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DATA PACKAGE 94.1

Compartment I Acceptance Review Control Data package

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- Introduction within Call Off Orders 8 of some minor hardware modifications on C1 process - Introduction within Call Off Orders 8 of C1 alarms and maintenance mode in the PLC software and corresponding HMI screens	0	1	final	30/10/10
- Introduction within Call Off Orders 8 and 10 of some minor hardware modifications on C1 process (cf.TN94.11 ed 1) - Introduction within Call Off Orders 8 and 10 of C1 alarms and maintenance mode in the PLC software and corresponding HMI screens	1	0	final	30/09/11

Distribution List

Name/*Nom*	Company/*Société*	Quantity/*Quantité*
Brigitte LAMAZE	ESA	2 hardcopies + electronic version

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SECTION 2: PLC Design and wiring (NTE Documents)

D:\Project_Files\Melissa\PN15030_LOM4\DP84.1_Issue_1\DP94.1_issue1_Section_2 CI HARDWARE DESIGN DOCUMENT.doc

SECTION 3: PLC Cabinet assembly (NTE Documents)

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SECTION 4: Implementation of remote and local HMI (NTE Document)

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ANNEXES

CI_List_Equipments_IO_Tag_20090212.xls

CI_NewHWaddress_20090212.xls

HMI_FU_Test_20090401.xls

CI: Software Description and Procedures

Prepared by/Préparé par	Christophe Bourg, Olivier Gerbi
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1. Introduction

The objective of this document is the detailed description of Compartment I software. This software has been implemented in the same way of the other compartments with the mode management of the defined Control Loops.
In order to preserve the previous "procedure software manual", this report is separated in 2 main parts.

- The first part concerns the detailed Control Loop descriptions with the explanation of the block diagram implementation (Chapter 3).
- The second part keeps the previous report organization with the entire procedure description (Chapter 4). The procedure numbering is kept.

2. Software Configuration

2.1. PLC Configuration

Here below, the configuration of the I/O of the PLC.
There are two rack connected by a XBE cable. On the first rack, the power supply, the CPU (Quantum), the Network (NOE card) and analog I/O followed by digital I/O cards. The second rack contains only digital I/O cards.

PLC									
1	2	3	4	5	6	7	8	9	10
140CPS11410	140CPU43412	140NOE77101	140ACI04000	140ACI04000	140ACI04000	140ACO02000	140DDI35300	140DDI35300	140XBE10000
Backplane Power Supply module	CPU module	Ethernet module	16 Analog current Input	16 Analog current Input	16 Analog current Input	8 Analog current Output (ACO 1)	32 Digital Input 24V	32 Digital Input 24V	Rack expansion
CI_PLC_CPS	CI_PLC_CPU	CI_PLC_NOE	CI_PLC_ACI	CI_PLC_ACI2	CI_PLC_ACI3	CI_PLC_ACO	CI_PLC_DDI1	CI_PLC_DDI2	CI_PLC_XBE
Address			300001 --> 300017	300018 --> 300034	300035 --> 300051	400001->400004	100001->100032	100033->100064	

PLC EXPANSION									
1	2	3	4	5	6	7	8	9	10
140CPS11420	140DDI35300	140DDI35300	140DDO35300	140DDO35300	140DDO35300	140DDO35300	140DDI35300		140XBE10000
Backplane Power Supply module	32 Digital Input 24V	32 Digital Input 24V	32 Digital Output 24V	32 Digital Output 24V	32 Digital Output 24V	32 Digital Output 24V	32 Digital Input 24V		Rack expansion
CI_PLC_CPS	CI_PLC_DDI3	CI_PLC_DDI4	CI_PLC_DDO1	CI_PLC_DDO2	CI_PLC_DDO3	CI_PLC_DDO3	CI_PLC_DDI5		CI_PLC_XBE
Address	100065->100096	100097->100128	000001 -> 000032	000033 -> 000064	000065 -> 000096	000097 -> 000128	100129->100160		

2.2. Equipment Ranges (AO / AI)

The following table presents the analog connected with their implemented ranges in the PLC. If the signal is filtered or averaged, it is indicated in the “Filter” column.

Index	Tags	Description	Signal	PLC Address	ELECTRICAL SIGNAL	RANGE	OFF SET	FILTER
1	PT_1001_01	Measures pressure immediately after pump GP_1001_01 and gives an alarm if pressure increases above the pump’s limit	AI	300007	4-20mA	-200 / 200 (mbar)	NO	NO
2	TT_1002_01	Temperature sensor 1 Measures temperature in influent tank (VSL2_1000_01)	AI	300014	4-20mA	0 / 100 (°C)	NO	“TT_1002_01_Av” (used in the software) is Averaged on 2500 values
3	TT_1002_02	Temperature sensor 2 Measures temperature in influent tank (VSL2_1000_01)	AI	300009	4-20mA	0 / 100 (°C)	NO	“TT_1002_02_Av” (used in the software) is Averaged on 2500 values
4	PT_1003_01	Pressure transducer Measures pressure in gas phase for gas and volume measurement in influent tank (VSL2_1000_01)	AI	300006	4-20mA	-200 / 200 (mbar)	NO	NO
5	LT_1004_01	Pressure sensor used for volume measurement. Measures pressure in liquid phase for volume measurement in influent tank (VSL2_1000_01)	AI	300005	4-20mA	-200 / 200 (mbar)	NO	NO
6	TT_1008_01	Temperature sensor Measures temperature in bioreactor (VSL2_1007_01)	AI	300015	4-20mA	0 / 100 (°C)	NO	“TT_1008_01_Av” (used in the software) is Averaged on 2500 values
7	TT_1008_02	Temperature sensor Measures temperature in warm water bath HX_1008_01	AI	300016	4-20mA	0 / 100 (°C)	NO	“TT_1008_02_Av” (used in the software) is Averaged on 2500 values

Index	Tags	Description	Signal	PLC Address	ELECTRICAL SIGNAL	RANGE	OFF SET	FILTER
8	PT_1009_01	Pressure transducer Measures pressure in gas phase and volume measurement in bioreactor (VSL2_1007_01)	AI	300010	4-20mA	-200 / 200 (mbar)	NO	Block « LEAD_LAG1 » Gain : 1 Lag : 10s
9	PT_1009_02	Pressure transducer Measures pressure in liquid phase for volume measurement in bioreactor (VSL2_1007_01)	AI	300011	4-20mA	0 / 400 (mbar)	NO	Block « LEAD_LAG1 » Gain : 1 Lag : 10s
10	LT_1010_01	Level sensor Measures pressure in liquid phase for volume measurement in bioreactor (VSL2_1007_01)	AI	300013	4-20mA	0 / 400 (mbar)	NO	Block « LEAD_LAG1 » Gain : 1 Lag : 10s
11	AT_1011_01	pH sensor 1 Measures pH in bioreactor (VSL2_1007_01)	AI	300001	4-20mA	0 / 10	NO	NO
12	AT_1011_02	pH sensor 2 Measures pH in bioreactor (VSL2_1007_01)	AI	300003	4-20mA	0 / 10	NO	NO
13	TT_1011_01	Temperature probe of pH sensor1 Measures temp. of the Electrode	AI	300002	4-20mA	20 / 70 (°C)	NO	NO
14	TT_1011_02	Temperature probe of pH sensor2 Measures temp. of the Electrode	AI	300004	4-20mA	20 / 70 (°C)	NO	NO
15	PT_1100_01	Measures pressure in buffer vessel VSSL_1100_01	AI	300026	4-20mA	0 / 10000 (mbar)	NO	NO
16	PT_1100_02	Measures pressure of gas produced by bioreactor (VSL2_1007_01) and accumulated in VSSL_1100_02 for flow measurement	AI	300040	4-20mA	0 / 200 (mbar)	NO	NO
17	SCV_1100_01_MV	Used to adapt the gas flow coming from buffer vessel VSSL_1100_01 and going to bioreactor VSL2_1007_01 in order to keep the pressure constant in the bioreactor	AO	400003	4-20mA	0 / 100 (%)	NO	NO
18	AT_1101_01_CO2	Gas analyser Analyses bioreactor gas phase composition for CO2 and CH4. One sensor, 2 measurements	AI	300049	4-20mA	0 / 100 (%)	NO	NO

Index	Tags	Description	Signal	PLC Address	ELECTRICAL SIGNAL	RANGE	OFF SET	FILTER
19	AT_1101_01_CH4	Gas analyser Analyses bioreactor gas phase composition for CO2 and CH4. One sensor. 2 measurement	AI	300050	4-20mA	0 / 20 (%)	NO	NO
20	FT_1101_01	Mass Flow meter Measures the gas flow entering in the gas analyser.	AI	300036	4-20mA	0 / 5.8 (L/h)	NO	NO
21	PT_1101_01	Pressure transducer. Measures pressure of gas after gas analyser	AI	300025	4-20mA	0 / 400 (mbar)	NO	NO
22	FT_1103_01	N2 Mass Flow meter Measures the N2 gas flow entering the bioreactor VSL2_1007_01 (passive gas loop configuration)	AI	300037	4-20mA	0 / 2 (L/h)	NO	"FT_1103_01_Av" (used in the software) is Averaged on 2500 values
23	SCV_1103_01_MV	Powered proportional valve to keep bioreactor pressure constant (passive gas loop configuration) Regulates N2 inlet in bioreactor VSL2_1007_01	AO	400004	4-20mA	0 / 100 (%)	NO	NO
24	TT_1104_01	Temperature sensor Measures temperature in VSSL_1100_02 for determination of produced gas flow	AI	300041	4-20mA	0 / 100 (°C)	NO	NO
25	PT_1104_01	Measures the gas pressure on the gas line before the columns.	AI	300024	4-20mA	0 / 100 (mbar)	NO	NO
26	TT_1200_01	Temperature sensor Measures temperature in retentate	AI	300021	4-20mA)	0 / 100 (°C)	NO	NO
27	TT_1200_02	Temperature sensor Measures temperature Membrane1	AI	300043	4-20mA	0 / 400 (°C)	NO	NO
28	TT_1200_03	Temperature sensor Measures temperature Membrane2	AI	300044	4-20mA	0 / 400 (°C)	NO	NO
29	FT_1201_01	Flow meter Measures the retentate flow	AI	300018	4-20mA	0 / 580 (L/h)	NO	NO
30	AT_1201_01	Turbidity sensor Measures turbidity of retentate	AI	300035	4-20mA	0 / 100 (NTU)	NO	NO

Index	Tags	Description	Signal	PLC Address	ELECTRICAL SIGNAL	RANGE	OFF SET	FILTER
31	GP_1201_01_MV2	2 variables for the pump	AO	400002	4-20mA	0 / 100 (%)	NO	NO
32	PP_1202_01_MV2	2 variables for the pump	AO	400001	4-20mA)	0 / 100 (%)	NO	NO
33	PT_1203_01	Pressure transducer Measures pressure of retentate at inlet of membrane LUF_1200_01	AI	300033	4-20mA	0 / 4 (bar)	NO	NO
34	PT_1203_02	Pressure transducer Measures pressure of retentate at outlet of membrane LUF_1200_01	AI	300032	4-20mA	0 / 4 (bar)	NO	NO
35	PT_1203_03	Pressure transducer Measures pressure of filtrate at outlet of membrane LUF_1200_01	AI	300031	4-20mA	-1 / 4 (bar)	NO	NO
36	PT_1203_04	Pressure transducer Measures pressure of retentate at inlet of membrane LUF_1200_02	AI	300030	4-20mA	0 / 4 (bar)	NO	NO
37	PT_1203_05	Pressure transducer Measures pressure of retentate at outlet of membrane LUF_1200_02	AI	300029	4-20mA	0 / 4 (bar)	NO	NO
38	PT_1203_06	Pressure transducer Measures pressure of filtrate at outlet of membrane LUF_1200_02	AI	300028	4-20mA	-1 / 4 (bar)	NO	NO
39	PT_1203_07	Pressure transducer Measures pressure of retentate after pump PMP-F-01 (safety pump)	AI	300027	4-20mA	-1 / 9 (bar)	NO	NO
40	PT_1203_08	Pressure transducer Measures pressure at inlet of dead end filter LF_1200_01 (to follow clogging)	AI	300042	4-20mA	0 / 4 (bar)	NO	NO
41	TT_1205_01	Temperature sensor Measures temperature in filtrate tank VSSL_1204_01	AI	300022	4-20mA	0 / 150 (°C)	NO	NO

Index	Tags	Description	Signal	PLC Address	ELECTRICAL SIGNAL	RANGE	OFF SET	FILTER
42	LT_1206_01	Level sensor Measures pressure in gas phase for volume measurement in filtrate tank (VSSL_1204_01)	AI	300038	4-20mA	0 / 100 (%)	NO	NO
43	TT_1208_01	Temperature sensor Measures temperature in cleaning buffer vessel (VSSL_1209_02	AI	300023	4-20mA	0 / 100 (°C)	NO	NO

2.3. Initial Values

The following tables present the initial values at the start up of the PLC. It is divided in two parts:
First the general initial values without units
Second all the thresholds linked to the alarms

2.3.1.General

Control Loop	variable	type	address	Initial value	comments
CL1001	CL1001_ControlLoop_Mode	INT	400800	0	Bioreactor feeding mode (0: Off / 1: Auto / 2: Manu)
CL1002	CL1002_ControlLoop_Mode	INT	400800	0	Influent temperature mode (0: Off / 1: Auto / 2: Manu)
CL1002	CL1002_Temp_probe_selection	INT	400802	0	Permit to select the temperature probe (0: probe 1 / 1: probe 2 / 2: average)
CL1003	CL1003_ControlLoop_Mode	INT	400800	0	Influent pressure mode (0: Off / 1: Auto / 2: Manu)
CL1005	CL1005_ControlLoop_Mode	INT	400804	0	Influent tank blender mode (0: Off / 1: Auto / 2: Manu)
CL1008	CL1008_ControlLoop_Mode	INT	400805	0	Bioreactor temperature mode (0: Off / 1: Auto / 2: Manu)
CL1008	TT_1008_02_SP	REAL	400010	55	Bioreactor temperature set point
CL1009	CL1009_ControlLoop_Mode	INT	400807	0	Bioreactor Pressure mode (0: Off / 1: Auto / 2: Manu)
CL1009	PT_1009_Hyst_Falling	REAL		200	hysteresis linedk to the high alarm Alarm Threshold of PT_1009_01
CL1009	PT_1009_Hyst_Rising	REAL		210	hysteresis linedk to the high alarm Alarm Threshold of PT_1009_01
CL1011	CL1011_Acid_injection_Time	REAL	400047	0	The timer is increasing in second with a step of 0.1 s
CL1011	CL1011_Base_injection_Time	REAL	400045	0	The timer is increasing in second with a step of 0.1 s
CL1011	CL1011_ControlLoop_Mode	INT	400809	0	Bioreactor pH mode (0: Off / 1: Auto / 2: Manu)
CL1011	CL1011_pH_DeadZone	REAL	400049	0.03	Absolute value which defines a Zone arround the Set point where the control is not active
CL1011	CL1011_pH_Hour	BYTE	400862		Date of the last reset done by the operator
CL1011	CL1011_pH_SP	REAL	400185	5.4	pH set point entered by the operator (Initial value: 6)
CL1011	CL1011_probe_selection	INT	400810	1	Permit to select the the pH probe (0: probe 1 / 1: probe 2 / 2: average)Previously, the tag was a boolean (old PLC@: 000329)
CL1012	CL1012_ControlLoop_Mode	INT	400811	0	Bioreactor Blender mode (0: Off / 1: Auto / 2: Manu)
CL1100	CL1100_ControlLoop_Mode	INT	400812	0	Gas loop pressure mode (0: Off / 1: Auto / 2: Manu)
CL1100	CL1100_G_Active_Loop_Error	UDINT	400335	0	Error number in procedure "G_Active_Loop"
CL1101	CL1101_ControlLoop_Mode	INT	400813	0	Gas loop Analyser mode (0: Off / 1: Auto / 2: Manu). OFF= stop analyser loop / Auto = start analyser loop / Manu = stop analyser loop then give the control to the operator
CL1101	CL1101_G_Ana_Cal_Start_Error	UDINT	400341	0	Error number in procedure "G_Ana_Cal_Start"
CL1101	CL1101_G_Ana_Start_Error	UDINT	400337	0	Error number in procedure "G_Ana_Start"
CL1101	CL1101_G_Ana_Stop_Error	UDINT	400339	0	Error number in procedure "G_Ana_Stop"
CL1102	CL1102_ControlLoop_Mode	INT	400814	0	Gas loop Condensate flow mode (0: Off / 1: Auto / 2: Manu)
CL1103	CL1103_ControlLoop_Mode	INT	400815	0	Gas Loop N2 mode (0: Off / 1: Auto / 2: Manu)

Control Loop	variable	type	address	Initial value	comments
CL1103	CL1103_G_PAS_Esc_Error	UDINT	400347	0	Error number in procedure "G_PAS_Esc"
CL1103	CL1103_G_PAS_Start_Error	UDINT	400343	0	Error number in procedure "G_PAS_Start"
CL1103	CL1103_G_PAS_Stop_Error	UDINT	400345	0	Error number in procedure "G_PAS_Stop"
CL1103	CL1103_TOTAL_N2_FLOW	REAL	400119	0	total N2 flow (LITRE) since the last reset done by the operator
CL1104	CL1104_CH4_Full_Vessel	REAL	400243	0	% of CH4 used during gas outlet calculation
CL1104	CL1104_CO2_Full_Vessel	REAL	400199	0	% of CO2 used during gas outlet calculation
CL1104	CL1104_MOL_Ejected	REAL	400357	0	total gas ejected (mol) from CI
CL1104	CL1104_MOL_Empty_Vessel	REAL	400241	0	gas calculation (mol) of the empty vessel VSSL_1100_02
CL1104	CL1104_MOL_Full_Vessel	REAL	400231	0	gas calculation (mol) of the full vessel VSSL_1100_02
CL1104	CL1104_N2_Full_Vessel	REAL	400245	0	N2 calculation deduced from the CO2 and CH4 measurement
CL1104	CL1104_TOTAL_CH4_mol	REAL	400027	0	total CH4 (mol) since the last reset done by the operator
CL1104	CL1104_TOTAL_CO2_mol	REAL	400025	0	total CO2 (mol) since the last reset done by the operator
CL1104	CL1104_TOTAL_N2_mol	REAL	400029	0	total N2 (mol) since the last reset done by the operator
CL1200	CL1200_ControlLoop_Mode	INT	400816	0	Filtration Unit mode (0: Off / 1: Auto / 2: Manu)
CL1200	CL1200_F_Cir1_error	UDINT	400253	0	error number in procedure F_Cir1
CL1200	CL1200_F_Cir2_error	UDINT	400255	0	error number in procedure F_Cir2
CL1200	CL1200_F_Fil_error	UDINT	400257	0	error number in procedure F_Fil
CL1200	CL1200_F_Nom_error	UDINT	400259	0	error number in procedure F_Nom
CL1200	CL1200_F_Rec_error	UDINT	400265	0	error number in procedure F_Rec
CL1200	CL1200_F_S12_error	UDINT	400263	0	error number in procedure F_S12
CL1200	CL1200_F_S21_error	UDINT	400261	0	error number in procedure F_S21
CL1200	CL1200_F_Stop_error	UDINT	400251	0	error number in procedure F_Stop
CL1201	CL1201_F_Auto_Bypass_error	UDINT	400267	0	error number in procedure F_Auto_Bypass
CL1201	CL1201_F_Bypass_error	UDINT	400269	0	error number in procedure F_Bypass
CL1202	CL1202_Filtr_flowrate_cal_factor	REAL	400461	2	parameter used for the calculation of the pump speed (PP_1202_01_MV2). This parameter is multiply by the desired flow set point
CL1204	CL1204_F_Harvest_error	UDINT	400271	0	error number in procedure F_Harvest
CL1204	CL1204_OP_Harvest_Flag	BOOL		0	flag permitting to harvest without sterilization (used during CIP procedures)
CL1207	CL1207_ControlLoop_Mode	INT	400817	0	CIP General mode (0: Off / 1: Auto / 2: Manu)
CL1207	CL1207_C_BCl1_error	UDINT	400285	0	error number in procedure C_BCl1
CL1207	CL1207_C_BCl2_error	UDINT	400287	0	error number in procedure C_BCl2
CL1207	CL1207_C_BW1_error	UDINT	400289	0	error number in procedure C_BW1
CL1207	CL1207_C_BW2_error	UDINT	400291	0	error number in procedure C_BW2
CL1207	CL1207_C_Cl1_error	UDINT	400281	0	error number in procedure C_Cl1
CL1207	CL1207_C_Cl2_error	UDINT	400283	0	error number in procedure C_Cl2
CL1207	CL1207_C_Clean_CAB_error	UDINT	400273	0	error number in procedure C_Clean_CAB
CL1207	CL1207_C_CLPMP_error	UDINT	400297	0	error number in procedure C_CLPMP
CL1207	CL1207_C_ET1_error	UDINT	400293	0	error number in procedure C_ET1
CL1207	CL1207_C_ET2_error	UDINT	400295	0	error number in procedure C_ET2
CL1207	CL1207_C_P_Cl1_error	UDINT	400301	0	error number in procedure C_P_Cl1

Control Loop	variable	type	address	Initial value	comments
CL1207	CL1207_C_P_Cl2_error	UDINT	400303	0	error number in procedure C_P_Cl2
CL1207	CL1207_C_Rinse_CA_error	UDINT	400275	0	error number in procedure C_Rinse_CA
CL1207	CL1207_C_Rinse_CB_error	UDINT	400277	0	error number in procedure C_Rinse_CB
CL1207	CL1207_C_R_F_01_error	UDINT	400299	0	error number in procedure C_R_F_01
CL1207	CL1207_C_Stop_error	UDINT	400279	0	error number in procedure C_Stop
CL1207	CL1207_P_Cl_cntr_Times_1	INT	400463	1	used during procedure56 : protocol of cleaning (number of time ask for cleaning the Retentate side of FU with clear water (Procedure 49))
CL1207	CL1207_P_Cl_cntr_Times_2	INT	400465	1	used during procedure56 : protocol of cleaning (number of time ask for cleaning the Retentate side of FU with cleaning agent (Procedure 49))
CL1207	CL1207_P_Cl_cntr_Times_3	INT	400467	1	used during procedure56 : protocol of cleaning (number of time ask for cleaning the Filtrate side of FU with cleaning agent (Procedure 50))
CL1207	CL1207_P_Cl_cntr_Times_4	INT	400469	1	used during procedure56 : protocol of cleaning (number of time ask for cleaning the Retentate side of FU with clear water (Procedure 49))
CL1207	CL1207_P_Cl_cntr_Times_5	INT	400471	1	used during procedure56 : protocol of cleaning (number of time ask for cleaning the Filtrate side of FU with clear water (Procedure 50))
CL1208	CL1208_RAMP_SP	REAL	400776	0	Set point for the ramp of the cleaning solution temperature
CL1208	CL1208_TIME_CFG	TIME		t#30m	time for warm cleaning solution circulation
CL1209	CL1209_C_Empty_CA_error	UDINT	400305	0	error number in procedure C_Empty_CA
CL1209	CL1209_C_Empty_CB_error	UDINT	400307	0	error number in procedure C_Empty_CB
CL1209	CL1209_C_Fill_CA_error	UDINT	400309	0	error number in procedure C_Fill_CA
CL1209	CL1209_C_Fill_CB_error	UDINT	400311	0	error number in procedure C_Fill_CB
CL1209	CL1209_C_Fill_WA_error	UDINT	400313	0	error number in procedure C_Fill_WA
CL1210	CL1210_All_PurgeTime_CFG	TIME	400731	t#10m	monitor CL1210_All_PurgeTime when running
CL1210	CL1210_ControlLoop_Mode	INT	400818	0	SIP General mode (0: Off / 1: Auto / 2: Manu)
CL1210	CL1210_Harvest_CoolingTime_CFG	TIME	400761	t#5m	monitor CL1210_Harvest_CoolingTime when running
CL1210	CL1210_Harvest_DrainTime_CFG	TIME	400745	t#5m	monitor CL1210_Harvest_DrainTime when running
CL1210	CL1210_Harvest_SterilTime_CFG	TIME	400753	t#20m	monitor CL1210_Harvest_SterilTime when running
CL1210	CL1210_Membr_CoolingTime_CFG	TIME	400723	t#1m	monitor CL1210_Membr_CoolingTime when running
CL1210	CL1210_Membr_PurgeTime_CFG	TIME	400707	t#10m	monitor CL1210_Membr_PurgeTime when running
CL1210	CL1210_Membr_SterilTime_CFG	TIME	400715	t#30m	monitor CL1210_Membr_SterilTimeTime when running
CL1210	CL1210_Rec_CoolingTime_CFG	TIME	400729	t#5m	Timer for Cooling Time of procedure S_Rec (Procedure 80)
CL1210	CL1210_Rec_DrainTime_CFG	TIME	400713	t#5m	monitor CL1210_Rec_DrainTime when running
CL1210	CL1210_Rec_FlushingTime_CFG	TIME	400737	t#5m	monitor CL1210_Rec_FlushingTime when running
CL1210	CL1210_Rec_SterilisationTime_CFG	TIME	400721	t#20m	monitor CL1210_Rec_SterilisationTime when running
CL1210	CL1210_S_All1_error	UDINT	400327	0	error number in procedure S_All1
CL1210	CL1210_S_All2_error	UDINT	400329	0	error number in procedure S_All2
CL1210	CL1210_S_Harvest_error	UDINT	400317	0	error number in procedure S_Harvest
CL1210	CL1210_S_P_All1_error	UDINT	400331	0	error number in procedure S_P_All1
CL1210	CL1210_S_P_All2_error	UDINT	400333	0	error number in procedure S_P_All2

Control Loop	variable	type	address	Initial value	comments
CL1210	CL1210_S_Rec_error	UDINT	400319	0	error number in procedure S_Rec
CL1210	CL1210_S_Rec_Flush_error	UDINT	400315	0	error number in procedure S_Rec_Flush
CL1210	CL1210_S_S1_error	UDINT	400323	0	error number in procedure S_S1
CL1210	CL1210_S_S2_error	UDINT	400325	0	error number in procedure S_S2
CL1210	CL1210_S_Stop_error	UDINT	400321	0	error number in procedure S_Stop

2.3.2.Thresholds

The yellow color underline the action linked to the alarm triggered by the threshold.
The orange color points that need to be confirmed of still to defined.

INDEX	Threshold variable name	Type	HMI Address	Value	Unit	ACTION	Comments
1	FB_TIME_LIM	TIME	400900	5	seconds	Display an alarm	When a valve is in failure, an alarm process will occur
2	PS_TIME_LIM	TIME	400902	10	seconds	Display an alarm	Pressure switch time limit alarm
3	PT_1001_01_LIM_AH	REAL	400904	180 fixed value	mBar	Display an alarm	triggered after 5 seconds
4	PT_1001_01_LIM_AHH	REAL	400906	200 fixed value	mBar	Display an alarm Stop The pump	triggered after 5 seconds
5	PT_1001_01_LIM_AL	REAL	400908	-50 fixed value	mBar	Display an alarm	triggered after 5 seconds
6	PT_1001_01_LIM_ALL	REAL	400910	-100 fixed value	mBar	Display an alarm Stop The pump GP_1001_01 Lock S3V_1001_01 (to protect the Bioreactor)	the valve is locked in default position triggered after 5 seconds
7	TT_1002_01_LIM_AH	REAL	400912	+1 compared to the setpoint Only in automatic mode	°C	Display an alarm	triggered after 5 seconds
8	TT_1002_01_LIM_AHH	REAL	400914	+2 compared to the setpoint Only in automatic mode	°C	Display an alarm	triggered after 5 seconds
9	TT_1002_01_LIM_AL	REAL	400916	-1 compared to the setpoint	°C	Display an alarm	triggered after 5 seconds
10	TT_1002_01_LIM_ALL	REAL	400918	-2 compared to the setpoint Only in automatic mode	°C	Display an alarm	triggered after 5 seconds
11	TT_1002_02_LIM_AH	REAL	400920	+1 compared to the setpoint Only in automatic mode	°C	Display an alarm	The sensor is in Error at the current time (2010/07/20) triggered after 5 seconds
12	TT_1002_02_LIM_AHH	REAL	400922	+2 compared to the setpoint	°C	Display an alarm	The sensor is in Error at the current time (2010/07/20) triggered after 5 seconds
13	TT_1002_02_LIM_AL	REAL	400924	-1 compared to the setpoint Only in automatic mode	°C	Display an alarm	The sensor is in Error at the current time (2010/07/20) triggered after 5 seconds
14	TT_1002_02_LIM_ALL	REAL	400926	-2 compared to the setpoint Only in automatic mode	°C	Display an alarm	The sensor is in Error at the current time (2010/07/20) triggered after 5 seconds

INDEX	Threshold variable name	Type	HMI Address	Value	Unit	ACTION	Comments
15	PT_1003_01_LIM_AH	REAL	400928	170 fixed value	mBar	Display an alarm	triggered after 5 seconds
16	PT_1003_01_LIM_AHH	REAL	400930	200 fixed value	mBar	Display an alarm after 5 seconds SV_1003_01 is opened when the pressure inside the influent vessel reaches 150 mbar The alarm is triggered after 5 seconds	triggered after 5 seconds
17	PT_1003_01_LIM_AL	REAL	400932	-30 fixed value	mBar	Display an alarm	triggered after 5 seconds
18	PT_1003_01_LIM_ALL	REAL	400934	-50 fixed value	mBar	Display an alarm and Open the valve SV_1003_01	triggered after 5 seconds
19	CL1004_LEVEL_LIM_AH	REAL	400936	55 fixed value Only in automatic mode	mBar	Display an alarm	triggered after 5 seconds
20	CL1004_LEVEL_LIM_AH H	REAL	400938	60 fixed value Only in automatic mode	mBar	If at the same time the valve S3V_1001_02 is set , the get cake function is stopped	triggered after 5 seconds
21	CL1004_LEVEL_LIM_AL	REAL	400940	20 fixed value Only in automatic mode	mBar	Display an alarm	triggered after 5 seconds
22	CL1004_LEVEL_LIM_ALL	REAL	400942	10 fixed value Only in automatic mode	mBar	Display an alarm Put The Control Loop 1001 OFF. For Reminding, the pump stop when the "GP_1001_01_mightrundry_A" tag is set volume equal or less than 9 litres	triggered after 5 seconds
23	TT_1008_01_LIM_AH	REAL	400944	+1 compared to the setpoint Only in automatic mode	°C	Display an alarm	triggered after 5 seconds
24	TT_1008_01_LIM_AHH	REAL	400946	60 fixed value	°C	Display an alarm Cut the Bioreactor temperature control loop	following the discussion with Arnaud (20100813) triggered after 5 seconds
25	TT_1008_01_LIM_AL	REAL	400948	-1 compared to the setpoint Only in automatic mode	°C	Display an alarm	triggered after 5 seconds
26	TT_1008_01_LIM_ALL	REAL	400950	-4 compared to the setpoint Only in automatic mode	°C	Display an alarm	triggered after 5 seconds
27	TT_1008_02_LIM_AH	REAL	400952	65 fixed value	°C	Display an alarm	triggered after 5 seconds
28	TT_1008_02_LIM_AHH	REAL	400954	70 fixed value	°C	Display an alarm Cut the Bioreactor temperature control loop	following the discussion with Arnaud (20100813) triggered after 5 seconds
29	TT_1008_02_LIM_AL	REAL	400956	40 fixed value	°C	Display an alarm	triggered after 5 seconds
30	TT_1008_02_LIM_ALL	REAL	400958	30 fixed value	°C	Display an alarm	triggered after 5 seconds
31	2 variables : PT_1009_Hyst_Rising PT_1009_Hyst_Falling	REAL		Hysteresis: up: 150 Down: 140 Fixed Value	mBar	Close SV_1102_01 In the software, the threshold called.	Close SV_1102_01 In the software, the threshold called.
32	PT_1009_01_LIM_AHH	REAL	401202	190 Fixed Value	mBar	Open SV_1009_01 Display an alarm	
33	PT_1009_01_LIM_AL	REAL	401204	-30 Fixed Value	mBar	Display an alarm	
34	PT_1009_01_LIM_ALL	REAL	401206	-50 Fixed Value	mBar	Open SV_1009_01 / Stop FU Display an alarm	

INDEX	Threshold variable name	Type	HMI Address	Value	Unit	ACTION	Comments
35	PT_1009_02_LIM_AH	REAL	400960	Hysteresis: up: 210 Down: 200 Fixed Value	mBar	Display an alarm	
36	PT_1009_02_LIM_AHH	REAL	400962	250 Fixed Value	mBar	Display an alarm	
37	PT_1009_02_LIM_AL	REAL	400964	-30 Fixed Value	mBar	Display an alarm	
38	PT_1009_02_LIM_ALL	REAL	400966	-50 Fixed Value	mBar	Display an alarm	
39	CL1010_LEVEL_LIM_AH	REAL	400968	5 compared to the setpoint Only in automatic mode and in feed volume mode	L	Display an alarm	
40	CL1010_LEVEL_LIM_AHH	REAL	400970	120 Fixed value (Wait for the confirmation of the LSH_1010_01 position. Once confirmed, put the same value	L	Close S3V_1001_01_MV(same triggered than the LSH_1010_01/ Will work in case of equipment failure)	
41	CL1010_LEVEL_LIM_AL	REAL	400972	-5 compared to the setpoint Only in automatic mode and in feed volume mode	L	Display an alarm	
42	CL1010_LEVEL_LIM_ALL	REAL	400974	30 Fixed value	L	Display an alarm Trigger the bioreactor pH , the bioreactor blender, the bioreactor temperature and the filtration control loop to OFF MODE	
43	CL1011_PH_LIM_AH	REAL	400976	+0.2 compared to the setpoint Only in automatic mode	-	Display an alarm	
44	CL1011_PH_LIM_AHH	REAL	400978	5.8 fixed value Only in Automatic mode	-	Display an alarm Cut the pH Control loop	When operator starts the bioreactor, he must increase the pH in manual mode. For this, the fixed value (which cuts the control loop) must be linked to the automatic mode. If it is not the case, the operator won't be able to manage the pH
45	CL1011_PH_LIM_AL	REAL	400980	-0.2 compared to the setpoint Only in automatic mode	-	Display an alarm	
46	CL1011_PH_LIM_ALL	REAL	400982	5.0 fixed value Only in Automatic mode	-	Display an alarm Cut the pH Control loop	When operator starts the bioreactor, he must increase the pH in manual mode. For this, the fixed value (which cuts the control loop) must be linked to the automatic mode. If it is not the case, the operator won't be able to manage the pH
47	CL1011_PH_SENSOR_DEVIATION_LIM	REAL	401208	0.5	-	Display an alarm	

INDEX	Threshold variable name	Type	HMI Address	Value	Unit	ACTION	Comments
48	TT_1011_01_LIM_AH	REAL	400984	+1 compared to the setpoint Only in automatic mode	°C	Display an alarm	
49	TT_1011_01_LIM_AHH	REAL	400986	60 fixed value	°C	Display an alarm Cut the Bioreactor temperature control loop only if the bioreactor temperature probe is in ERROR	
50	TT_1011_01_LIM_AL	REAL	400988	-1 compared to the setpoint Only in automatic mode	°C	Display an alarm	
51	TT_1011_01_LIM_ALL	REAL	400990	-4 compared to the setpoint Only in automatic mode	°C	Display an alarm	
52	TT_1011_02_LIM_AH	REAL	400992	+1 compared to the setpoint Only in automatic mode	°C	Display an alarm	
53	TT_1011_02_LIM_AHH	REAL	400994	60 fixed value	°C	Display an alarm Cut the Bioreactor temperature control loop only if the bioreactor temperature probe is in ERROR	
54	TT_1011_02_LIM_AL	REAL	400996	-1 compared to the setpoint Only in automatic mode	°C	Display an alarm	
55	TT_1011_02_LIM_ALL	REAL	400998	-4 compared to the setpoint Only in automatic mode	°C	Display an alarm	
56	PT_1100_01_LIM_AH	REAL	401000	3100 fixed value	mBar	Display an alarm	
57	PT_1100_01_LIM_AHH	REAL	401002	3200 fixed value	mBar	Display an alarm cut the active gas loop	
58	PT_1100_01_LIM_AL	REAL	401004	2900 fixed value Only in automatic mode	mBar	Display an alarm	
59	PT_1100_01_LIM_ALL	REAL	401006	2800 fixed value Only in automatic mode	mBar	Display an alarm Close the condensate valve SV_1102_01 (EPAS Implementation)	
60	PT_1100_02_LIM_AH	REAL	401008	150	mBar	Display an alarm	
61	PT_1100_02_LIM_AHH	REAL	401010	190	mBar	Display an alarm	
62	PT_1100_02_LIM_AL	REAL	401012	-30	mBar	Display an alarm	
63	PT_1100_02_LIM_ALL	REAL	401014	-50	mBar	Display an alarm	
64	AT_1101_02_H2_LIM_AH	REAL	401016	TBD	% (?)	Display an alarm	
65	AT_1101_02_H2_LIM_AHH	REAL	401018	TBD	% (?)	Display an alarm	
66	AT_1101_02_H2_LIM_AL	REAL	401020	TBD	% (?)	Display an alarm	
67	AT_1101_02_H2_LIM_ALL	REAL	401022	TBD	% (?)	Display an alarm	
68	AT_1101_01_CO2_LIM_AH	REAL	401024	60 fixed value Only in automatic mode	%	Display an alarm after 5 seconds	

