

Chapter Four

Control System Design

4.1 Purpose of the control system

The main purpose of the newly designed control system is to carry out the control of the Backwashing process of the diesel filters. The control system consists of a combination of hardware and software using Foxboro Distributed Control System (DCS) (Figure 4-1).

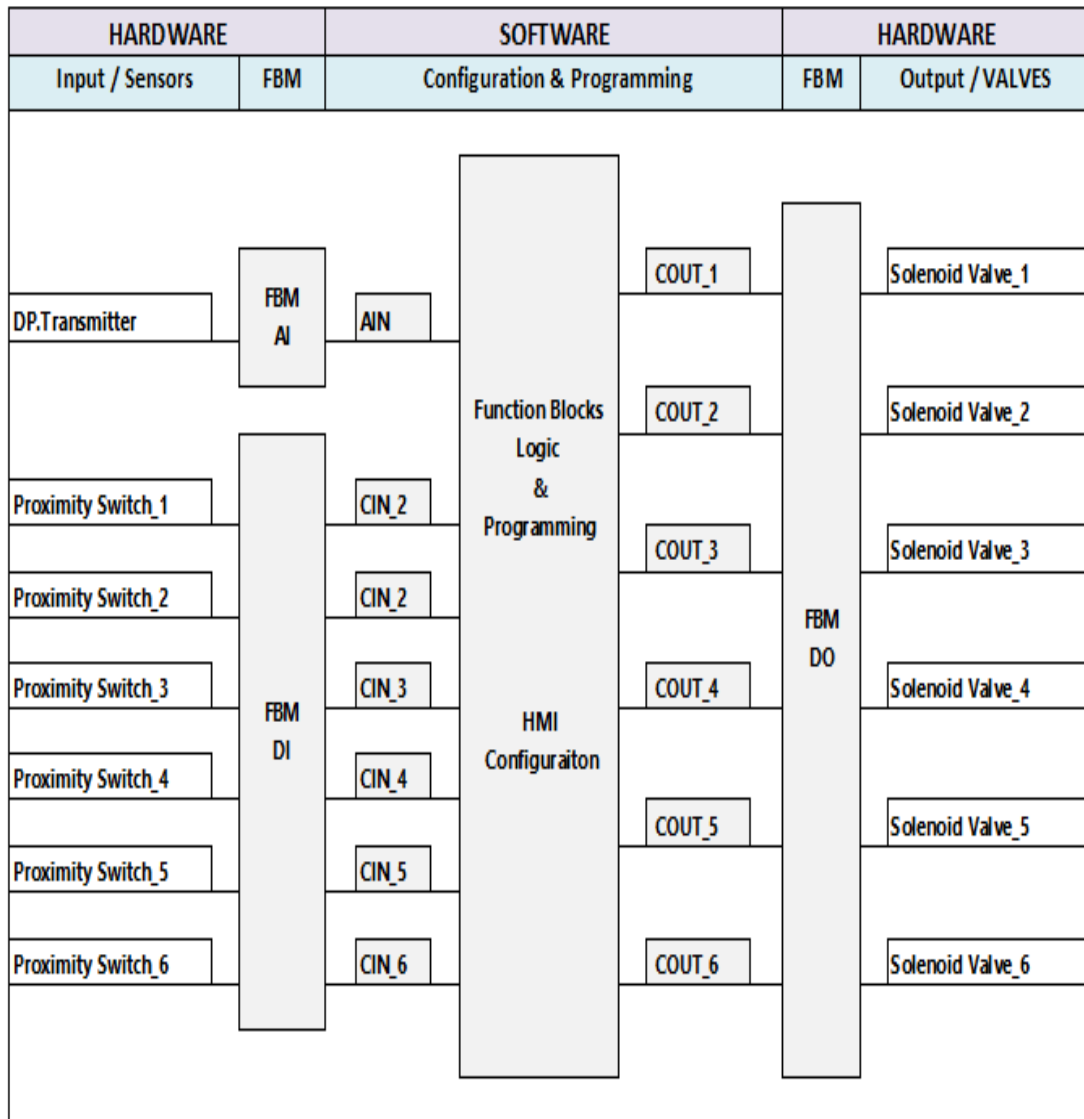


Figure 4-1: New Designed Control System Diagram

4.2 Functions Blocks List used for the new control system

The control system is designed using different types of function blocks listed on (Table 4-1) below.

Table 4-1: Function Block List

Block Name	Type	Function
WASHIN TIME	AIN	Used to set the washing time (5-10 Sec).
SWITCH TIME	AIN	Used to set the Dwell time (2-3 Sec).
Controller1	CALCA	Provide both logical functions and arithmetic computational capability within one integrated environment, programmed using assembly language.
Controller2	CALCA	Provide both logical functions and arithmetic computational capability within one integrated environment, programmed using assembly language.
XVFA4101A	COU	Output to Actuator 1 solenoid valve.
XVFA4102A	COU	Output to Actuator 2 solenoid valve.
XVFA4103A	COU	Output to Actuator 3 solenoid valve.
XVFA4104A	COU	Output to Actuator 4 solenoid valve.
XVFA4105A	COU	Output to Actuator 5 solenoid valve.
XVFA4106A	COU	Output to Actuator 6 solenoid valve.
PCV4114	COU	Backwashing Start Output Block.
ZVFA4101A	CIN	Valve1 feedback position signal.
ZVFA4102A	CIN	Valve 2 feedback position signal.
ZVFA4103A	CIN	Valve 3 feedback position signal.
ZVFA4104A	CIN	Valve 4 feedback position signal.

ZVFA4105A	CIN	Valve 5 feedback position signal.
ZVFA4106A	CIN	Valve 6 feedback position signal.
PDIA4114A	AIN	Differential pressure across the filter.
Reset	CIN	Reset the whole system.
Timer_1	ACUMM	Banck1 (Elements1&2) washing duration.
Timer_2	ACUMM	Banck2 (Elements3&4) washing duration.
Timer_3	ACUM	Banck3 (Elements5&6) washing duration.
Timer_4	ACUMM	Banck4 (Elements7&8) washing duration.
Timer_5	ACUMM	Banck5 (Elements9&10) washing duration.
Timer_6	ACUMM	Banck6 (Element11&12)washing duration.
W_Time	CALCA	Total washing time using Timer_1 ~6.
RESET_TIMER	CALCA	Reset Timer1~6 and the Total W. Time.
Inlet Flow	ACUMM	Inlet flow Totalized.
W. Flow	ACUMM	Washing flow Totalized.
Outlet Flow	ACUMM	Outlet Flow Totalized.

