provided concerning the valve setup.

- Go to Plunger>Setup>Valve Setup and verify that the "Valve Position" value field is set for "Upstream". This implies that the valve is *upstream* from the point at which we are taking the "line pressure" reading on the measurement tube.
- 2) "Valve Time Limit" needs to have a value of "5" entered. This is the time in seconds that the Digital Output will energize while *manually* operating the valve.
- 3) "Main Valve Type" allows for the type of outputs used for the valve. Enter "Latch-Two output" for our scenario. This means that two Digital Outputs will be used to operate the valve and that those outputs will remain "latched" or "on" till command is given to turn off.
- 4) "Main Open DO" value field should be set as "7.2.4". This represents the Digital Output # 1. "Main Close DO" value field should be set as "7.2.5". This would represent assignment of Digital Output # 2.

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Communications		ierierai setup	Table Setup   Table Setup   Tiput	semb					
Totalflow - ICP		Description Value State Comment							
MMI Serial + COM0		1214.2 Closing Value 00:00:07:51 00:00:00:00 State / Timer / Max Timer							
TF Remote - COM1									
Modbus - COM2		101.10							
J-I/O Interface		121.1.27	Valve Position	Upstream		Valve position relative to meter. This is set from valve control screen when VCntrl Option is enabled			
Flow Measurement		121.2.1	Valve Time Limit	5	Seconds	Time to energize Digital Output's to control the valve manually(not valve control)			
Setup									
- Analysis Digital Outputs			MAIN VALVE SETUP						
No Flow		121.1.27	Main Valve Type	Latch-Two output		Specifies the number and type of outputs used for the Main Valve when Valve Control is not used			
Adv Setup		121.3.1	Main Open DO	7.2.4	High	Address of Main Valve Open Digital Output when Valve Control is not used, Auto = IOS,DIDO,2			
Speed of Sound		121 3 10	Main Close DO	725	Low	Address of Main Valve Close Digital Output when Valve Control is not used. Auto = IOS DIDO 3			
Display		121.1.28	Main Value Fail State	Close		Fail Main Value Desition			
Holding Registers		121.1.20	mani valve i an state	CIUSE					
H- Trend System									
- Plunger		121.1.30	Manual Main Valve Open NOW	Auto					
Setup		121.1.33	Manual Main Valve Close NOW	Auto					
CLOSED									
1:Falling			BLOW VALVE SETUP						
- 2:Closed		121.1.27	Plow Value Turne	Disabla		Specifies the number and type of outputs used for the Blow Value			
- 3 Waiting		121.1.51	blow valve Type	Disable		specifies the number and type of outputs used for the blow valve			
6:Afterflow			CAPTURE VALVE SETUP						
Statistics		121.1.44	Capture Valve Type	Disable		Specifies the number and type of outputs used for the Capture Valve			
			VALVE CONTROL						
		121.1.24	Valve Controller (Option)	Disabled		Optional - Use Valve Control during flow cycle(Plunger Arriving and AfterFlow)			
				l					
		4				P			
	Revead Monitor Print Screen Save Send Close Help X Help 🐌								
Ready						#Polls: 64 #Errors: 0 Connected to XEC-boward Login: user			

Figure 23 Valve Setup

# 3.9 Plunger Tube Setup

The "Tube Setup" will provide the Plunger Application necessary flow information required. The following is provided concerning the Tube setup.

1) Go to Plunger>Setup>Tube Setup and verify that the "Tube App" value field is set for "11". This verifies that our AGA-3 measurement tube is running in Application slot # 11.