INDEX	Threshold variable name	Type	HMI Address	Value	Unit	ACTION	Comments
69	AT_1101_01_CO2_LIM_AHH	REAL	401026	80 fixed value Only in automatic mode	%	Display an alarm after 5 seconds	
70	AT_1101_01_CO2_LIM_AL	REAL	401028	10 fixed value Only in automatic mode	%	Display an alarm after 5 seconds	
71	AT_1101_01_CO2_LIM_ALL	REAL	401030	0 fixed value Only in automatic mode	%	Display an alarm after 5 seconds	
72	AT_1101_01_CH4_LIM_AH	REAL	401032	5 fixed value Only in automatic mode	%	Display an alarm after 5 seconds	
73	AT_1101_01_CH4_LIM_AHH	REAL	401034	15 fixed value Only in automatic mode	%	Display an alarm after 5 seconds	
74	AT_1101_01_CH4_LIM_AL	REAL	401036	0 fixed value Only in automatic mode	%	Display an alarm after 5 seconds	
75	AT_1101_01_CH4_LIM_ALL	REAL	401038	0 fixed value Only in automatic mode	%	Display an alarm after 5 seconds	
76	FT_1101_01_LIM_AH	REAL	401040	90 fixed value For all modes	L/hour	Display an alarm	The flow that the analyzer can support is between 5 and 100 litre/hour
77	FT_1101_01_LIM_AHH	REAL	401042	95 fixed value For all modes	L/hour	Display an alarm	The flow that the analyzer can support is between 5 and 100 litre/hour
78	FT_1101_01_LIM_AL	REAL	401044	6 fixed value For all modes	L/hour	Display an alarm	The flow that the analyzer can support is between 5 and 100 litre/hour
79	FT_1101_01_LIM_ALL	REAL	401046	5 fixed value For all modes	L/hour	Display an alarm	The flow that the analyzer can support is between 5 and 100 litre/hour
80	PT_1101_01_LIM_AH	REAL	401048	180 fixed value For all modes	mBar	Display an alarm open S3V_1101_01	The maximum pressure that the analyzer can support is 300 mbar
81	PT_1101_01_LIM_AHH	REAL	401050	200 fixed value For all modes	mBar	Display an alarm trigger the control loop to OFF	The maximum pressure that the analyzer can support is 300 mbar
82	TT_1104_01_LIM_AH	REAL	401064	40	°C	Display an alarm	
83	TT_1104_01_LIM_AHH	REAL	401066	45	°C	Display an alarm	
84	TT_1104_01_LIM_AL	REAL	401068	10	°C	Display an alarm	
85	TT_1104_01_LIM_ALL	REAL	401070	5	°C	Display an alarm	
86	TT_1200_01_LIM_AH	REAL	401072	55 Only during nominal or recycle mode / membrane 1 and 2	°C	Display an alarm	THE ALARM IS OPERATIONAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
87	TT_1200_01_LIM_AHH	REAL	401074	60 Only during nominal or recycle mode / membrane 1 and 2	°C	Display an alarm	THE ALARM IS OPERATIONAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING

INDEX	Threshold variable name	Type	HMI Address	Value	Unit	ACTION	Comments
88	TT_1200_01_LIM_AL	REAL	401076	40 Only during nominal or recycle mode / membrane 1 and 2	°C	Display an alarm	THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
89	TT_1200_01_LIM_ALL	REAL	401078	35 Only during nominal or recycle mode / membrane 1 and 2	°C	Display an alarm	THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
90	TT_1200_02_LIM_AH	REAL	401080	55 Only during nominal or recycle mode / membrane 1	°C	Display an alarm	THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
91	TT_1200_02_LIM_AHH	REAL	401082	60 Only during nominal or recycle mode / membrane 1	°C	Display an alarm	THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
92	TT_1200_02_LIM_AL	REAL	401084	40 Only during nominal or recycle mode / membrane 1	°C	Display an alarm	THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
93	TT_1200_02_LIM_ALL	REAL	401086	35 Only during nominal or recycle mode / membrane 1	°C	Display an alarm	THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
94	TT_1200_03_LIM_AH	REAL	401088	55 Only during nominal or recycle mode / membrane 2	°C	Display an alarm	THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
95	TT_1200_03_LIM_AHH	REAL	401090	60 Only during nominal or recycle mode / membrane 2	°C	Display an alarm	THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
96	TT_1200_03_LIM_AL	REAL	401092	40 Only during nominal or recycle mode / membrane2	°C	Display an alarm	THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
97	TT_1200_03_LIM_ALL	REAL	401094	35 Only during nominal or recycle mode / membrane2	°C	Display an alarm	THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
98	FT_1201_01_LIM_AH	REAL	401096	%5 compared to the setpoint Only in automatic mode	L/h	Display an alarm	
99	FT_1201_01_LIM_AHH	REAL	401098	%10 comparedd to the setpoint Only in automatic mode	L/h	Display an alarm	
100	FT_1201_01_LIM_AL	REAL	401100	-%5 compared to the setpoint Only in automatic mode	L/h	Display an alarm	
101	FT_1201_01_LIM_ALL	REAL	401102	-%10 compared to the setpoint Only in automatic mode	L/h	Display an alarm	

INDEX	Threshold variable name	Type	HMI Address	Value	Unit	ACTION	Comments
102	AT_1201_01_LIM_AH	REAL	401104	90 Fixed value Only during Bypass mode / AND nominal or recycle mode / membrane 1 & 2	NTU	Display an alarm	NTU = nephelometric turbidity unit
103	AT_1201_01_LIM_AHH	REAL	401106	95 Fixed value Only during Bypass mode / AND nominal or recycle mode / membrane 1 & 2	NTU	Display an alarm	
104	AT_1201_01_LIM_AL	REAL	401108	55 Fixed value Only during Bypass mode / AND nominal or recycle mode / membrane 1 & 2	NTU	Display an alarm	
105	AT_1201_01_LIM_ALL	REAL	401110	50 Fixed value Only during Bypass mode / AND nominal or recycle mode / membrane 1 & 2	NTU	Display an alarm	
106	PT_1203_01_LIM_AH	REAL	401112	1.5 Fixed value Only during nominal or recycle mode / membrane 1	Bar	Display an alarm	
107	PT_1203_01_LIM_AHH	REAL	401114	1.7 Fixed value Only during nominal or recycle mode / membrane 1	Bar	Display an alarm trigger in Bypass mode Only if S_ALL1 and S_S1 procedures are not running and the filtration is not in stop mode	
108	PT_1203_01_LIM_AL	REAL	401116	0.4 Fixed value Only during nominal or recycle mode / membrane 1	Bar	Display an alarm	
109	PT_1203_01_LIM_ALL	REAL	401118	0.2 Fixed value Only during nominal or recycle mode / membrane 1	Bar	Display an alarm	
110	PT_1203_02_LIM_AH	REAL	401120	1.5 Only during nominal or recycle mode / membrane 1	Bar	Display an alarm	
111	PT_1203_02_LIM_AHH	REAL	401122	1.7 Fixed value Only during nominal or recycle mode / membrane 1	Bar	Display an alarm trigger in Bypass mode Only if S_ALL1 and S_S1 procedures are not running and the filtration is not in stop mode	
112	PT_1203_02_LIM_AL	REAL	401124	0.4 Fixed value Only during nominal or recycle mode / membrane 1	Bar	Display an alarm	
113	PT_1203_02_LIM_ALL	REAL	401126	0.2 Fixed value Only during nominal or recycle mode / membrane 1	Bar	Display an alarm	

INDEX	Threshold variable name	Type	HMI Address	Value	Unit	ACTION	Comments
114	PT_1203_03_LIM_AH	REAL	401128	0.3 Fixed value Only during nominal or recycle mode / membrane 1	Bar	Display an alarm	
115	PT_1203_03_LIM_AHH	REAL	401130	0.6 Fixed value Only during nominal or recycle mode / membrane 1	Bar	Display an alarm trigger in Bypass mode Only if S_ALL1 and S_S1 procedures are not running and the filtration is not in stop mode	
116	PT_1203_03_LIM_AL	REAL	401132	0 Fixed value Only during nominal or recycle mode / membrane 1	Bar	Display an alarm	
117	PT_1203_03_LIM_ALL	REAL	401134	-0.1 Fixed value Only during nominal or recycle mode / membrane 1	Bar	Display an alarm	
118	PT_1203_04_LIM_AH	REAL	401136	1.5 Fixed value Only during nominal or recycle mode / membrane 2	Bar	Display an alarm	
119	PT_1203_04_LIM_AHH	REAL	401138	1.7 Fixed value Only during nominal or recycle mode / membrane 2	Bar	Display an alarm trigger in Bypass mode Only if S_ALL2 and S_S2 procedures are not running and the filtration is not in stop mode	
120	PT_1203_04_LIM_AL	REAL	401140	0.4 Fixed value Only during nominal or recycle mode / membrane 2	Bar	Display an alarm	
121	PT_1203_04_LIM_ALL	REAL	401142	0.2 Fixed value Only during nominal or recycle mode / membrane 2	Bar	Display an alarm	
122	PT_1203_05_LIM_AH	REAL	401144	1.5 Fixed value Only during nominal or recycle mode / membrane 2	Bar	Display an alarm	
123	PT_1203_05_LIM_AHH	REAL	401146	1.7 Fixed value Only during nominal or recycle mode / membrane 2	Bar	Display an alarm trigger in Bypass mode Only if S_ALL2 and S_S2 procedures are not running and the filtration is not in stop mode	
124	PT_1203_05_LIM_AL	REAL	401148	0.4 Fixed value Only during nominal or recycle mode / membrane 2	Bar	Display an alarm	
125	PT_1203_05_LIM_ALL	REAL	401150	0.2 Fixed value Only during nominal or recycle mode / membrane 2	Bar	Display an alarm	
126	PT_1203_06_LIM_AH	REAL	401152	0.3 Fixed value Only during nominal or recycle mode / membrane 2	Bar	Display an alarm	

INDEX	Threshold variable name	Type	HMI Address	Value	Unit	ACTION	Comments
127	PT_1203_06_LIM_AHH	REAL	401154	0.6 Fixed value Only during nominal or recycle mode / membrane 2	Bar	Display an alarm trigger in Bypass mode Only if S_ALL2 and S_S2 procedures are not running and the filtration is not in stop mode	
128	PT_1203_06_LIM_AL	REAL	401156	0 Fixed value Only during nominal or recycle mode / membrane 2	Bar	Display an alarm	
129	PT_1203_06_LIM_ALL	REAL	401158	-0.1 Fixed value Only during nominal or recycle mode / membrane 2	Bar	Display an alarm	
130	PT_1203_07_LIM_AH	REAL	401160	1.8 Fixed value Only during nominal or recycle mode / membrane 1 & 2 / AND Bypass mode	Bar	Display an alarm	
131	PT_1203_07_LIM_AHH	REAL	401162	2 Fixed value Only during nominal or recycle mode / membrane 1 & 2 / AND Bypass mode	Bar	Display an alarm Stop the filtration control loop. Done on 2010/10/18 after the broth loss.	
132	PT_1203_07_LIM_AL	REAL	401164	0.3 Fixed value Only during nominal or recycle mode / membrane 1 & 2 / AND Bypass mode	Bar	Display an alarm	
133	PT_1203_07_LIM_ALL	REAL	401166	0.1 Fixed value Only during nominal or recycle mode / membrane 1 & 2 / AND Bypass mode	Bar	Display an alarm	
134	PT_1203_08_LIM_AH	REAL	401168	0.08 Fixed value Only during nominal / membrane 1 & 2	Bar	Display an alarm	need to be confirmed when the filtrate part of the process will be running
135	PT_1203_08_LIM_AHH	REAL	401170	0.15 Fixed value Only during nominal / membrane 1 & 2	Bar	Display an alarm	need to be confirmed when the filtrate part of the process will be running need to pass in recycle mode ?
136	PT_1203_08_LIM_AL	REAL	401172	0 Fixed value Only during nominal / membrane 1 & 2	Bar	Display an alarm	need to be confirmed when the filtrate part of the process will be running
137	PT_1203_08_LIM_ALL	REAL	401174	-0.1 Fixed value Only during nominal / membrane 1 & 2	Bar	Display an alarm	need to be confirmed when the filtrate part of the process will be running
138	TT_1205_01_LIM_AH	REAL	401176	+1 compared to the setpoint (4°C)	°C	Display an alarm	As no set point exists, the value defined is 4 °C

INDEX	Threshold variable name	Type	HMI Address	Value	Unit	ACTION	Comments
139	TT_1205_01_LIM_AHH	REAL	401178	+2 compared to the setpoint (4°C)	°C	Display an alarm	As no set point exists, the value defined is 4 °C
140	TT_1205_01_LIM_AL	REAL	401180	-1 compared to the setpoint (4°C)	°C	Display an alarm	As no set point exists, the value defined is 4 °C
141	TT_1205_01_LIM_ALL	REAL	401182	-2 compared to the setpoint (4°C)	°C	Display an alarm	As no set point exists, the value defined is 4 °C
142	LT_1206_01_LIM_AH	REAL	401184	15 fixed Value	L	Display an alarm	To be confirmed with volume profile of effluent vessel
143	LT_1206_01_LIM_AHH	REAL	401186	17 fixed Value	L	Display an alarm	To be confirmed with volume profile of effluent vessel
144	LT_1206_01_LIM_AL	REAL	401188	5 fixed Value	L	Display an alarm	To be confirmed with volume profile of effluent vessel
145	LT_1206_01_LIM_ALL	REAL	401190	4.5 fixed Value	L	Display an alarm	To be confirmed with volume profile of effluent vessel
146	TT_1208_01_LIM_AH	REAL	401192	Membrane temperaure + 30° C Depending on the membrane cleanned	°C	Display an alarm	
147	TT_1208_01_LIM_AHH	REAL	401194	95 fixed Value	°C	Display an alarm Trigger the CIP control Loop to OFF mode	
148	TT_1208_01_LIM_AL	REAL	401196	Membrane temperaure - 30° C Depending on the membrane cleanned	°C	Display an alarm	
149	TT_1208_01_LIM_ALL	REAL	401198	10 fixed Value	°C	Display an alarm	

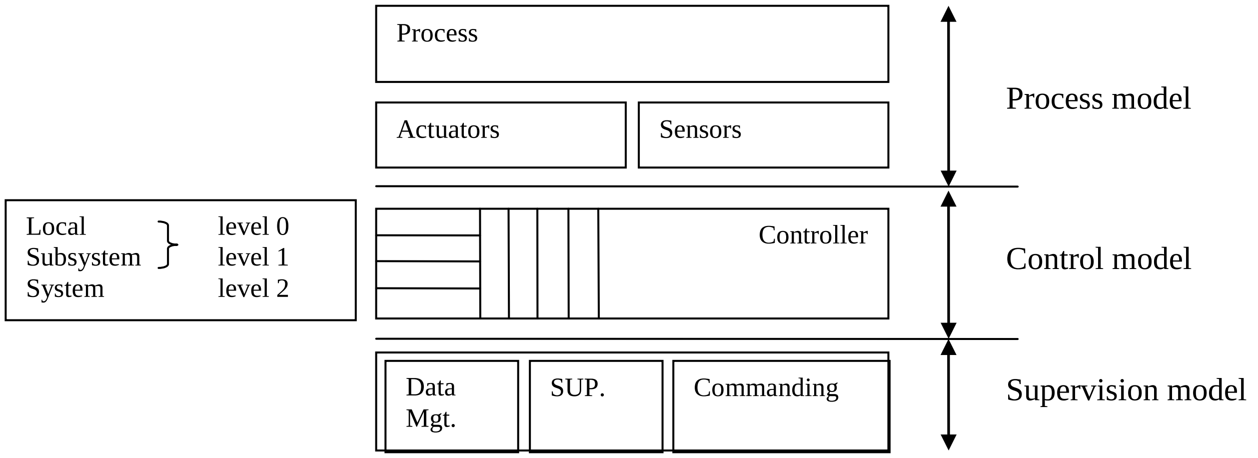
3. System Description

3.1. Control levels

4 levels for the control are commonly used:

- Level 0 control: ancillaries, local regulations
- Level 1 control: dynamic control
- Level 2 control: static/dynamic optimization
- Level 3 control: planning, sequencing and scheduling.

Different Levels of Model are developed:
Process model including Process, Sensors and Actuators
Control Model: for the Controller and including Local (level 0), subsystem and system (level 1 and 2) control laws.


Process
Actuators
Sensors
Process model
Local
Subsystem
System
level 0
level 1
level 2
Controller
Control model
Data
Mgt.
SUP.
Commanding
Supervision model

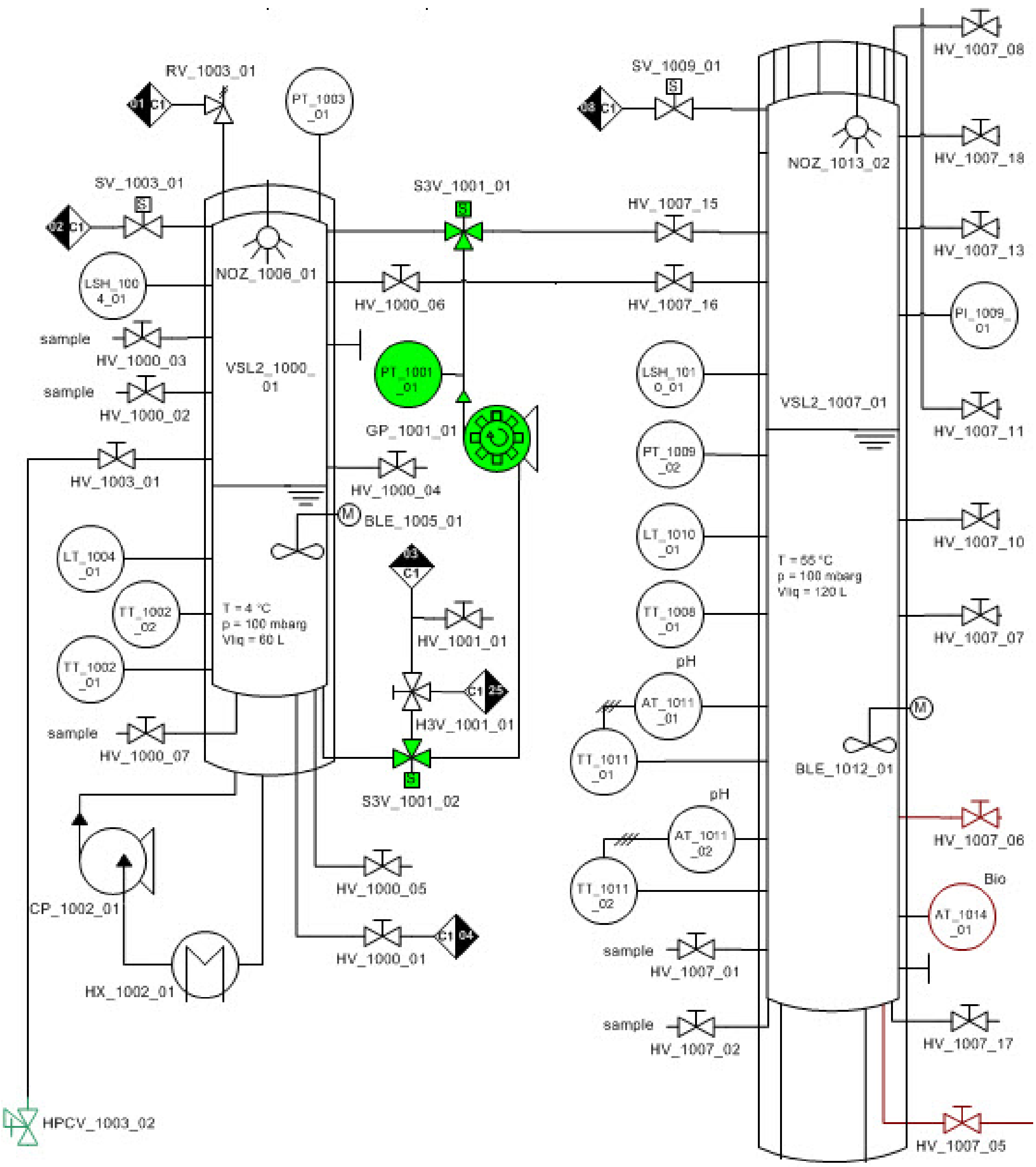
4. Control Loops

New Control Loop	*Control Loop Name*	*Location*
1000	Influent Tank General	Influent Tank
1001	Influent Tank Feed to Bioreactor	Influent Tank
1002	Influent Tank Temperature control	Influent Tank
1003	Influent Tank Pressure control	Influent Tank
1004	Influent Tank Level control	Influent Tank
1005	Influent Tank Blender	Influent Tank
1006	Influent Tank CIP	Influent Tank
1007	BioReactor General	Bioreactor
1008	BioReactor Temperature Control	Bioreactor
1009	BioReactor Pressure Control	Bioreactor
1010	BioReactor Level Control	Bioreactor
1011	BioReactor pH Control	Bioreactor
1012	BioReactor Blender	Bioreactor
1013	BioReactor CIP	Bioreactor
1014	Biomass Control Loop	Bioreactor
1100	Gas Loop Pressure Control (active gas Loop)	Gas Loop
1101	Gas Loop Analyser Control	Gas Loop
1102	Gas Loop Condensate Flow	Gas Loop
1103	Gas Loop N2 (Passive gas loop)	Gas Loop
1104	Gas Loop Outlet	Gas Loop
1200	Filtration Unit General	Filtration Unit
1201	Filtration Unit Retentate Flow Control	Filtration Unit
1202	Filtration Unit Filtrate Flow Control	Filtration Unit
1203	Filtration Unit Pressure control	Filtration Unit
1204	Effluent Tank General	Effluent Tank
1205	Effluent Tank Temperature Control	Effluent Tank
1206	Effluent Tank Level Control	Effluent Tank
1207	CIP General	Cleaning In Place (CIP)
1208	CIP Temperature control	Cleaning In Place (CIP)
1209	CIP Filling control	Cleaning In Place (CIP)
1210	SIP General	Sterilization In Place (SIP)
1211	GN2 loop for underpressure breaking	Sterilization In Place (SIP)

4.1. Influent Tank General (CL1000)

No controlled equipment is referenced in this loop. Only Influent vessel and a set of manual hand valves are named with this loop number.

4.2. Influent Tank Feed to Bioreactor (CL1001)



4.2.1.Function

The aim of this control loop is to feed the bioreactor with the influent content. It is also use d to feel Influent tank thanks to the “Get cake” function.
The nominal way of working of the influent does a recirculation of its content using the pump GP_1001_01.
Two modes of feeding are implemented.

-The timer mode: The valve S3V_1001_01 is switched according to a defined amount per day (L/day) and an interval per hour.

-The Volume mode: The valve S3V_1001_01 is switched according to a volume set point entered by the operator. The volume is checked every hour by the Bioreactor level measurement.

When the Get cake function (function which adds wastes in influent vessel) is triggered by the operator, the valve S3V_1001_01 is locked in recirculation position. This is done to prevent fresh waste injection directly inside the bioreactor.

<u>Important point:</u> This control loop is triggered to OFF mode if the bioreactor Very High level Alarm is set (“CL1004_LEVEL_AHH”).

Three modes are available in this control loop:

-OFF mode: all equipments are stopped or set in default position.

-Auto mode: By default the feeding mode is in: volume mode.
The pump GP_1001_01 does the recirculation of the Influent content punctuated by the switch of the valve SV_1001_01 for feeding the bioreactor.

-Manu mode: Each equipment can be controlled independently by the operator.

PLC Section name	Equipment tag	Type	Address	Comment
Influent Tank Feed to Bioreactor	PT_1001_01	AI	400193	Measures pressure immediately after pump GP_1001_01 and gives an alarm if pressure increases above the pump's limit
Influent Tank Feed to Bioreactor	GP_1001_01_MV1	DO	000007	Default position of the Recirculation pump / clockwise Circulates continuously the influent in a loop
Influent Tank Feed to Bioreactor	GP_1001_01_MV2	DO	000008	Recirculation pump / counter clockwise Circulates continuously the influent in a loop
Influent Tank Feed to Bioreactor	S3V_1001_01_MV	DO	000016	Powered 3-way valve Used to feed the bioreactor VSL2_1007_01 with influent at regular intervals of time
Influent Tank Feed to Bioreactor	S3V_1001_01_FB	DI	100027	valve feedback
Influent Tank Feed to Bioreactor	S3V_1001_02_MV	DO	000015	Powered 3-way valve Used to fill in the influent tank VSL2_1000_01 with fresh influent or to circulate the influent in a loop
Influent Tank Feed to Bioreactor	S3V_1001_02_FB	DI	100028	valve feedback

Figure 1: Influent Tank Feed to Bioreactor - EQUIPMENT

PLC Section name	Button tag	Type	Address	Comment
Influent Tank Feed to Bioreactor	CL1001_ControlLoop_Mode	INT	400800	Bioreactor feeding mode (0: Off / 1: Auto / 2: Manu)
Influent Tank Feed to Bioreactor	CL1001_SCI_Feed	BOOL	000202	Start the feeding process
Influent Tank Feed to Bioreactor	CL1001_Feed	BOOL	000224	Feeding process tracing bit.
Influent Tank Feed to Bioreactor	CL1001_Feed_mode_timer_S	BOOL	000315	Configure the feeding of the bioreactor in mode timer (Initial value: 1). When triggered, the volume mode is automatically reset.
Influent Tank Feed to Bioreactor	CL1001_Feed_mode_timer	BOOL	000316	Tracing bit which informs operator that the bioreactor is in feeding timer mode
Influent Tank Feed to Bioreactor	CL1001_SCI_Feed_Amount_per_day	REAL	400115	total amount per day to inject inside the bioreactor (used in timer mode)
Influent Tank Feed to Bioreactor	CL1001_SCI_Feed_Interval_in_hour	REAL	400117	interval of injection (in hour) to reach the total amount per day / used in timer mode
Influent Tank Feed to Bioreactor	CL1001_Feed_mode_volume_S	BOOL	000313	Configure the feeding of the bioreactor in mode volume (volume set point need to be configured). When triggered, the timer mode is automatically reset.
Influent Tank Feed to Bioreactor	CL1001_Feed_mode_volume	BOOL	000314	Tracing bit which informs operator that the bioreactor is in feeding volume mode
Influent Tank Feed to Bioreactor	CL1001_Feed_volume_SP	REAL	400443	set point of the volume entered in the bioreactor
Influent Tank Feed to Bioreactor	CL1001_GetCake	BOOL	000212	Start adding wastes in influent tank.
Influent Tank Feed to Bioreactor	CL1001_GettingCake	BOOL	000328	Tracing bit which monitor the action of get cake..

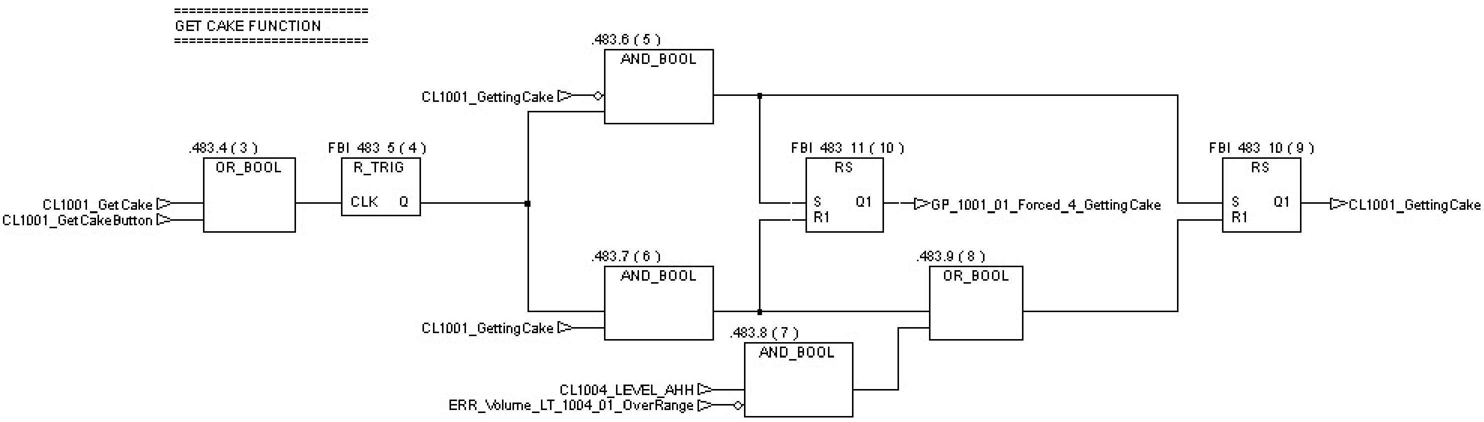
PLC Section name	Button tag	Type	Address	Comment
Influent Tank Feed to Bioreactor	GP_1001_01_MV1_OP	BOOL	000213	Operator can start/stop the pump in manual mode
Influent Tank Feed to Bioreactor	S3V_1001_01_OP	BOOL	000411	Operator can change the position of the 3 way valve (get cake or recirculation) in manual mode
Influent Tank Feed to Bioreactor	S3V_1001_02_OP	BOOL	000413	Operator can change the position of the 3 way valve (recirculation or feeding the bioreactor) in manual mode

Figure 2: Influent Tank Feed to Bioreactor – USER INDICATOR / INPUT

4.2.2.Block Diagram

4.2.2.1. *Get Cake Function*

The function is activated if the mechanical button situated on the skid is pushed or if the operator starts the function from the HMI.

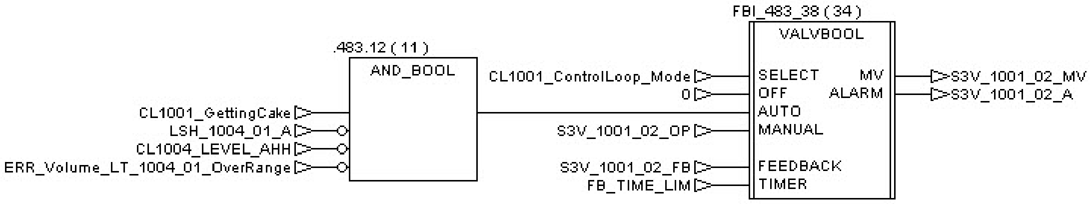


The Valve S3V_1001_02 is set to fill fresh wastes inside the influent.
The following conditions reset the valve in the default position:

-The level switch high of the influent is activated

-The level of the influent is very high alarm

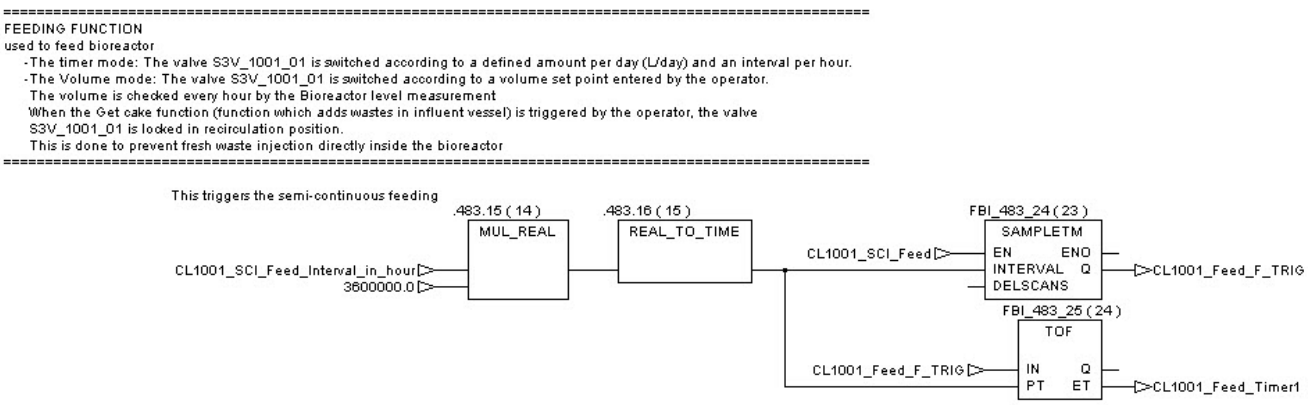
-The influent pressure mustn’t exceed 200 mbar (Range limit of the probe).



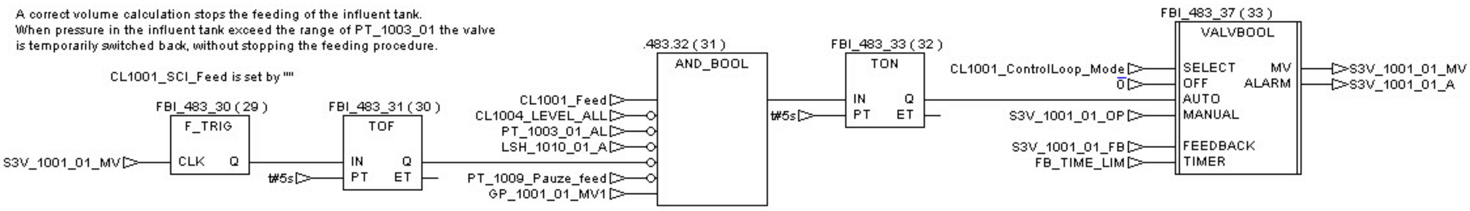
During the get cake function, the Valve S3V_1001_01, which permits to inject influent content inside the bioreactor, is forced in default position. It protects the bioreactor from direct injection of fresh wastes.

4.2.2.2. *Feeding Bioreactor Function*

The operator needs to trigger in automatic mode the Bioreactor Feeding button (Control Loop mode button).



Once set, depending on the selected mode (Timer / Volume), the variable "CL1001_Feed" is set to feed the bioreactor by the valve S3V_1001_01 as follow.



Two modes described here under, are available.

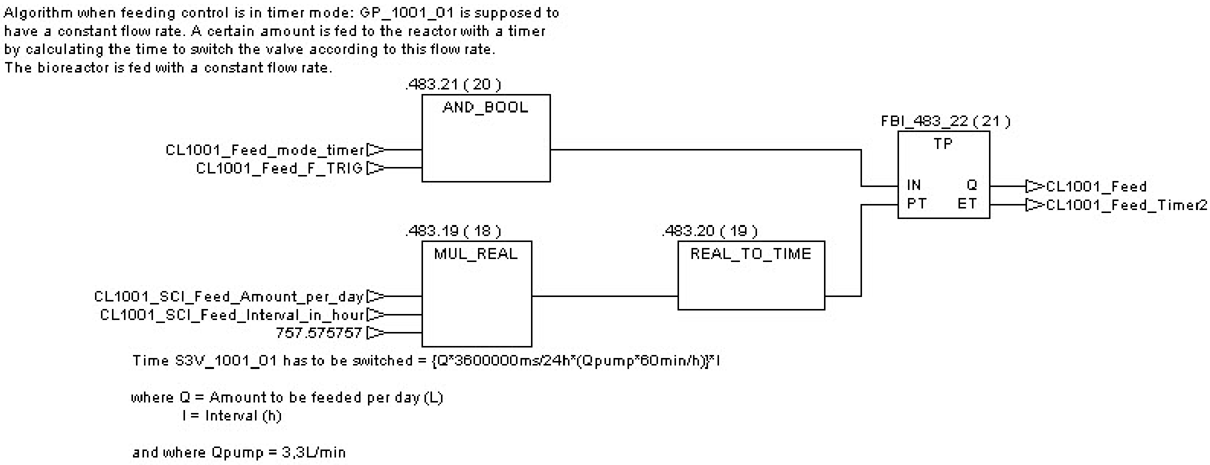
<u>Important point:</u>
In case of :

- Very low level in the influent
- Low pressure in the influent
- Bioreactor level switch high set
- 140 mbar of pressure in the bioreactor gas phase
- GP_1001_01 stopped

The valve S3V_1001_01 is forced in default position

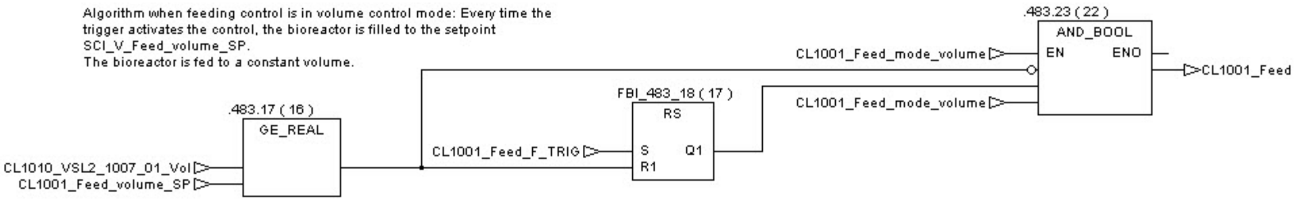
4.2.2.2.1. Timer Mode

The operator enters a certain amount per day then, each hour, 1/24 of the desire quantity is filled inside the bioreactor



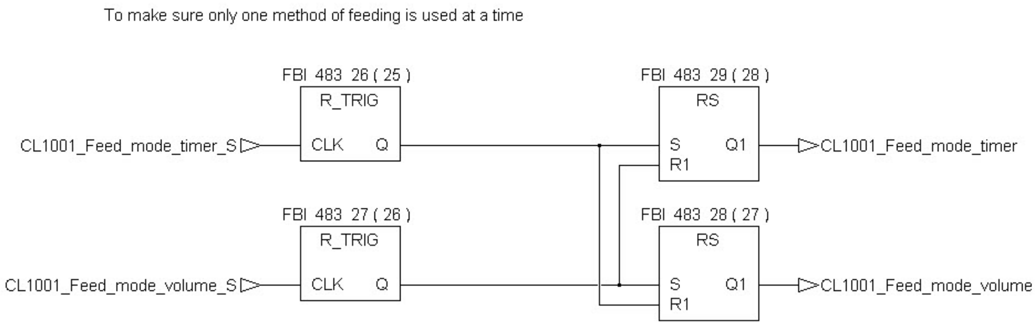
4.2.2.2.2. Volume mode

The operator defines the volume set point of the bioreactor, and then each hour, the bioreactor is fed with the missing amount.



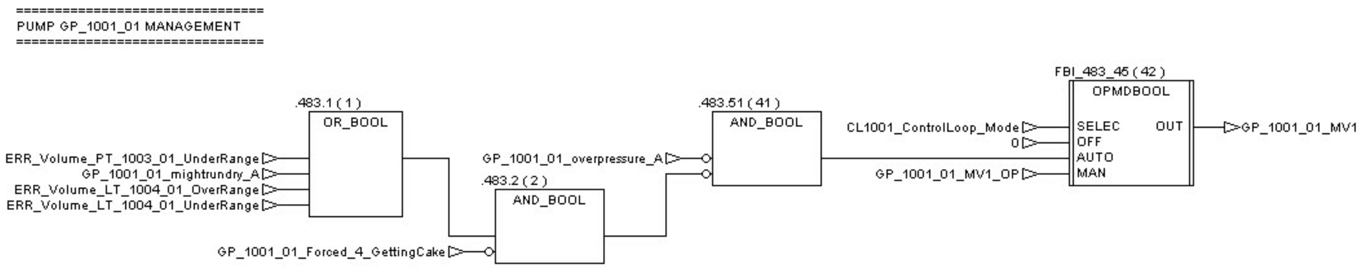
4.2.2.2.3. Mode selection safety

The following function ensures that only one mode is set.