4.3 New control system Configuration

The Below diagram (Figure 4-2) shows the software configuration / connection between the above listed function blocks:

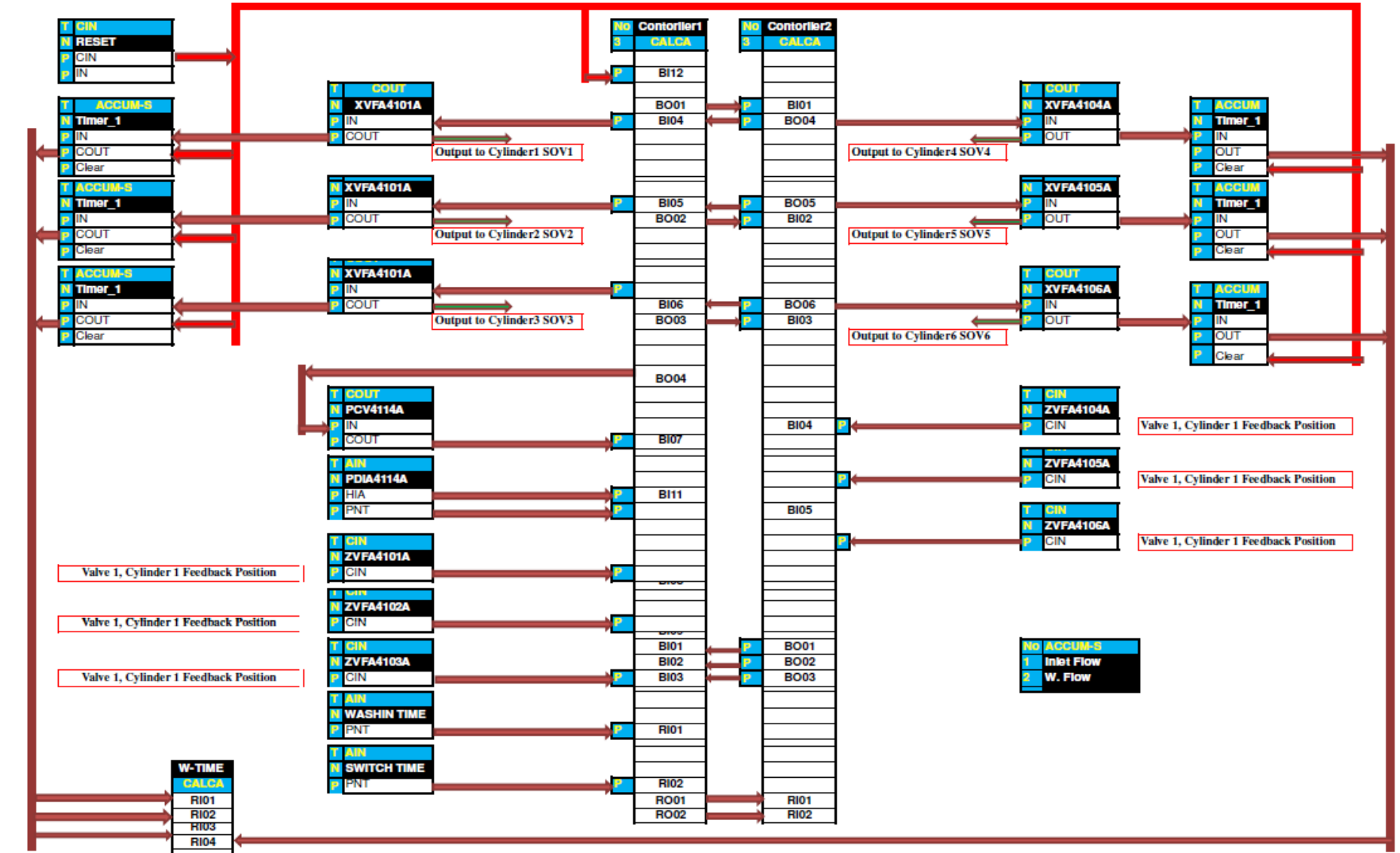


Figure 4-2: Control System Function Blocks Configuration Diagram

4.3.1 Controller 1 & Controller 2 Configuration

As shown on the diagram above (Fig 4-2), and explicated on tables (Table 4-3), (Table4-4), (Table4-5), and (Table4-6) below the following configuration take please:

1. (WASHING TIME) and (SWITCH TIME) outputs are connected respectively to the real input parameter RI01 and RI02 of (Controller1) function block.
2. The Boolean Outputs parameters BO01, BO02, and BO03 of (Controller1) are connected directly to the Binary Input parameters BI01, BI02, and BI03 of (Controller2).
3. The Boolean Output parameters BO01, BO02, BO03, BO04, BO05, and BO06 of (Controller2) are connected to the Binary Input parameters BI01, BI02, BI03, BI04, BI05, and BI06 of (Controller1).
4. The output parameters of the Contact Inputs (CINs) function blocks (ZVFA4101A, ZVFA4102A, and ZVFA4103A, are connected directly to the Binary Input parameters BI08, BI09 and BI10 of (Controller1).
5. The output parameters of the CINs function blocks (ZVFA4104A, ZVFA4105A, and ZVFA4106A) are connected directly to the Binary Input parameters BI04, BI05 and BI6 of (Controller2).
6. The High Alarm Indicator (HAI) parameter output of the Analog Input (PDIA4114A), is connected to the Binary Input parameters BI1 of (Controller 1).
7. The (Reset) is a Contact Input (CIN) and its output connected to the Binary Input parameters BI12 of the (Controller1) and it used to reset the whole system.

8. The (PCV4114) is a Contact Output (COUT) Function Block and is used for starting the backwash process manually or automatically; their input and output are connected to BO04 and BI7 parameters of (Contrller1) respectively.
9. The Boolean Outputs parameters BO01, BO02, and BO03 of Controller1 are connected respectively to (XVFA4101A, XVFA4102A, and XVFA4103A (COUT) Function Blocks.
10. The Boolean Outputs parameters BO04, BO05, and BO06 of Controller2 are connected respectively to (XVFA4104A, XVFA4105A, and XVFA4105A (COUT) Function Blocks.

Table 4-2: Controller 1 Software Connections

Par	Connection From	Description
RI01	:WSHING_TIME.PNT	Read the Washing time.
RI02	:SWITCH_TIME.PNT	Read Delay time.
BI01	:CONTROLLER_2.BO01	Delay time BO01 to BO02.
BI02	:CONTROLLER_2.BO02	Delay time BO02 to BO03.
BI03	:CONTROLLER_2.BO03	Delay time BO03 to BO04.
BI04	:CONTROLLER_2.BO04	Output BO04 to Solenoid Valve 4.
BI05	:CONTROLLER_2.BO05	Output BO05 to Solenoid Valve 4.
BI06	:CONTROLLER_2.BO06	Output BO06 to Solenoid Valve 4.
BI07	:4P100:PCV4114A.COUT	Start the backwashing.
BI08	:ZVF4101A_1.CIN	Open/Close Feedback of Valve 1.
BI09	:ZVF4101A_2.CIN	Open/Close Feedback of Valve 2.
BI10	:ZVF4101A_3.CIN	Open/Close Feedback of Valve 3.
BI11	:4P100:PDIA4114A.HAI	High differential pressure.
BI12	:RESET.CIN	Reset Button.