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- TOTALFLOW		eneral Set in	Value Seturo Tube Seturo Tonut Setur	5			
Communications	1 C	eneral setup	Ture seap	<u>n</u>			
Totalflow - USB			Description	Register	Value	Comment	
MMI Serial - COM0		121.4.2	Closing Valve	00:00:07:51	00:00:00:00	State / Timer / Max Timer	
TF Remote - COM1			TUBE VALUE REGISTERS				
Modbus - COM2		424.4.422	Tube App	44	999	Tube Application esting will auto est the Tube Desister Address	
		121.1.133	Tabe App		app	Table Application - seeing will auto-set the Table Register Address	
How Measurement     Sature		121.3.1	AP Register	11.3.0	50	Address of Abs Pres Al, normal= (aga3).3.0	
Setup		121.3.2	DP Register	11.7.0		Address of Diff Press AI, normal = (aga3).7.0	
Digital Outputs		121.3.3	Flow Rate Register	11.7.19	248.039	Address of Flow Rate, normal = (aga3).7.19	
No Flow		121.3.8	Volume - Accum Register	11.7.21	7215.49	Address of accumulated volume, normal = (aga3).7.21	
Adv Setup		121.3.30	Volume - Today Register	11.7.22	88.924	Address of Today's volume, normal = (aga3).7.22	
Speed of Sound		121.3.31	Volume - Yesterday Register	11.7.23	248.039	Address of Yesterday's volume, normal = (aga3).7.23	
Holding Registers		121.3.4	Temp flowing Register	11.3.3	75	Address of Temperature, normal = (aga3).3.3	
Operations		121.3.15	Z factor	11.7.31	1.002	Address of gas compressibility, normal = (aga3).7.31	
Trend System		121.3.7	Barometric Pressure Register	11.3.16	14.73	Address of Barometer Pressure used to adjust FCU pressure to PSIG, normal=(a)	ga3).3.16
B-Plunger Saturn		121 3 16	Contract Hour Undate	11 2 3	06/27/13 00:00:00	Address of Last Contract Hour Undate normal = (ana3) 2.3	
CLOSED		121.0.10		11.2.5	00/21/13 00:00:00	Address of Last Contract from Opdate, normal - (agas),2.5	
-1:Falling							
2:Closed							
OPEN							
5-Afterflow							
-Statistics							
		<					•
		Re-read	Monitor			Print Screen Save Send Close Help	CHelp 🎘
Ready	-					#Polls: 59 #Errors: 0 Connected to XFC-howard Login:	user

Figure 24 Tube Setup

### 3.10 Plunger Input Setup

The "Input Setup" will provide the Plunger Application necessary information for register locations of the Casing pressure transmitter and the plunger arrival switch. The following is provided concerning this setup.

- Go to Plunger>Setup>Input Setup and verify that the "Casing Pressure AI" value field is set for "7.4.3". This selects Analog Input # 1 will be used for casing pressure.
- 2) Confirm that "Detection Type" is set up for "Plunger".
- Plunger arrival switch location needs to be established by entering "7.0.104" in the Register field in "Plunger Arrival PI". This will confirm use of Pulse Input # 1 for the arrival switch.

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- TOTALFLOW		eneral Setun	Valve Setup Tube Setup Input Setu	D		
Communications	IC.		Terretaria international			1
Totalflow - USB			Description	Register	Value	Comment
MMI Serial - COM0		121.4.2	Closing Valve	00:00:07:51	00:00:00:00	State / Timer / Max Timer
TF Remote - COM1						
Modbus - COM2			INPUT VALUE REGISTERS			
Elow Measurement		121.3.6	Casing Pressure Al	7.4.3	300	Address of Casing Pressure AI, normal = IOS.3.4 (AI5)
Setup		121.3.5	External Pressure Al	0.0.0		Address of External Pressure AI. Used for either tubing or line pressure depending on valve location
Analysis		121.3.9	Hold Pressure Register	0.0.0	0	Address of Hold Pressure Al
No Flow		121.3.10	Open 1 Register	0.0.0	0	Address of Open 1
Adv Setup		121.3.11	Open 2 Register	0.0.0	0	Address of Open 2
Speed of Sound		121.3.12	Close 1 Register	0.0.0	0	Address of Close 1 (in1)
- Holding Registers		121.3.13	Close 2 Register	0.0.0	0	Address of Close 2 (in2)
Operations		121.3.26	Hold External Register	0.0.0	Low	Address of Hold External
Irend System     Plunger						
Setup			MISC REGISTERS			
CLOSED		121.1.4	Detection Type	Plunger		Selects whether a plunger is being used or if the logic will act as an intermitter
1:Falling 2:Closed		121.3.0	Plunger Arrival Pl	7.0.104	0	Address of plunger arrival Pulse Input - Current
- OPEN				V.		
3:Waiting		121.3.27	Restart Button Register	0.0.0		Address of Restart Plunger DI
6:Afterflow		121.3.28	Open button	0.0.0	Low	Address for valve open push button DI
- Statistics		121.3.29	Close button	0.0.0	Low	Address for valve close push button DI
		<	Monter			Peter Grown Swont Grown Helm XHilds (2)
Ready						#Polls: 65 #Errors: 0 Connected to XFC-howard Login: user