4.2.2.3. *Pump management*

In automatic mode, the pump works only if no alarm is triggered.



4.2.3.Alarms and Threshold

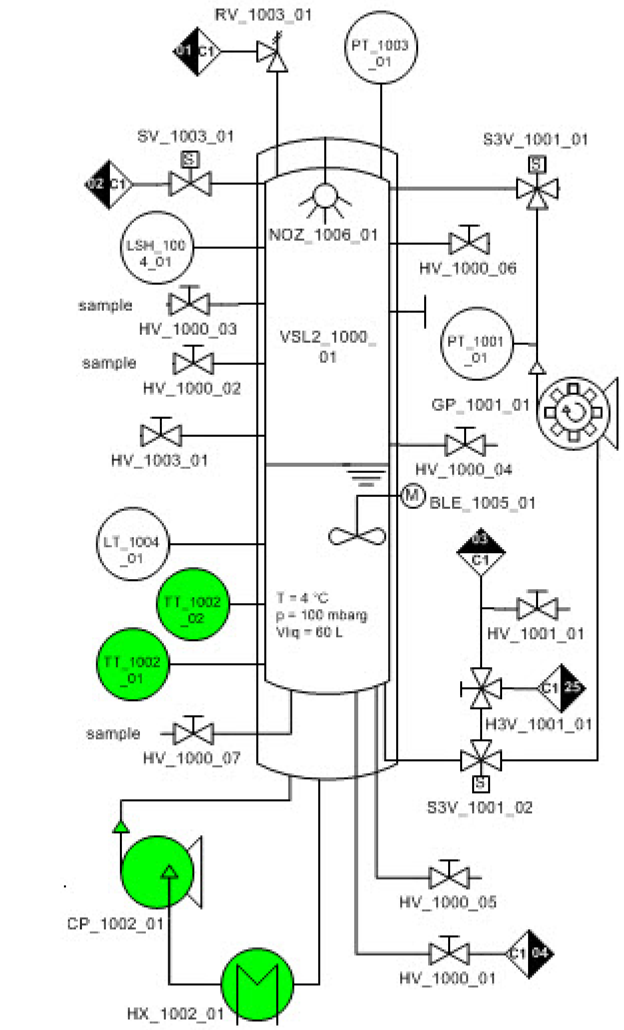
Alarm tag Name	type	Address	description
PT_1001_01_AH	BOOL	000400	High pressure alarm ACTION : DISPLAY ALARM ON HMI
PT_1001_01_AHH	BOOL	000401	Very High pressure alarm. Triggered at 200 mbar ACTION : Stop The pump
PT_1001_01_AL	BOOL	000402	Low pressure alarm ACTION : DISPLAY ALARM ON HMI
PT_1001_01_ALL	BOOL	000403	Very Low pressure alarm ACTION : Stop The pump DISPLAY ALARM ON HMI
PT_1001_01_ERR	BOOL	000404	broken wire alarm ACTION : DISPLAY ALARM ON HMI
GP_1001_01_overpressure_A	BOOL	000406	OLD TAG: "ERR_GP_1001_01_OverP" pump is stopped if the pressure goes over 200 mbar ACTION : DISPLAY ALARM ON HMI
GP_1001_01_mightrundry_A	BOOL	000407	OLD TAG: "ERR_GP_1001_01_Might_Run_Dry" pump is stopped if the volume filtered of VSL2_1000_01 is lower or equal than 9 litres ACTION : DISPLAY ALARM ON HMI
GP_1001_01_fusemotorswitch_A	BOOL	000408	OLD TAG: "ERR_GP_1001_01_Electrical_Q2" motor switch fuse problem (Fuse F19) ACTION : DISPLAY ALARM ON HMI
GP_1001_01_fusecountclockwise_A	BOOL	000409	OLD TAG: "ERR_GP_1001_01_Electrical_K1" Counter clockwise fuse problem (Fuse F20) ACTION : DISPLAY ALARM ON HMI
GP_1001_01_fuseclockwise_A	BOOL	000410	OLD TAG: "ERR_GP_1001_01_Electrical_K2" clockwise fuse problem (Fuse F21) ACTION : DISPLAY ALARM ON HMI
S3V_1001_01_A	BOOL	000412	Valve alarm/ Triggered after 5 second
S3V_1001_02_A	BOOL	000414	Valve alarm/ Triggered after 5 second

Figure 3: Influent Tank Feed to Bioreactor – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
FB_TIME_LIM	TIME	400900	5	seconds	Display an alarm
PT_1001_01_LIM_AH	REAL	400904	180 fixed value	mBar	Display an alarm
PT_1001_01_LIM_AHH	REAL	400906	200 fixed value	mBar	Display an alarm Stop The pump
PT_1001_01_LIM_AL	REAL	400908	-50 fixed value	mBar	Display an alarm
PT_1001_01_LIM_ALL	REAL	400910	-100 fixed value	mBar	Display an alarm Stop The pump Lock S3V_1001_01 (to protect the vessel)

Figure 4: Influent Tank Feed to Bioreactor – THRESHOLDS

4.3. Influent Tank Temperature control (CL1002)



4.3.1.Function

The temperature of the influent tank needs to be maintained to 4 °C. The pump CP_1002_01 (not connected to the PLC) makes a permanent circulation through the jacket of the influent tank. According to the set point defined by the operator, the heat exchanger is started or stopped by the controller to adjust the temperature.

The operator can choose the temperature probe used for the control by the tag “CL1002_Temp_probe_selection” (probe 1 / probe 2 / Average).

Three modes are available:

OFF Mode: The heat exchanger “HX_1002_01_MV” is unpowered.

Auto mode: The operator defines a temperature set point and the probe to use. Then the internal controller starts or stops the heat exchanger to maintain it.

Manu mode: The operator can manually start or stop the heat exchanger

PLC Section name	Equipment tag	Type	Address	Comment
Influent Tank Temperature control	HX_1002_01_MV	DO	000005	Start / Stop the Cooler of the influent tank (VSL2_1000_01) in manual mode
Influent Tank Temperature control	TT_1002_01	AI	400846	Temperature sensor 1 Measures temperature in influent tank (VSL2_1000_01)
Influent Tank Temperature control	TT_1002_02	AI	400848	Temperature sensor 2 Measures temperature in influent tank (VSL2_1000_01)
Influent Tank Temperature control	CP_1002_01	NC		Cold water pump Circulates the cooling liquid through the double jacket of the influent tank (VSL2_1000_01)

Figure 5: Influent Tank Temperature control - EQUIPMENT

PLC Section name	Button tag	Type	Address	Comment
Influent Tank Temperature control	CL1002_ControlLoop_Mode	INT	400801	Influent tank temperature mode (0: Off / 1: Auto / 2: Manu)
Influent Tank Temperature control	HX_1002_01_OP	BOOL	000415	Cooler Cool down influent tank (VSL2_1000_01) to prevent pre-degradation
Influent Tank Temperature control	TT_1002_SP	REAL	400181	Set point of the influent temperature.
Influent Tank Temperature control	CL1002_Temp_probe_selection	INT	400802	Permit to select the temperature probe (0: probe 1 / 1: probe 2 / 2: average)
Influent Tank Temperature control	TT_1002_AVERAGE	REAL	400037	Influent temperature average Measures temperature in influent tank using the two filtered probe
Influent Tank Temperature control	TT_1002_01_Av	REAL	400105	Temperature sensor 1 filtered Measures temperature in influent tank (VSL2_1000_01)

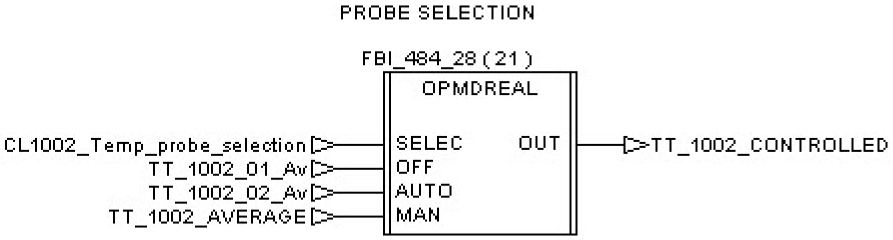
PLC Section name	Button tag	Type	Address	Comment
Influent Tank Temperature control	TT_1002_02_Av	REAL	400039	Temperature sensor 2 average Measures temperature in influent tank (VSL2_1000_01). Averaged on 2500 values.

Figure 6: Influent Tank Temperature control – USER INDICATOR / INPUT

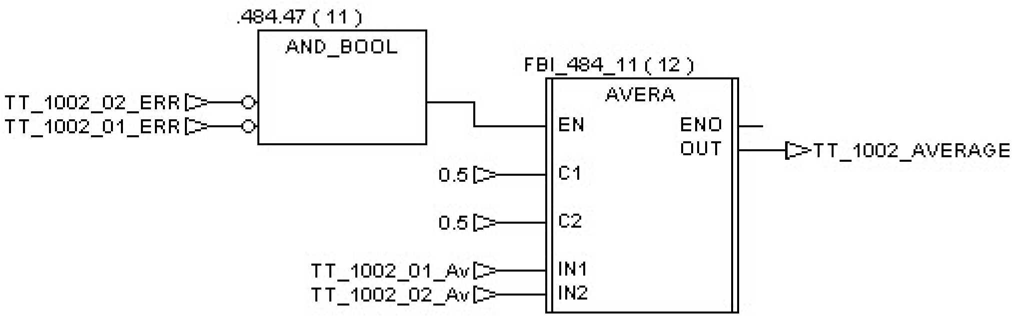
4.3.2.Block Diagram

4.3.2.1. *Probe selection*

The operator can select the probe 1 (TT_1002_01), the probe 2 (TT_1002_02) or the average of the two probes as process value given to the temperature controller (TT_1002_CONTROLLED).



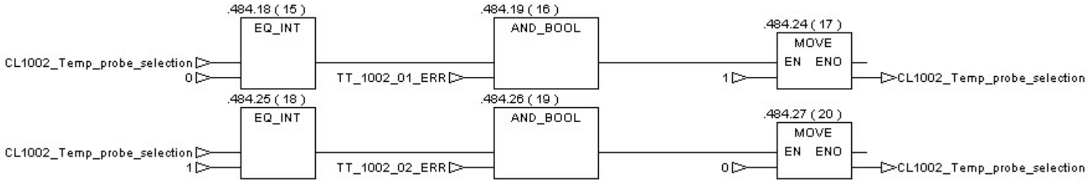
The average value is calculated as follow:



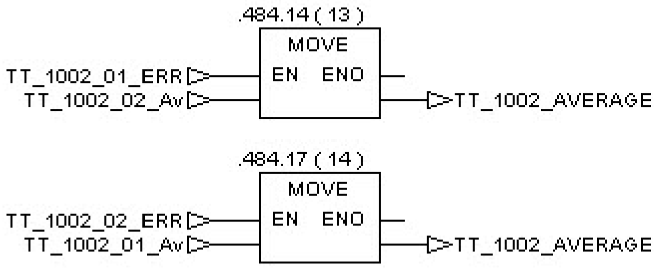
4.3.2.2. *Probe error management*

Depending of the selection of the operator, here is the error management logic:

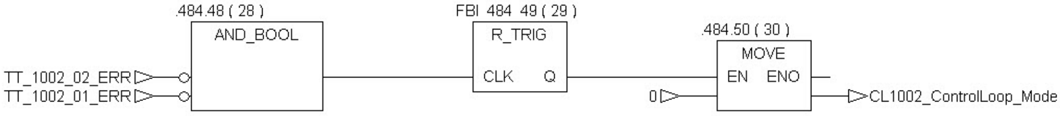
1- If the selected probe goes into failure, the other is automatically selected.



2- If the average is selected, the probe which works well becomes the average.

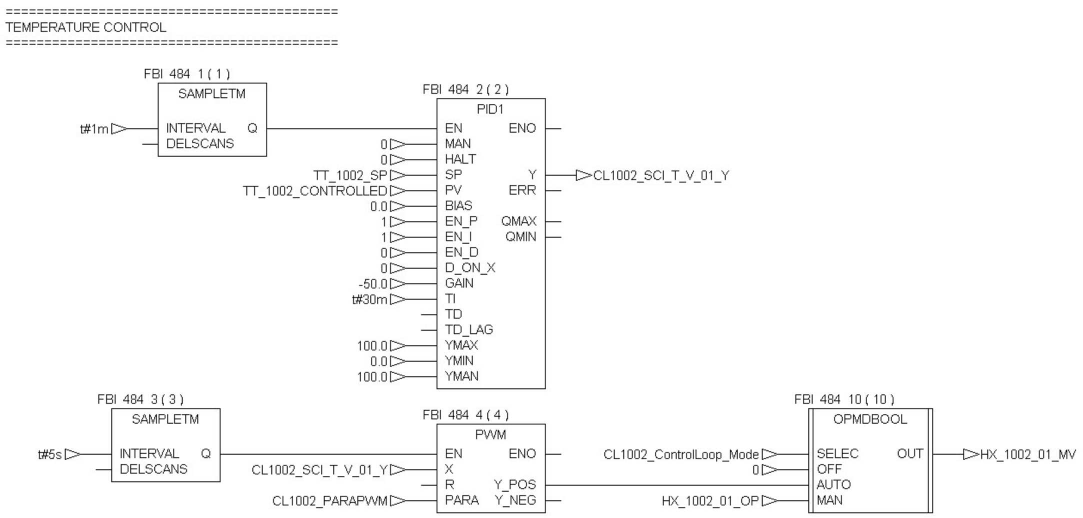


3- In case of both probes go into failure, the temperature control loop is triggered to OFF.



4.3.2.3. *Temperature controller*

The Influent temperature controller is the EPAS one validated by Sherpa Engineering in 2008. The pump CP_1002_01 (not connected to the PLC) is permanently activated. Depending of the defined Set point, the cooler is activated by the controller.



Controlled Variable	**CONTROLLER TYPE**	**DEAD ZONE**	**ZTR Zone Control**	**PWM**	**SAMPLETM**	**PROCESS VALUE (input)**	**SET POINT**
Cooler of the Influent tank	PID	NO	NO	CL1002_PARAPWM t_period : 60s t_pause : 0s t_brake : 0s t_min : 5s t_max : 60s up_pos : 100 up_neg : 0	Controller : 60 s PWM : 5 s	TT_1002_CONTROLLED	TT_1002_SP

Controlled Variable	**INTERNAL MODEL PROCESS**	**TUNE**	**LIMIT**	**SELF_CMP**	**DECOMP**	**Manipulated Variable (Controller Output in Auto Mode)**	**Controlled Equipment**
Cooler of the Influent tank	NO INTERNAL MODEL / NOT A PREDICTIVE CONTROLLER	K : -50 TI : 30 m	YMIN : 0 YMAX : 100	NO	NO	CL1002_SCI_T_V_01_Y	HX_1002_01_MV

4.3.3. Alarms and Threshold

Alarm tag Name	**type**	**Address**	**description**

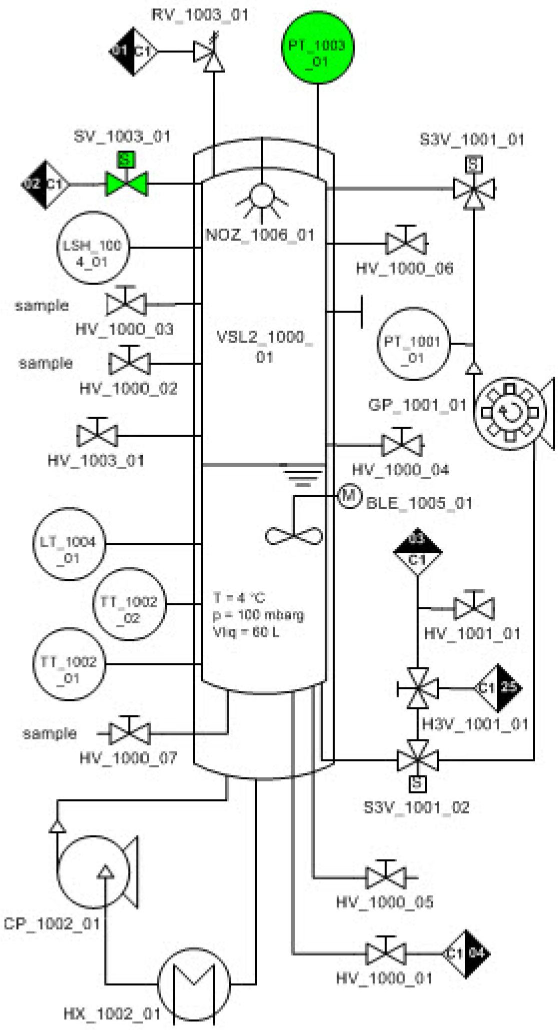
HX_1002_01_A	BOOL	000785	Set when tag "CL1002_E_RV_Q3_F26" or tag "CL1002_E_RV_K3_F27" =0
TT_1002_01_AH	BOOL	000416	High temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1002_01_AHH	BOOL	000417	Very High temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1002_01_AL	BOOL	000418	Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1002_01_ALL	BOOL	000419	Very Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1002_01_ERR	BOOL	000420	broken wire alarm ACTION : DISPLAY ALARM ON HMI
TT_1002_02_AH	BOOL	000421	High temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1002_02_AHH	BOOL	000422	Very High temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1002_02_AL	BOOL	000423	Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1002_02_ALL	BOOL	000424	Very Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1002_02_ERR	BOOL	000425	broken wire alarm ACTION : DISPLAY ALARM ON HMI

Figure 7: Influent Tank Temperature control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
TT_1002_01_LIM_AH	REAL	400912	+1 compared to the setpoint Only in automatic mode	°C	Display an alarm
TT_1002_01_LIM_AHH	REAL	400914	+2 compared to the setpoint Only in automatic mode	°C	Display an alarm
TT_1002_01_LIM_AL	REAL	400916	-1 compared to the setpoint	°C	Display an alarm
TT_1002_01_LIM_ALL	REAL	400918	-2 compared to the setpoint Only in automatic mode	°C	Display an alarm
TT_1002_02_LIM_AH	REAL	400920	+1 compared to the setpoint Only in automatic mode	°C	Display an alarm
TT_1002_02_LIM_AHH	REAL	400922	+2 compared to the setpoint	°C	Display an alarm
TT_1002_02_LIM_AL	REAL	400924	-1 compared to the setpoint Only in automatic mode	°C	Display an alarm
TT_1002_02_LIM_ALL	REAL	400926	-2 compared to the setpoint Only in automatic mode	°C	Display an alarm

Figure 8: Influent Tank Temperature control – THRESHOLDS

4.4. Influent Tank Pressure control (CL1003)



4.4.1.Function

The aim of this loop is to release gas from the influent vessel. The valve SV_1003_01 is opened when:

-PT_1003_01_AHH or PT_1003_01_ALL is set.

-When PT_1003_01 (pressure sensor in the Gas phase) is greater than 150 mbar. This case happens when the operator fills the Influent tank with fresh wastes (see Get Cake Function). In that case, the valve is opened during 2 seconds.

Three modes are available:

OFF Mode: The valve SV_1003_01 is closed.

Auto mode: the valve is automatically opened depending of pressure in the influent.

Manu mode: The operator can manually open or close the valve.

PLC Section name	Equipment tag	Type	Address	Comment
Influent Tank Pressure control	PT_1003_01	REAL	400191	Pressure transducer Measures pressure in gas phase for gas and volume measurement in influent tank (VSL2_1000_01)
Influent Tank Pressure control	SV_1003_01_MV	DO	000014	Powered 2-way valve Releases gas from the influent tank (VSL2_1000_01) when the pressure increases too much (safety). During feeding of the influent tank it switches to release gas faster than HPCV_1003_02 (done when pressure becomes so high that volume measurement is impossible: pressure probe in over range).

Figure 9: Influent Tank Pressure control – EQUIPMENT

PLC Section name	Button tag	Type	Address	Comment
Influent Tank Pressure control	CL1003_ControlLoop_Mode	INT	400803	Influent tank pressure mode (0: Off / 1: Auto / 2: Manu)
Influent Tank Pressure control	SV_1003_01_OP	BOOL	000426	Open or close the valve in manual mode

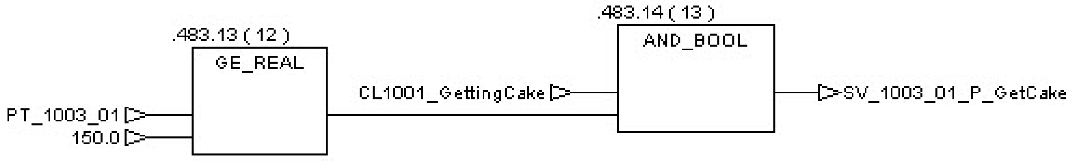
Figure 10: Influent Tank Pressure control – USER INDICATOR / INPUT

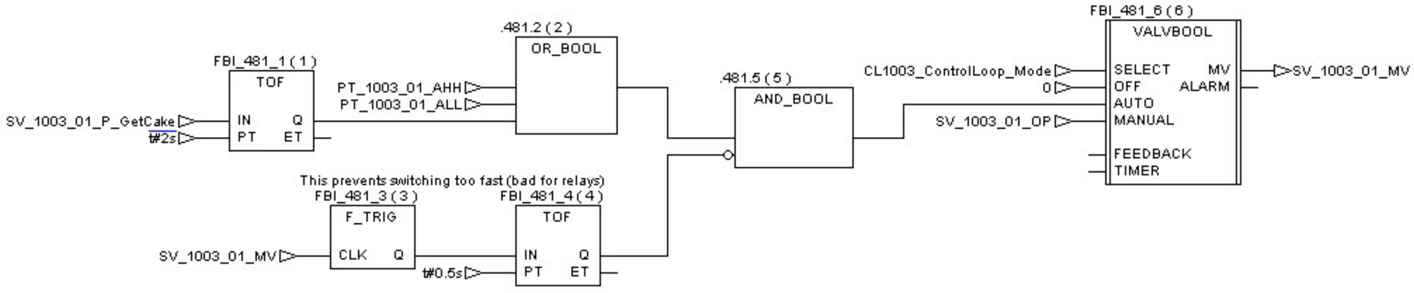
4.4.2.Block Diagram

4.4.2.1. *Influent Pressure Management*

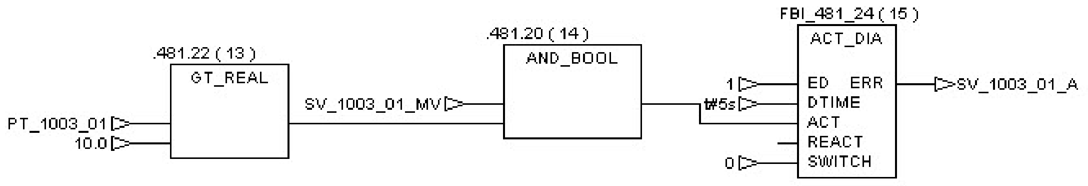
During the filling of influent tank (get cake function), the pressure increases inside the vessel. When it reaches 150 mbar, the internal tag named SV_1003_01_P_GetCake is set. Then the valve SV_1003_01 is opened during 2 seconds.

In case of very high or very low pressure Alarm, the valve is also opened for a minimum of 0,5second.





As the valve has no Feedback, the block ‘VALVBOOL’ (Described in annex) is not configured to trigger any valve alarm. The alarm is set after 5 seconds if the Influent pressure is still greater than 10 mbar with the valve opened.



4.4.3.Alarms and Thresholds

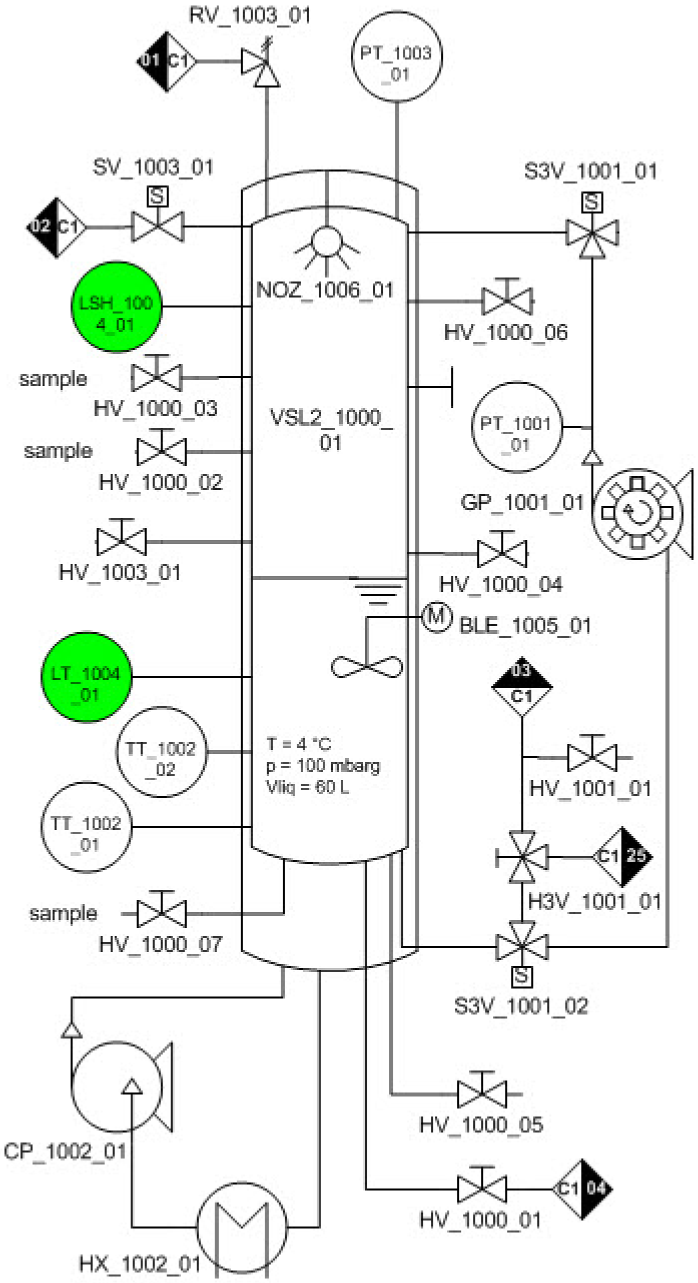
Alarm tag Name	type	Address	description
SV_1003_01_A	BOOL	000427	Valve alarm. As no feedback exits, if the valve is opened and the pressure still greater than 10 mbar, the alarm is set. ACTION : DISPLAY ALARM ON HMI
PT_1003_01_AH	BOOL	000428	High pressure alarm ACTION : DISPLAY ALARM ON HMI
PT_1003_01_AHH	BOOL	000429	Very High pressure alarm open SV_1003_01 during 0.5 s ACTION : DISPLAY ALARM ON HMI
PT_1003_01_AL	BOOL	000430	Low pressure alarm ACTION : DISPLAY ALARM ON HMI
PT_1003_01_ALL	BOOL	000431	Very Low pressure alarm open SV_1003_01 during 0.5 s ACTION : DISPLAY ALARM ON HMI
PT_1003_01_ERR	BOOL	000432	broken wire alarm ACTION : DISPLAY ALARM ON HMI

Figure 11: Influent Tank Pressure control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
PT_1003_01_LIM_AH	REAL	400928	115 fixed value	mBar	fixed Value Display an alarm
PT_1003_01_LIM_AHH	REAL	400930	150 fixed value	mBar	Display an alarm after 5 seconds SV_1003_01 is opened when the pressure inside the influent vessel reaches 150 mbar The alarm is triggered after 5 seconds
PT_1003_01_LIM_AL	REAL	400932	-30	mBar	Display an alarm
PT_1003_01_LIM_ALL	REAL	400934	-50	mBar	fixed Value Display an alarm and Open the valve SV_1003_01

Figure 12: Influent Tank Pressure control – THRESHOLDS

4.5. Influent Tank Level control (CL1004)



4.5.1.Function

As the loading of fresh waste inside the influent tank is done manually, this control loop has no mode. Only the monitoring of the influent volume is calculated using the differential pressure between gas phase and liquid phase.
Here below, the equation used for the volume calculation, with:
Liquid pressure: LT_1004_01
Gas pressure: PT_1003_01
((liquid Pressure – gas pressure) / 1.364) + 7.0232 = VSL2_1000_01 volume.

PLC Section name	Equipment tag	Type	Address	Comment
Influent Tank Level control	LSH_1004_01	DI	100022	Level switch Gives an alarm when the level in influent tank (VSL2_1000_01) becomes too high
Influent Tank Level control	LT_1004_01	AI	400844	Level sensor Measures pressure in liquid phase for volume measurement in influent tank (VSL2_1000_01)

Figure 13: Influent Tank Level control – EQUIPMENT

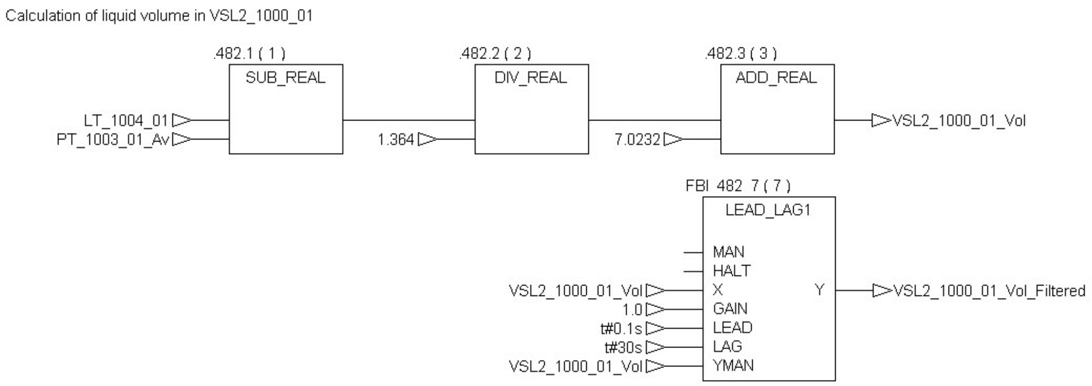
PLC Section name	Equipment tag	Type	Address	Comment
Influent Tank Level control	VSL2_1000_01_Vol_Filtered	REAL	400107	Influent level(calculated with 2 pressure sensor: liquid & gas phase)

Figure 14: Influent Tank Level control – USER INDICATOR / INPUT

4.5.2.Block Diagram

As explained above, the volume of the Influent tank is:
((liquid Pressure – gas pressure) / 1.364) + 7.0232 = VSL2_1000_01 volume.
Then, this calculation is filtered with:

- 30 second of time constant
- 0.1 second of derivative time constant.



4.5.3.Alarms and Thresholds

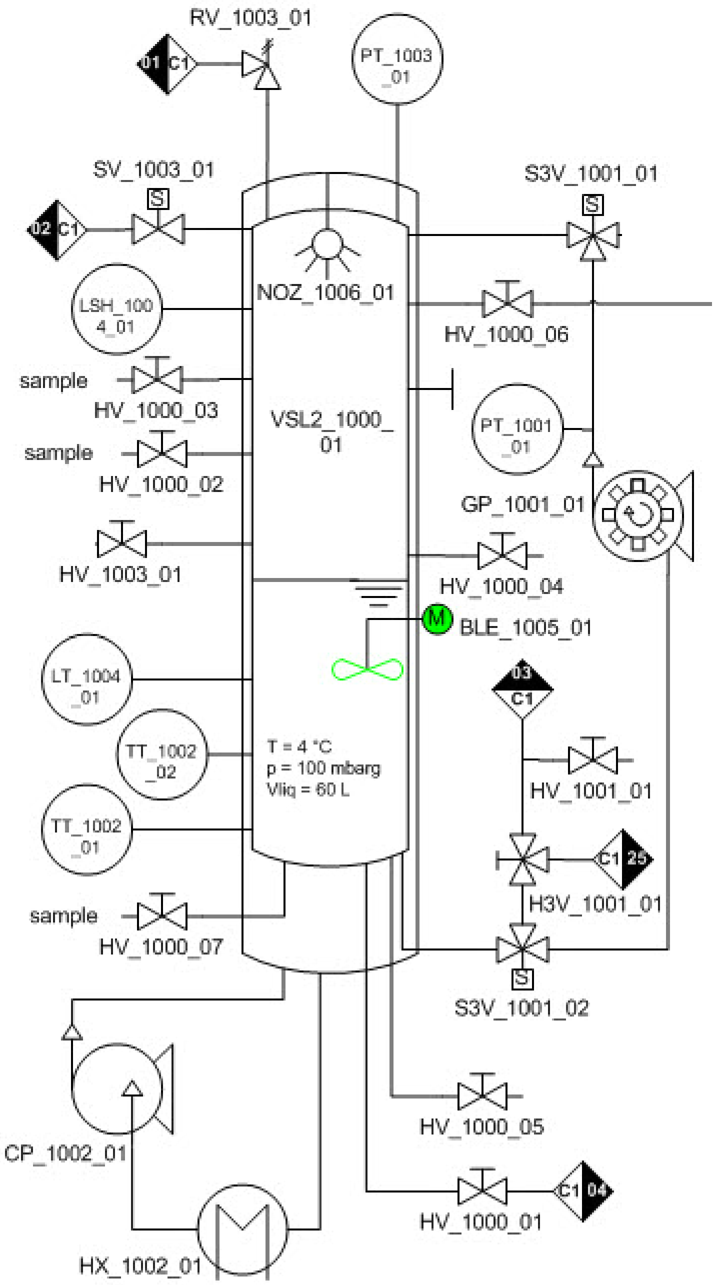
Alarm tag Name	type	Address	description
LSH_1004_01_A	BOOL	000433	Level switch alarm Gives an alarm when the level in influent tank (VSL2_1000_01) becomes too high during a 10s. ACTION : DISPLAY ALARM ON HMI
LT_1004_01_AH	BOOL	000434	High level alarm ACTION : DISPLAY ALARM ON HMI
LT_1004_01_AHH	BOOL	000435	Very High level alarm ACTION : DISPLAY ALARM ON HMI If at the same time the valve S3V_1001_02 is set , the get cake function is stopped
LT_1004_01_AL	BOOL	000436	Low level alarm ACTION : DISPLAY ALARM ON HMI If the valve S3V_1001_02 is set, the get cake function is stopped.
LT_1004_01_ALL	BOOL	000437	Very Low level alarm ACTION : DISPLAY ALARM ON HMI Put The Control Loop 1001 OFF. For Reminding, the pump stop when the "GP_1001_01_mightrundry_A" tag is set volume equal or less than 9 litres
LT_1004_01_ERR	BOOL	000438	broken wire alarm ACTION : DISPLAY ALARM ON HMI

Figure 15: Influent Tank Level control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
CL1004_LEVEL_LIM_AH	REAL	400936	55 fixed value Only in automatic mode	mbar	Display an alarm
CL1004_LEVEL_LIM_AHH	REAL	400938	60 fixed value Only in automatic mode	mbar	Display an alarm If at the same time the valve S3V_1001_02 is set , the get cake function is stopped
CL1004_LEVEL_LIM_AL	REAL	400940	20 fixed value Only in automatic mode	mbar	Display an alarm
CL1004_LEVEL_LIM_ALL	REAL	400942	10 fixed value Only in automatic mode	mbar	Display an alarm Put The Control Loop 1001 OFF. For Reminding, the pump stop when the "GP_1001_01_mightrundry_A" tag is set volume equal or less than 9 litres

Figure 16: Influent Tank Level control – THRESHOLDS

4.6. Influent Tank Blender (CL1005)



4.6.1.Function

The influent blender is used to permanently mix the wastes in order to homogenize it before entering in the bioreactor.

Three modes are available:

OFF Mode: The blender is stopped.

Auto mode: The blender is running (if no alarm linked to the equipment) is triggered.

Manu mode: The operator can manually start or stop the blender.