Table 4-3: Controller 2 Software Connections

Par	Connection From	Description
RI01	:CONTROLLER_1.RO01	Setting the washing time.
RI02	:CONTROLLER_1.RO02	Setting the delay time.
BI01	:CONTROLLER_1.BO01	Output BO04 to Solenoid Valve 1.
BI02	:CONTROLLER_1.BO02	Output BO04 to Solenoid Valve 2.
BI03	:CONTROLLER_1.BO03	Output BO04 to Solenoid Valve 3.
BI04	:ZVF4101A_4.CIN	Open/Close Feedback of Valve 4.
BI05	:ZVF4101A_5.CIN	Open/Close Feedback of Valve 5.
BI06	:ZVF4101A_6.CIN	Open/Close Feedback of Valve 6.

Table 4-4: Start Output Block Software Connections (PCV4114)

Parameter	Connection From	Description
IN	:CONTROLLER_1.BO04	Start Backwashing to Controller_1.

Table 4-5: Output Connection (XVF4101A_1 to 6)

Name	Block	Parameters Connections	
		IN	MA
XVF4101A_1	COU	:Controller_1.BO01	:AM.CIN
XVF4101A_2	COU	Controller_1.BO02:	:AM.CIN
XVF4101A_3	COU	Controller_1.BO03:	:AM.CIN
XVF4101A_4	COU	:Controller_2.BO04	:AM.CIN
XVF4101A_5	COU	:Controller_2.BO05	:AM.CIN
XVF4101A_6	COU	:Controller_2.BO06	:AM.CIN

4.3.2 Timers Configuration

As shown on the diagram above (Fig 4-2), and explicated on table (Table4-7), (Table4-8), and (Table4-9) below the following timing configuration takes place:

1. The Boolean Outputs parameters COUT (XVFA4101A, XVFA4102A, and XVFA4103A) are connected to the input of accumulator parameter function blocks (Timer_1, Timer_2, and Timer_3) for starting the counting process.
2. The Boolean Outputs parameters COUT (XVFA4104A, XVFA4105A, and XVFA4106A) are connected The Input of accumulator parameter function blocks (Timer_4, Timer_5, and Timer_6) for starting the counting process.
3. The (W_Time) is Advanced Calculator (CALCA) function blocks, and are programmed to compute the total washing time using (Timer_1, Timer_2, Timer_3, Timer_4, Timer_5, and Timer_6), which is connected to the (RI01, RI02, RI03, RI04, RI05, and RI06) parameters.
4. The (RESET_TIMER) is Advanced Calculator (CALCA) function block which provide both logical functions and arithmetic computational capability within one integrated environment, and is programmed and used here to reset the whole timers (Timer1, Timer2, Timer3, Timer4, Timer5, Timer6, and the Total timer W_Time) of the system.

Table 4-6: Washing Timer Blocks for Element (1 to 3)

Param	BLCOKS		
	Timer_1	Timer_2	Timer_3
Type	ACCUM	ACCUM	ACCUM
MEAS	:XVF44101A_1.C OUT	:XVF44101A_2.CO UT	:XVF44101A_3.COUT
HSCI1	0	0	0
LSCI1	1.0	1.0	1.0
EI1	Second	Second	Second
CLEAR	:Reset_Timer.BO02	:Reset_Timer.BO02	:Reset_Timer.BO02
HSCO1	1000000	1000000	1000000
LSCO1	0	0	0
DELTO 1	1.0	1.0	1.0
EO1	Second	Second	Second

Table 4-7: Washing timer Blocks for Element (4 to 6)

Param	BLCOKS		
	Timer_4	Timer_5	Timer_6
Type	ACCUM	ACCUM	ACCUM
MEAS	:XVF44101A_4.C OUT	:XVF44101A_5.CO UT	:XVF44101A_6.COUT
HSCI1	0	0	0
LSCI1	1.0	1.0	1.0
EI1	Second	Second	Second
CLEAR	:Reset_Timer.BO 02	:Reset_Timer.BO02	:Reset_Timer.BO02
HSCO1	1000000	1000000	1000000
LSCO1	0	0	0
DELTO1	1.0	1.0	1.0
EO1	Second	Second	Second

Table 4-8: Total washing time block connection

Para	Connection/Link	Description
RI01	:TIMER_1.OUT	Element_1 Washing Time.
RI02	:TIMER_1.OUT	Element_2 Washing Time.
RI03	:TIMER_1.OUT	Element_3 Washing Time.
RI04	:TIMER_1.OUT	Element_4 Washing Time.
RI05	:TIMER_1.OUT	Element_5 Washing Time.
RI06	:TIMER_1.OUT	Element_6 Washing Time.

Table 4-9: RESET_TIMER Internal Connection

Par	Connection From	Description
BI01	:CONTROLLER_1.BO01	Delay time BO01 to BO02.
BI02	:CONTROLLER_1.BO02	Delay time BO02 to BO03.
BI03	:CONTROLLER_1.BO03	Delay time BO03 to BO0.
BI04	:CONTROLLER_2.BO04	Output BO04 to element 4.
BI05	:CONTROLLER_2.BO05	Output BO05 to element 5.
BI06	:CONTROLLER_2.BO06	Output BO06 to element 6.
BI07	:AM.CIN	Start the washing.
BI08	:XVF4101A_1.CIN	Output of Element 1.
BI09	:XVF4101A_2.CIN	Output of Element 2.
BI10	:XVF4101A_3.CIN	Output of Element 3.
BI11	:XVF4101A_4.CIN	Output of Element 4.
BI12	:XVF4101A_5.CIN	Output of Element 5.
BI13	:XVF4101A_6.CIN	Output of Element 6.
BI14	:RESET.CIN	Reset Button.

4.3.3 Flow Configuration

As shown on the diagram above (Fig 4-2), and explicated on table (Table4-11) below following flow configuration:

1. The (Inlet Flow, W. Flow, and the Outlet Flow) are Accumulator Function Blocks, ACCUM, provides a convenient method for accumulating values from an analog flow signal source, and they are used for accumulating the actual amount of Inlet flow, Washing flow, and the Outlet Flow.

Table 4-10: Flow Function Blocks Configuration

	BLCOKS		
Para.	Inlet Flow	W. Flow	Outlet Flow
Type	ACCUM	ACCUM	ACCUM
MEAS	:4F100:FI4101.PNT	BACKWASH:FLOW.RO02	BACKWASH:FLOW.RO01
HSCI1	0	0	0
LSCI1	1.0	1.0	1.0
EI1	T/H	T/H	T/H
CLEAR			
HSCO1	613200	613200	613200
LSCO1	0	0	0
DELTO1	1.0	1.0	1.0
EO1	T	T	T

4.3.4 Washing and Dwell Time Function Block Configuration

The (WASHING TIME) is an Analog input (AIN) function block used for setting the washing time (5~10 Seconds) and the (SWITCH TIME) is an Analog input (AIN) function Block and its used for setting the dwell time (2~3 Seconds) between Banks.