Figure 25 Input Setup

# 3.11 Verify (Test) I/O Operation

### 3.11.1 Test Arrival Switch

The true test of the Plunger arrival switch is confirmed by an indication by the plunger application that the plunger arrived during a normal plunger run. However, the user can perform a simple test to determine if the switch is working correctly prior to an actual plunger run by performing the following steps.

- 1) Verify that "Plunger Control" is in "Disable" mode in Plunger>General Setup.
- 2) Proceed to I/O Interface>Digital Inputs in the tree view and view the "Total Pulse Count" value field in PI1.
- 3) Using something metallic, a crescent wrench or valve handle, swipe up and down across the back of the switch to simulate a plunger arriving.
- 4) If the switch is working properly, "PI1" under "Total Pulse Count", should indicate an increase in pulse count.

### 3.11.2 Test valve output

In this scenario we will operate the Production valve from Digital Output 1 (open) and Digital output 2 (close) respectively. Use the following testing procedure to test the valve "open" and "closed".

- 1) Verify that "Plunger Control" is in "Manual" mode in Plunger>General Setup.
- 2) Go to Plunger>Setup>Valve Setup. One at a time select "Force OPEN" and then "Force CLOSE" and verify valve action.
- 3) Return Plunger mode to "Disable" upon completion of testing

### 3.11.3 Test Casing Pressure input

The Casing pressure input value will be read on the XFC on-board Analog Input (AI1).

- 1) Go to I/O Interface>Analog Inputs>Al1
- 2) Verify that "Value" indicates the current Casing Pressure expected.

### 3.11.4 Test AGA-3 Measurement Values

Flowrate and line pressure are required inputs to the Plunger Application in this scenario. Use the following step to verify values.

1) Go to Flow Measurement>Current, and verify that "Volume Flow Rate" and "Static Pressure" (Line Pressure) are correct per your gas flow conditions.

### 3.12 Configure Plunger

The following steps will give the user specific instructions on setting up the Plunger "Casing-Line" scenario using PCCU software.

### 3.12.1 Configure Plunger "Closed" condition

Now we are ready to setup our "Closed" conditions (valve is closed) that need to be met in order for the valve to OPEN. To begin,

- 1) Go to Plunger>CLOSED>1: Falling, and "ENABLE" in the tree view window.
- 2) Enter the "Plunger Fall Delay" time in the "Fall Timer" location. Our fall time in this scenario is 25 minutes.