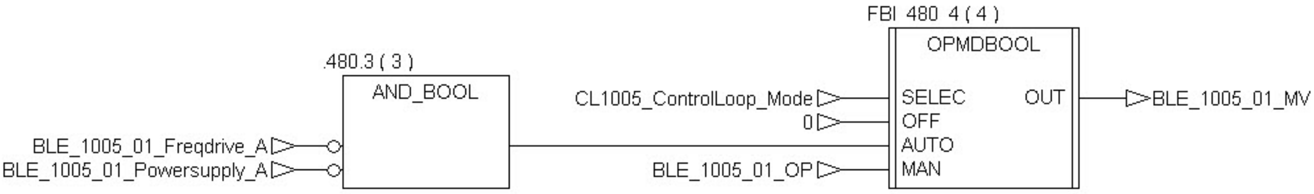
PLC Section name	Equipment tag	Type	Address	Comment
Influent Tank Blender	BLE_1005_01_MV	DO	000003	Blender Homogenize influent tank content (VSL2_1000_01)
Influent Tank Blender	BLE_1005_01_FUSE_F29_F31_ERR	DI	100017	Control circuit breaker
Influent Tank Blender	BLE_1005_01_U1_ERR	DI	100016	blender frequency drive error Not clear in the EPAS doc. Need to confirm which equipment send the signal

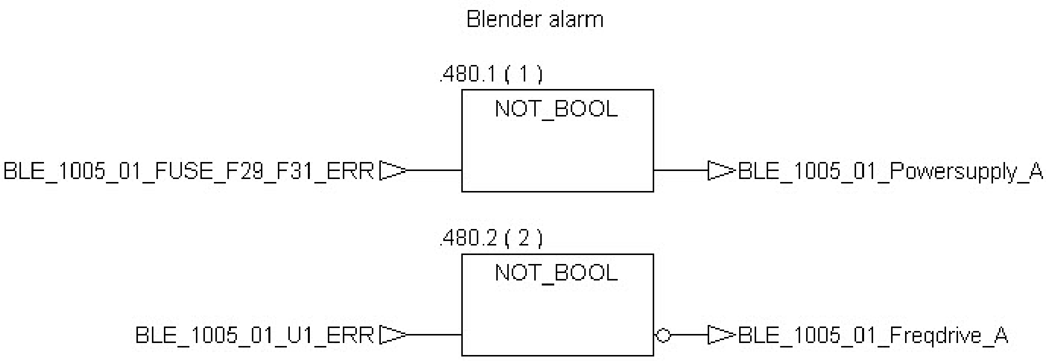
Figure 17: Influent Tank Blender – EQUIPMENT

PLC Section name	Button tag	Type	Address	Comment
Influent Tank Blender	CL1005_ControlLoop_Mode	INT	400804	Influent tank blender mode (0: Off / 1: Auto / 2: Manu)
Influent Tank Blender	BLE_1005_01_OP	BOOL	000201	Start or stop the blender in manual mode. OLD NAME: SCI_BLE_1005_01

Figure 18: Influent Tank Blender – USER INDICATOR / INPUT

4.6.2.Block Diagram





4.6.3.Alarms and Thresholds

Alarm tag Name	type	Address	description
BLE_1005_01_Freqdrive_A	BOOL	000440	Blender frequency drive alarm. Triggered when "BLE_1005_01_U1_ERR" =1 ACTION : DISPLAY ALARM ON HMI
BLE_1005_01_Powersupply_A	BOOL	000441	Blender fuses error alarm. Triggered when "BLE_1005_01_FUSE_F29_F31_ERR" =0 ACTION : DISPLAY ALARM ON HMI

Figure 19: Influent Tank Blender – ALARMS

NO ALARMS THRESHOLDS

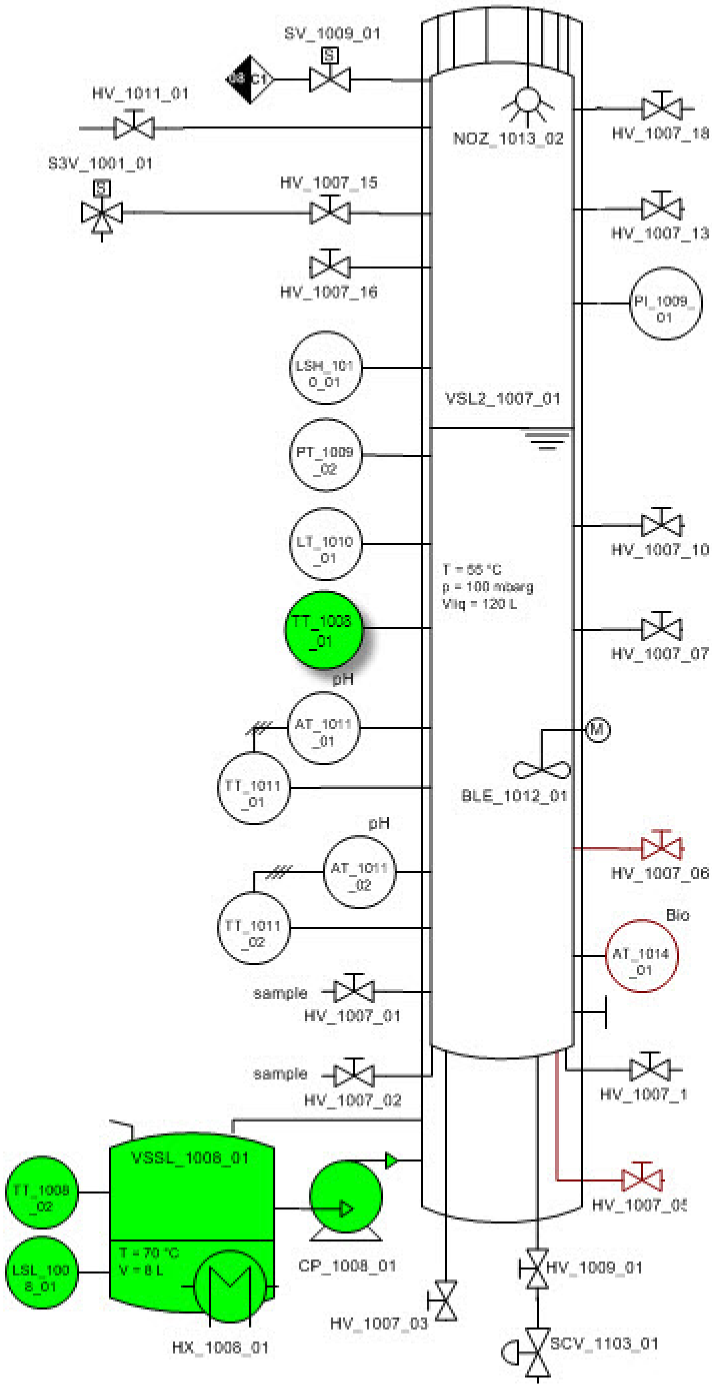
4.7. Influent Tank CIP (CL1006)

No controlled equipment is referenced in this loop. Only Influent vessel nozzle "NOZ_1006_01" are named with this loop number.

4.8. Bioreactor General (CL1007)

No controlled equipment is referenced in this loop. Only Bioreactor vessel and a set of manual hand valves are named with this loop number.

4.9. Bioreactor Temperature Control (CL1008)



4.9.1.Function

The bioreactor temperature is controlled to ensure a good bacterial fermentation. For this, the bioreactor is maintained to 55°C.
In case of sensor failure, the temperature probes of pH sensors are automatically taken as measurement.
The pump CP_1008_01 (not connected to the PLC) circulates permanently the warm liquid inside the bioreactor jacket. Depending of the bioreactor temperature set point, the heat exchanger is started or stopped by controller.
Three modes are available:

OFF Mode: The heat exchanger "HX_1008_01_MV" is unpowered.
Auto mode: The operator defines a temperature set point then the internal controller manages the heat exchanger.
Manu mode: The operator can manually start or stop the heat exchanger.

PLC Section name	Equipment tag	Type	Address	Comment
BioReactor Temperature Control	HX_1008_01_MV	DO	000006	Heat exchanger Heat bioreactor (VSL2_1007_01)
BioReactor Temperature Control	CL1008_E_RV_K4_F22	DI	100013	Control Contactor K4 / error on temperature contactor (Fuse F24)
BioReactor Temperature Control	CL1008_E_RV_Q4_F23	DI	100012	Control Circuit-breaker Q4 / error on temperature power supply (Fuse F23)
BioReactor Temperature Control	LSL_1008_01	DI	100024	Level Switch Gives an alarm/action when the level in the warm water bath (HX_1008_01) becomes too low
BioReactor Temperature Control	TT_1008_01	AI	400239	Temperature sensor Measures temperature in bioreactor (VSL2_1007_01)
BioReactor Temperature Control	TT_1008_02	AI	400061	Temperature sensor Measures temperature in warm water bath HX_1008_01
BioReactor Temperature Control	CP_1008_01	NC		Hot water pump Circulates the heating liquid through the double jacket of the bioreactor (VSL2_1007_01)

Figure 20: Bioreactor Temperature Control – EQUIPMENTS

PLC Section name	Button tag	Type	Address	Comment
BioReactor Temperature Control	CL1008_ControlLoop_Mode	INT	400805	Bioreactor temperature mode (0: Off / 1: Auto / 2: Manu)
BioReactor Temperature Control	TT_1008_SP	REAL	400183	Bioreactor temperature Set point
BioReactor Temperature Control	TT_1008_01_Av	REAL	400103	Temperature sensor Average Measures temperature in bioreactor (VSL2_1007_01)
BioReactor Temperature Control	TT_1008_02_Av	REAL	400113	Temperature sensor Average Measures temperature in warm water bath HX_1008_01

PLC Section name	Button tag	Type	Address	Comment
BioReactor Temperature Control	HX_1008_01_OP	BOOL	000192	Start or stop the heat exchanger in manual mode

Figure 21: Bioreactor Temperature Control – USER INDICATOR / INPUT

4.9.2.Block Diagram

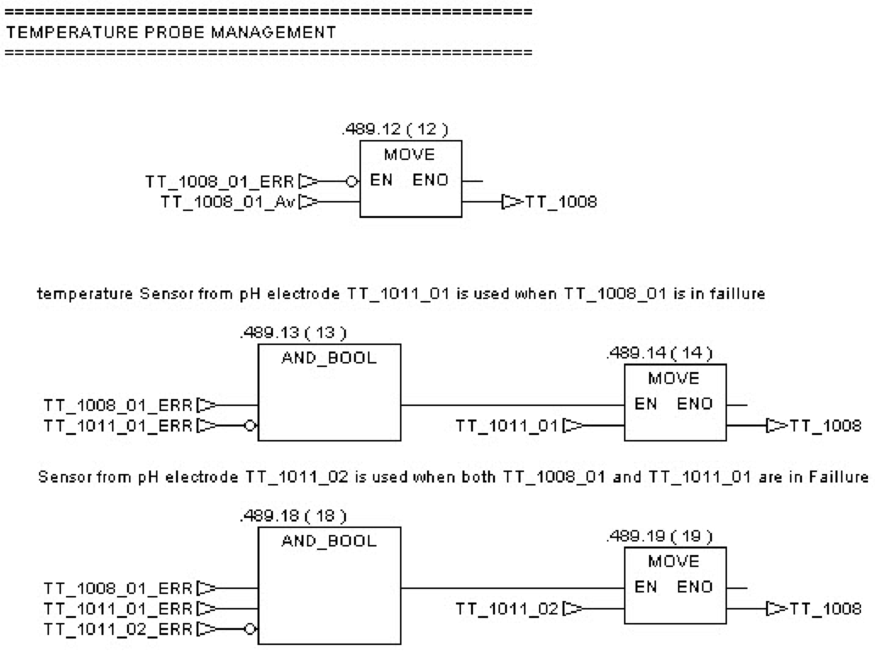
4.9.2.1. *Bioreactor temperature probes management*

In normal condition, the probe which is used to control the bioreactor temperature is TT_1008_01. This probe is averaged on 2500 values

In case of failure, the PLC will use the pH temperature probe.

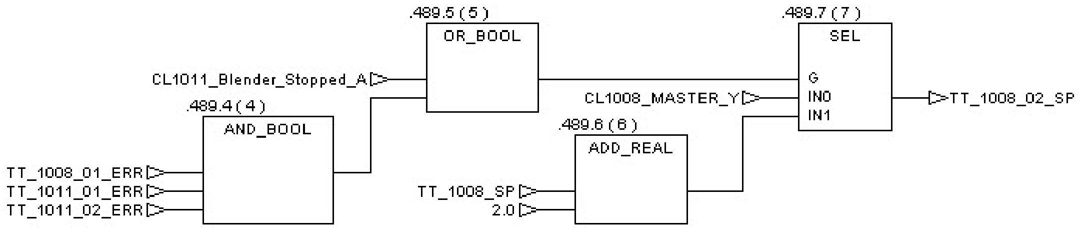
- First the TT_1011_01
- Second the TT_1011_02

In the diagram, the tag TT_1008 is the temperature to control



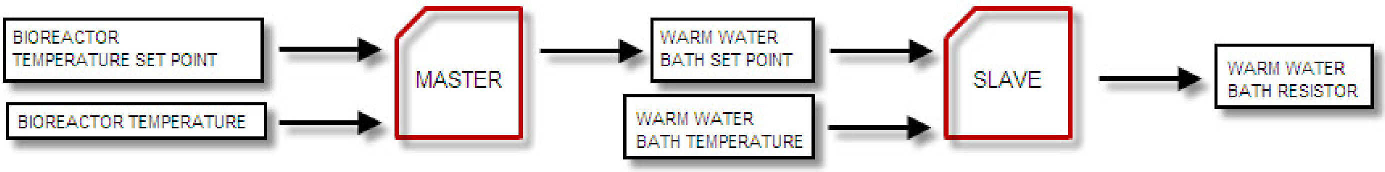
When no bioreactor temperature probes can be used for control, or if the bioreactor blender is in alarm, the PLC send to the slave controller (the one which manages the warm water bath temperature) the set point entered by the operator with 2 °C more.

This set point is not displayed on HMI.



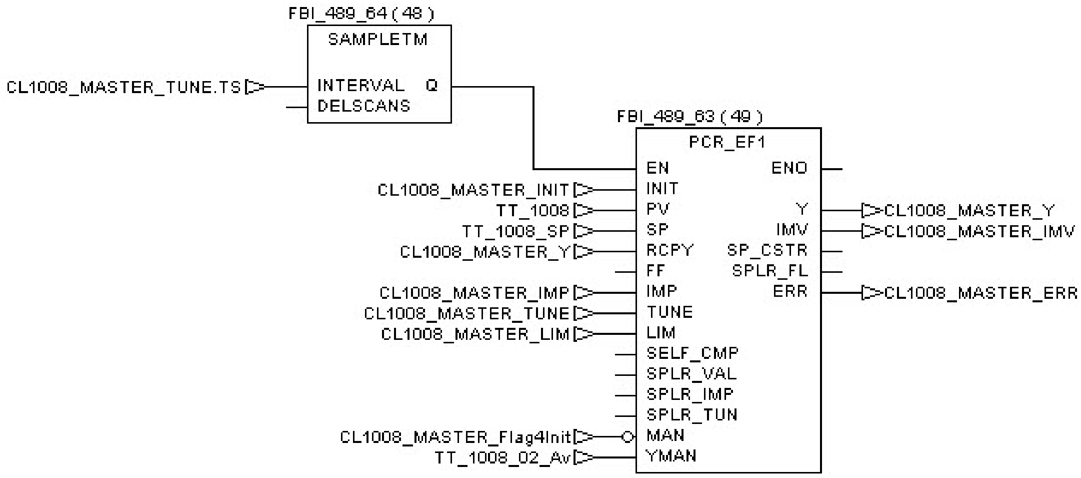
4.9.2.2. *Controller (automatic mode)*

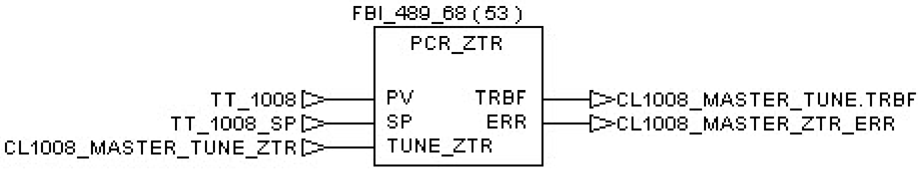
The control is done with two controllers in cascade. The master is a predictive first order (EF1 Block / See annex) and the slave is an Integrative first order (IF1 Block / see annex).



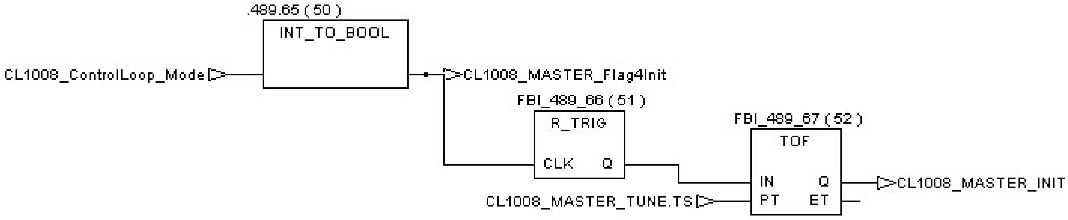
4.9.2.2.1. Master controller

The master sends a set point for the warm water bath (managed by the slave controller), Depending of the bioreactor temperature. A ZTR block (see annex) slow down the control provides by the master to the slave around the set point area (see controller parameters).



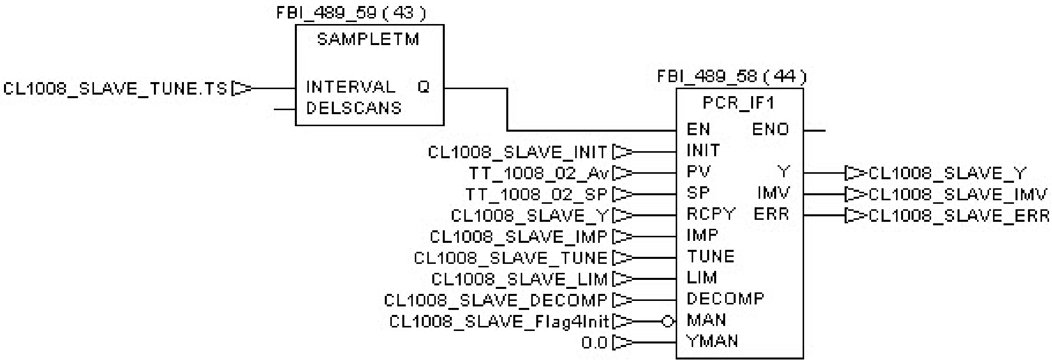


The Master controller is initialized when the Bioreactor temperature control loop is triggered in Automatic mode.

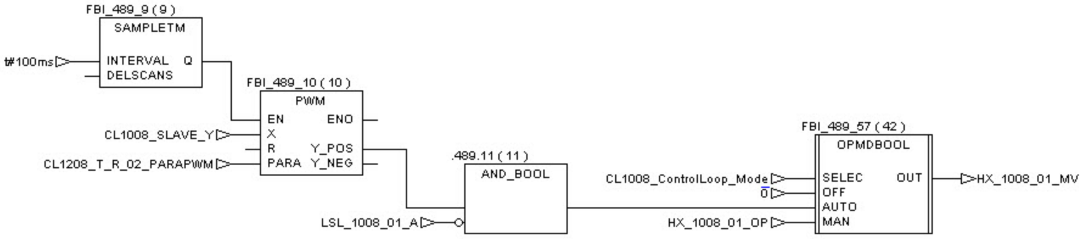


4.9.2.2.1. Slave controller

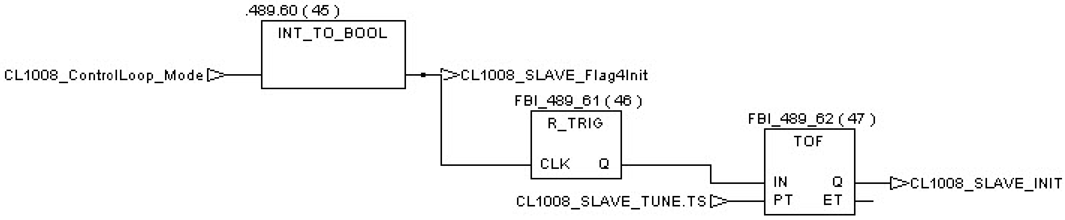
The slave controller manages the warm water bath resistor to provide temperature requested by the Master controller.
TT_1008_02 monitors the warm water bath temperature. This probe is averaged on 2500 values.



The output of the slave controller is converted into a time binary signal by a PWM block (see annex) to command the resistor.
Important point: The Resistor can be activated only if liquid is present inside the warn water bath (LSL_1008_01 mustn't be in alarm).



The Slave controller is initialized when the Bioreactor temperature control loop is triggered in Automatic mode.



4.9.2.2.2. Controller parameters

Controlled Variable	PCR CONTROLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
Bioreactor temperature	EF1	NO	CL1008_MASTER_TUNE_ZTR ZONE : 0.2 TRBF_LO : 90m TRBF_HI : 900m	NO	Controller : CL1008_MASTER_TUNE.TS (1m)	TT_1008	TT_1008_SP
Warm water bath temperaure	IF1	NO	NO	CL1208_T_R_02_PARAPWM t_period : 10s t_pause : 0s t_brake : 0s t_min : 0.5s t_max : 10 s up_pos : 1 up_neg : 0	CL1008_SLAVE_TUNE.TS (10s)	TT_1008_02_Av	TT_1008_02_SP OR in case of complete probes failure, TT_1008_SP + 2°C

Controlled Variable	INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
Bioreactor temperature	CL1008_MASTER_IMP KM : 1 TM : 2000s DM : 0	CL1008_MASTER_TUNE TS : 1m H : 1m TRBF :90m	CL1008_LIM 1 YMIN : 0 YMAX : 70 YRATE : 1	NO	NO	CL1008_MASTER_IMP	NO equipment controlled. Temperature Set point send to the slave
Warm water bath temperaure	CL1008_SLAVE_IMP KM : 0.0132 TM : 0s DM : 34s	CL1008_SLAVE_TUNE TS : 10s H : 20s TRBF : 1m40s	CL1008_SLAVE_LIM YMIN : 0 YMAX : 1 YRATE : 1	NO	CL1008_SLAVE_DECOMP 1m40s	CL1008_SLAVE_Y	HX_1008_01_MV

4.9.3.Alarms and Thresholds

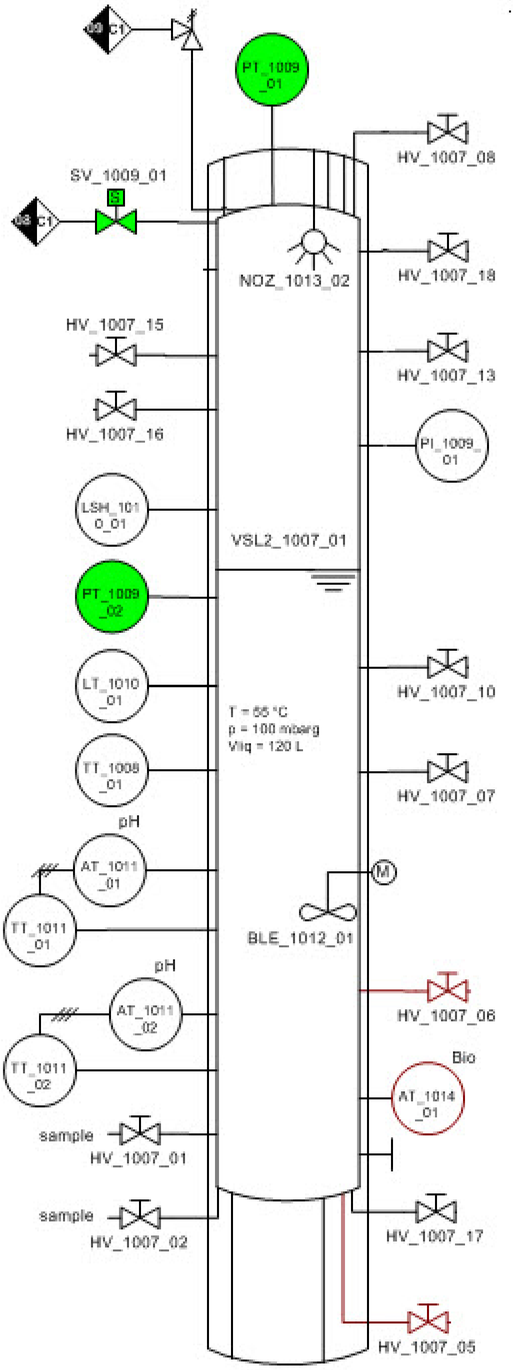
Alarm tag Name	type	Address	description
LSL_1008_01_A	BOOL	000442	Level switch low alarm Prevents the resistor HX_1008_01 to be active
TT_1008_01_AH	BOOL	000443	High temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1008_01_AHH	BOOL	000444	Very High temperature alarm ACTION : DISPLAY ALARM ON HMI Cut the Bioreactor temperature control loop
TT_1008_01_AL	BOOL	000445	Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1008_01_ALL	BOOL	000446	Very Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1008_01_ERR	BOOL	000447	broken wire alarm ACTION : DISPLAY ALARM ON HMI
TT_1008_02_AH	BOOL	000448	High temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1008_02_AHH	BOOL	000449	Very High temperature alarm ACTION : DISPLAY ALARM ON HMI Cut the Bioreactor temperature control loop
TT_1008_02_AL	BOOL	000450	Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1008_02_ALL	BOOL	000451	Very Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1008_02_ERR	BOOL	000452	broken wire alarm ACTION : DISPLAY ALARM ON HMI

Figure 22: Bioreactor Temperature Control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
PS_TIME_LIM	TIME	400902	10	seconds	Display an alarm
TT_1008_01_LIM_AH	REAL	400944	+1 compared to the setpoint Only in automatic mode	°C	Display an alarm
TT_1008_01_LIM_AHH	REAL	400946	60 fixed value	°C	Display an alarm Cut the Bioreactor temperature control loop
TT_1008_01_LIM_AL	REAL	400948	-1 compared to the setpoint Only in automatic mode	°C	Display an alarm
TT_1008_01_LIM_ALL	REAL	400950	-4 compared to the setpoint Only in automatic mode	°C	Display an alarm
TT_1008_02_LIM_AH	REAL	400952	65 fixed value	°C	Display an alarm
TT_1008_02_LIM_AHH	REAL	400954	70 fixed value	°C	Display an alarm Cut the Bioreactor temperature control loop
TT_1008_02_LIM_AL	REAL	400956	40 fixed value	°C	Display an alarm
TT_1008_02_LIM_ALL	REAL	400958	30 fixed value	°C	Display an alarm

Figure 23: Bioreactor Temperature Control – THRESHOLDS

4.10. Bioreactor Pressure Control (CL1009)


PT_1009_01
SV_1009_01
HV_1007_08
HV_1007_18
NOZ_1013_02
HV_1007_15
HV_1007_13
HV_1007_16
PI_1009_01
LSH_1010_01
VSL2_1007_01
PT_1009_02
HV_1007_10
LT_1010_01
T = 55 °C
p = 100 mbarg
Vliq = 120 L
TT_1008_01
HV_1007_07
pH
AT_1011_01
M
TT_1011_01
BLE_1012_01
pH
HV_1007_06
AT_1011_02
Bio
TT_1011_02
AT_1014_01
sample
HV_1007_01
sample
HV_1007_17
HV_1007_02
HV_1007_05

4.10.1.Function

The aim of this loop is to release gas from the Bioreactor. The valve SV_1009_01 is opened when PT_1009_01_AHH or PT_1009_01_ALL is set.
Three modes are available:

OFF Mode: The valve SV_1009_01 is closed.
Auto mode: the valve is automatically opened depending of pressure in the bioreactor.
Manu mode: The operator can manually open or close the valve.

PLC Section name	Equipment tag	Type	Address	Comment
BioReactor Pressure Control	SV_1009_01_MV	DO	000013	Powered 2-way valve Releases gas from bioreactor (VSL2_1007_01) when the pressure increases over the set point
BioReactor Pressure Control	PT_1009_01	AI	400175	Pressure transducer Measures pressure in gas phase and volume measurement in bioreactor (VSL2_1007_01)
BioReactor Pressure Control	PT_1009_02	AI	400177	Pressure transducer Measures pressure in liquid phase for volume measurement in bioreactor (VSL2_1007_01)

Figure 24: Bioreactor Pressure Control – EQUIPMENTS

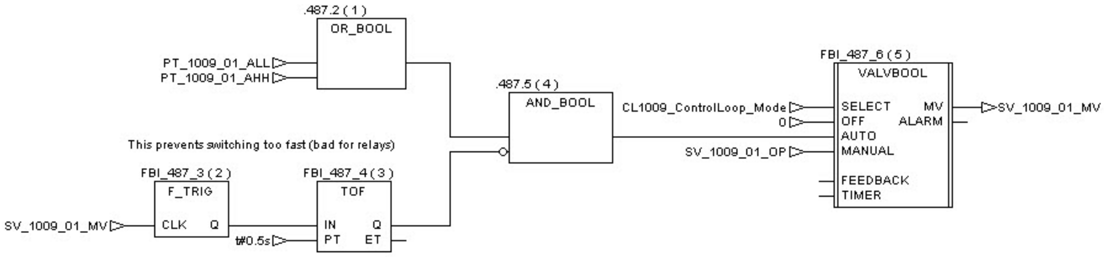
PLC Section name	Button tag	Type	Address	Comment
BioReactor Pressure Control	CL1009_ControlLoop_Mode	INT	400807	BioReactor tank pressure mode (0: Off / 1: Auto / 2: Manu)
BioReactor Pressure Control	SV_1009_01_OP	BOOL	000453	Open or close the valve in manual mode

Figure 25: Bioreactor Pressure Control – USER INDICATOR / INPUT

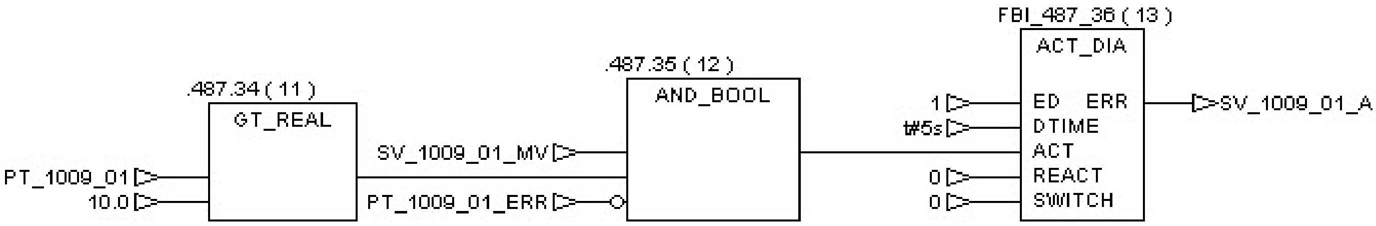
4.10.2.Block Diagram

4.10.2.1. *Valve management (SV_1009_01)*

In case of very high or very low pressure inside the bioreactor, the valve SV_1009_01 is open for 0.5 second.



As the valve has no FB, we have changed the way to trigger the alarm.
If the valve is open during 5 seconds and the pressure is upper than
10 mBar, the alarm is SET. This alarm happens only if the pressure probe is not in error.



4.10.3.Alarms and Thresholds

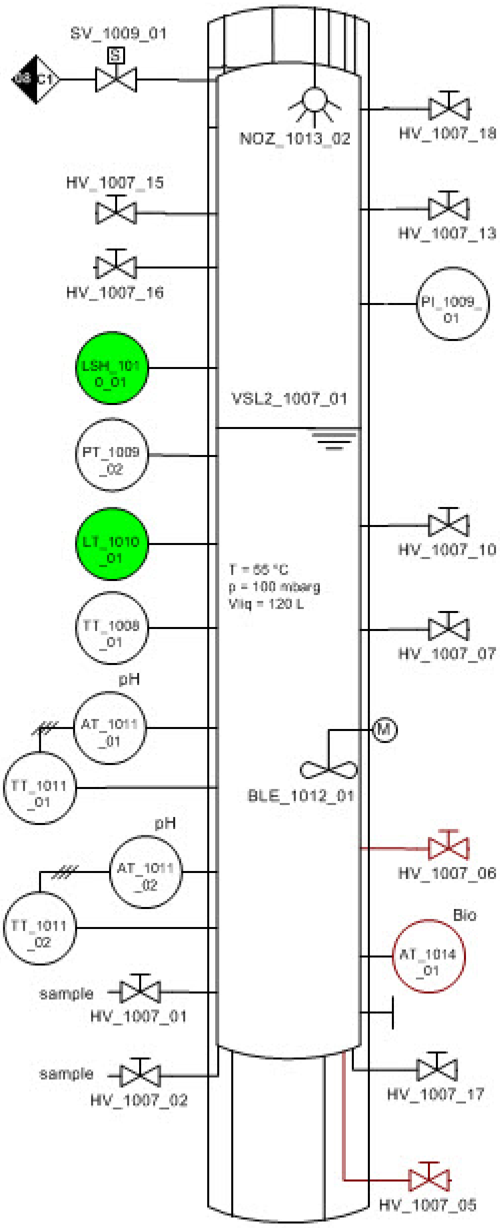
Alarm tag Name	type	Address	description
PT_1009_01_AH	BOOL	000455	High pressure alarm ACTION : DISPLAY ALARM ON HMI Close SV_1102_01
PT_1009_01_AHH	BOOL	000456	Very High pressure alarm open SV_1009_01 during 0.5 s ACTION : DISPLAY ALARM ON HMI
PT_1009_01_AL	BOOL	000457	Low pressure alarm ACTION : DISPLAY ALARM ON HMI
PT_1009_01_ALL	BOOL	000458	Very Low pressure alarm open SV_1009_01 during 0.5 s ACTION : DISPLAY ALARM ON HMI
PT_1009_01_ERR	BOOL	000459	broken wire alarm ACTION : DISPLAY ALARM ON HMI
PT_1009_02_AH	BOOL	000460	High pressure alarm ACTION : DISPLAY ALARM ON HMI
PT_1009_02_AHH	BOOL	000461	Very High pressure alarm ACTION : DISPLAY ALARM ON HMI
PT_1009_02_AL	BOOL	000462	Low pressure alarm ACTION : DISPLAY ALARM ON HMI
PT_1009_02_ALL	BOOL	000463	Very Low pressure alarm ACTION : DISPLAY ALARM ON HMI
PT_1009_02_ERR	BOOL	000464	broken wire alarm ACTION : DISPLAY ALARM ON HMI
SV_1009_01_A	BOOL	000454	Valve alarm. As no feedback exits, if the valve is opened and the pressure still greater than 10 mbar, the alarm is set. ACTION : DISPLAY ALARM ON HMI

Figure 26: Bioreactor Pressure Control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
PT_1009_Hyst_Rising PT_1009_Hyst_Falling	REAL	No address	Hysteresis: up: 150 Down: 140 Fixed Value	mBar	Close SV_1102_01 Display an alarm
PT_1009_01_LIM_AHH	REAL	401202	190 Fixed Value	mBar	Open SV_1009_01 Display an alarm
PT_1009_01_LIM_AL	REAL	401204	-30 Fixed Value	mBar	Display an alarm
PT_1009_01_LIM_ALL	REAL	401206	-50 Fixed Value	mBar	Open SV_1009_01 / Stop FU
PT_1009_02_LIM_AH	REAL	400960	Hysteresis: up: 210 Down: 200 Fixed Value	mBar	Display an alarm
PT_1009_02_LIM_AHH	REAL	400962	250 Fixed Value	mBar	Display an alarm
PT_1009_02_LIM_AL	REAL	400964	-30 Fixed Value	mBar	Display an alarm
PT_1009_02_LIM_ALL	REAL	400966	-50 Fixed Value	mBar	Display an alarm

Figure 27: Bioreactor pressure Control – THRESHOLDS

4.11. Bioreactor Level Control (CL1010)



4.11.1.Function

Depending on the feeding mode chosen, the level can have two distinct behaviors.

-In timer mode, the bioreactor is filled with a defined amount per day with a configurable time interval (per hour).

-In volume mode, the bioreactor is filled each hour to reach the operator set point.

Thus, this loop doesn't have mode. Its function monitors and alerts in case of problem.

The Bioreactor volume is calculated using the differential pressure between gas phase and liquid phase.

Here below, the equation used for the volume calculation.

Liquid Pressure: LT_1010_01 (or PT_1009_02 +11 if LT_1010_01 is in failure)

Gas Pressure: PT_1009_01

((liquid Pressure – gas pressure) * 1.2719) + 16.235 = CL1010_VSL2_1007_01_Vol

Then, this calculation is filtered (Gain : 1 / Lag : 30s / Lead : 0.1s) to display the bioreactor volume on the HMI. This final variable is named "CL1010_VSL2_1007_01_Vol_Filtered"

Some safeties concerning the volume calculation are also implemented:

- if PT_1009_02 and LT_1010_01 are in failure (No more bioreactor calculation) the feeding valve S3V_1001_01 is locked in recirculation position and the filtration is triggered to bypass state.

- if PT_1009_01 is in failure (No more bioreactor calculation) the feeding valve S3V_1001_01 is locked in recirculation position and the filtration is triggered to bypass state.

PLC Section name	Equipment tag	Type	Address	Comment
BioReactor Level Control	LSH_1010_01	DI	100023	Level Switch Gives an alarm/action when the level in bioreactor (VSL2_1007_01) becomes too high
BioReactor Level Control	LT_1010_01	AI	400063	Level sensor Measures pressure in liquid phase for volume measurement in bioreactor (VSL2_1007_01)

Figure 28: Bioreactor Level Control – EQUIPMENTS

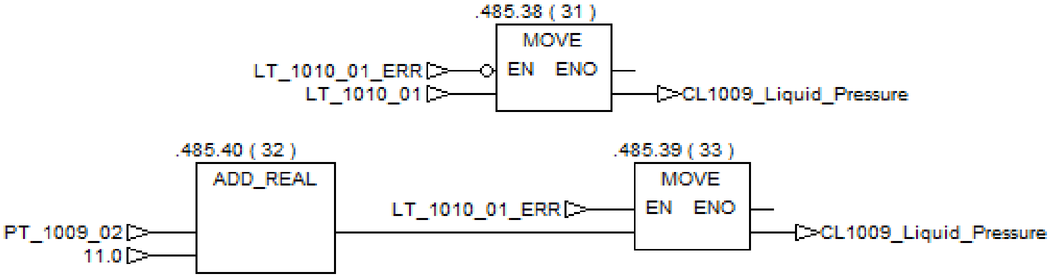
PLC Section name	Button tag	Type	Address	Comment
BioReactor Level Control	CL1010_VSL2_1007_01_Vol_Filtered	REAL	400215	Bioreactor liquid volume calculation

Figure 29: Bioreactor Level Control – USER INDICATOR / INPUT

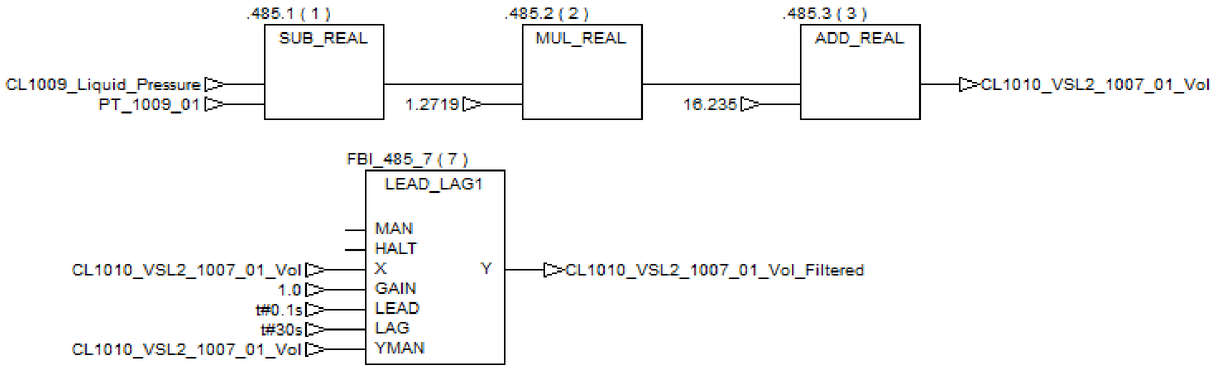
4.11.2.Block Diagram

As explained above, here is the way of implementation of the volume calculation.