Table 4-11: Washing and Dwell Time Function Blocks Configuration

Parameter	WSHING_TIME	SWITCH_TIME
Type	AIN	AIN
HSC01	10	3
LSC01	5	2
DELT01	1.0	1.0
E01	SECOND	SECOND

4.4 New Control System Programming

The Below diagram (Figure 4-3) shows the new designed logic diagram in simple way, the program details is explained below.

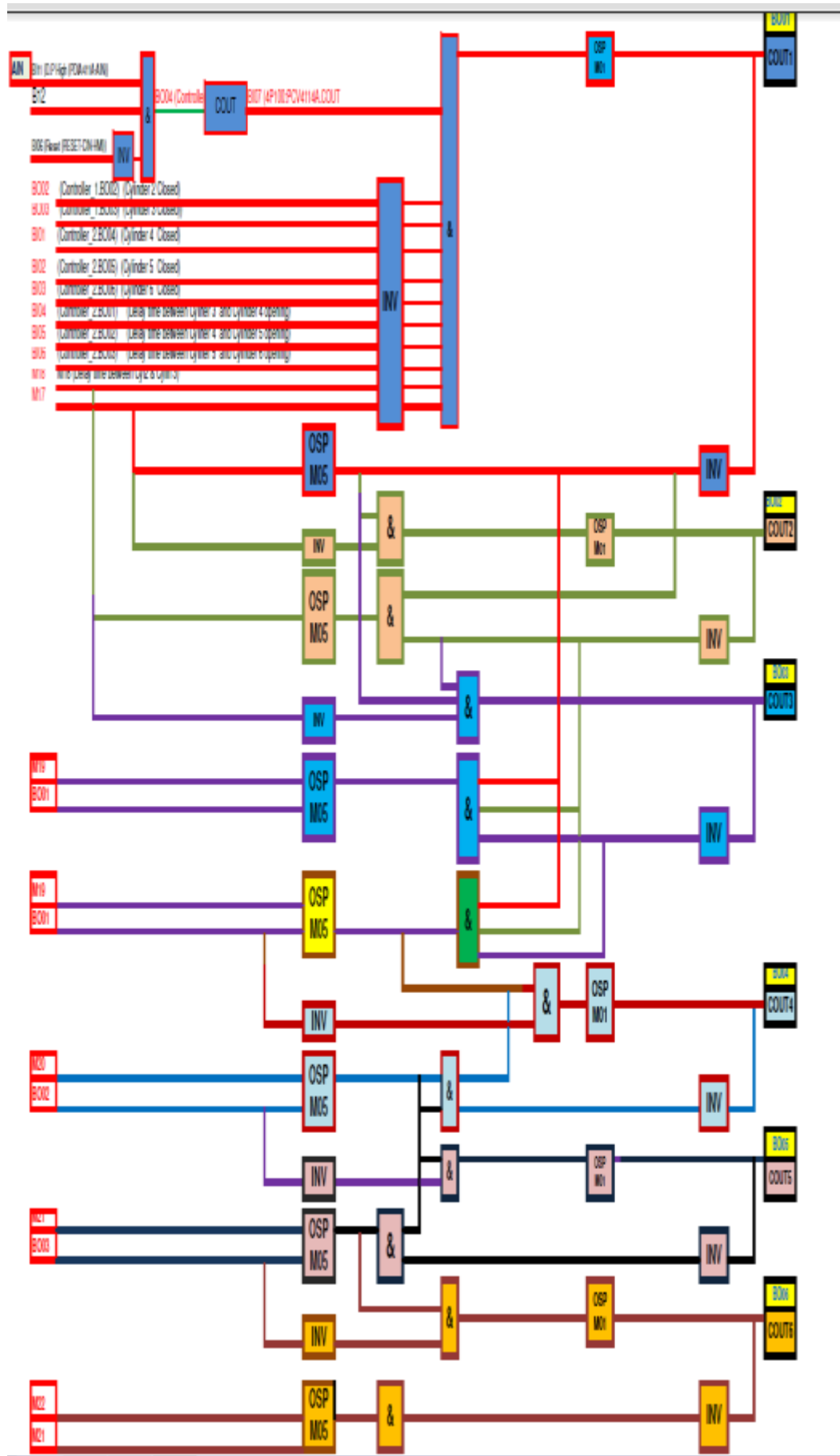


Figure 4-3: Proposed Logic/ Program for BWF Control

4.4.1 Copies Washing & Delay Time to Controller1&2 Program

The steps (STEP01 to STEP06) below explain the Washing and Delay time's program.

Table 4-12: Washing and Delay Time Program

Steps	Logic	Description
STEP01	IN RI01	Places RI01 into accumulator.
STEP02	STM M01	Copies accumulator value of RI01 to M01.
STEP03	OUT RO01	Outputs accumulator contents to output RO01.
STEP04	IN RI02	Places RI02 into accumulator.
STEP05	STM M05	Copies accumulator value of RI02 to M05.
STEP06	OUT RO02	Outputs accumulator contents to output RO02.

4.4.2 Start the Backwashing Sequence program

The Backwash filtering process can be started manually or automatically by activating the Binary Input BI07 in (Controller1). In the manual mode the Output contact function block (PCV4114A) is kept in manual mode and it is output toggled, which activate (BI07) and start the washing sequence, while in the Auto mode the filtering process will started by BO04 when the differential pressure across the filter is high (BI11) and the reset is normal and the BO06 is off. The filtering process will continue by BO06 Output. And the Rest (BI12) is used for reset the filtering process.

Table 4-13: Start Sequence program

Steps	Logic	Description
STEP08	AND BI11 BI12	Performs the logical AND of BI11 (HIA) and B12 (Reset).
STEP09	AND ~BI06	Performs the logical AND of ~BI06 (Element 6 output) and accumulator.
STEP10	OUT BO04	Outputs accumulator to output BO04.

4.4.3 BANK 1, Solenoid 1 Activated, Output (BO01) Program

Bank1 will start washing if the start signal BO04 of (**Controller1**) activate (**PCV4114A**) and so BI07, beside that Bank 2, Bank 3, Bank 4, Bank 5, and Bank 6 must not in washing process in addition Bank 1 will not be washed during the delay time between Bank 1 and 2, Bank 2 and 3, Bank 3 and 4, Bank 4 and 5, Bank 5 and 6.