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- TOTALFLOW	1:Closing Valv	e				
Communications     Totalflow - TCP						
- Totalflow - USB		Description	Value	Limit	Comment	
- MMI Serial - COM0	121.4.2	Closing Valve	00:00:00:18	00:00:25:00	State / Timer / Max Timer	
TF Remote - COM1		PLUNGER FALL DELAY				
Modbus - COM2	121.4.4	Fall Timer	00:00:00:18	00:00:25:00	Time to wait when closing valve before going to state 2	
Elow Measurement		VALVE CLOSE CHECK				
Setup	121 1 49	Valve Close Check (Option)	Disabled		Option - lise only flow to verify Valve Close	
Analysis						
Digital Outputs						
			•			
⊞- Display						
Holding Registers						
Operations						
IFWeb Server						
Trend System						
E- Plunger						
-1:Falling						
-2:Closed						
- OPEN						
- 3:Waiting						
5:Arrived						
6:Afterflow						
I Statistics						
	Re-read	Monitor			Print Screen Save Send Close Help	X Help 🐌
Ready					#Polls: 77 #Errors: 0 Connected to XFC-howard Lo	ogin: user

Figure 26 Fall Timer

- 3) Go to Plunger>CLOSED>2: Closed, and "Enable" the "Case-Line Open".
- 4) Enter a value of "160" in the "Limit" field location. This will be the set point when exceeded, that the valve will open *after* plunger fall delay has expired.
- 5) Note: We are given in this scenario that our Casing pressure = 200# and that our Line pressure = 50#. Rule of thumb for a good place to start for determining "Casing-Line" set point is: Casing pressure x 80%= set point
- 6) Casing pressure (200#) x 80%= 160# (set point)

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- TOTALFLOW	Closed-Setup	Clored-HOLD 2:Care-Line				
Communications						
Totalflow - USB		Description	Value Limit		Comment	
- MMI Serial - COM0	121.4.2	Closing Valve	00:00:01:01	00:00:01:00	State / Timer / Max Timer	
TF Remote - COM1	121.1.16	Hold / Open Reason	None	None		
- Modbus - COM2		2:Open Valve Enables			Reasons To End Valve Closed	
- Flow Measurement	121.1.51	Closed Timer	Disabled	00:00:02:00	Optional - Use timer to open main valve	
Setup	121.1.62	Tube-Line Open	Disabled	0.0000	Optional - Use tubing-line pressure to open main valve	
- Analysis Digital Outputs	121.1.63	Case-Line Open	ENABLED	160.0000	Optional - Use case-line pressure to open main valve	
- No Flow	121.1.67	C-L & T-L Open	Disabled	1	Optional - Use Case-Line and Tube-Line to open main valve	
- Adv Setup	121.1.64	Case-Tube Open	Disabled	0.0000	Optional - Use casing-tubing to open main valve	
Holding Registers	121.1.66	"C-T & T-L" Open	Disabled		Optional - Use casing-tubing AND Tube-Line to open main valve	
	121.1.68	Load Ratio Open	Disabled	0.0000	Optional - Use Load Ratio to open main valve	
Trend System	121.1.124	Foss Gaul Open	Disabled	90.2700	Optional - Use Foss Gaul to open main valve, LR=C-T/C-L	
- Setup	121.1.54	Tube Pressure Open	Disabled	0.0000	Optional - Use Tubing Pressure to open main valve	
	121.1.52	Case Pressure Open	Disabled	0.0000	Optional - Use Casing Pressure to open main valve	
1:Falling	121.1.56	SP Open	Disabled	0.0000	Optional - Use Static Pressure to open main valve	
- OPEN	121.1.58	Open 1	Disabled	0.0000	Optional - Use Open 1 to open main valve	
3:Waiting	121.1.60	Open 2	Disabled	0.0000	Optional - Use Open 2 to open main valve	
SArrived SArterflow @ Statistics	Reread	Montor			Prot Screen Save Send Ocee Help	XHeip 🍋
Pandy					#Poller 100 #Errore 0 Connected to VEC housed	ogin: urer
neauy					erons, 190 echors, 0 Connected to APC-howard	Jogin user

Figure 27 Casing-Line Setup

### 3.12.2 Configure Casing – Line Tuning Parameters

#### Plunger Optimization (Tuning)

The goal of "Plunger Control" on a well is to reach a scenario with a minimum "off" time while at the same time allowing that liquids get lifted properly to the surface. This says that we want the well to be shut in just long enough for the plunger to hit the bottom and return again to the surface. To accomplish this, the ABB Totalflow Plunger Application has the ability to "tune" the "Casing-Line" set point (OPEN) as well as "tune" the Flowrate set point (CLOSE) conditions. The user has the capability in the application to set minimum and maximum tuning parameters as well as incremental step change amounts to precisely control the tuning process.