Automatic selection of liquid probe:



Bioreactor Volume calculation:



4.11.3.Alarms and Thresholds

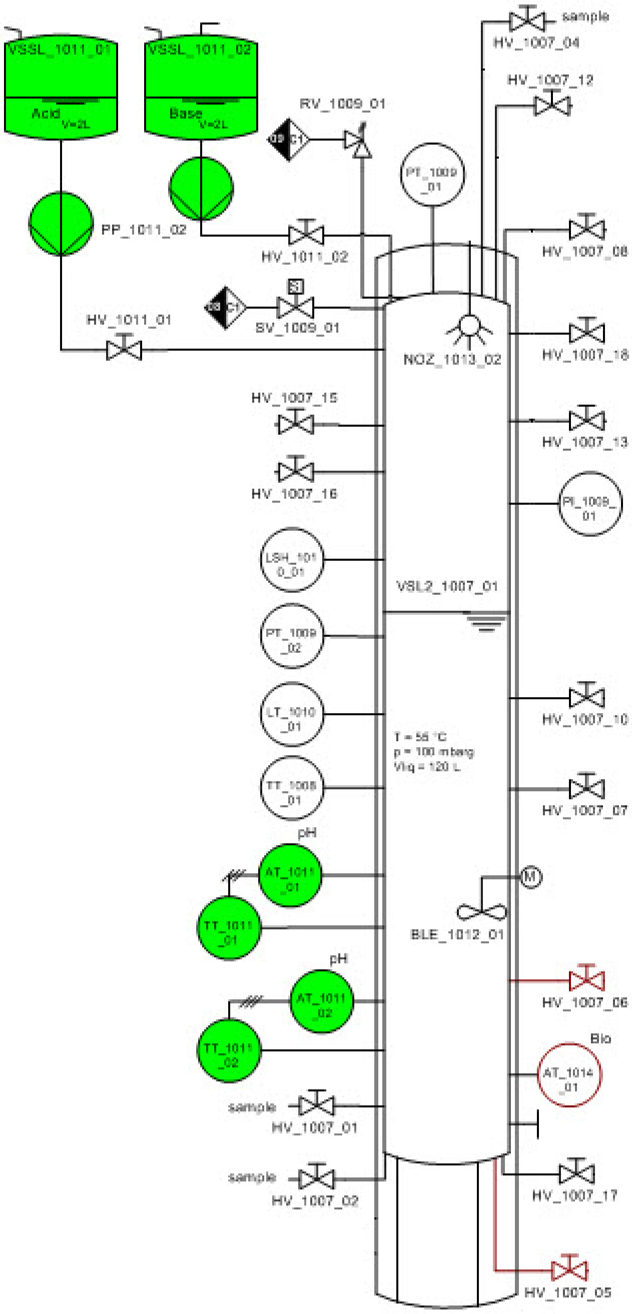
Alarm tag Name	type	Address	description
LSH_1010_01_A	BOOL	000465	Level Switch High alarm ACTION : DISPLAY ALARM ON HMI
CL1010_LEVEL_AH	BOOL	000466	High level alarm ACTION : DISPLAY ALARM ON HMI
CL1010_LEVEL_AHH	BOOL	000467	Very High level alarm ACTION : DISPLAY ALARM ON HMI Close S3V_1001_01_MV(For information, LSH_1010_01 triggers the same action. This redundancy is done to prevent pressure probe or LSH failure)
CL1010_LEVEL_AL	BOOL	000468	Low level alarm
CL1010_LEVEL_ALL	BOOL	000469	Very low level alarm ACTION : DISPLAY ALARM ON HMI Display an alarm Cut the pH loop, the blender loop and the temperature control loop
LT_1010_01_ERR	BOOL	000470	broken wire alarm

Figure 30: Bioreactor Level Control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
CL1010_LEVEL_LIM_AH	REAL	400968	5 compared to the setpoint Only in automatic mode and in feed volume mode	L	Display an alarm
CL1010_LEVEL_LIM_AHH	REAL	400970	120 Fixed value Wait for the confirmation of the LSH_1010_01 position. Once confirmed, put the same value	L	Close S3V_1001_01_MV (For information, LSH_1010_01 triggers the same action. This redundancy is done to prevent pressure probe or LSH failure)
CL1010_LEVEL_LIM_AL	REAL	400972	-5 compared to the setpoint Only in automatic mode and in feed volume mode	L	Display an alarm
CL1010_LEVEL_LIM_ALL	REAL	400974	30 Fixed value	L	Display an alarm Trigger the bioreactor pH , the bioreactor blender, the bioreactor temperature and the filtration control loop to OFF MODE

Figure 31: Bioreactor Level Control – THRESHOLDS

4.12. Bioreactor pH Control (CL1011)



4.12.1.Function

During the liquefaction of waste, the pH has to be controlled to provide the best condition to bacteria activities.
The operator can select the measurement to control (0: probe1 / 1: probe2 / 2: average of probe 1&2). In case of probe failure, a logic (explained in the block diagram section) is implemented to change or to correct the selected measurement.

Important points:

1- If the blender is not running, the tag “CL1011_Blender_Stopped_A” is set. In that case neither ACID nor BASE solution can be injected.
2- If the bioreactor level reaches the Very Low Level Alarm, the Ph Control Loop is triggered to OFF mode (For information: in that case, the Bioreactor temperature and Bioreactor blender Control Loop mode are also triggered to OFF mode)

Three modes are available.

OFF Mode: all equipments are in default position.

1. Auto mode: The controller adjusts the pH value depending on the set point and the dead zone entered by the operator. The injection time is recorded permitting an estimated volume of ACID or BASE used.

Manu mode: The operator can manually inject pH solution thanks to a timer function. This function gives the ability to define an injection time.

PLC Section name	Equipment tag	Type	Address	Comment
BioReactor pH Control	PP_1011_01_MV	DO	000001	Peristaltic pump acid pump for bioreactor ph control
BioReactor pH Control	PP_1011_02_MV	DO	000002	Peristaltic pump base pump for bioreactor ph control
BioReactor pH Control	CL1011_POWERSUPPLY_PUMP_ERR	DI	100031	Reset when fuse F45 is broken.
BioReactor pH Control	AT_1011_01_contactor_A	DI	100020	This Relay triggers an alarm (on its low level) if the probe AT_1011_02 goes into failure
BioReactor pH Control	AT_1011_01	AI	300001	pH sensor 1 Measures pH in bioreactor (VSL2_1007_01)
BioReactor pH Control	AT_1011_02_contactor_A	DI	100021	This Relay triggers an alarm (on its low level) if the probe AT_1011_02 goes into failure
BioReactor pH Control	AT_1011_02	AI	300003	pH sensor 2 Measures pH in bioreactor (VSL2_1007_01)

BioReactor pH Control	TT_1011_01	AI	300002	temperature probe of pH sensor1 Measures temp. of the Electrode
BioReactor pH Control	TT_1011_02	AI	300004	temperature probe of pH sensor2 Measures temp. of the Electrode

Figure 32: Bioreactor pH Control – EQUIPMENTS

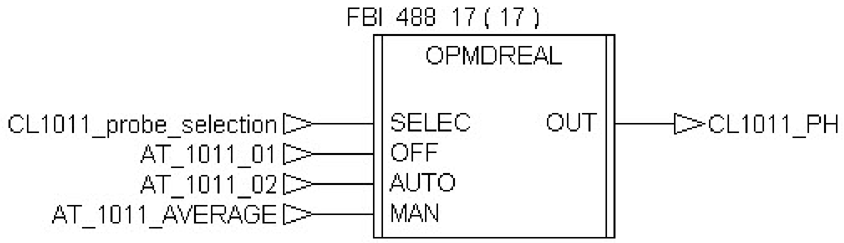
PLC Section name	Button tag	Type	Address	Comment
BioReactor pH Control	CL1011_ControlLoop_Mode	INT	400809	Bioreactor pH mode (0: Off / 1: Auto / 2: Manu)
BioReactor pH Control	CL1011_pH_SP	REAL	400185	pH set point entered by the operator (Initial value: 6)
BioReactor pH Control	CL1011_pH_DeadZone	REAL	400049	Absolute value which defines a Zone around the Set point where the control is not active
BioReactor pH Control	PP_1011_01_OP	BOOL	000471	start or stop the acid pump in manual mode
BioReactor pH Control	PP_1011_02_OP	BOOL	000472	start or stop the base pump in manual mode
BioReactor pH Control	CL1011_probe_selection	INT	400810	Permit to select the pH probe (0: probe 1 / 1: probe 2 / 2: average)
BioReactor Pressure Control	AT_1011_AVERAGE	REAL	400053	Bioreactor pH probe average.
BioReactor pH Control	CL1011_ACID_OP_Time	UDINT	400840	Time entered by the operator : define the ACID injection time in second
BioReactor pH Control	CL1011_BASE_OP_Time	UDINT	400842	Time entered by the operator : define the BASE injection time in second
BioReactor pH Control	CL1011_Base_injection_Time	REAL	400045	The timer is increasing in second with a step of 0.1 s
BioReactor pH Control	CL1011_Acid_injection_Time	REAL	400047	The timer is increasing in second with a step of 0.1 s
BioReactor pH Control	CL1011_pH_Second	BYTE	400860	Date of the last reset done by the operator
BioReactor pH Control	CL1011_pH_Minute	BYTE	400861	Date of the last reset done by the operator
BioReactor pH Control	CL1011_pH_Hour	BYTE	400862	Date of the last reset done by the operator
BioReactor pH Control	CL1011_pH_Day	BYTE	400863	Date of the last reset done by the operator
BioReactor pH Control	CL1011_pH_Month	BYTE	400864	Date of the last reset done by the operator
BioReactor pH Control	CL1011_pH_Year	BYTE	400865	Date of the last reset done by the operator
BioReactor pH Control	CL1011_pH_Reset_timer	BOOL	000494	Date of the last reset done by the operator

Figure 33: Bioreactor pH Control – USER INDICATOR / INPUT

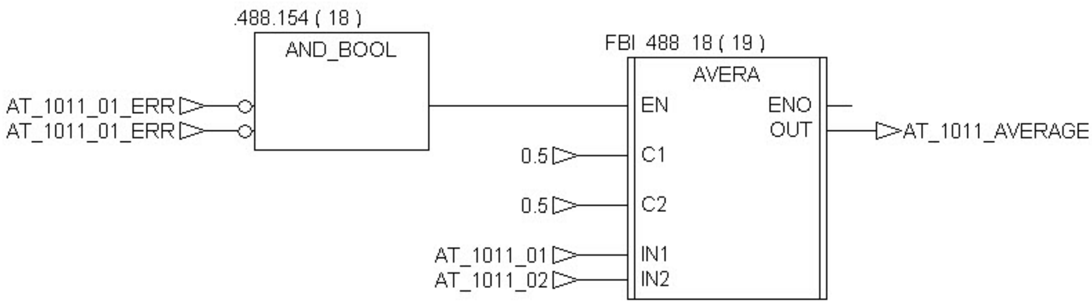
4.12.2.Block Diagram

4.12.2.1. *pH probe selection*

The operator can choose both probes separately or the average of the two probes. 0: probe1 / 1: probe2 / 2: average of probe 1&2. The variable named "CL1011_PH" is used for the pH controller.

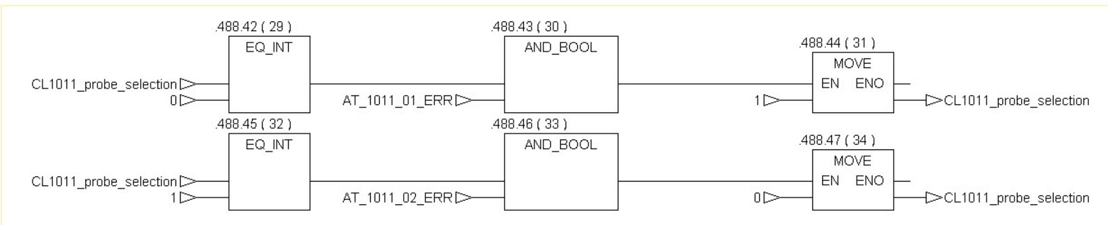


If the average is chosen, each probe corresponds to 50% of the average value.

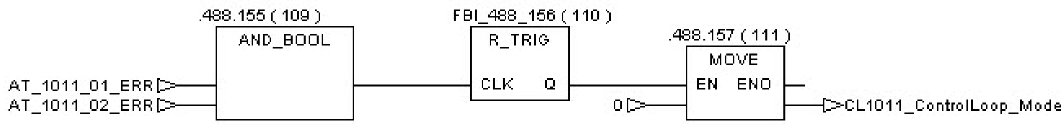


4.12.2.2. *pH probe error management*

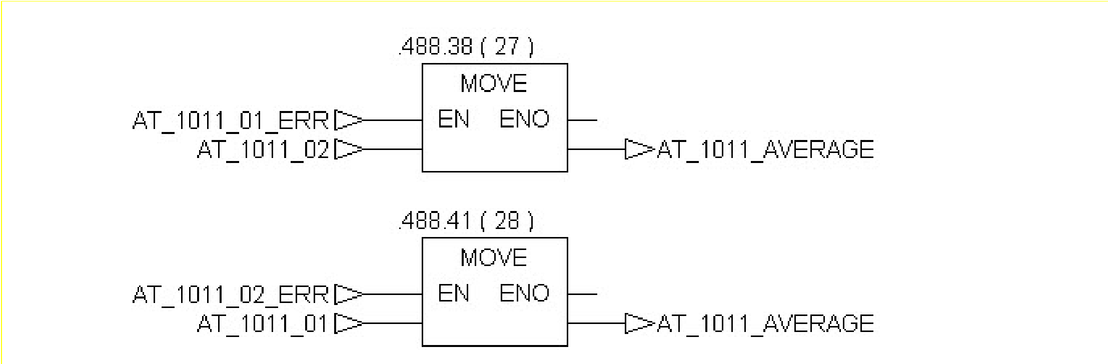
If the operator selected probe goes into failure, the PLC automatically takes the second probe as current measurement.



If both probes are in failure, the pH mode is triggered to OFF.

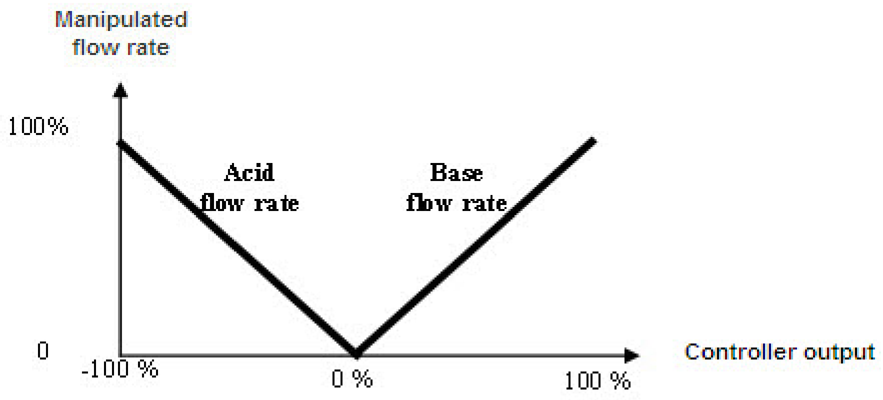


In case of average measurement, if one probe goes into failure, the controlled value becomes the other probe.



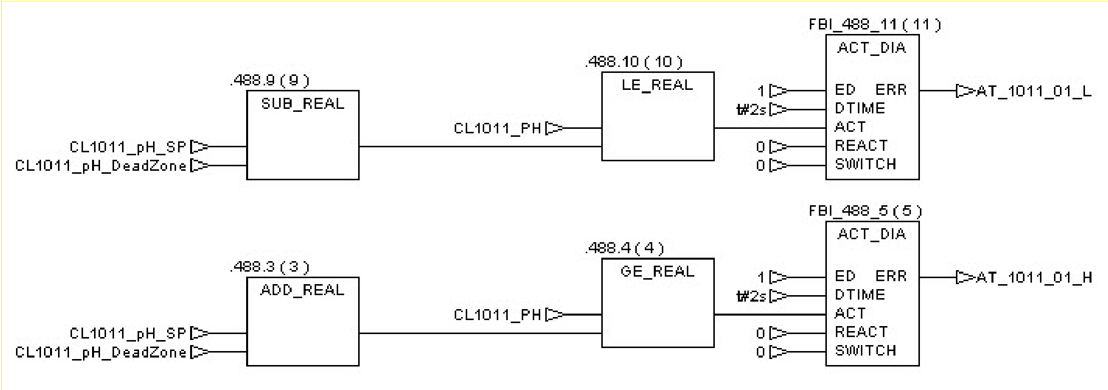
4.12.2.3. *Dead Zone implementation and process value calculation*

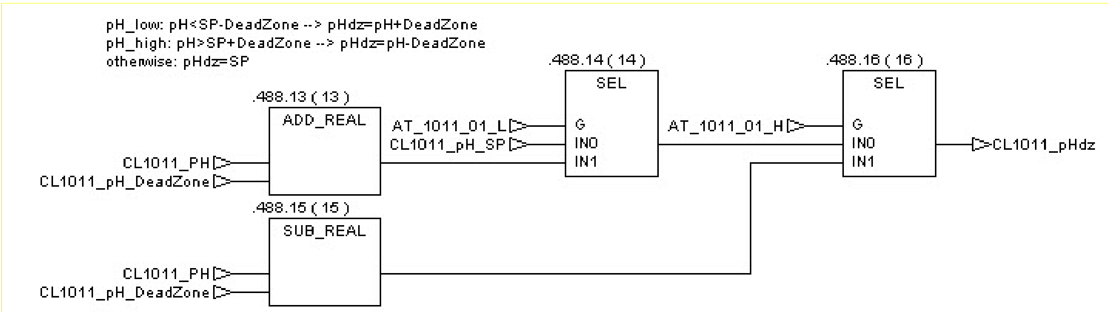
The split range logic is implemented for the pH control. The following scheme gives an explanation of the split range logic:



In order to control the pH, the PLC needs to have, at the input of the controller, the process value +/- the dead zone defined by the operator. Depending on the mode pH state (High or low) the dead zone is added (pH high) or subtracted (pH low) to the analyser value.
Once added, the calculated value becomes the process value measurement: “**pHdz**”.
So:
If pH <(SP–DeadZone) we have a pH_low, then pHdz becomes (pH+DeadZone)
If pH >(SP+DeadZone) we have a pH_high, then pHdz becomes (pH-DeadZone)

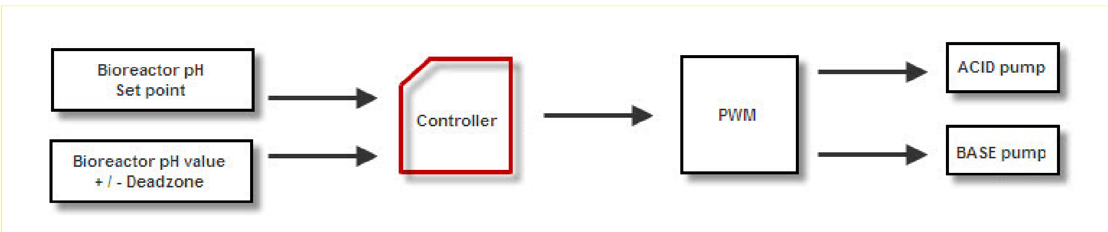
The limit has to be reached during 2 seconds before it is triggered in pH high or pH low mode.

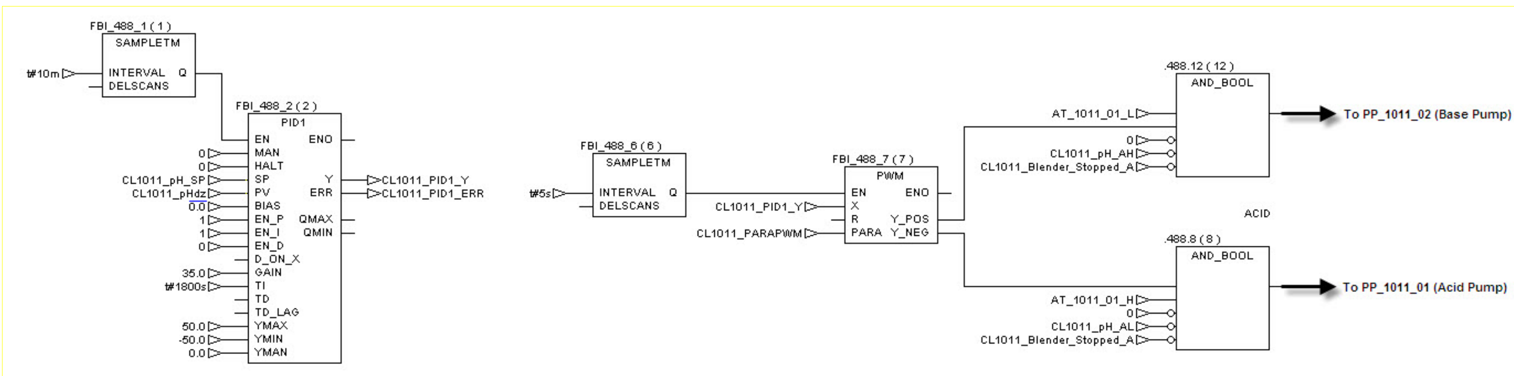




4.12.2.4. *Controllers*

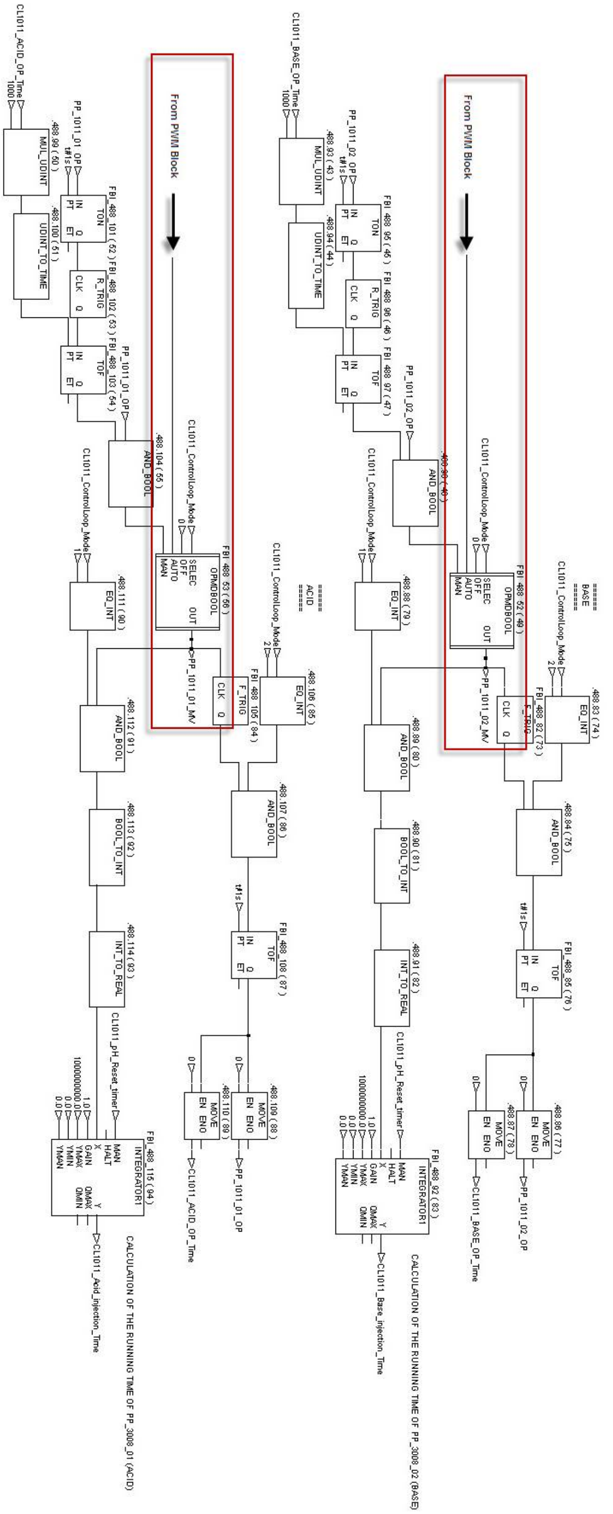
Depending of the dead zone configured by the operator and the pH measurement to be controlled, the controller will decide to inject ACID or BASE. As the pumps and the valves are managed in a Boolean logic, a PWM block is implemented to convert analogical signal coming from the controller into time. For more details on PWM block, see annex chapter.





4.12.2.4.1. Acid and Base pump management in automatic mode

In automatic mode, the operator configures a set point and a dead zone. The dead zone defines an area +/- around the set point where the controller will not do any injection. It prevents to inject permanently opposite solution to maintain the set point. The red rectangles of the following scheme show the implemented logic of the automatic branch.

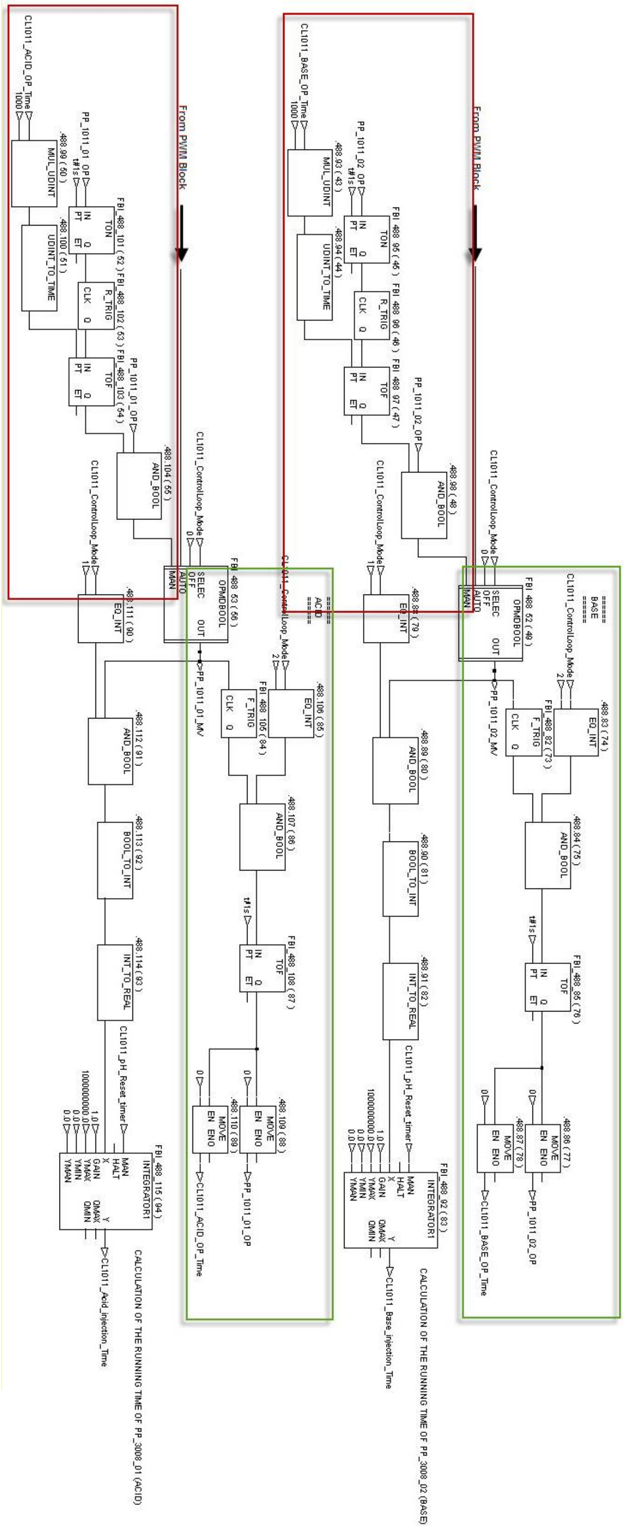

From PWM Block
From PWM Block
CALCULATION OF THE RUNNING TIME OF PP_3008_01 (ACID)
CALCULATION OF THE RUNNING TIME OF PP_3008_02 (BASE)

4.12.2.4.2. Acid and Base pump management in manual mode

In manual mode, the operator chooses to start the pump during a defined time. The red rectangles on the following scheme correspond to the implementation of this function. The green rectangle corresponds to the reset of the time and the selected equipment after execution of the task.
The operator inputs are reset if one of the following conditions appears:

- No time is configured.
- The control loop is set to OFF mode
- The desired opening time is over. (This condition doesn't appear on the block diagram).

2.


From PWM Block
From PWM Block
CALCULATION OF THE RUNNING TIME OF PP_3008_01 (ACID)
CALCULATION OF THE RUNNING TIME OF PP_3008_02 (BASE)

4.12.2.4.3. Acid and Base injection time records

In automatic mode, when the controller asks for ACID or BASE injection, the PLC records how long lasted the injection. A starting date is also recorded to calculate the amount of each injected solution. The Time is recorded by an integrator block..
The operator can reset this time and the starting date (see “reset opening time” section).

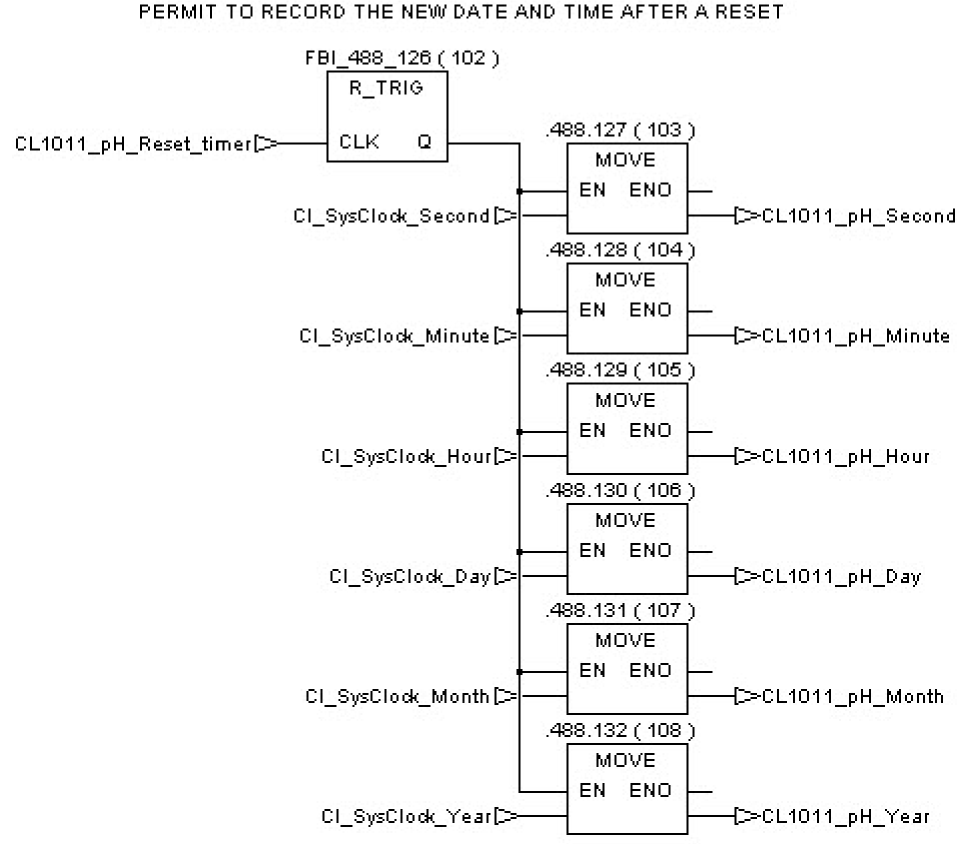
4.12.2.4.4. Acid and Base Controller Parameter

Controlled Variable	CONTROLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
Bioreactor pH	PI	Yes Configurable by the operator	No	CL1011_PARAPWM t_period : 10 m t_pause : 0 s t_brake : 0 s t_min : 2 s t_max : 5 m up_pos : 100 up_neg : 100	Controller : 10 m PWM : 5 s	CL1011_pHdz	CL1011_pH_SP

Controlled Variable	INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
Bioreactor pH	No internal model. The controller is not a predictive one	Gain: 35 TI: 1800 s	Y MAX : 50 Y MIN : - 50	NO	NO	CL1011_PID1_Y	PP_1011_01_MV (acid pump) PP_1011_02_MV (base pump)

4.12.2.5. *Reset timer function.*

The operator can reset the opening time and the starting date by the HMI. When the tag CL1011_pH_Reset_timer is set, the PLC internal time is recorded and the integrator block is reset.


PERMIT TO RECORD THE NEW DATE AND TIME AFTER A RESET
FBI_488_126 (102)
R_TRIG
CL1011_pH_Reset_timer
CLK
Q
.488.127 (103)
MOVE
EN ENO
CI_SysClock_Second
CL1011_pH_Second
.488.128 (104)
MOVE
EN ENO
CI_SysClock_Minute
CL1011_pH_Minute
.488.129 (105)
MOVE
EN ENO
CI_SysClock_Hour
CL1011_pH_Hour
.488.130 (106)
MOVE
EN ENO
CI_SysClock_Day
CL1011_pH_Day
.488.131 (107)
MOVE
EN ENO
CI_SysClock_Month
CL1011_pH_Month
.488.132 (108)
MOVE
EN ENO
CI_SysClock_Year
CL1011_pH_Year

4.12.3.Alarms and Thresholds

Alarm tag Name	type	Address	description
CL1011_PH_PUMP_A	BOOL	000473	pH pump power supply alarm. Triggered when "CL1011_POWERSUPPLY_PUMP_ERR"=0 ACTION : DISPLAY ALARM ON HMI
AT_1011_01_A	BOOL	000474	pH sensor 1 transmitter alarm. Triggered when the entry 100020 is reset ACTION : DISPLAY ALARM ON HMI
AT_1011_01_ERR	BOOL	000475	broken wire alarm
AT_1011_02_A	BOOL	000476	pH sensor 2 transmitter alarm. Triggered when the entry 100021 is reset ACTION : DISPLAY ALARM ON HMI
AT_1011_02_ERR	BOOL	000477	broken wire alarm ACTION : DISPLAY ALARM ON HMI
CL1011_pH_AH	BOOL	000478	High pH in bioreactor ACTION : DISPLAY ALARM ON HMI
CL1011_pH_AHH	BOOL	000479	Very High pH in bioreactor ACTION : DISPLAY ALARM ON HMI Cut the pH Control loop
CL1011_pH_AL	BOOL	000480	Low pH in bioreactor ACTION : DISPLAY ALARM ON HMI
CL1011_pH_ALL	BOOL	000481	Very Low pH in bioreactor ACTION : DISPLAY ALARM ON HMI Cut the pH Control loop
TT_1011_01_AH	BOOL	000482	High temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1011_01_AHH	BOOL	000483	Very High temperature alarm ACTION : DISPLAY ALARM ON HMI Display an alarm Cut the Bioreactor temperature control loop only if the bioreactor temperature probe is in ERROR
TT_1011_01_AL	BOOL	000484	Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1011_01_ALL	BOOL	000485	Very Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1011_01_ERR	BOOL	000486	broken wire alarm ACTION : DISPLAY ALARM ON HMI
TT_1011_02_AH	BOOL	000487	High temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1011_02_AHH	BOOL	000488	Very High temperature alarm ACTION : DISPLAY ALARM ON HMI Display an alarm Cut the Bioreactor temperature control loop only if the bioreactor temperature probe is in ERROR
TT_1011_02_AL	BOOL	000489	Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1011_02_ALL	BOOL	000490	Very Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1011_02_ERR	BOOL	000491	broken wire alarm ACTION : DISPLAY ALARM ON HMI
AT_1011_SENSOR_DEVIATION_A	BOOL	000492	Triggered when the pH gap between the two probe is more than 5% ACTION : DISPLAY ALARM ON HMI
CL1011_Blender_Stopped_A	BOOL	000493	Lock the ACID AND BASE solution injection (happen when the bioreactor blender is stopped). ACTION : DISPLAY ALARM ON HMI

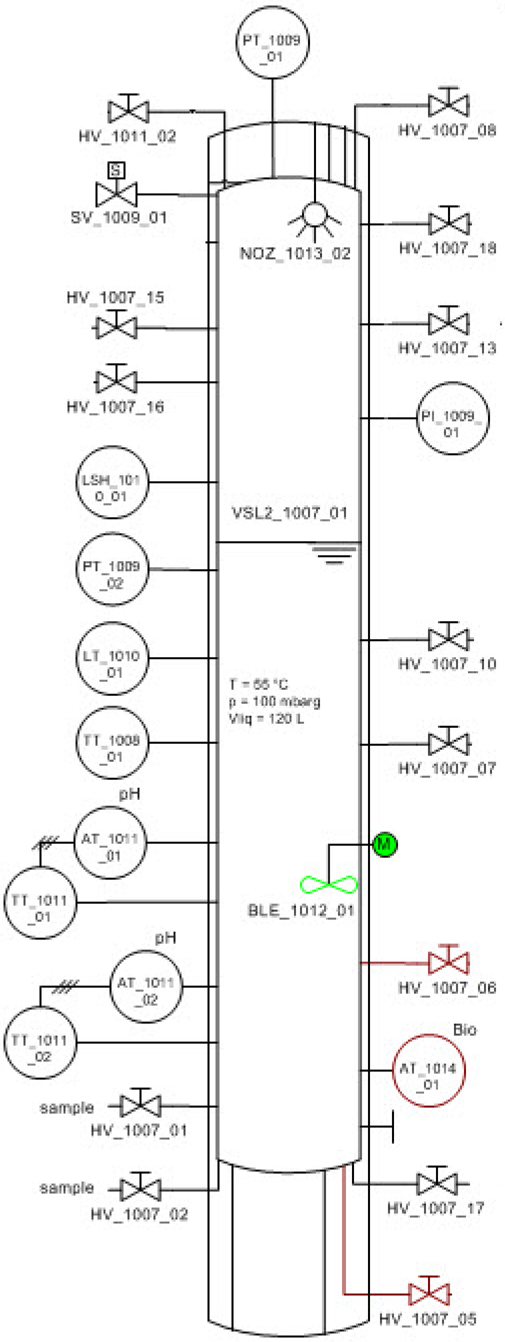
Figure 34: Bioreactor pH Control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
CL1011_PH_LIM_AH	REAL	400976	+0.2	-	Display an alarm

			compared to the setpoint Only in automatic mode		
CL1011_PH_LIM_AHH	REAL	400978	5.8 fixed value Only in Automatic mode	-	Display an alarm Cut the pH Control loop
CL1011_PH_LIM_AL	REAL	400980	-0.2 compared to the setpoint Only in automatic mode	-	Display an alarm
CL1011_PH_LIM_ALL	REAL	400982	5.0 fixed value Only in Automatic mode	-	Display an alarm Cut the pH Control loop
CL1011_PH_SENSOR_DEVIATION_LIM	REAL	401208	0.5	-	Display an alarm
TT_1011_01_LIM_AH	REAL	400984	+1 compared to the set point Only in automatic mode	°C	Display an alarm
TT_1011_01_LIM_AHH	REAL	400986	60 fixed value	°C	Display an alarm Cut the Bioreactor temperature control loop only if the bioreactor temperature probe is in ERROR
TT_1011_01_LIM_AL	REAL	400988	-1 compared to the set point Only in automatic mode	°C	Display an alarm
TT_1011_01_LIM_ALL	REAL	400990	-4 compared to the set point Only in automatic mode	°C	Display an alarm
TT_1011_02_LIM_AH	REAL	400992	+1 compared to the set point Only in automatic mode	°C	Display an alarm
TT_1011_02_LIM_AHH	REAL	400994	60 fixed value	°C	Display an alarm Cut the Bioreactor temperature control loop only if the bioreactor temperature probe is in ERROR
TT_1011_02_LIM_AL	REAL	400996	-1 compared to the setpoint Only in automatic mode	°C	Display an alarm
TT_1011_02_LIM_ALL	REAL	400998	-4 compared to the setpoint Only in automatic mode	°C	Display an alarm

Figure 35: Bioreactor pH Control – THRESHOLDS

4.13. Bioreactor Blender (CL1012)



4.13.1.Function

The Bioreactor blender is used to homogenize waste solution which will circulate through the retentate line during filtration nominal mode.