Table 4-14: BANK 1 washing program

Steps	Logic	Description
STEP12	IN BI07	Puts BI07 into accumulator (Start Signal).
STEP13	AND ~BO02	Performs the logical AND function on the ~BO02 and accumulator, And stores the result on to the accumulator.
STEP14	AND ~BO03	Performs the logical AND function on the ~BO03 and accumulator, and stores the result on to the accumulator.
STEP15	AND ~BI01	Performs the logical AND function on the ~BI01 and accumulator, and stores the result on to the accumulator.
STEP16	AND ~BI04	Performs the logical AND function on the ~BI04 and accumulator, and stores the result on to the accumulator.
STEP17	AND ~BI02	Performs the logical AND function on the ~BI02 and accumulator. BI06 and stores the result on to the accumulator.
STEP18	AND ~BI05	Performs the logical AND function on the ~BI05 and accumulator, and stores the result on to the accumulator.
STEP19	AND ~BI03	Performs the logical AND function on the ~BI03 and accumulator, and stores the result on to the accumulator.
STEP20	AND ~BI06	Performs the logical AND function on the ~BI06 and accumulator, and stores the result on to the accumulator.
STEP21	OSP M01	Looks at input to the accumulator, uses it to control the Step 21 OSP element, and writes the result to the accumulator.
STEP22	OUT BO01	Outputs accumulator contents (the results of the OSP M01 instruction) to output BO01. Assume block is in Auto.

4.4.4 Dwell time between Bank 1 & 2 Washing Program

The delay time between BANK 1 and BANK 2 washing will start immediately after BANK 1 was washed.

Table 4-15: Dwell time program between Bank1 & Bank2 washing

Steps	Logic	Description
STEP26	IN ~BO01	Puts ~BO01 into accumulator.
STEP27	OSP M05	Looks at input to the accumulator, uses it to control the Step 27 OSP element, and writes the result to the accumulator.
STEP28	OUT M17	Outputs accumulator contents (the results of the OSP M05 instruction) to memory location M17.

4.4.5 BANK 2 Washing, Solenoid 2 Activated, (BO02) Program

BANK 2 will start washing process if BANK 1 was washed and the delay time between BANK 1 and 2 was completed.

Table 4-16: BANK 2 washing program

Steps	Logic	Description
STEP31	AND ~BO01 ~M17	Performs the logical AND of BO01 and M17 and stores the result on to the accumulator.
STEP32	OSP M01	Looks at input to the accumulator, uses it to control the Step 39 OSP element, and writes the result to the accumulator.
STEP33	OUT BO02	Outputs accumulator contents (the results of the OSP M01 instruction) to output BO02. Assume block is in Auto.

4.4.6 Dwell time between BANK 2 and BANK 3 Program

The delay time between BANK 2 and BANK 3 washing will start immediately after BANK 1 and BANK 2 were washed.

Table 4-17: Dwell time program between Bank2 & Bank3

Steps	Logic	Description
STEP37	AND ~BO01 ~BO02	Performs the logical AND of ~BO01 and ~BO02 and stores the result on to the accumulator.
STEP38	OSP M05	Looks at input to the accumulator, uses it to control the Step 43 OSP element, and writes the result to accumulator.
STEP 39	OUT M18	Outputs accumulator contents (the results of the OSP M05 instruction) to memory location M18.

4.4.7 BANK 3 Washing, Solenoid 3 Activated, (BO03) Program

Element 3 will start washing process if Element 1, Element 2 were washed and the delay time between Element 2 and 3 washing were completed.

Table 4-18: BANK 3 washing program

Steps	Logic	Parameters
STEP43	AND ~BO01 ~BO02	Performs the logical AND of ~BO01 and ~BO02 and stores the result to the accumulator.
STEP44	AND ~M18	Performs the logical AND of ~BO01 and ~BO02 and ~M18 and stores the result on to the accumulator.
STEP45	OSP M01	Looks at input to the accumulator, uses it to control the Step 48 OSP, and writes the result to accumulator.
STEP46	OUT BO03	Outputs accumulator contents (the results of the OSP M01 instruction) to output BO03. Assume block is in Auto.

4.4.8 Dwell time between BANK 3 and BANK 4 Program

The delay time between BANK 3 and BANK 4 washing will start immediately after BANK 1, BANK 2, and BANK 3 were washed.

Table 4-19: Dwell time program between Bank3 & Bank4

Steps	Logic	Description
STEP09	AND ~BI01 ~BI02	Performs the logical AND of ~BI01 and ~BI02 and stores the result to the accumulator.
STEP10	AND ~BI03	Performs the logical AND of ~BI01 and ~BI02 and ~BI03 and stores the result on to the accumulator.
STEP 11	OSP M05	Looks at input to the accumulator, uses it to control the Step 09 OSP element, and writes the result to accumulator.
STEP12	OUT M19	Outputs accumulator contents (the results of the OSP M05 instruction) to memory location M19.
STEP13	OUT BO01	Outputs accumulator contents (the results of the OSP M05 instruction) to Output BO01.

4.4.9 BANK 4 Washing, Solenoid 4 Activated, (BO04) Program

Element 4 will start washing process if Element 1, Element 2, Element 3 were washed and the delay time between Element 2 and 3 & Element 3 and 4 washing were completed.

Table 4-20: BANK 4 washing program

Steps	Logic	Description
STEP15	AND ~BI01 ~ BI02	Performs the logical AND of ~BI01 and ~BI02 and stores the result to the accumulator.
STEP16	AND ~BI03	Performs the logical AND of ~BI03 with accumulator and stores the result on to the accumulator.
STEP17	AND ~M19	Performs the logical AND of ~M19 with accumulator and stores the result on to the accumulator.
STEP18	OSP M01	Looks at input to the accumulator, uses it to control the Step 15 OSP element, and writes the result to the accumulator.
STEP19	OUT BO04	Outputs accumulator contents (the results of the OSP M01 instruction) to output BO04. Assume block is in Auto.

4.4.10 Dwell time between BANK 4 and BANK 5 Program

The delay time between Element 4 and Element 5 washing will start immediately after Element 1, Element 2, Element 3, and Element 4 were washed.

Table 4-21: Dwell time program between Bank4 & Bank5

Steps	Logic	Description
STEP18	AND ~BI01 ~BI02	Performs the logical AND of ~BI01 and ~BI02 and stores the result to the accumulator (Accumulator = 1).
STEP19	AND ~BI03	Performs the logical AND of ~BI03 with accumulator and stores the result on to the accumulator.
STEP 20	AND ~BO04	Performs the logical AND of ~BO04 with accumulator and stores the result on to the accumulator.
STEP21	OSP M05	Looks at input to the accumulator, uses it to control the Step 21 OSP element, and writes the result to accumulator.
STEP22	OUT M20	Outputs accumulator contents (the results of the OSP M05 instruction) to memory location M20.
STEP23	OUT BO02	Outputs accumulator contents (the results of the OSP M05 instruction) to Output BO02.