To complete the tuning set up, we need to enter our "Open Tune Amount, Max Tune and Min Tune settings. Use the following steps:

- "Case-Line Open Tune Amount" will be set with a value of "2". This tuning amount value is determined by using a starting point of 2% of the set point value (160). It is always a good idea to make small changes initially in tuning.
- 2) "Case-Line Open Max.Tune" value will be entered as "185". This was determined by using a starting point of 15% of the set point (160).
- 3) "Case-Line Open Min.Tune" value should be set as "135". This was determined by using 15% of the set point (160) as a starting point.

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- TOTALFLOW	Closed-Setup	Closed-HOLD 2:Case-Line								
- Totalflow - TCP										
Totalflow - USB		Description Value Limit Comment								
MMI Serial - COM0	121.4.2	AfterFlow	00:00:52:42	00:00:00:00	State / Timer / Max Timer					
TF Remote - COM1		CASE-LINE								
I Modbus - COM2 IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	121.1.63	Case-Line Open (Option)	ENABLED		Optional - Use case-line pressure to open main valve					
Flow Measurement	121.5.20	Case-Line Current Value	114.7300	160.0000	If (case-line) > this limit, then open valve					
Setup		CASE-LINE TUNING								
Analysis Digital Outputs	121.5.43	Case-Line Open Tune Amount	2.0000		Amount to tune "Case-Line Open Limit"					
No Flow	121.5.140	Case-Line Open Max. Tune	185.0000		Can not be tuned above this limit					
Adv Setup	121.5.44	Case-Line Open Min. Tune	135.0000		Can not be tuned below this Minimum "Case-Line Open" limit					
Holding Registers		combinations								
Operations	121.1.67	C-L & T-L Open (Option)	Disabled		Optional - Use Case-Line and Tube-Line to open main valve					
Trend System										
i⊒- Plunger										
- Setup										
-1:Falling										
2:Closed										
- OPEN										
3:Waiting										
5:Arrived										
6:Afterflow										
	•				•					
	Re-read	Monitor		Pr	rint Screen Save Send Close Help XHelp 🥘					
Ready				#Polls:	69 #Errors: 0 Connected to XFC-howard Login: user					

Figure 28 Casing-Line Tuning

### 3.12.3 Configure Plunger "OPEN" condition

Now we are ready to setup our "Open" conditions (valve is open) that need to be met in order for the valve to CLOSE. To begin,

- 1) Go to Plunger>OPEN> 6:Afterflow>6:AF Setup
- 2) Set the "Flow Rate Close (Option)" to "Enable".