Important: The control loop which manages the blender is triggered to OFF if the very low level alarm is triggered.

Three modes are available:

OFF Mode: The blender is stopped.
Auto mode: The blender is running.
Manu mode: The operator can manually start or stop the blender.

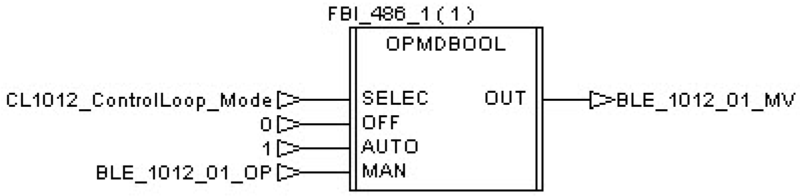
PLC Section name	Equipment tag	Type	Address	Comment
Bioreactor Blender	BLE_1012_01_MV	DO	000004	Blender Homogenize bioreactor content (VSL2_1007_01)
Bioreactor Blender	BLE_1012_01_U2_ERR	DI	100018	Blender Frequencydrive (fuse F32) error / Alarm Frequency regulator U2
Bioreactor Blender	BLE_1012_01_FUSE_F33_F35_ERR	DI	100019	Blender Powersupply (FUSE F35) error / Control Circuit-breaker F33

Figure 36: Bioreactor Blender – EQUIPMENTS

PLC Section name	Button tag	Type	Address	Comment
Bioreactor Blender	CL1012_ControlLoop_Mode	INT	400811	Bioreactor Blender mode (0: Off / 1: Auto / 2: Manu)
Bioreactor Blender	BLE_1012_01_OP	BOOL	000200	Start / stop the blender in manual mode.

Figure 37: Bioreactor Blender – USER INDICATOR / INPUT

4.13.2.Block Diagram



4.13.3.Alarms and Thresholds

Alarm tag Name	type	Address	description
BLE_1012_01_Freqdrive_A	BOOL	000495	Blender Frequencydrive alarm. Triggered when "BLE_1012_01_U2_ERR"=1 ACTION : DISPLAY ALARM ON HMI
BLE_1012_01_Powersupply_A	BOOL	000496	Blender Powersupply alarm. Triggered when "BLE_1012_01_FUSE_F33_F35_ERR" = 0 ACTION : DISPLAY ALARM ON HMI

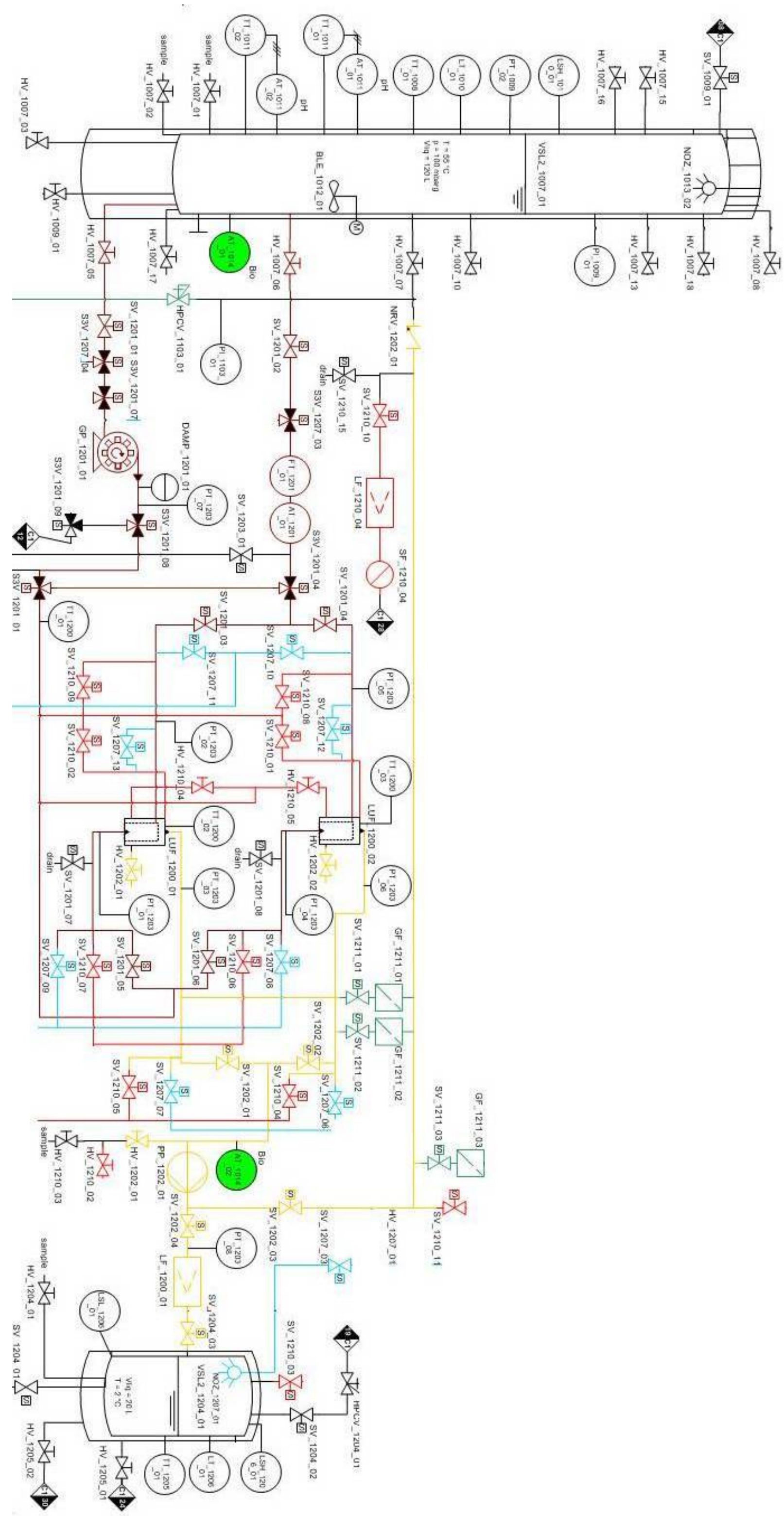
Figure 38: Bioreactor Blender – ALARMS

NO THRESHOLDS

4.14. Bioreactor CIP (CL1013)

No controlled equipment is referenced in this loop. Only Influent vessel nozzle "NOZ_1013_02" are named with this loop number.

4.15. Biomass Control (CL1014)



4.15.1.Function

No dynamic control is implemented on the loop. Only the monitoring of the biomass is recorded. This will be useful for the future characterisation test of the compartment.

PLC Section name	Equipment tag	Type	Address	Comment
Biomass Control Loop	AT_1014_01		TBD	VIAMASS Sensor bioreactor measure biomass content in bioreactor
Biomass Control Loop	AT_1014_02		TBD	VIAMASS Sensor filtrate measure biomass content in filtrate line

Figure 39: Biomass Control – EQUIPMENTS

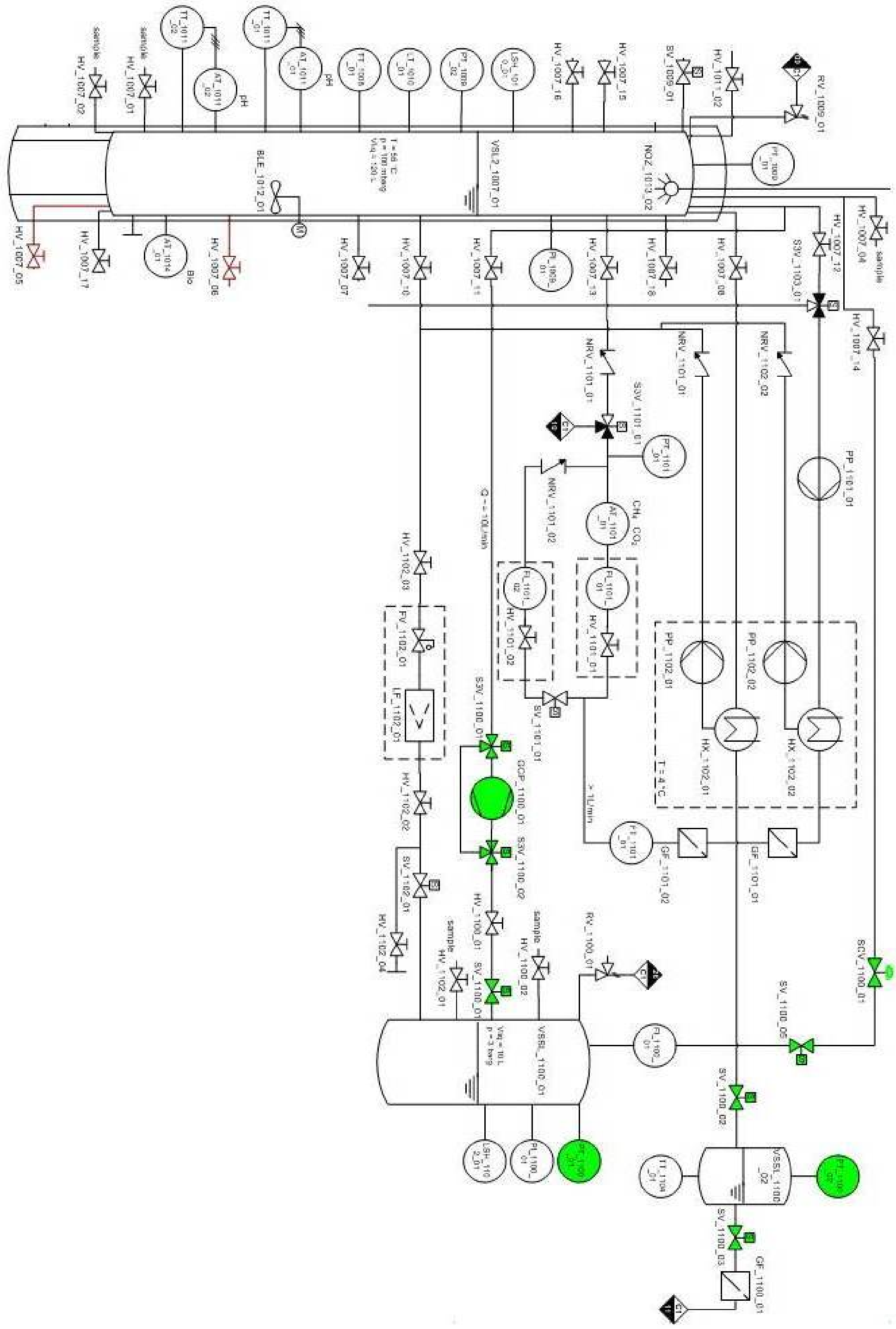
4.15.2.Block Diagram

As the biomass sensor is used only for measurement, no logic is implemented.

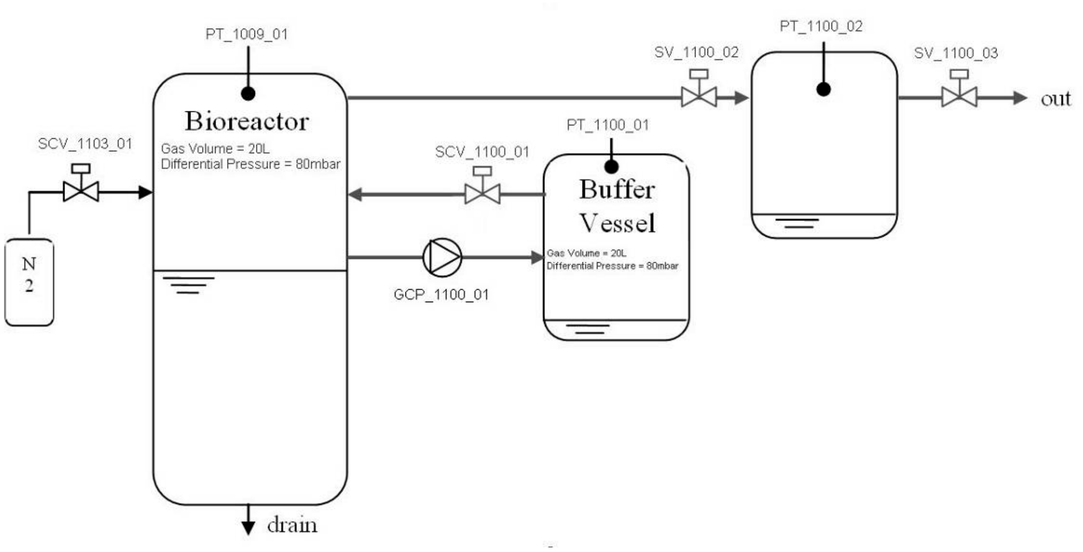
4.15.3.Alarms and Thresholds

NO ALARMS
NO THRESHOLDS

4.16. Gas Loop Pressure Control (CL1100)



4.16.1.Function



The gas loop pressure control represents the Active Gas loop. A procedure named “G_Active_Loop” which manages the active gas loop is detailed in the chapter “User Manual Procedures”.

Passive control:

-flush of nitrogen N_2 into the reactor if the pressure is too low (70 mbar).
-Release of gas outside the reactor if the pressure is too high (90 mbar).

Active control:

-an internal gas recirculation loop is used between the reactor and a pressurized gas buffer vessel (3 bars). When the bioreactor begins to produce biogas, the N2 injection stopped naturally, then when the pressure is upper than 80 mbar and lower than 90 mbar the buffer vessel is filled. This vessel is then use to stabilize pressure of the bioreactor. If the buffer vessel reaches 3 bar, the biogas is re-injected inside the bioreactor until 2,9 bar. In that case, the bioreactor pressure also increases, thus the “G_PAS_Esc” procedure (Figure 111) is activated by the PLC. Then the gas is ejected to the atmosphere (in CIVA/CIVB compartment in the future). During this release, the gas production is calculated (see chapter “Gas loop Outlet”).
The proportional valve SCV_1100_01 is controlled by a PI controller.

IMPORTANT POINT:
When this control loop is activated in automatic mode, the Gas loop N2 is also triggered in automatic mode.
Following some request, the valves SV_1100_02 and SV_1100_03 which permit to release and to calculate the biogas produced by the bioreactor are now linked to the “Gas Loop N2” (passive gas loop). This has been done to release gas with calculation when only the passive gas loop is in automatic mode.

Three modes are available:

OFF Mode: All equipment are in default position, the pump GCP_1100_01 is stopped and the proportional valve SCV_1100_01 is in 0 % opening state.

Auto mode: Depending on the current bioreactor pressure and the bacteria activities, the pressure is regulated by active or passive gas loop. As explain above, when this mode is set the active gas loop is started in parallel with the passive gas loop (the Gas Loop N2 (CL1103) is triggered in automatic mode).

Manu mode: The operator can manipulate equipments linked to this loop.

PLC Section name	Equipment tag	Type	Address	Comment
Gas Loop Pressure Control	PT_1100_01	AI	400035	Measures pressure in buffer vessel VSSL_1100_01
Gas Loop Pressure Control	PT_1100_02	AI	400249	Measures pressure of gas produced by bioreactor (VSL2_1007_01) and accumulated in VSSL_1100_02 for flow measurement
Gas Loop Pressure Control	GCP_1100_01	DO	000022	Pumps gas from the bioreactor through the buffer vessel VSSL_1100_01 (active gas loop)
Gas Loop Pressure Control	SCV_1100_01_MV	AO	400171	Used to adapt the gas flow coming from buffer vessel VSSL_1100_01 and going to bioreactor VSL2_1007_01 in order to keep the pressure constant in the bioreactor
Gas Loop Pressure Control	S3V_1100_01_MV	DO	000046	Used to by-pass the gas compressor GCP_1100_01
Gas Loop Pressure Control	S3V_1100_01_FB	DI	100071	valve feedback
Gas Loop Pressure Control	S3V_1100_02_MV	DO	000047	Used to by-pass the gas compressor GCP_1100_01
Gas Loop Pressure Control	S3V_1100_02_FB	DI	100070	valve feedback
Gas Loop Pressure Control	SV_1100_01_MV	DO	000048	Opens/closes inlet of biogas in buffer vessel VSSL_1100_01
Gas Loop Pressure Control	SV_1100_01_FB	DI	100069	valve feedback
Gas Loop Pressure Control	SV_1100_02_MV	DO	000087	Opens/ closes inlet of gas in VSSL_1100_02(used for calculation of produced biogas)
Gas Loop Pressure Control	SV_1100_02_FB	DI	100107	valve feedback

PLC Section name	Equipment tag	Type	Address	Comment
Gas Loop Pressure Control	SV_1100_03_MV	DO	000033	Opens/ closes outlet of gas in VSSL_1100_02(used for calculation of produced biogas)
Gas Loop Pressure Control	SV_1100_03_FB	DI	100068	valve feedback
Gas Loop Pressure Control	SV_1100_05_MV	DO	000039	Opens/ closes gas flow from buffer vessel VSSL_1100_01 to bioreactor VSL2_1007_01
Gas Loop Pressure Control	SV_1100_05_FB	DI	100062	valve feedback

Figure 40: Gas Loop Pressure Control – EQUIPMENTS

PLC Section name	Button tag	Type	Address	Comment
Gas Loop Pressure Control	CL1100_ControlLoop_Mode	INT	400812	Gas loop pressure mode (0: Off / 1: Auto / 2: Manu)
Gas Loop Pressure Control	CL1100_G_Active_Loop_Error	UDINT	400335	Error number in procedure "G_Active_Loop"
Gas Loop Pressure Control	GCP_1100_01_OP	BOOL	000507	Start or stop the pump in manual mode.(active gas loop).
Gas Loop Pressure Control	SCV_1100_01_OP	REAL	400055	Used to control the opening of the valve in manual mode. No opening position feedback.
Gas Loop Pressure Control	S3V_1100_01_OP	BOOL	000509	Operator can change the position of the 3 way valve (by pass of the gas compressor pump) in manual mode. This valve needs to be use with caution in nominal condition. The valve SV_1100_02 should also be in the bypass position
Gas Loop Pressure Control	S3V_1100_02_OP	BOOL	000511	Operator can change the position of the 3 way valve (by pass of the gas compressor pump) in manual mode. This valve needs to be used with caution in nominal condition. The valve SV_1100_01 should also be in the bypass position
Gas Loop Pressure Control	SV_1100_01_OP	BOOL	000191	Opens / closes the valve in manual mode
Gas Loop Pressure Control	SV_1100_02_OP	BOOL	000514	Opens / closes the valve in manual mode
Gas Loop Pressure Control	SV_1100_03_OP	BOOL	000516	Opens / closes the valve in manual mode
Gas Loop Pressure Control	SV_1100_05_OP	BOOL	000518	Opens / closes the valve in manual mode

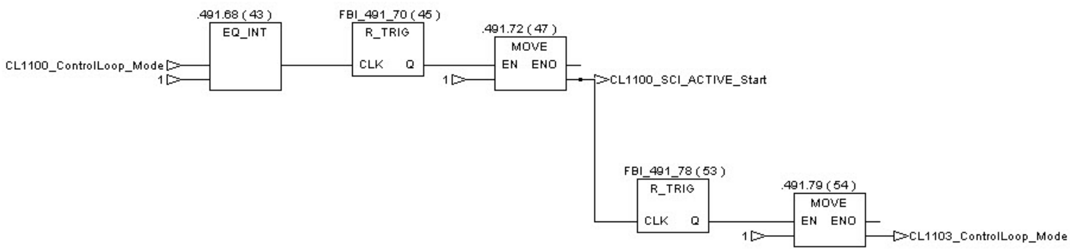
Figure 41: Gas Loop Pressure Control – USER INDICATOR / INPUT

4.16.2.Block Diagram

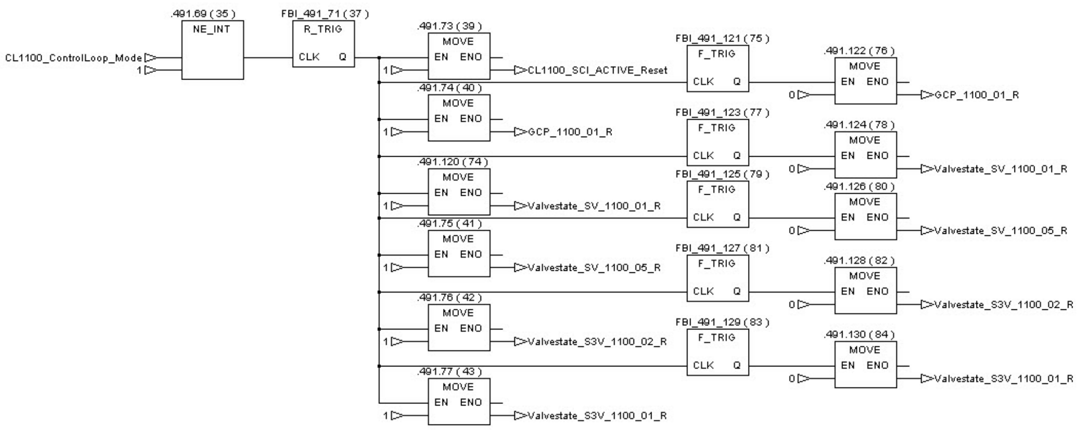
4.16.2.1. *Control Loop mode management*

When the Control Loop mode is configured to automatic mode, the procedure “G_Active_Loop” is started. The objective of this procedure is to maintain the internal pressure of the bioreactor and to conserve the excess of biogas inside the buffer vessel. The buffer vessel VSSL_1100_01 is filled until the pressure reaches 3 bars (see procedure “G_Active_Loop” in the procedure chapter). When this pressure is reached, the excess of Biogas is re-injected to the bioreactor then released by the procedure “G_PAS_Esc”. This procedure calculates the volume and the type of gas escaped from the bioreactor.

If the “Gas Loop N2” (passive gas loop) is not in automatic mode when the operator triggers the Gas loop Pressure, the gas loop N2 is automatically triggered in automatic mode. This is done to permit to the valve SV_1100_02 and SV_1100_03 to release gas by the “G_PAS_Esc” procedure (As explained above, these two valves are now linked to the passive gas loop: CL1103).



When the Control Loop mode is configured to OFF or Manual mode, the procedure “G_Active_Loop” and all equipments linked are stopped.

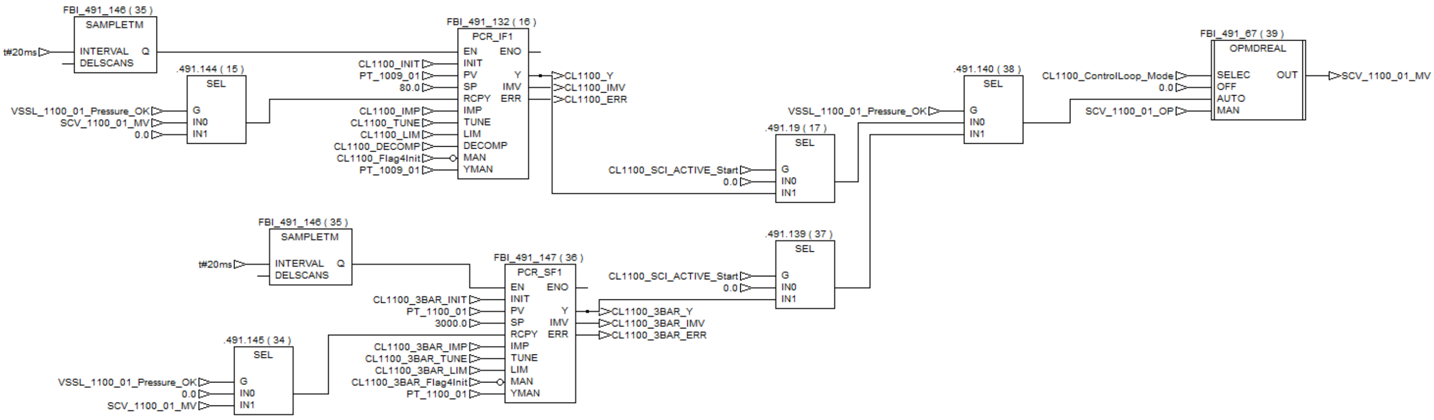


4.16.2.2. *Controller*

The controller used is a PI controller (Proportional /Integral) to manage the proportional valve SCV_1100_01. The way of working of the controller has been designed by the EPAS Company. Depending on the pressure inside gas buffer VSSL_1100_01 and the bioreactor, the process value, the set point and the controller parameters change thanks to selector block.
Here is the logic implemented:

If the bioreactor pressure is less than 73 mbar or if the gas buffer vessel pressure is less than 2,5 bars, the controller receives 80 mbar as set point and takes the bioreactor pressure probe PT_1009_01 as Process value. It keeps these parameters until the pressure inside the gas buffer vessel reaches 3 bars.

When the buffer vessel pressure is greater than 3 bars, the controller receives 3 bars as set point and takes the gas buffer vessel pressure probe PT_1100_01 as process value. When this pressure increases, the controller releases the gas thanks to the proportional valve SCV_1100_01 to the bioreactor.



4.16.2.3. *Controller parameters*

<u>Bioreactor Pressure < 73 mbar OR gas buffer vessel < 2.5 bars</u>

Controlled Variable	**CONTROLLER TYPE**	**DEAD ZONE**	**ZTR Zone Control**	**PWM**	**SAMPLETM**	**PROCESS VALUE (input)**	**SET POINT**
Bioreactor pressure or gas buffer vessel	PCR_IF1	NO	NO	NO	Controller : 20 ms	PT_1009_01	80 mbars

Controlled Variable	**INTERNAL MODEL PROCESS**	**TUNE**	**LIMIT**	**SELF_CMP**	**DECOMP**	**Manipulated Variable (Controller Output in Auto Mode)**	**Controlled Equipment**
Bioreactor pressure or gas buffer vessel	KM : 0.6 TM : 150 ms DM : 0 s	TS : 20 ms H : 2.2s TRBF : 3.2 s	Y MAX : 20 Y MIN : 0 YRATE 10	NO	4,8 s	SCV_1100_01_MV	SCV_1100_01

Gas buffer vessel > 3 bars

Controlled Variable	CONTROLLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
Gas buffer vessel (VSSL_1100_01) pressure	SF1	NO	NO	NO	Controller : 20 ms	PT_1100_01	3 bars

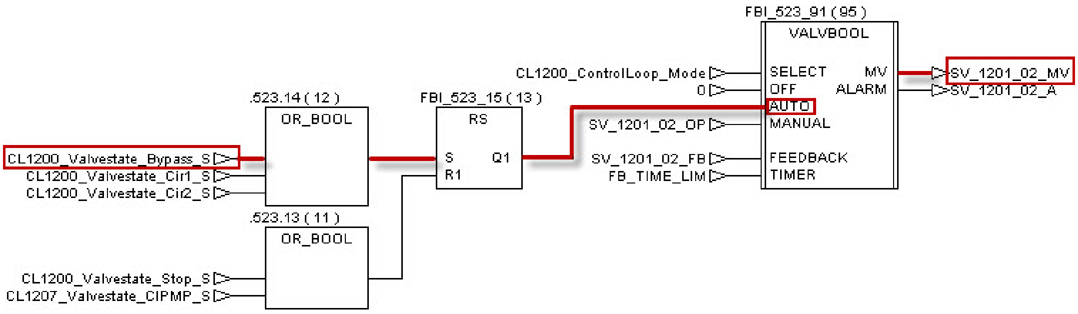
Controlled Variable	INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
Gas buffer vessel (VSSL_1100_01) pressure	KM : -1226 TM : 21 s DM : 2 s	TS : 20 ms H : 2.2s TRBF : 32 s	Y MAX : 1.5 Y MIN : 0 YRATE : 1	NO	NO	SCV_1100_01_MV	SCV_1100_01

4.16.2.4. *Valve management*

Important point:
The "Valvbool" block has been created to manage the Boolean valve. This block allows the mode management thanks to internal selector block (OFF/ AUTO / MANU) and the valve alarm linked to the feedback. The complete description is detailed in the annex chapter.
In automatic mode, depending on the procedure activated, the valves are set or reset to provide desired functions. The way to change the valves status is a pulse sent by the procedure to a defined tag. To be easily recognizable, all these kind of tags are named with the same logic.
Here is this named logic:

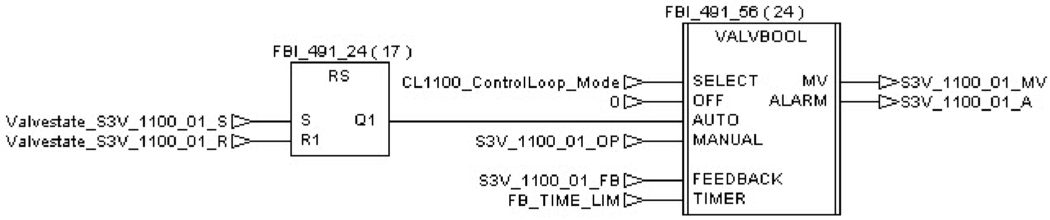
1- The control loop number
2- "_valvestate_"
3- The name of the procedure which triggers the valve
4- "_S" or "_R

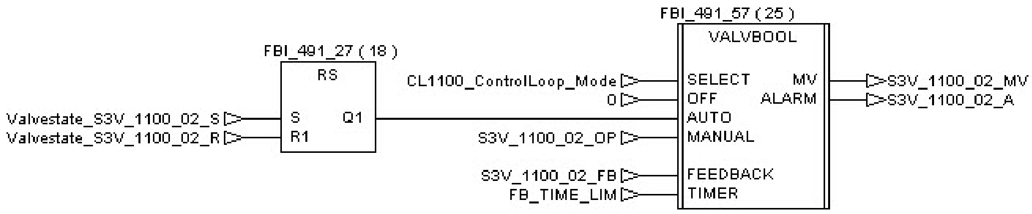
Example:
During the procedure F_Bypass, "CL1200_Valvestate_Bypass_S" triggers the valve SV_1201_02 in bypass position. This tag will be find on each valves linked the bypass mode of the Filtration Unit.

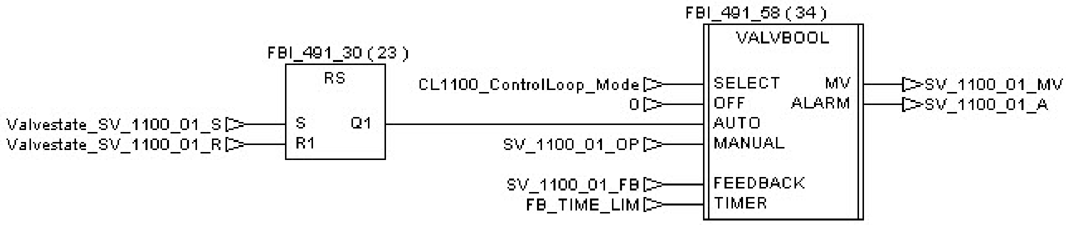


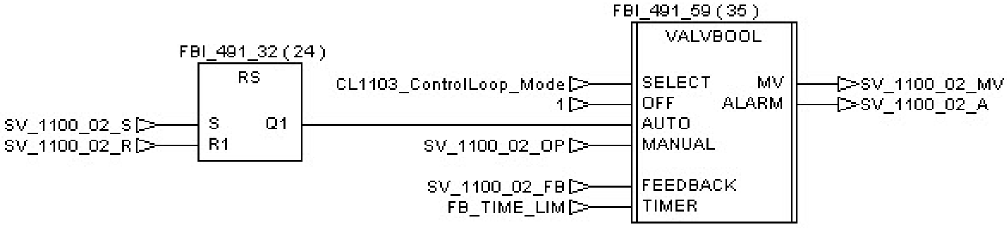
Depending on the procedure step needs, the "_S", situated at the end of the tag name, will set the valves in good position (either open or close), as well for the "_R" which will reset the valves in the default position.
Most of the procedure follows this logic.
However, sometimes, when only one valve needs to be triggered inside the procedure, the pulse is named as "*name of the valve*_S" for the opening and "*name of the valve*_R" for the closing.

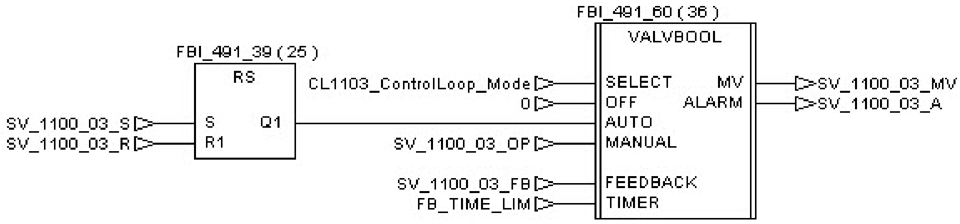
The valves S3V_1100_01 / S3V_1100_02, SV_1100_01 and SV_1100_05 are managed by the procedure "G_Active_Loop"
The valve SV_1100_02 and SV_1100_03 are managed by the procedure "G_PAS_Esc".

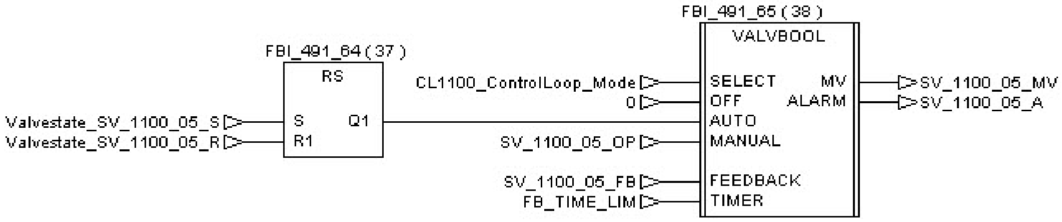






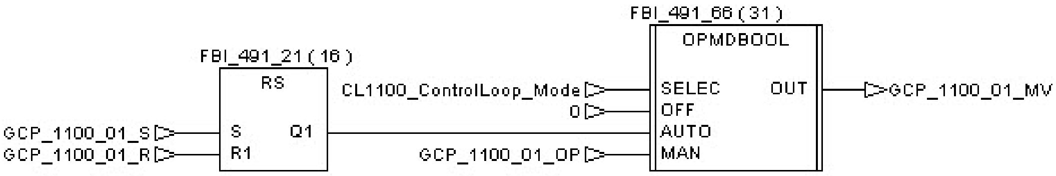






4.16.2.5. *Pump management (GCP_1100_01)*

The start of the pump GCP_1100_01 is provided by the control loop mode button when triggered in AUTOMATIC mode (this modeis activated the procedure “G_ACTIVE_Loop” which sends a pulse on the variable “GCP_1100_01_S”).
The stop of the pump is also provided by the control loop mode button when triggered in OFF or MANUAL mode (pulse on the variable “GCP_1100_01_R”).