4.4.11 BANK 5 Washing, Solenoid5 Activated,(BO05) Program

Element 5 will start washing process if Element 1, Element 2, Element 3, Element 4 were washed and the delay time between Element 2 and 3 & Element 3 and 4 & Element 4 and 54 washing were completed.

Table 4-22: BANK 5 washing program

Steps	Logic	Description
STEP24	AND ~BI01 ~ BI02	Performs the logical AND of ~BI01 and ~BI02 and stores the result to the accumulator (Accumulator = 1).
STEP25	AND ~BI03	Performs the logical AND of ~BI03 with accumulator and stores the result on to the accumulator.
STEP26	AND ~BO04	Performs the logical AND of ~BO04 with accumulator and stores the result on to the accumulator.
STEP27	AND ~M20	Performs the logical AND of ~M20 with accumulator and stores the result on to the accumulator.
STEP28	OSP M01	Looks at input to the accumulator, uses it to control the Step 28 OSP element, and writes the result to the accumulator.
STEP29	OUT BO05	Outputs accumulator contents (the results of the OSP M01 instruction) to output BO05. Assume block is in Auto.

4.4.12 Dwell time between BANK 5 and BANK 6 Program

The delay time between Element 5 and Element 6 washing will start immediately after Element 1, Element 2, Element 3, Element 4, and Element 5 were washed.

Table 4-23: Dwell time program between Bank5 & Bank6

Steps	Logic	Description
STEP31	AND ~BI01 ~ BI02	Performs the logical AND of ~BI01 and ~BI02 and stores the result to the accumulator (Accumulator = 1).
STEP32	AND ~BI03	Performs the logical AND ~BI03 with accumulator and stores the result on to the accumulator.
STEP33	AND ~BO04	Performs the logical AND of ~BO04 with accumulator and stores the result on to the accumulator.
STEP34	AND ~BO05	Performs the logical AND of ~BO05 with accumulator and stores the result on to the accumulator.
STEP35	OSP M05	Looks at input to the accumulator, uses it to control the Step 35 OSP element, and writes the result to accumulator.

STEP36	OUT M21	Outputs accumulator contents (the results of the OSP M05 instruction) to memory location M21.
STEP37	OUT BO03	Outputs accumulator contents (the results of the OSP M05 instruction) to Output BO03.

4.4.13 BANK6 Washing, Solenoid6 Activated, (BO06) Program

Element 6 will start washing process if Element 1, Element 2, Element 3, Element 4, and Element 5 were washed and the delay time between Element 2 and 3 & Element 3 and 4 & Element 4 and 5 & Element 5 and 6 washing were completed.

Table 4-24: BANK 6 washing program

Steps	Logic	Description
STEP38	AND ~BI01 ~BI02	Performs the logical AND of ~BI01 and ~BI02 and stores the result to the accumulator.
STEP39	AND ~BI03	Performs the logical AND of ~BI03 with accumulator and stores the result on to the accumulator.
STEP40	AND ~BO04	Performs the logical AND of ~BO04 with accumulator and stores the result on to the accumulator.
STEP42	AND ~BO05	Performs the logical AND of ~BO05 with accumulator and stores the result on to the accumulator.
STEP42	AND ~M21	Performs the logical AND of ~M21 with accumulator and stores the result on to the accumulator.
STEP43	OSP M01	Looks at input to the accumulator, uses it to control the Step 28 OSP element, and writes the result to the accumulator.
STEP43	OUT BO06	Outputs accumulator contents (the results of the OSP M01 instruction) to output BO06. Assume block is in Auto.

4.4.14 Total Washing Time counting Program

Table 4-25: Total Washing Time Program

Steps	Logic	Description
STEP01	IN RI01	Places RI01 into accumulator.
STEP02	ADD RI02	Adds RI02 to accumulator, pushes result into stack.
STEP03	STM M01	Copies accumulator value to M01.
STEP04	ADD RI03	Adds RI03 to accumulator, pushes result into stack.
STEP05	STM M01	Copies accumulator value to M01.
STEP06	ADD RI04	Adds RI04 to accumulator, pushes result into stack.
STEP07	STM M01	Copies accumulator value of RI01 to M01.
STEP08	ADD RI05	Adds RI05 to accumulator, pushes result into stack.
STEP09	STM M01	Copies accumulator value to M01.
STEP10	ADD RI06	Adds RI06 to accumulator, pushes result into stack.
STEP11	STM M01	Copies accumulator value to M01.
STEP12	OUT RO01	Outputs accumulator contents to output RO01.

4.4.15 RESET_TIMERS Program

Table 4-26: Reset _ Timer Function Block program

Steps	Logic	Description
STEP01	IN BI01	Puts BI01 into accumulator.
STEP02	OSP 10	Looks at input to the accumulator, uses it to control the Step 02 OSP element, and writes the result to the accumulator.

STEP03	OUT M01	Outputs accumulator contents (the results of the OSP 10 instruction) to memory M01.
STEP04	IN BI02	Puts BI02 into accumulator.
STEP05	OSP 10	Looks at input to the accumulator, uses it to control the Step 05 OSP element, and writes the result to the accumulator.
STEP06	OUT M02	Outputs accumulator contents (the results of the OSP 10 instruction) to memory M02.
STEP07	IN BI03	Puts BI03 into accumulator.
STEP08	OSP 10	Looks at input to the accumulator, uses it to control the Step 08 OSP element, and writes the result to the accumulator.
STEP09	OUT M03	Outputs accumulator contents (the results of the OSP 10 instruction) to memory M03.
STEP10	IN BI04	Puts BI04 into accumulator.
STEP11	OSP 10	Looks at input to the accumulator, uses it to control the Step 11 OSP element, and writes the result to the accumulator.
STEP12	OUT M04	Outputs accumulator contents (the results of the OSP 10 instruction) to memory M04.
STEP13	IN BI05	Puts BI05 into accumulator.
STEP14	OSP 10	Looks at input to the accumulator, uses it to control the Step 14 OSP element, and writes the result to the accumulator.
STEP15	OUT M05	Outputs accumulator contents (the results of the OSP 10 instruction) to memory M05.
STEP16	IN BI06	Puts BI01 into accumulator.
STEP17	OSP10	Looks at input to the accumulator, uses it to control the Step 17 OSP element, and writes the result to the accumulator.
STEP18	OUT M06	Outputs accumulator contents (the results of the OSP 10 instruction) to memory M06.
STEP19	IN ~M01	Puts ~M01 into accumulator