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B- TOTALFLOW	6:AF Setup	AF Timer 6:Flow Rate								
- Totalflow - TCP										
Totalflow - USB		Description Value Limit Comment								
MMI Serial - COM0	121.4.2	121.4.2 AfterFlow 00:00:04:20 00:00:00								
TF Remote - COM1	121.1.85	AfterFlow Timer Close (Option)	Disabled	00:00:01:00	Optional - Use AfterFlow timer to close main valve					
I/O Interface	121.1.92	Turner FR Close (Option)	Disabled	0.0000	Optional - Use Turner Flow Rate to close valve					
- Flow Measurement	121.1.98	Load Ratio Close (Option)	Disabled	0.0000	Optional - Use Load Ratio to close main valve					
Setup	121.1.91	DP Close (Option)	Disabled	0.0000	Optional - Use DP to close main valve					
Analysis Digital Outputs	121.1.95	Flow Rate Close (Option)	ENABLED	450.0000	Optional - Use flow rate to close main valve					
- No Flow	121.1.129	Casing Rise (Option)	Disabled	0.0000	Optional - Close valve for Casing Rise					
Adv Setup	121.1.130	Casing Slope (Option)	Disabled	0.0000	Optional - Close valve for Casing Sway					
Uisplay     Holding Registers	121.1.96	Tube-Line Close (Option)	Disabled	0.0000	Optional - Use tubing-line pressure to close main valve					
Operations	121.1.97	Case-Tube Close (Option)	Disabled	0.0000	Optional - Use casing-tubing to close main valve					
Trend System	121.1.86	Case Close (Option)	Disabled	0.0000	Optional - Use casing pressure to close main valve					
- Plunger - Setup	121.1.89	SP Close (Option)	Disabled	0.0000	Optional - Use Static Pressure to close valve					
- CLOSED	121.1.87	Tubing Close (Option)	Disabled	0.0000	Optional - Use Tubing pressure to close main valve					
1:Falling				A						
- 2:Closed										
- 3:Waiting										
5:Arrived										
6:Afterflow										
a- Statistics										
4 m >										
	Remaid Monitor Print Screen Save Send Close Help X Help At									
Ready				#Polls: 859	9 #Errors: 0 Connected to XFC-howard Login: user					

Figure 29 Flowrate Close Setup

### 3.12.4 Configure Flowrate Tuning Parameters

To determine the Flowrate set point to **CLOSE** the valve, the user needs to consider the "critical velocity" condition of the well. Critical velocity is generally defined as the minimum gas velocity in the production tubing required to move liquid droplets upward. In this scenario, our flowing tubing pressure is 150 PSIG and the tubing is 2% inch (1.998 I.D.). With this information we are able to use the "Critical Rate Curves" chart (located in the Reference Information section 4.0) to determine a good estimate of our critical velocity which is a Flowrate of 400 mcfd. Use the following steps to set up;

- Go to Plunger > OPEN >6: Afterflow >6: Flow Rate, and enter "450" in the Limit field. The value of 450 is entered here so as to have the Flowrate shutoff *before* reaching the critical velocity rate of 400 mcfd.
- 2) Next, we need to enter a value in the "Flow rate Low Timer" field. We will enter a value of "1 minute" in the "Limit" field. With this setting, the Flowrate will now have to remain less than 450 mcfd for a period of 1 Minute for the valve to close.
- 3) "Flow Rate Limit Tune Amount" needs to be set at a value of "10". This setting determines that the tune amount will be in increments of 10mcfd.
- 4) "Flow Rate Limit Min.Tune" will be set as "400". This indicates that we will not allow the tuning to adjust below the 400 mcfd set point.
- 5) "Flow Rate Limit Max.Tune" will be set as "1000" in this scenario. This would indicate that the tuning will not allow adjustment over this limit.

Eg. PCCU32 - [Entry]		10						
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TOTALFLOW     Ommunications	6:AF Setup	6:AF Timer 6:Flow Rate			4			
Totalflow - TCP								
Totalflow - USB		Description	Value	Limit	Comment			
MMI Serial - COM0	121.4.2	AfterFlow	00:00:01:35	00:00:00:00	State / Timer / Max Timer			
- Modbus - COM2		FLOW RATE LOW						
	121.1.95	Flow Rate Close (Option)	ENABLED		Optional - Use flow rate to close main valve			
Setup	121.5.3	Flow Rate	407.0138	450.0000	When FlowRate remains below this limit for FRLowTime during AfterFlow, then close the valve			
Digital Outputs	121.4.42	Flow Rate Low Timer	00:00:00:00	00:00:01:00	Time that flow rate will remain low before closing the valve			
No Flow Adv Setup		FLOW RATE TUNING						
Display	121.5.68	Flow Rate Limit Tune Amount	10.0000		Tune "Flow Rate Limit"			
Holding Registers     Derations	121.5.69	Flow Rate Limit Min. Tune	400.0000		Can not be tuned below this Min Limit			
Trend System     Plunger	121.5.144	Flow Rate Limit Max. Tune	1000.0000		Can not be tuned above this Limit			
- Setup CLOSED - Isfalling - 2:Closed - OPEN - 33Waiting - 5:Arrived - 6Atterflow - Statistics								
			111		• • •			
	Re-read Monitor Print Screen Save Send Close Help X Help 🍭							
Ready				#Polls:	61 #Errors: 0 Connected to XFC-howard Login: user			