4.16.3. Alarms and Thresholds

Alarm tag Name	type	Address	description
PT_1100_01_AH	BOOL	000497	High pressure alarm ACTION : DISPLAY ALARM ON HMI
PT_1100_01_AHH	BOOL	000498	Very High pressure alarm ACTION : DISPLAY ALARM ON HMI Trigger the active gas loop in OFF mode
PT_1100_01_AL	BOOL	000499	Low pressure alarm ACTION : DISPLAY ALARM ON HMI

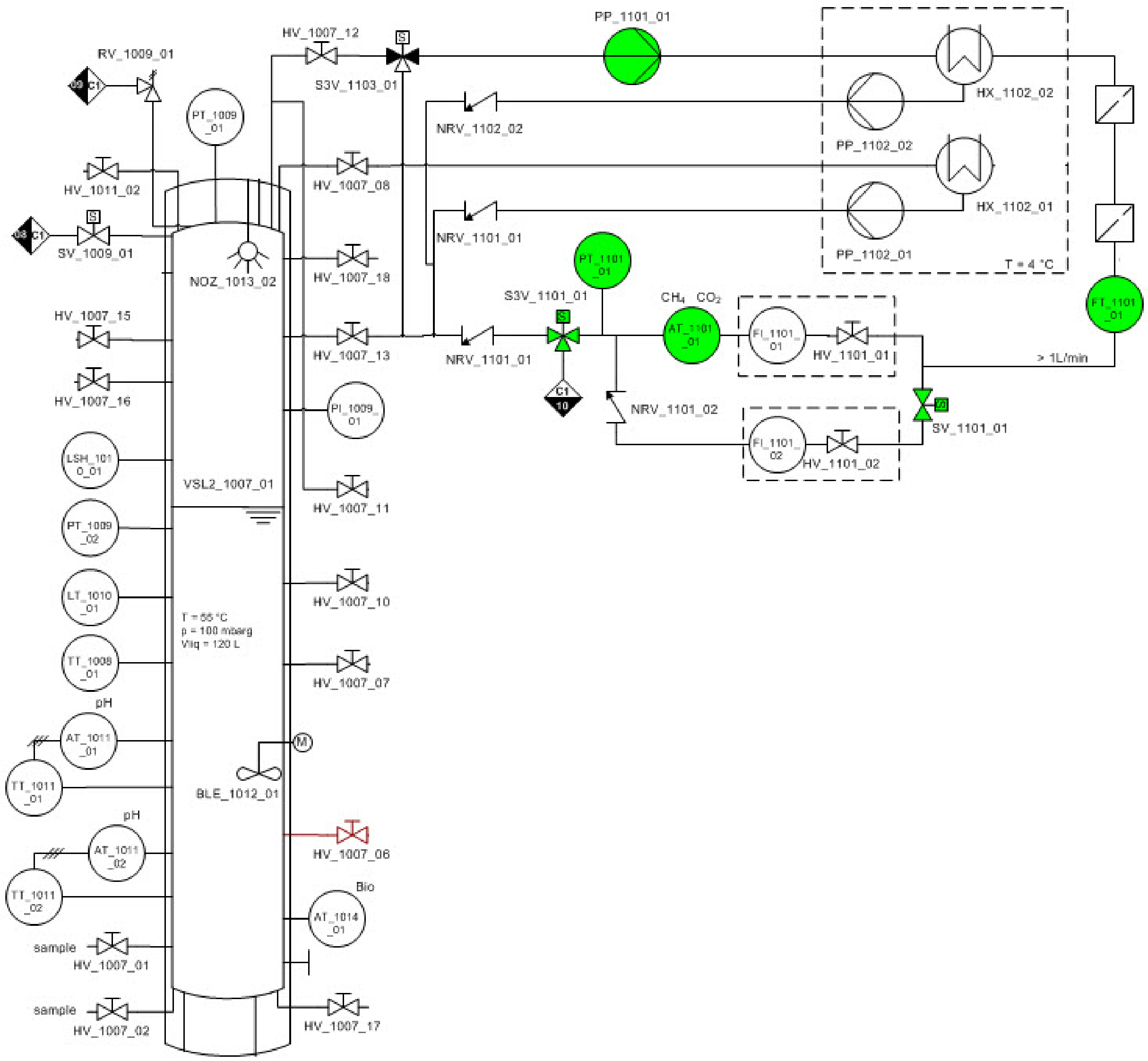
PT_1100_01_ALL	BOOL	000500	Very Low pressure alarm ACTION : DISPLAY ALARM ON HMI Close the condensate valve SV_1102_01 (EPAS Implementation)
PT_1100_01_ERR	BOOL	000501	broken wire alarm ACTION : DISPLAY ALARM ON HMI
PT_1100_02_AH	BOOL	000502	High pressure alarm ACTION : DISPLAY ALARM ON HMI
PT_1100_02_AHH	BOOL	000503	Very High pressure alarm ACTION : DISPLAY ALARM ON HMI
PT_1100_02_AL	BOOL	000504	Low pressure alarm ACTION : DISPLAY ALARM ON HMI
PT_1100_02_ALL	BOOL	000505	Very Low pressure alarm ACTION : DISPLAY ALARM ON HMI
PT_1100_02_ERR	BOOL	000506	broken wire alarm ACTION : DISPLAY ALARM ON HMI
SCV_1100_01_ERR	BOOL	000508	broken wire alarm ACTION : DISPLAY ALARM ON HMI
S3V_1100_01_A	BOOL	000510	valve alarm ACTION : DISPLAY ALARM ON HMI
S3V_1100_02_A	BOOL	000512	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1100_01_A	BOOL	000513	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1100_02_A	BOOL	000515	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1100_03_A	BOOL	000517	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1100_05_A	BOOL	000519	valve alarm ACTION : DISPLAY ALARM ON HMI

Figure 42: Gas Loop Pressure Control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
PT_1100_01_LIM_AH	REAL	401000	3100 fixed value	mBar	Display an alarm
PT_1100_01_LIM_AHH	REAL	401002	3200 fixed value	mBar	Display an alarm Trigger the active gas loop to OFF mode
PT_1100_01_LIM_AL	REAL	401004	2900 fixed value Only in automatic mode	mBar	Display an alarm
PT_1100_01_LIM_ALL	REAL	401006	2800 fixed value Only in automatic mode	mBar	Display an alarm Close the condensate valve SV_1102_01 (EPAS Implementation)
PT_1100_02_LIM_AH	REAL	401008	150	mBar	Display an alarm
PT_1100_02_LIM_AHH	REAL	401010	190	mBar	Display an alarm
PT_1100_02_LIM_AL	REAL	401012	-30	mBar	Display an alarm
PT_1100_02_LIM_ALL	REAL	401014	-50	mBar	Display an alarm

Figure 43: Gas Loop Pressure Control – THRESHOLDS

4.17. Gas Loop Analyser Control (CL1101)



4.17.1.Function

The aim of this loop is to provide a gas measurement coming from the bacteria activities. At the current time only CO2 and CH4 analyzer are installed on the skid (H2 analyzer should be installed in the future).
PP_1101_01 pumps the gas from the bioreactor through a heat exchanger. Once dry, the gas is measured by infrared analyser before being re-injected into the bioreactor.
Three different procedures manage the analyzer:

- "G_ANA_Start" to allow the flow through the analyzer.
- "G_ANA_Stop" to stop the gas analyse.
- "G_ANA_Cal_Start" to manage analyzer calibration. This procedure is started and stopped by the operator through the HMI.

3. These three procedures are detailed in chapter 4 (User manual procedure).
4.

Important point: As the valve S3V_1103_01 permits to inject N2, it is used to do the zero calibration. Due to this, this valve has been linked to the "Gas loop analyzer" control loop.

Three modes are available:

OFF Mode: All valves are in default position and the pump PP_1101_01 is stopped.
Auto mode: The gas coming from the bioreactor is analyzed.
Manu mode: The operator can manipulate the valves and the pump.

PLC Section name	Equipment tag	Type	Address	Comment
Gas Loop Analyser Control	PP_1101_01_MV	DO	000023	Pumps gas from the bioreactor through gas analyzers
Gas Loop Analyser Control	AT_1101_02_H2		TBD when installed	Gas analyzers Analyses bioreactor gas phase composition for H2
Gas Loop Analyser Control	AT_1101_01_CO2	AI	400445	Gas analyzers Analyses bioreactor gas phase composition for CO2 and CH4. One sensor, 2 measurements
Gas Loop Analyser Control	AT_1101_01_CH4	AI	400447	Gas analyzers Analyses bioreactor gas phase composition for CO2 and CH4. One sensor. 2 measurements
Gas Loop Analyser Control	FT_1101_01	AI	400153	Mass Flow meter Measures the gas flow entering in the gas analyzers.
Gas Loop Analyser Control	PT_1101_01	AI	400033	Pressure transducer. Measures pressure of gas after gas analyzers
Gas Loop Analyser Control	S3V_1103_01_MV	DO	000045	Powered 3-way valve Used to connect N2 gas inlet to gas analysis loop for gas analyser calibration
Gas Loop Analyser Control	S3V_1103_01_FB	DI	100072	valve feedback
Gas Loop Analyser Control	S3V_1101_01_MV	DO	000035	Powered 3-way valve. Used to evacuate N2 gas from the gas analysis loop in case of gas analyzers calibration.

PLC Section name	Equipment tag	Type	Address	Comment
Gas Loop Analyser Control	S3V_1101_01_FB	DI	100066	Valve Feedback
Gas Loop Analyser Control	SV_1101_01_MV	DO	000040	Powered 2-way valve. Opens/ closes the second gas analysis loop
Gas Loop Analyser Control	SV_1101_01_FB	DI	100061	Valve feedback

Figure 44: Gas Loop Analyser Control – EQUIPMENTS

PLC Section name	Button tag	Type	Address	Comment
Gas Loop Analyser Control	CL1101_ControlLoop_Mode	INT	400813	Gas loop Analyzer mode (0: Off / 1: Auto / 2: Manu). OFF= stop analyzer loop / Auto = start analyzer loop / Manu = stop analyzer loop then give the control to the operator.
Gas Loop Analyser Control	CL1101_TB_Ana	BOOL	000782	Tracing bit set when the analyzer loop is running
Gas Loop Analyser Control	CL1101_G_Ana_Start_Error	UDINT	400337	Error number in procedure "G_Ana_Start"
Gas Loop Analyser Control	CL1101_G_Ana_Stop_Error	UDINT	400339	Error number in procedure "G_Ana_Stop"
Gas Loop Analyser Control	CL1101_SCI_Ana_Cal_Start	BOOL	000317	Start the calibration of the analyzer
Gas Loop Analyser Control	CL1101_SCI_End_Calibration_Gas	BOOL	000318	Stop the calibration of the analyzer
Gas Loop Analyser Control	CL1101_TB_Ana_Cal	BOOL	000783	Tracing bit set when the analyzer are in calibration mode
Gas Loop Analyser Control	PP_1101_01_OP	BOOL	000520	Start / stop the pump in manual mode
Gas Loop Analyser Control	S3V_1101_01_OP	BOOL	000546	Operator can change the position of the 3 way valve in manual mode
Gas Loop Analyser Control	SV_1101_01_OP	BOOL	000547	Opens / closes the valve in manual mode
Gas Loop Analyser Control	S3V_1103_01_OP	BOOL	000557	Operator can change the position of the 3 way valve in manual mode.

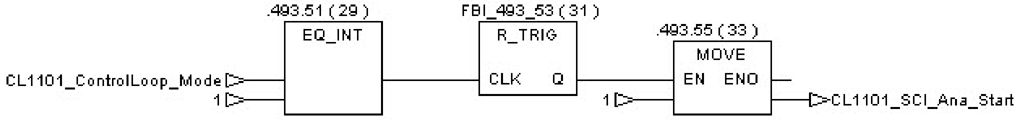
Figure 45: Gas Loop Analyser Control – USER INDICATOR / INPUT

4.17.2.Block Diagram

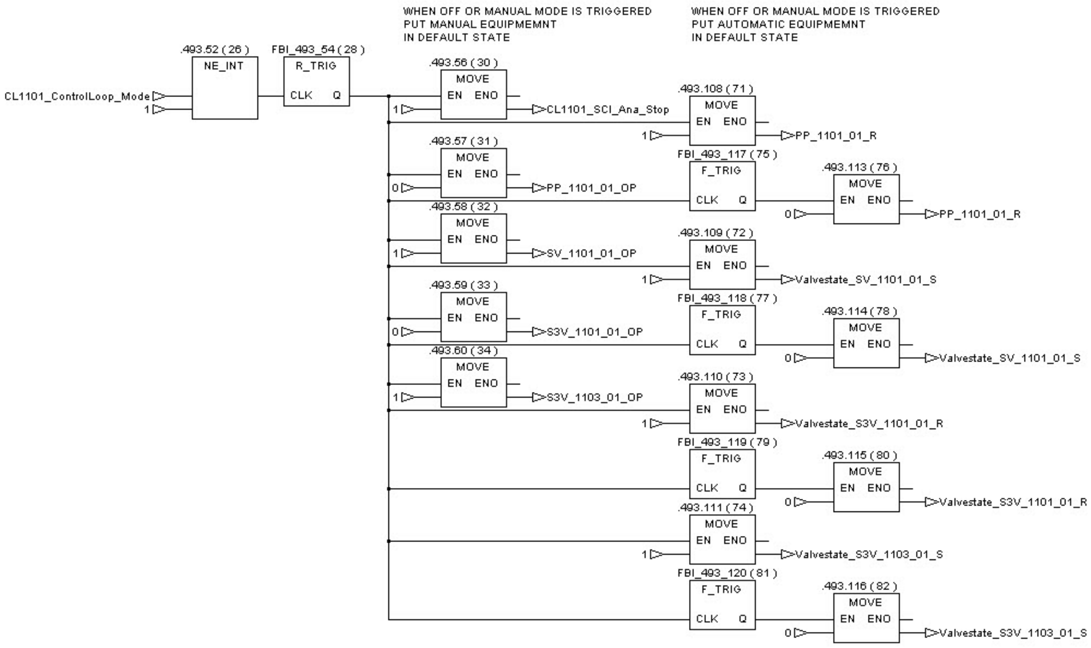
4.17.2.1. *Control Loop mode management*

The start and the stop of the bioreactor gas analyzer are done by two procedures named “G_Ana_start” and G_Ana_Stop” (detailed in the chapter 4 “User Manual Procedures”). These procedures are triggered by the control loop mode button.

When the operator decides to trigger the automatic mode, “G_Ana_start” procedure is called.



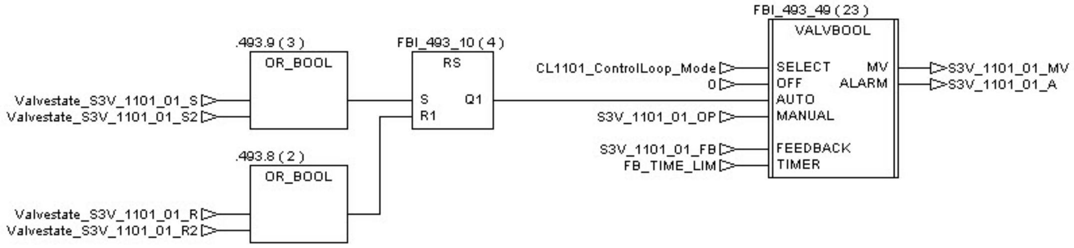
When the operator triggers the OFF or MANUAL mode, “G_Ana_Stop” procedure is called and the variables which manage equipment in MANUAL mode are configured in default position.
As the following logic is the same for OFF or manual mode, we ensure the good state of the equipment.
In case of analyzer procedure failure, the control loop mode is triggered to OFF mode. That why the automatic control of equipment is also reset.



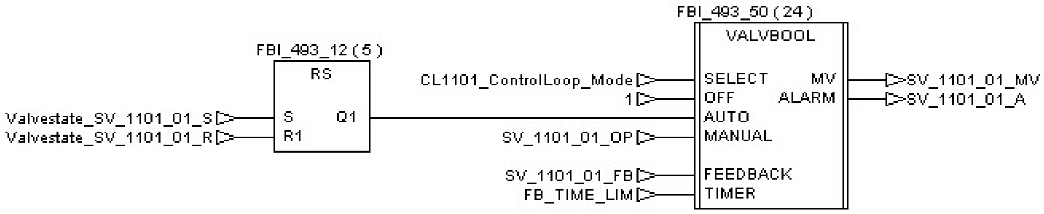
4.17.2.2. *Valves and Pump management*

The procedures “G_ANA_Start”, “G_ANA_Stop”, “G_ANA_Cal_Start” (Described in “User Manual procedure” chapter 4) send pulse on the Reset/Set block to trigger valve and pump in desired position.
The “Valvbool” block has been created to manage the Boolean valve. This block allows the mode management thanks to internal selector block (OFF/ AUTO / MANU) and the valve alarm linked to the feedback. The complete description is detailed in the annex chapter.

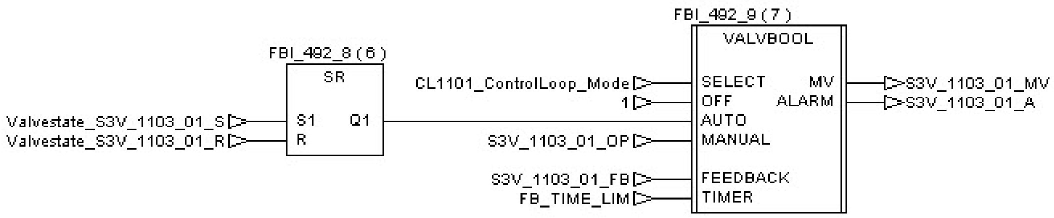
S3V_1101_01:



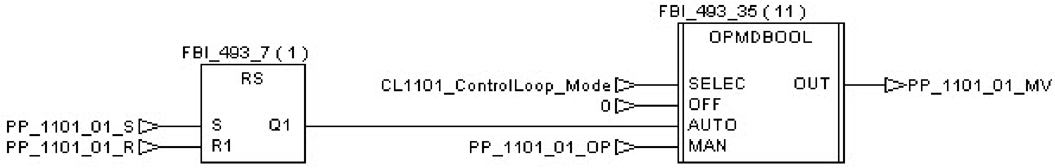
SV_1101_01:



S3V_1103_01:



PP_1101_01:



4.17.3.Alarms and Thresholds

Alarm tag Name	type	Address	description
AT_1101_02_H2_AH	BOOL	000521	high H2 concentration ACTION : DISPLAY ALARM ON HMI
AT_1101_02_H2_AHH	BOOL	000522	Very high H2 concentration ACTION : DISPLAY ALARM ON HMI
AT_1101_02_H2_AL	BOOL	000523	low H2 concentration ACTION : DISPLAY ALARM ON HMI
AT_1101_02_H2_ALL	BOOL	000524	Very low H2 concentration ACTION : DISPLAY ALARM ON HMI
AT_1101_02_H2_ERR	BOOL	000525	broken wire alarm ACTION : DISPLAY ALARM ON HMI

Alarm tag Name	type	Address	description
AT_1101_01_CO2_AH	BOOL	000526	high CO2 concentration ACTION : DISPLAY ALARM ON HMI
AT_1101_01_CO2_AHH	BOOL	000527	Very high CO2 concentration ACTION : DISPLAY ALARM ON HMI
AT_1101_01_CO2_AL	BOOL	000528	low CO2 concentration ACTION : DISPLAY ALARM ON HMI
AT_1101_01_CO2_ALL	BOOL	000529	Very low CO2 concentration ACTION : DISPLAY ALARM ON HMI
AT_1101_01_CO2_ERR	BOOL	000530	broken wire alarm ACTION : DISPLAY ALARM ON HMI
AT_1101_01_CH4_AH	BOOL	000531	high CH4 concentration ACTION : DISPLAY ALARM ON HMI
AT_1101_01_CH4_AHH	BOOL	000532	Very high CH4 concentration ACTION : DISPLAY ALARM ON HMI
AT_1101_01_CH4_AL	BOOL	000533	low CH4 concentration ACTION : DISPLAY ALARM ON HMI
AT_1101_01_CH4_ALL	BOOL	000534	Very low CH4 concentration ACTION : DISPLAY ALARM ON HMI
AT_1101_01_CH4_ERR	BOOL	000535	broken wire alarm ACTION : DISPLAY ALARM ON HMI
FT_1101_01_AH	BOOL	000536	Mass Flow meter High Alarm ACTION : DISPLAY ALARM ON HMI
FT_1101_01_AHH	BOOL	000537	Mass Flow meter Very High Alarm ACTION : DISPLAY ALARM ON HMI
FT_1101_01_AL	BOOL	000538	Mass Flow meter Low Alarm ACTION : DISPLAY ALARM ON HMI
FT_1101_01_ALL	BOOL	000539	Mass Flow meter Very Low Alarm ACTION : DISPLAY ALARM ON HMI
FT_1101_01_ERR	BOOL	000540	broken wire alarm ACTION : DISPLAY ALARM ON HMI
PT_1101_01_AH	BOOL	000541	Pressure transducer High Alarm ACTION : DISPLAY ALARM ON HMI Open S3V_1101_01.
PT_1101_01_AHH	BOOL	000542	Pressure transducer Very High Alarm ACTION : DISPLAY ALARM ON HMI trigger the control loop to OFF mode
PT_1101_01_ERR	BOOL	000545	broken wire alarm ACTION : DISPLAY ALARM ON HMI
S3V_1101_01_A	BOOL	000193	Valve Alarm ACTION : DISPLAY ALARM ON HMI
SV_1101_01_A	BOOL	000548	Valve Alarm ACTION : DISPLAY ALARM ON HMI
S3V_1103_01_A	BOOL	000558	Valve Alarm ACTION : DISPLAY ALARM ON HMI

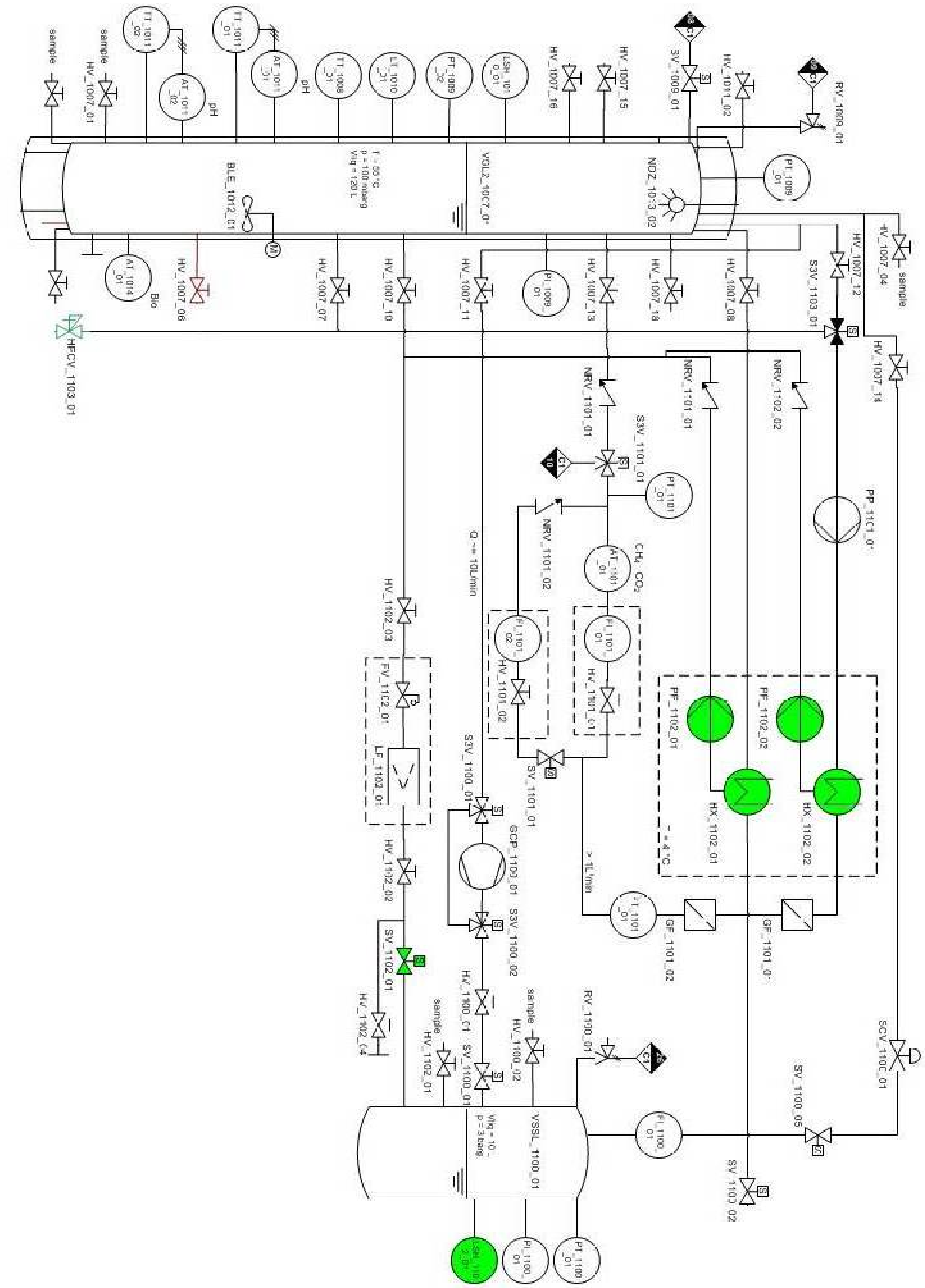
Figure 46: Gas Loop Analyser Control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
FB_TIME_LIM	TIME	400900	5	seconds	Display an alarm
AT_1101_02_H2_LIM_AH	REAL	401016	TBD	% (?)	Display an alarm
AT_1101_02_H2_LIM_AHH	REAL	401018	TBD	% (?)	Display an alarm
AT_1101_02_H2_LIM_AL	REAL	401020	TBD	% (?)	Display an alarm
AT_1101_02_H2_LIM_ALL	REAL	401022	TBD	% (?)	Display an alarm
AT_1101_01_CO2_LIM_AH	REAL	401024	60 fixed value Only in automatic mode	%	Display an alarm after 5 seconds
AT_1101_01_CO2_LIM_AHH	REAL	401026	80 fixed value Only in automatic mode	%	Display an alarm after 5 seconds

Threshold tag name	Type	Address	Value	Unit	Action
AT_1101_01_CO2_LIM_AL	REAL	401028	10 fixed value Only in automatic mode	%	Display an alarm after 5 seconds
AT_1101_01_CO2_LIM_ALL	REAL	401030	0 fixed value Only in automatic mode	%	Display an alarm after 5 seconds
AT_1101_01_CH4_LIM_AH	REAL	401032	5 fixed value Only in automatic mode	%	Display an alarm after 5 seconds
AT_1101_01_CH4_LIM_AHH	REAL	401034	15 fixed value Only in automatic mode	%	Display an alarm after 5 seconds
AT_1101_01_CH4_LIM_AL	REAL	401036	0 fixed value Only in automatic mode	%	Display an alarm after 5 seconds
AT_1101_01_CH4_LIM_ALL	REAL	401038	0 fixed value Only in automatic mode	%	Display an alarm after 5 seconds
FT_1101_01_LIM_AH	REAL	401040	90 fixed value For all modes	L/hour	Display an alarm
FT_1101_01_LIM_AHH	REAL	401042	95 fixed value For all modes	L/hour	Display an alarm
FT_1101_01_LIM_AL	REAL	401044	6 fixed value For all modes	L/hour	Display an alarm
FT_1101_01_LIM_ALL	REAL	401046	5 fixed value For all modes	L/hour	Display an alarm
PT_1101_01_LIM_AH	REAL	401048	180 fixed value For all modes	mBar	Display an alarm open S3V_1101_01
PT_1101_01_LIM_AHH	REAL	401050	200 fixed value For all modes	mBar	Display an alarm trigger the control loop to OFF mode

Figure 47: Gas Loop Analyser Control – THRESHOLDS

4.18. Gas Loop Condensate Flow (CL1102)



4.18.1.Function

The purpose of this loop is to dry the bioreactor gas before:

-entering to the analyser (Gas Loop Analyser Control).
-sending them to atmosphere (Gas Loop Pressure Control).
-to remove the condensate situated inside the gas buffer vessel.

All the condensate are re-injected inside the Bioreactor.
According that the heat exchanger and the pump are not connected to the PLC only valve SV_1102_01 can be manipulated in manual mode.
Three modes are available:

OFF Mode: SV_1102_01 is closed. Both peristaltic pumps and both heat exchanger (not connected to the PLC) are working.
Auto mode: SV_1102_01 is closed.
Manu mode: The operator can manipulate the valve SV_1102_01.

PLC Section name	Equipment tag	Type	Address	Comment
Gas Loop Condensate Flow	LSH_1102_01	DI	100047	Level switch Gives an alarm/action when the condensate level in buffer vessel VSSL_1100_01 becomes too high (=> problem with condensate evacuation system)
Gas Loop Condensate Flow	SV_1102_01_MV	DO	000034	Powered 2-way valve Opens/ closes condensate flow from buffer vessel VSSL_1100_01 to bioreactor VSL2_1007_01
Gas Loop Condensate Flow	SV_1102_01_FB	DI	100067	valve feedback
Gas Loop Condensate Flow	HX_1102_01	NC		Gas cooler Cools down gas circulating in gas loop to condensate humidity
Gas Loop Condensate Flow	HX_1102_02	NC		Gas cooler Cools down gas circulating in gas loop to condensate humidity
Gas Loop Condensate Flow	PP_1102_01	NC		Condensate pump Pumps condensate produced by cooler HX_1102_01 back to bioreactor VSL2_1007_01
Gas Loop Condensate Flow	PP_1102_02	NC		Condensate pump Pumps condensate produced by cooler HX_1102_02 back to bioreactor

Figure 48: Gas Loop Condensate Flow – EQUIPMENTS

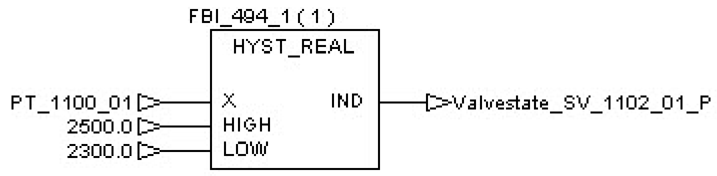
PLC Section name	Button tag	Type	Address	Comment
Gas Loop Condensate Flow	CL1102_ControlLoop_Mode	INT	400814	Gas loop Condensate flow mode (0: Off / 1: Auto / 2: Manu)
Gas Loop Condensate Flow	SV_1102_01_OP	BOOL	000550	Opens / closes the valve in manual mode

Figure 49: Gas Loop Condensate Flow – USER INDICATOR / INPUT

4.18.2.Block Diagram

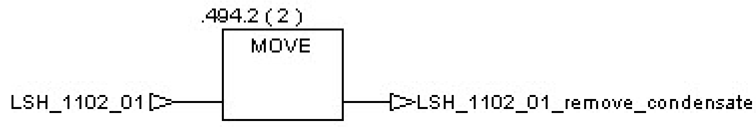
4.18.2.1. *Pressure management*

When the gas buffer vessel pressure reaches 2500 mbar, the tag Valvestate_SV_1102_01_P is set and the valve SV_1102_01 is opened.
When the pressure decreases to 2300 mbar, the valve is closed.



4.18.2.2. *Level switch high management*

When the Level Switch High is set, the valve is also open by the tag "LSH_1102_01_remove_condensate".

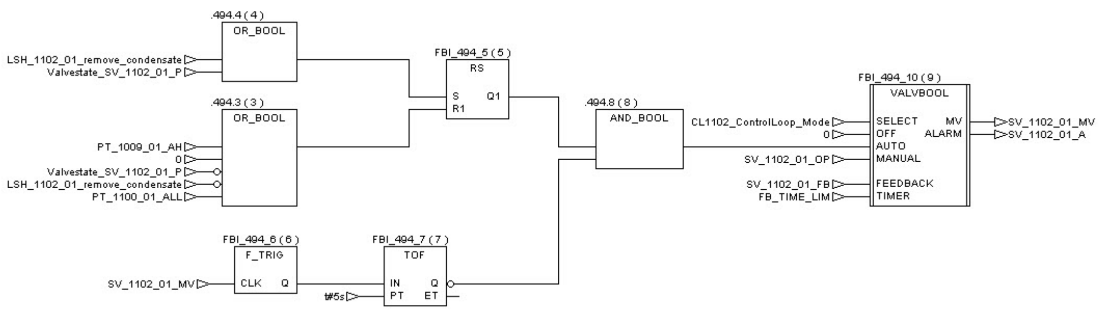


4.18.2.3. *Valve management*

As seen previously, the valve is opened when the gas buffer pressure reached 2500 mbar or when the Level Switch High is triggered. The maximum opening time is 5 seconds (linked to the block "TOF" which triggers its output to 0 after this time).

The closing conditions happen:

- If The High alarm of the bioreactor pressure probe SV_1009_01
- If the gas buffer vessel pressure goes under 2300 mbar
- If the LSH_1102_01is reset
- If the gas buffer vessel pressure reaches 1950 mbar (wait for the MPP answer concerning this threshold…At the Current time the value is 2800 mbar).



4.18.3. Alarms and Thresholds

Alarm tag Name	type	Address	description

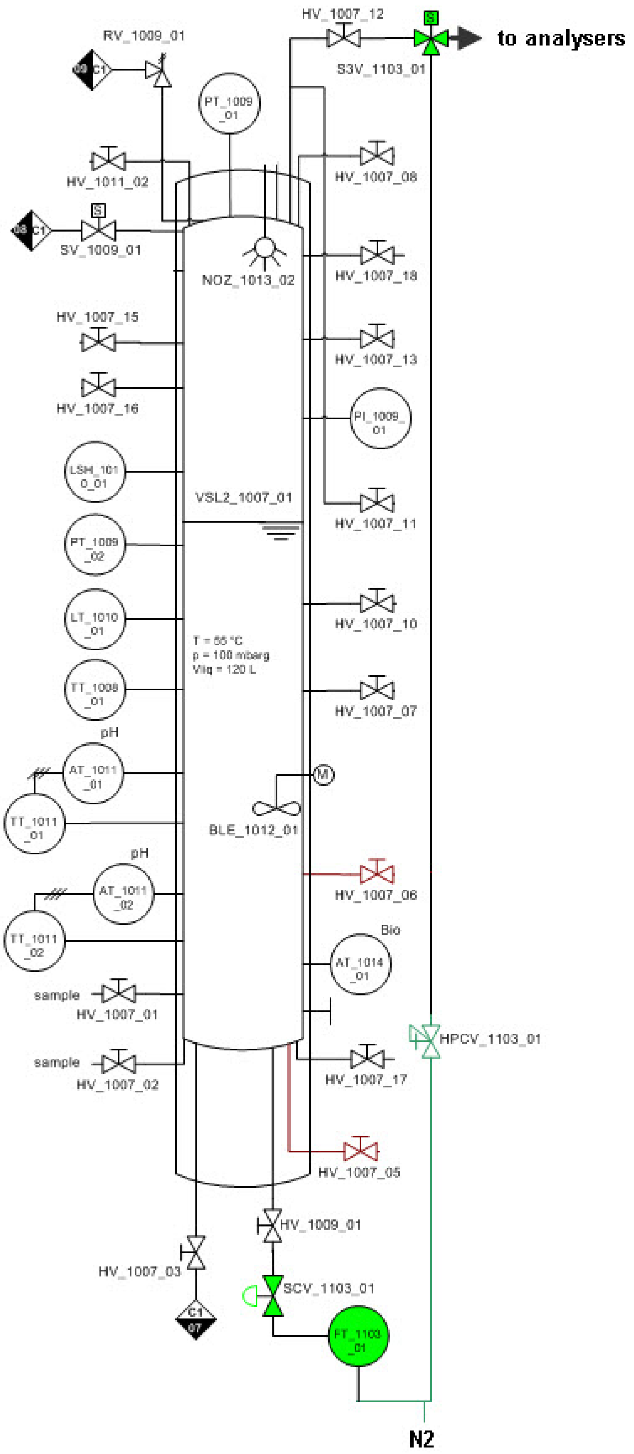
LSH_1102_01_A	BOOL	000549	Level switch high alarm ACTION : DISPLAY ALARM ON HMI
SV_1102_01_A	BOOL	000551	valve alarm ACTION : DISPLAY ALARM ON HMI

Figure 50: Gas Loop Condensate Flow – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
FB_TIME_LIM	TIME	400900	5	seconds	Display an alarm
PS_TIME_LIM	TIME	400902	10	seconds	Display an alarm

Figure 51: Gas Loop Condensate Flow – THRESHOLDS

4.19. Gas Loop N2 (CL1103): Passive gas loop



4.19.1.Function

The Nitrogen (passive gas loop) is used to regulate the bioreactor pressure at 70 mbar when the active gas loop is not able to do it or is not activated. It is also used during analyzer calibration.
The Nitrogen injected is recorded as Total injection since a reference date and also in Litre per day. This permits to know precisely the amount of Nitrogen added from the beginning of the nominal conditions.
For pressure regulation, the Passive control logic is:

- To flush of nitrogen N_2 into the reactor if the pressure is too low.
- To Release of gas outside the reactor if the pressure is too high (90mbar) using the procedure "G_PAS_Esc".

Important point:

1- The valve S3V_1103_01 has been linked to Gas loop analyzer (CL1101) to allow N2 injection during calibration phase.
2- When the control loop is triggered to OFF mode, the gas loop pressure (CL1100 / active gas loop) is also triggered to OFF.

Three modes are available:

OFF Mode: All equipments are in default position. The passive gas loop is OFF (No N2 injection inside the bioreactor).

Auto mode: The passive gas loop is started and the pressure inside the bioreactor is maintained by the proportional valve SCV_1103_01 around 70 mBar thanks to N2 injection.
In case of pressure greater than 90 mbar, the gas is released to atmosphere by calling the procedure "G_PAS_Esc" (figure 111).

Manu mode: The operator can manipulate equipments linked to this loop.