STEP20	AND ~M02	Performs the logical ~M02 and accumulator and stores the result on to the accumulator.
STEP21	AND ~M03	Performs the logical AND of ~M03 and accumulator and stores the result on to the accumulator.
STEP22	AND ~M04	Performs the logical AND of ~M04 and accumulator and stores the result on to the accumulator.
STEP23	AND ~M05	Performs the logical AND of ~M05 and accumulator and stores the result on to the accumulator.
STEP24	AND ~M06	Performs the logical AND of ~M06 and accumulator and stores the result on to the accumulator.
STEP25	OUT BO01	Outputs accumulator contents to output BO01.
STEP29	IN BI06	Puts ~BI06 into accumulator.
STEP30	OSP 09	Looks at input to the accumulator, uses it to control the Step 30 OSP element, and writes the result to the accumulator.
STEP31	OUT M17	Outputs accumulator contents (the results of the OSP 09 instruction) to memory M17.
STEP32	IN ~M17	Puts ~ M17 into accumulator.
STEP33	OSP 3	Looks at input to the accumulator, uses it to control the Step 33 OSP3 element, and writes the result to the accumulator.
STEP34	OUT M18	Outputs accumulator contents (the results of the OSP 3 instruction) to memory M18.
STEP35	OR ~BI07	OR the accumulator with ~BI07 and stores the result on to the accumulator.
STEP36	OR ~BI14	OR the accumulator with ~BI14 and stores the result on to the accumulator.
STEP37	OUT BO02	Outputs accumulator contents to output BO02.

4.5 HMI (Human Machine Interface) Description

The display showing diagram of the Backwash filters with on/off valves and state of objects etc. Most of the operation and supervision of the Backwash filter such as start/stop change pressure set points and also have a good overview of the main variables like differential pressure, etc. The six (1 to 6) banks of filter are shown below; each banks of the filter consist of two elements paired to the common headers. Only one pair of elements is cycled for backwashing at a given time. The others banks are always on-stream providing uninterrupted service.

These displays are used when you want to:

2. Manual/Auto Operation.
3. Washing Time adjustment.
4. Valves positions feedback.
5. Differential pressure setting.
6. Cut/Normal operation.
7. Total Washing time.
8. Washing time per bank.
9. Accumulators for Input, output and off aspect Diesel

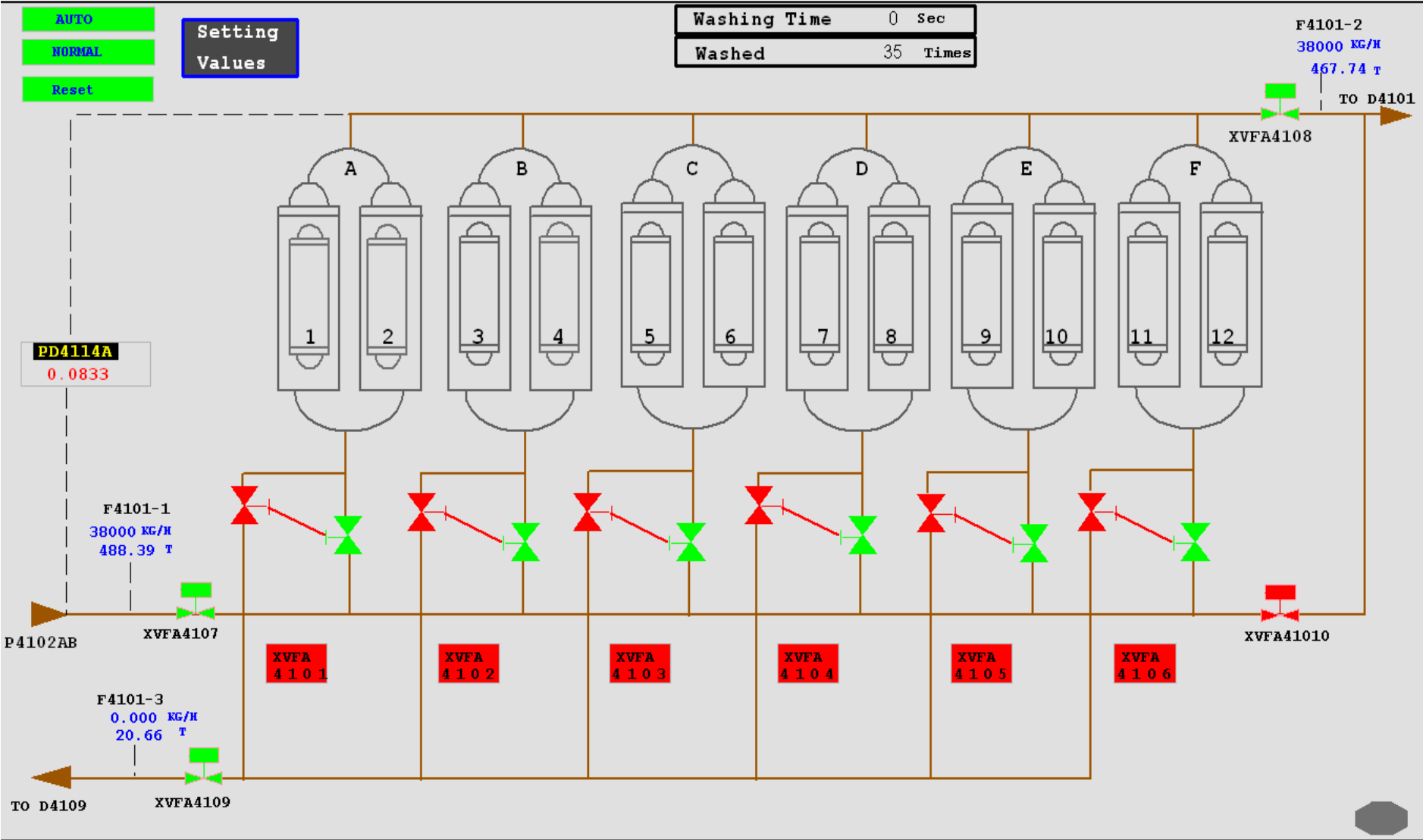


Figure 4-4: Backwash filter Human Machine Interface

4.5.1 Setting Values

4.5.1.1 DP Set point

The differential pressure set point can be adjusted according to the diesel specification and process situation.

4.5.1.2 Washing and Dwell time setting

The Washing and Dwell times are designed based on the old pneumatic system. The Washing time can be adjusted from (6 to 10) seconds, and the Dwell time can be adjusted form (2-3) seconds.

4.5.1.2.1 Washing Time

The amount of time that the filter backwashes and should be set in a range of 6 to 10 seconds.

4.5.1.2.2 Dwell Time

The dwell switch sets the time between following filter flushes. It allows the 1st filter's wash valves to close completely before the 2nd filter starts to flush, and so on. The setting range is between 2-3 seconds.