Figure 30 Flowrate Tuning Parameters

### 3.12.5 Arrival Time Limits Parameters

Arrival time limits need to be entered to allow the Plunger Application to define Max, Slow, Fast and Minimum arrival times for the plunger. In this scenario we will use the following to "estimate" the expected arrivals. Max= Well depth ft. /300ftmin (5000/300=16 minutes); Slow=5000/650=8 minutes; Fast=5000/850=6 minutes; Minimum = 5000 /1200=4 minutes

- Go to Plunger > OPEN >3:Waiting, and enter "16" in the "Max Arv Count/Time/Fail" Limit field. The value of 16 entered here defines the time in minutes for a Max arrival. We also need to enter "Fail Limit" value of "3" in the "Fail Limit" field. This allows 4 late arrivals before putting Plunger in a "Failed" state.
- 2) "Slow Arv Count/Time" needs to have a value of "8" as determined in the calulation above.
- 3) "Fast Arv Count/Time" needs to have a value of "6" as determined in the calulation above.
- 4) "Min Arv Count/Time" needs to have a value of "4" as determined in the calulation above.

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- TOTALFLOW	3:Waiting					
Communications     Totalflow - TCP						
Totalflow - USB		Description	Value	Limit	Fail Limit	Comment
MMI Serial - COM0	121.4.2	AfterFlow	00:01:47:43	00:00:00:00		State / Timer / Max Timer
- TF Remote - COM1		CLOSE VALVE ENABLES				Reasons to end 3:Arriving/6:AfterFlow
Modbus - CUIVIZ	121.1.84	Flow Timer Close (Option)	Disabled	00:00:00:00		Optional - Use Flow timer to close main valve
- Flow Measurement	121.1.99	Close 1 (Option)	Disabled	0.0000		Optional - Use Close 1 to close valve
Setup	121.1.102	Close 2 (Option)	Disabled	0.0000		Optional - Use Close 2 to close valve
- Analysis Disited Outputs						
- No Flow	121.4.24	Arrival Timer / Last	00:00:00:00	00:00:00:36		Elapsed time since valve was commanded open and plunger is arriving
Adv Setup						
Display	121.1.105	Mandatory Recovery Time	Disabled	00:00:00:00		Stav Closed Longer if plunger does not arrive
Operations		ARRIVAL TIME LIMITS				
Trend System	121.2.12	Max Ary Count / Time / Fail	0	00:00:16:00	3	IF arrival time exceeds THEN tune, and Use: Mandatory Recovery or use blow valve or enter FAIL state
Plunger	121.2.9	Slow Ary Count / Time	1135	00:00:08:00		If number arrives shower than this then tune
- Setup	121.2.10	Normal Ary Count	310	00.000000		Normal Arrival - Do Not Tunge
-1:Falling	121.2.8	East Any Count / Time	4788	00:00:05:00		If plugger arrives scoper than this then tune
- 2:Closed	121 2 11	Min Count / Time / Fail	5	00:00:04:00		If plunger arrives faster than this, don't tune
OPEN     AMathing	171.1.7	Reast Runner Counters		00:00.04.00		I punger arrives raster han one, our cone
- 5:Warting	121.1.1	Reset Plunger Counters	NO	1		Clear counters used to track prunger annvars
-6:Afterflow						
Statistics						
	Re-read	i Monitor				Print Screen Save Send Close Help X Help 🐌
Pandy	·					#Polls: 73 #Errors: 0 Connected to XEC-boward Login: user

Figure 31 Arrival Time Limits

### 3.12.6 Enable the Plunger APP and Tuning

The final task in completing this scenario is to "Enable "the plunger application and to "Enable" Optimization (Tuning). To accomplish this:

- Go to Plunger > Setup > General Setup, and select "Enabled" in the Plunger control value field. You should now see the plunger application begin in the "Closing Valve" state with timer counting up.
- 2) Next, proceed to "Optimization" and select "Enabled" in the Optimization Value field.



Figure 32 Enable Plunger App

### 3.12.7 View Plunger Application activity

To view activity of the Plunger application as it proceeds through the different states, Go to the tree view; Plunger>CLOSED>1.Falling" tab to view state 1 conditions.. Note: the top line of each state indicates the current state and timer status of the Plunger App when "monitor" is selected at the bottom left of your screen.

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- TOTALFLOW	1:Closing Val	ve				
- Totalflow - TCP						
Totalflow - USB		Description	Value	Linn	Comment	
MMI Serial - COM0	121.4.2	Closing Valve	00:00:00:48	00:00:01:00	e / Timer / Max Timer	
TF Remote - COM1		PLUNGER FALL DELAY				
Modbus - COM2	121.4.4	Fall Timer	00:00:00:48	00:00:01:00	Time to wait when closing valve before going to state 2	
Flow Measurement		VALVE CLOSE CHECK				
Setup	121.1.49	Valve Close Check (Option)	Disabled		Option - Use only flow to verify Valve Close	
Analysis - Digital Outputs - No Flow - No Flow - No Flow - Analysis - No Flow - Analysis - No Flow - Holding Registers - Capacity - Tend System - Cospectives - Cospect - Cos	~~~~			1	L	, , ,
Ge Statistics	Reread	V Monitor			Print Screen Save) Send Close He Bolic 223 Effort 0 Connected to XEC-bound	eb XHelp 🍖

Figure 33 View Plunger State

# 4.0 Reference Information



Figure 3	34	Critical	Rate	Curve	Chart
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Base Board	I/O Description	Drawing #	ABB Web Site Link		
TFIO DI-DO Module	Plunger Lift: Direct I/O option	2102981	Plunger DI-DO Wiring		
XFC	XFCG4 6410/6411/6413/6414 (2103328 BD) TO DRUCK1040/1240GP/AP TRANSDUCER	2104128	XFC to Druck wiring		
XFC	XFCG4 (2103328) BOARD PINOUTS	2104122	XFCg4 Board Pinouts		
XFC	Plunger Lift Tubing/Casing & ON/OFF for XFC W Versa-Valves(DI-DO Module)	2103174	XFC to Casing-Tubing & Di/Do versa		
XFC	XFCG4 (2103328 BOARD) COMM2 TO EXT MULTIVARIABLES W/RTD PROBE	2104126	XFC to XMV on com 2		
XRC	Plunger Lift on/off for XRC,Tubing/Casing,DI-DO Module( Arrival Sensor)	2102983	XRC to Tubing/Casing		
XRC	Plunger Lift Valve Control( wTubing, Casing, Arrival Sensor) using Valve	2102985	XRC to VIv Ctl Module		

Table 1 Links to Drawings	(ABB/Totalflow Website)
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Base Board	I/O Description	Drawing #	ABB Web Site Link
	Control Module		
XRC	XRCG4 (2103022 BD) COMM1 TO Ext MULTIVARIABLE W/RTD PROBE	2104127	XRC to XMV on com 1
XRC	XRCG4 (2103329 BD) AI TO 2-WIRE TRANSMITTER(ANALOG INPUT) W/EXTERNAL 12/24VDC POWER	2104337	XRC to Ext Xmitter with Ext Pwr



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Document Title				
XSeries G4 Plunger Application				
Document No.	Rev. Ind.	No. of Pages	Page	
2104945-001	AA	36	36	