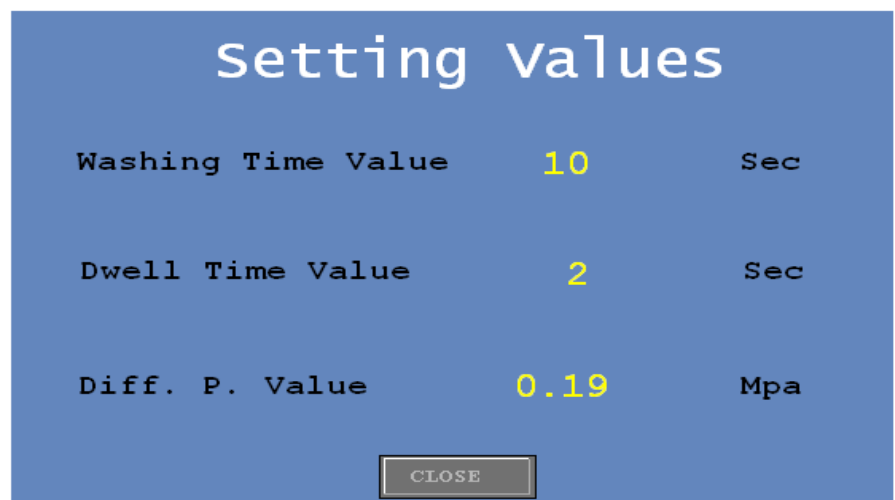


Figure 4-5: Setting Values

4.5.2 Setting Buttons

4.5.2.1 Auto/Manual

The filter can be operated manually or automatically by clicking Auto/Manual button and then confirm the Manual or the Automatic operation by Yes (Change BWF to Auto Mode) or Yes (Change BWF to Manual Mode).

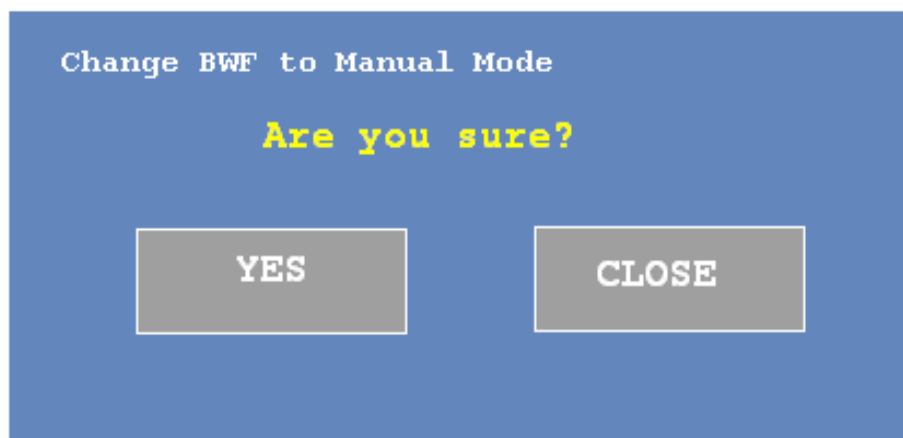


Figure 4-6: Change to Manual Mode

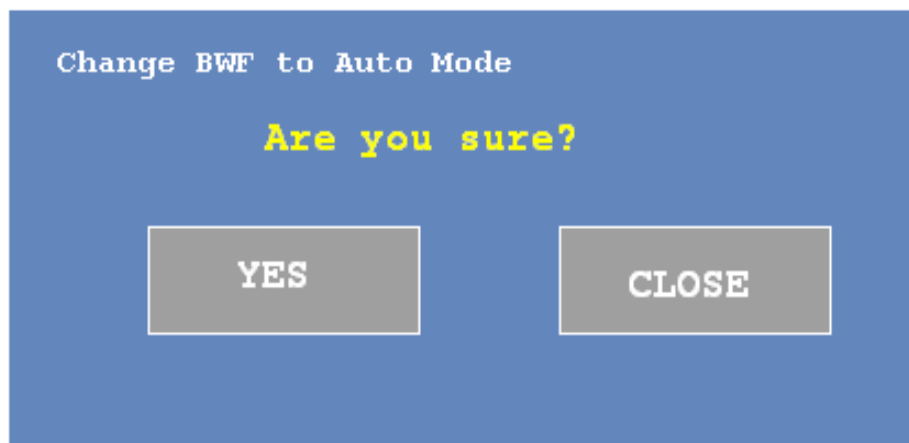


Figure 4-7: Change to Auto Mode

4.5.2.2 Reset Control

The Reset button is used to reset the operation of the filter when there is problem. The reset button also reset the timers to start form zero.

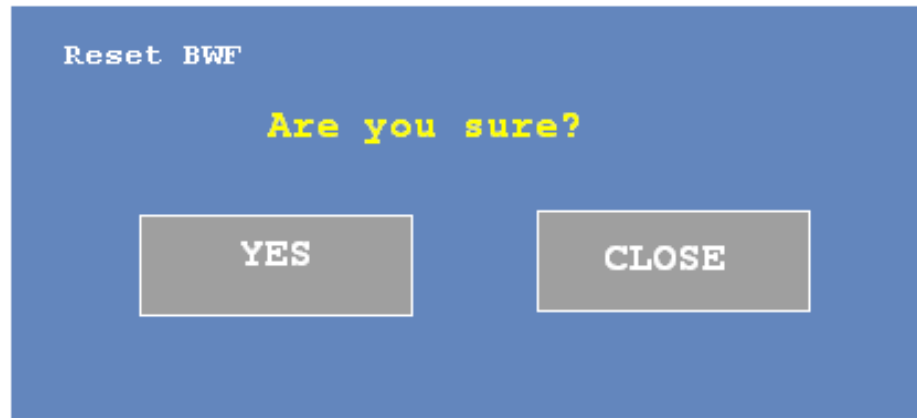


Figure 4-8: Reset Control System

4.5.2.3 Cut BWF

The Cut BWF button is used to cut, isolate and bypass the backwash filter operation in case of any leaks or any mechanical problem zero

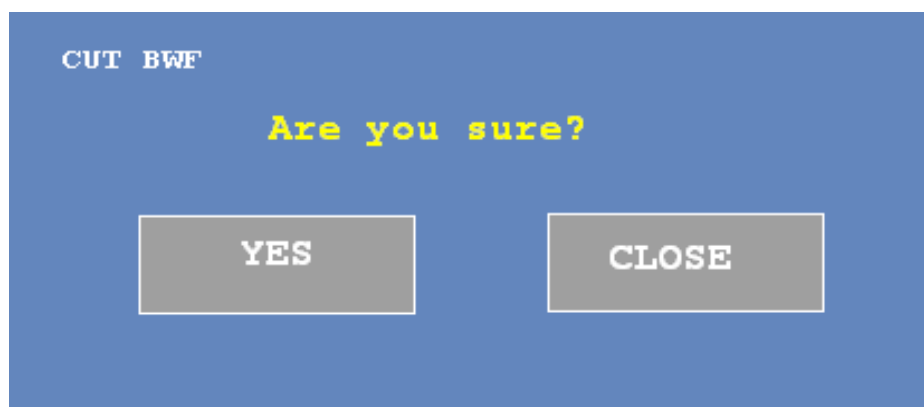


Figure 4-9: Cut BWF