PLC Section name	Equipment tag	Type	Address	Comment
Gas Loop N2 (Passive gas loop)	FT_1103_01	AI	400069	N2 Mass Flow meter Measures the N2 gas flow entering the bioreactor VSL2_1007_01 (passive gas loop configuration)
Gas Loop N2 (Passive gas loop)	SCV_1103_01_MV	AO	400004	Powered proportional valve to keep bioreactor pressure constant (passive gas loop configuration) Regulates N2 inlet in bioreactor VSL2_1007_01
Gas Loop N2 (Passive gas loop)	S3V_1103_01_MV	DO	000045	Powered 3-way valve Used to connect N2 gas inlet to gas analysis loop for gas analyzer calibration Linked to GasLoop_Analyser =>No more linked to GasLoop_N2
Gas Loop N2 (Passive gas loop)	S3V_1103_01_FB	DI	100072	valve feedback Linked to GasLoop_Analyser =>No more linked to GasLoop_N2

Figure 52: Gas Loop N2 – EQUIPMENTS

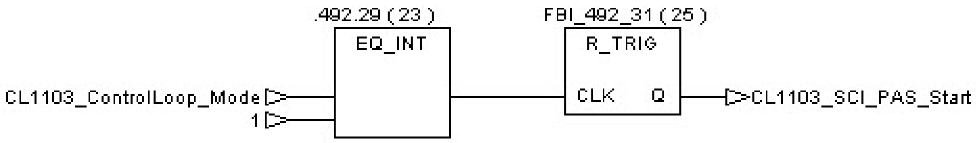
PLC Section name	Button tag	Type	Address	Comment
Gas Loop N2 (Passive gas loop)	CL1103_ControlLoop_Mode	INT	400815	Gas Loop N2 mode
Gas Loop N2 (Passive gas loop)	CL1103_G_PAS_Start_Error	UDINT	400343	Error number in procedure "G_PAS_Start"
Gas Loop N2 (Passive gas loop)	CL1103_G_PAS_Stop_Error	UDINT	400345	Error number in procedure "G_PAS_Stop"
Gas Loop N2 (Passive gas loop)	CL1103_TB_PAS	BOOL	000326	Tracing bit of the passive gas loop.
Gas Loop N2 (Passive gas loop)	CL1103_G_PAS_Esc_Error	UDINT	400347	Error number in procedure "G_PAS_Esc"
Gas Loop N2 (Passive gas loop)	CL1103_TOTAL_N2_FLOW_L_PER_DAY	REAL	400235	total N2 flow (L/day)
Gas Loop N2 (Passive gas loop)	FT_1103_01_Av	REAL	400155	Flow transmitter average (two filter of 50 values)
Gas Loop N2 (Passive gas loop)	SCV_1103_01_OP	REAL	400057	Used to control the opening of the valve in manual mode. No opening position feedback.
Gas Loop N2 (Passive gas loop)	S3V_1103_01_OP	BOOL	000557	Operator can change the position of the 3 way valve in manual mode. Linked to GasLoop_Analyser =>No more linked to GasLoop_N2

Figure 53: Gas Loop N2 – USER INDICATOR / INPUT

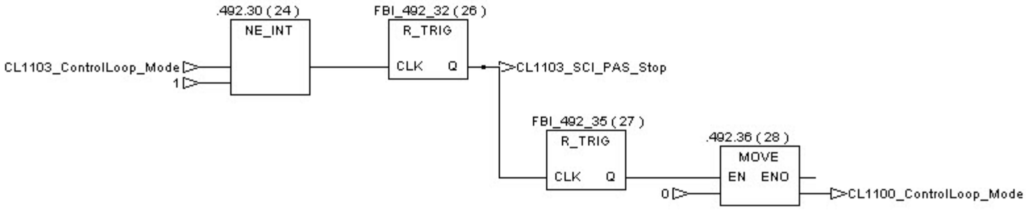
4.19.2. Block Diagram

4.19.2.1. *Control Loop mode management*

When the operator triggers the "GasLoop_N2" in automatic mode, the procedure "G_PAS_Start" (Detailed in the Chapter 4 "User Manual Procedure") is called. The Tracing Bit of the passive Gas loop is SET.

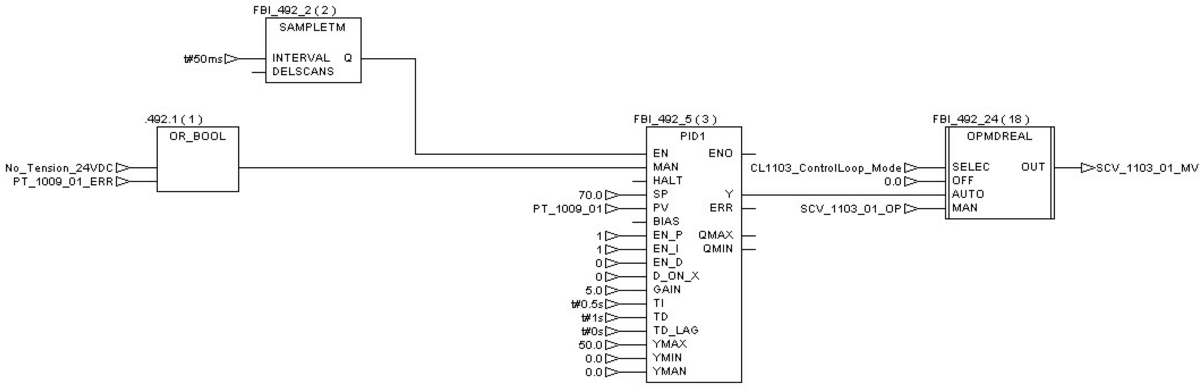


When the operator triggers the Control Loop to OFF or Manual Mode, the procedure "G_PAS_Stop" (Detailled in the Chapter 4 "User Manual Procedure") is called. The tracing Bit of the Passive Gas Loop is RESET.
The Gas Loop Pressure control is also triggered to OFF.



4.19.2.2. *Controller*

The controller used is a PI controller (Proportional / Integral). The set point is fixed to 70 mbar. The equipment controlled is the proportional valve SCV_1103_01 which is limited to 50% of maximum opening.



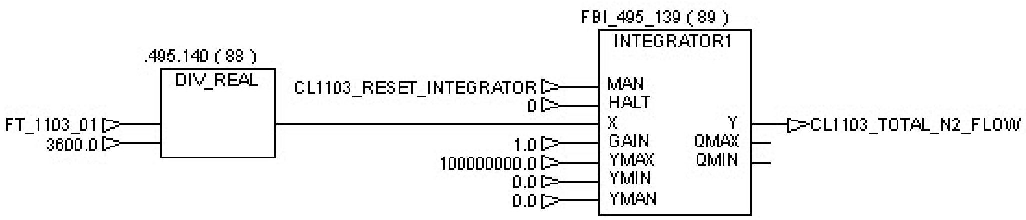
4.19.2.3. *Controller parameter*

Controlled Variable	CONTROLLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
Bioreactor Pressure	PI	NO	NO	NO	Controller : 50 ms	PT_1009_01	70 mbars

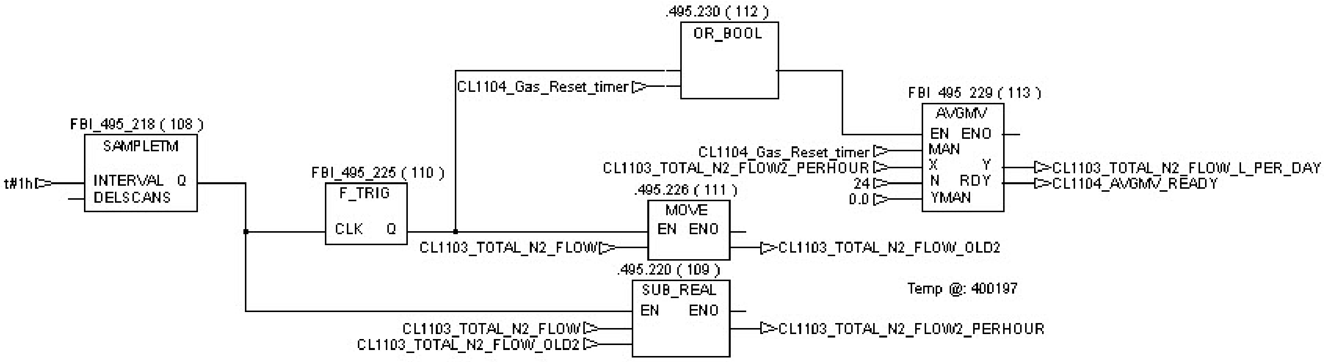
Controlled Variable	INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
Bioreactor Pressure	No internal model. The controller is not a predictive one	Gain : 5 TI : 0.5s	Y MAX : 50 Y MIN : 0	NO	NO	No variable (the branch goes directly in the selector block)	SCV_1103_01

4.19.2.4. *N2 injection calculation*

Each time that the controller asks for Nitrogen injection, the flow meter measurement is recorded by an integrator block to provide the total nitrogen injection. The date and the time are used as reference to mark the beginning of the test (this reference is also used for the gas composition calculation).



A second calculation is done to know the nitrogen quantity injected during the day. The calculation implemented is a sliding mean value updated each hour.



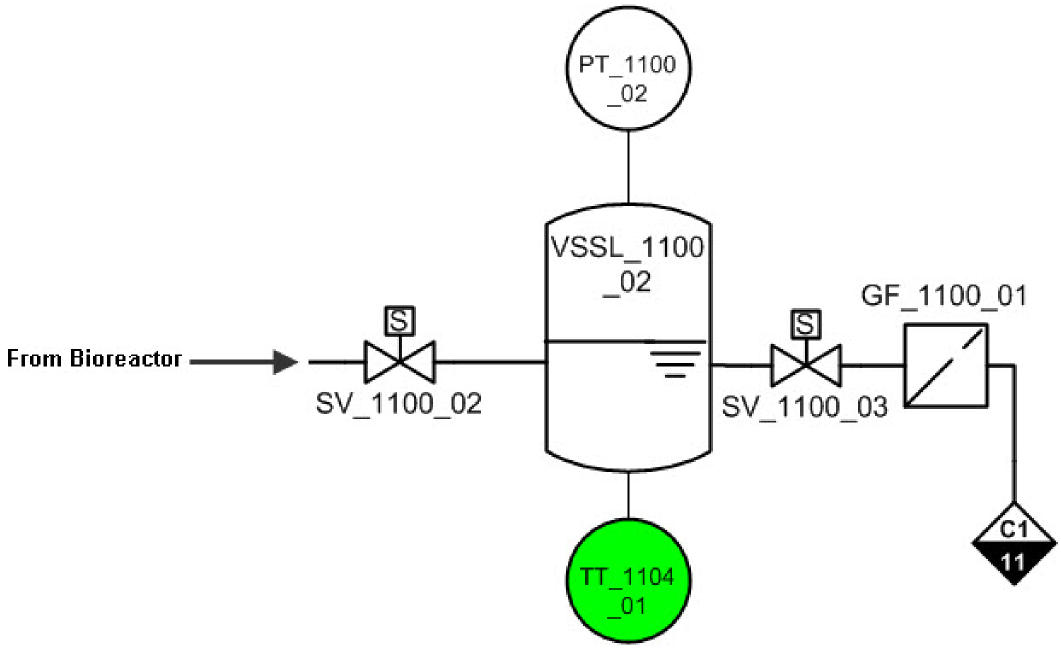
4.19.3. Alarms and Thresholds

Alarm tag Name	type	Address	description
FT_1103_01_A	BOOL	000553	in auto mode, if the valve is open more than 10% during 1 min. And the bioreactor pressure is less than 150 mbar This situation mean that the N 2 flow has a problem. ACTION : DISPLAY ALARM ON HMI
FT_1103_01_ERR	BOOL	000556	broken wire alarm ACTION : DISPLAY ALARM ON HMI
S3V_1103_01_A	BOOL	000558	valve alarm ACTION : DISPLAY ALARM ON HMI
SCV_1103_01_ERR	BOOL	000188	valve alarm ACTION : DISPLAY ALARM ON HMI

Figure 54: Gas Loop N2 – ALARMS

NO EXISTING THRESHOLD

4.20. Gas Loop Outlet (CL1104)



4.20.1.Function

When the Bioreactor works in nominal condition, the bacterial activity produces biogas (CH_4 / CO_2 / H_2?). This gas increases the bioreactor pressure. According to the Active gas loop and to maintain a constant pressure inside the bioreactor, this biogas is collected in the Buffer vessel (VSSL_1100_01) until its own pressure reaches 3 bars.
Once done, the excess of gas is re-injected inside the bioreactor by the valve SCV_1100_01 which makes the pressure increased. Before being evacuated, the gas volume ejected is calculated to record bioreactor gas production.
The procedure which manages the calculation is called "G_PAS_Esc" and is described in chapter 4 "User Manual procedure".
The calculation is done by the Ideal gases law " $pV = nRT$ ". The explanation is provided in the MPP document called "Melissa procedure of Gas Mass Flow_V11".

Important point: As the pressure probe is a relative probe, we need to define a referential absolute pressure to calculate the amount of each gaz.
We have chosen 1013 mbar.

Here is the way of implementation:
1- The vessel VSSL_1100_02 is closed with a gas volume and the analyzer measurement is recorded for CH_4 and CO_2. The N_2 is deducted from the é other mezsurement.
2- Wait a defined time (65 seconds) to stabilize the pressure
3- Pressure and Temperature of VSSL_1100_02 are recorded and are used to calculate the CO_2 (in mg), the CH_4 (in mg), the N_2 (in mg) and the total volume of gas (in mol) of the full vessel.
4- The valve SV_1100_03 is opened
5- Wait a defined time (65 seconds) to stabilize the pressure
6- Pressure and Temperature of VSSL_1100_02 are recorded and are used to calculate the CO_2 (in mg), the CH_4 (in mg), the N_2 (in mg) and the total volume of gas (in mol) of the empty vessel.
7- The valve SV_1100_03 is closed
8- The PLC does the calculation by computing the difference between Full and Empty vessel. This amount is added to the previous gas calculated.
9- The valve SV_1100_02 is opened.

PLC Section name	Equipment tag	Type	Address	Comment
Gas Loop Outlet	TT_1104_01	AI	400247	Temperature sensor Measures temperature in VSSL_1100_02 for determination of produced gas flow
Gas Loop Outlet	PT_1104_01	NC	400071	Measures the gas pressure on the gas line before the columns.

				in Design report: not delivered. So not implemented in the PLC code

Figure 55: Gas Loop Outlet – EQUIPMENTS

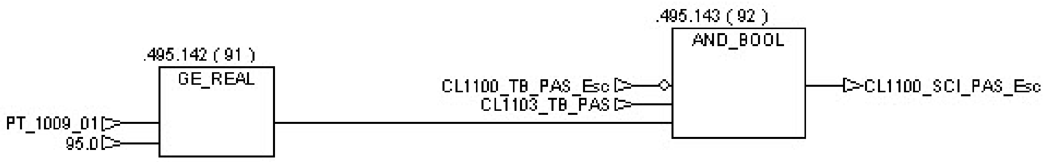
PLC Section name	Button tag	Type	Address	Comment
Gas Loop Outlet	CL1104_Gas_Second	BYTE	400854	Date of the last reset done by the operator for the gas calculation
Gas Loop Outlet	CL1104_Gas_Minute	BYTE	400855	Date of the last reset done by the operator for the gas calculation
Gas Loop Outlet	CL1104_Gas_Hour	BYTE	400856	Date of the last reset done by the operator for the gas calculation
Gas Loop Outlet	CL1104_Gas_Day	BYTE	400857	Date of the last reset done by the operator f or the gas calculation
Gas Loop Outlet	CL1104_Gas_Month	BYTE	400858	Date of the last reset done by the operator for the gas calculation
Gas Loop Outlet	CL1104_Gas_Year	BYTE	400859	Date of the last reset done by the operator for the gas calculation
Gas Loop Outlet	CL1104_Gas_Reset_timer	BOOL	000218	Date of the last reset done by the operator for the gas calculation
Gas Loop Outlet	CL1104_TOTAL_CO2_mol	REAL	400025	total CO2 (mol) since the last reset done by the operator
Gas Loop Outlet	CL1104_TOTAL_CH4_mol	REAL	400027	total CH4 (mol) since the last reset done by the operator
Gas Loop Outlet	CL1104_TOTAL_N2_mol	REAL	400029	total N2 (mol) since the last reset done by the operator
Gas Loop Outlet	CL1104_TOTAL_BIOGAS_L_PER_DAY	REAL	400237	total biomass flow (L/day)

Figure 56: Gas Loop Outlet – USER INDICATOR / INPUTS

4.20.2.Block Diagram

4.20.2.1. *G_PAS_Esc Calling*

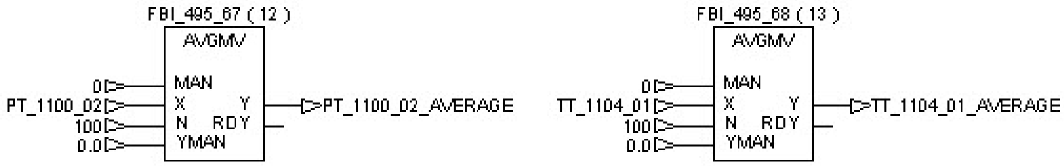
When the passive gas loop is in automatic mode and the bioreactor pressure reaches 95 mbar, the procedure G_PAS_Esc is called to release the gas pressure with gas volume calculation.



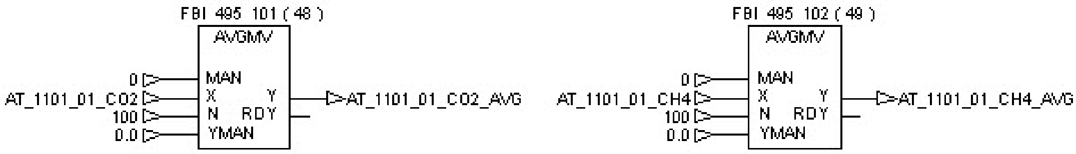
4.20.2.2. *Temperature, pressure and gas measurement average*

For the ejected gas volume calculation, the PLC uses an average measurement done on 100 values.

<u>For Pressure and Temperature of VSSL_1100_02</u>:

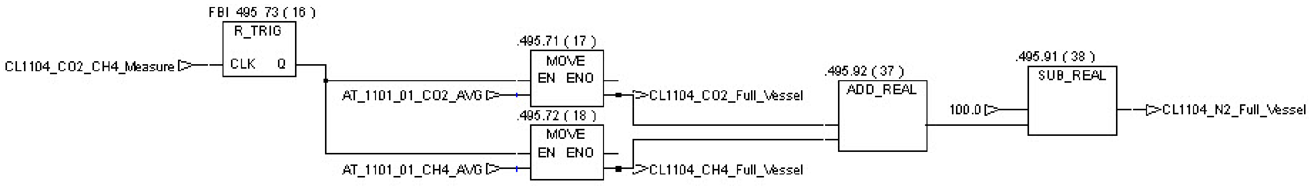


***For Bioreactor gas type measurement*:**



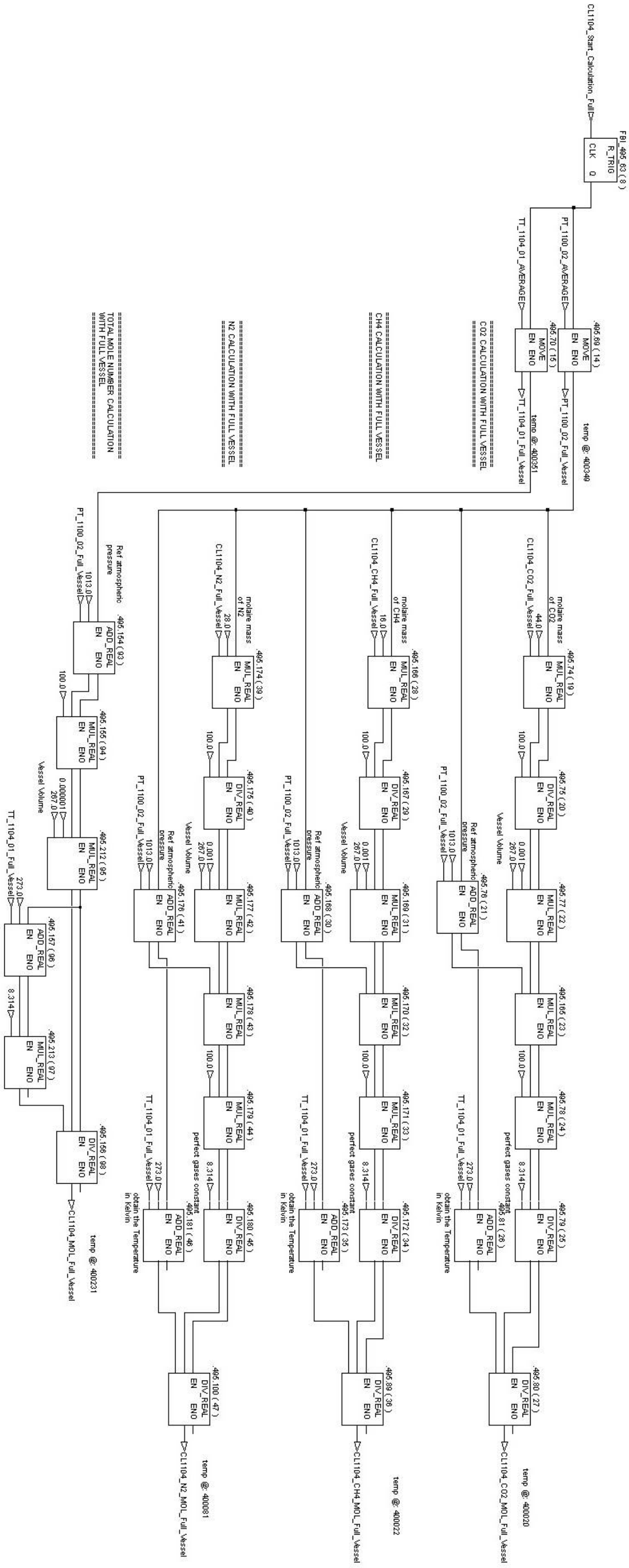
4.20.2.3. *Nitrogen measurement deduction*

When the “G_PAS_Esc” procedure starts, the entrance valve of the vessel (VSSL_1100_02) is closed to begin the gas amount ejected calculation. Before starting the calculation, the analyzer values averaged are recorded. Thanks to theses measurement, the Nitrogen measurement is deducted.



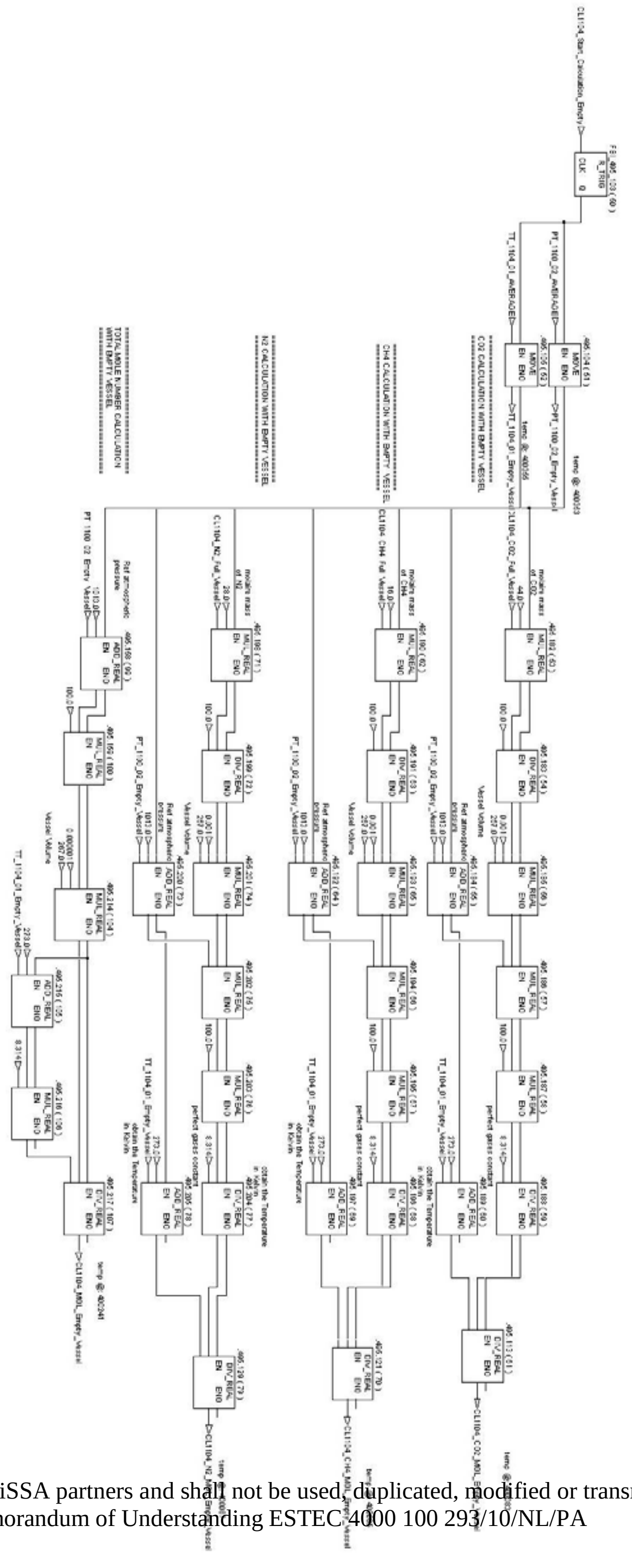
4.20.2.4. *Full vessel calculation*

During the “G_PAS_Esc” procedure, when the vessel VSSL_1100_02 is completely closed and after a stabilization time, the calculation of the full vessel starts thanks to a pulse sends on the tag “CL1104_Start_Calculation_Full”.



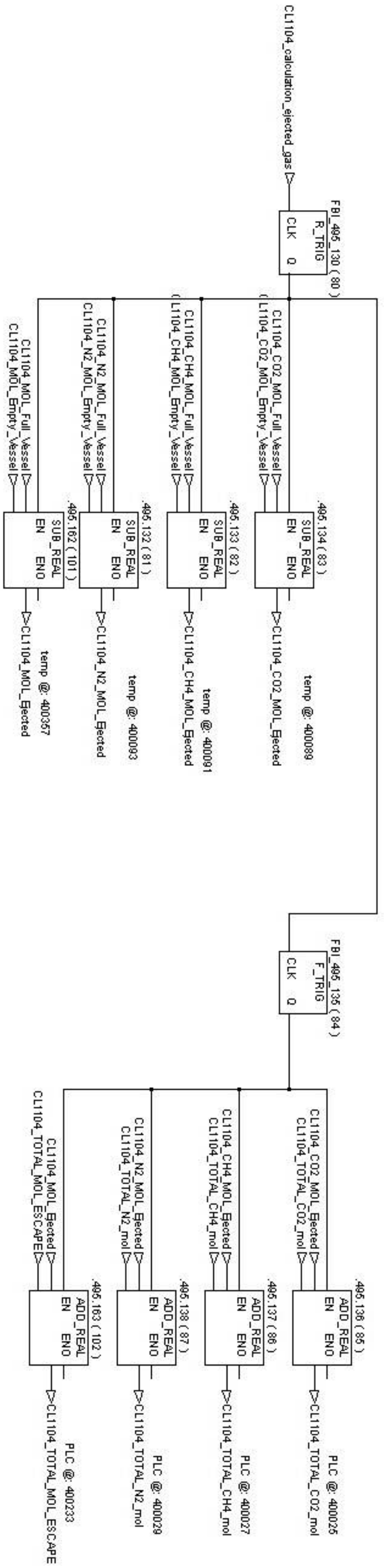
4.20.2.5. *Empty vessel calculation*

During the “G_PAS_Esc” procedure, when the vessel VSSL_1100_02 is opened to atmosphere and after a stabilization time, the calculation of the empty vessel starts thanks to a pulse sends on the tag “CL1104_Start_Calculation_Empty”.



4.20.2.6. *Total Ejected gas calculation*

Once the full vessel and the empty vessel calculation are recorded, each separated gas amount ejected is calculated (by subtraction) then added to the total amount calculated. This amount is linked to a date (YYYY/MM/DD/HH/MM/SS) recorded when the PLC when the operator decides to do a date reset. In general, the reset of the date should be done before starting the Bioreactor.


CL1104_calculation_ejected_gas
FBI_495_130 (80)
R_TRIG
CLK Q
CL1104_CO2_MOL_Full_Vessel
CL1104_CO2_MOL_Empty_Vessel
.495_134 (83)
SUB_REAL
EN ENO
CL1104_CO2_MOL_Ejected
temp @: 400089
CL1104_CH4_MOL_Full_Vessel
CL1104_CH4_MOL_Empty_Vessel
.495_133 (82)
SUB_REAL
EN ENO
CL1104_CH4_MOL_Ejected
temp @: 400091
CL1104_N2_MOL_Full_Vessel
CL1104_N2_MOL_Empty_Vessel
.495_132 (81)
SUB_REAL
EN ENO
CL1104_N2_MOL_Ejected
temp @: 400093
CL1104_MOL_Full_Vessel
CL1104_MOL_Empty_Vessel
.495_162 (101)
SUB_REAL
EN ENO
CL1104_MOL_Ejected
temp @: 400367
FBI_495_135 (84)
F_TRIG
CLK Q
CL1104_CO2_MOL_Ejected
CL1104_TOTAL_CO2_mol
.495_136 (85)
ADD_REAL
EN ENO
CL1104_TOTAL_CO2_mol
PLC @: 400025
CL1104_CH4_MOL_Ejected
CL1104_TOTAL_CH4_mol
.495_137 (86)
ADD_REAL
EN ENO
CL1104_TOTAL_CH4_mol
PLC @: 400027
CL1104_N2_MOL_Ejected
CL1104_TOTAL_N2_mol
.495_138 (87)
ADD_REAL
EN ENO
CL1104_TOTAL_N2_mol
PLC @: 400029
CL1104_MOL_Ejected
CL1104_TOTAL_MOL_ESCAPE
.495_163 (102)
ADD_REAL
EN ENO
CL1104_TOTAL_MOL_ESCAPE
PLC @: 400233

4.20.3.Alarms and Thresholds

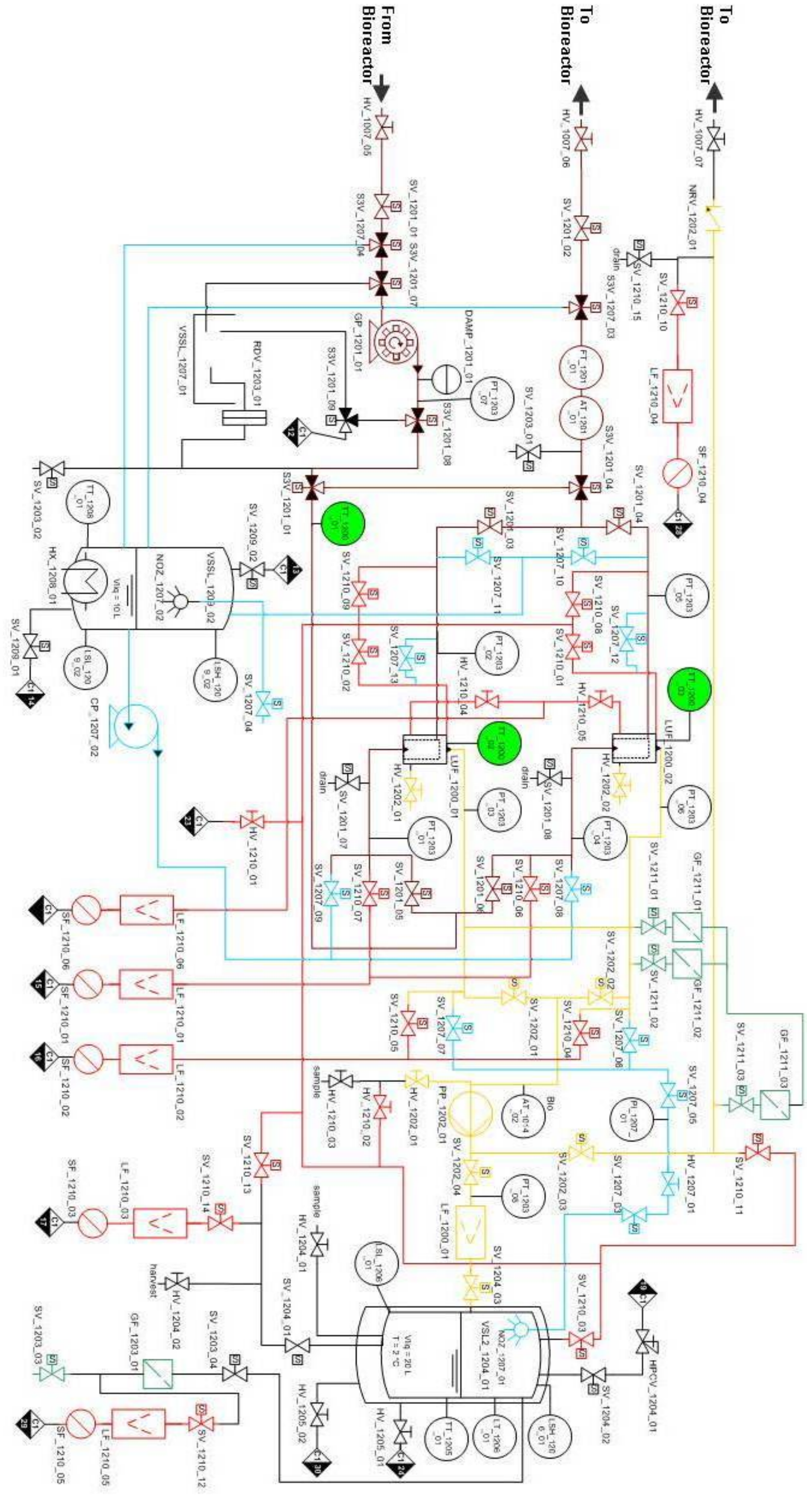
Alarm tag Name	type	Address	description
TT_1104_01_AH	BOOL	000559	High temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1104_01_AHH	BOOL	000560	Very High temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1104_01_AL	BOOL	000561	Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1104_01_ALL	BOOL	000562	Very Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1104_01_ERR	BOOL	000563	broken wire alarm ACTION : DISPLAY ALARM ON HMI

Figure 57: Gas Loop Outlet – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
TT_1104_01_LIM_AH	REAL	401064	40	°C	Display an alarm
TT_1104_01_LIM_AHH	REAL	401066	45	°C	Display an alarm
TT_1104_01_LIM_AL	REAL	401068	10	°C	Display an alarm
TT_1104_01_LIM_ALL	REAL	401070	5	°C	Display an alarm

Figure 58: Gas Loop Outlet – THRESHOLDS

4.21. Filtration Unit General (CL1200)



4.21.1.Function

Here after, the definition of the different part of the Filtration skid.

<u>Filtration unit Equipments:</u>

- CL1200 → CL1206. Each equipment related to the filtration function

1200	Filtration Unit General	Filtration Unit
1201	Filtration Unit Retentate Flow Control	Filtration Unit
1202	Filtration Unit Filtrate Flow Control	Filtration Unit
1203	Filtration Unit Pressure control	Filtration Unit
1204	Effluent Tank General	Effluent Tank
1205	Effluent Tank Temperature Control	Effluent Tank
1206	Effluent Tank Level Control	Effluent Tank

<u>Cleaning in place equipments:</u>

- CL1207 →CL1209. Each equipment related to Cleaning

1207	CIP General	Cleaning In Place (CIP)
1208	CIP Temperature control	Cleaning In Place (CIP)
1209	CIP Filling control	Cleaning In Place (CIP)

<u>Sterilization in place equipments:</u>

- CL1210 →CL1211. Each equipment related to Sterilization

1210	SIP General	Sterilization In Place (SIP)
1211	GN2 loop for under pressure breaking	Sterilization In Place (SIP)

The filtration Unit mode is implemented in a different way compared to the CIP and SIP control loop modes. According to the important function of the filtration, it was decided with UAB to manage filtration skid equipments in manual mode without stopping the on going filtration state.
As the filtration procedures work from one state to another (ex: from stop to filtration or from nominal mode to recycle mode…etc) the check of the equipment status is done only when the operator changes the process state.
For this, when filtration is in “stable mode” (any status of filtration function), the operator can switch to manual mode to drive independently each equipment.

- For equipment linked to CL1200 to CL1206 the filtration control loop mode button should be triggered in manual mode.
- For equipment linked to CL1207 to CL1209 the Cleaning control loop mode button should be triggered in Manual mode.
- For equipment link to CL1210 to CL1211 the Sterilization control loop mode button should be triggered in Manual mode.

Each equipment (from any of the three control loop mode buttons) will recover automatically its nominal status when the mode is triggered back to automatic. For example, if the operator opens a valve manually on the membrane 2, this valve will be automatically close when its mode returns to automatic.
As long as he stays in manual mode, he won't be able to start any other procedure linked to the filtration (recycle mode or filtration through membrane 2 etc…).

All the procedures linked to the filtration functions and their management are detailed in the chapter 4 named "User manual procedure".

Important point:
To start a filtration procedure, the filtration control mode, the CIP control mode and the SIP control mode must be in automatic Mode.

Three modes are available:

OFF Mode: All equipments are in default position. The filtration unit is stopped and no procedure can be started.

Auto mode: The procedure linked to the filtration unit can be started (With the CIP AND SIP control loop also in automatic). The equipment status are checked when the process state is changing (When automatic procedure is called). The alarm thresholds make sure the process runs smoothly.

Manu mode: The operator can manipulate valves and pumps but can't change the filtration state until he switches to automatic mode.

The filtration pumps (GP_1016_01 and PP_1017_01) are configured with the last calculated speed value.

Important point: If the operator decides to switch from manual to automatic mode with a valve linked to the filtration function in a wrong position, the process will recover the good position instantaneously. This is true for FU/CIP/SIP when they are triggered in automatic.

PLC Section name	Equipment tag	Type	Address	Comment
Filtration Unit General	TT_1200_01	AI	400125	Temperature sensor Measures temperature in retentate
Filtration Unit General	TT_1200_02	AI	400073	Temperature sensor Measures temperature Membrane1

Filtration Unit General	TT_1200_03	AI	400075	Temperature sensor Measures temperature Membrane2

Figure 59: Filtration Unit General – EQUIPMENTS

PLC Section name	Button tag	Type	Address	Comment
Filtration Unit General	CL1200_ControlLoop_Mode	INT	400816	Filtration Unit mode (0: Off / 1: Auto / 2: Manu)
Filtration Unit General	CL1200_SCI_Cir1	BOOL	000271	start filtration through membrane 1
Filtration Unit General	CL1200_TB_Cir1	BOOL	000331	Tracing bit set when filtration is running though membrane 1
Filtration Unit General	CL1200_F_Cir1_error	UDINT	400253	error number in procedure F_Cir1
Filtration Unit General	CL1200_SCI_Cir2	BOOL	000272	start filtration through membrane 2
Filtration Unit General	CL1200_TB_Cir2	BOOL	000332	Tracing bit set when filtration is running though membrane 2
Filtration Unit General	CL1200_F_Cir2_error	UDINT	400255	error number in procedure F_Cir2
Filtration Unit General	CL1200_F_Fil_error	UDINT	400257	Error number in procedure F_Fil (this procedure is called directly from the PLC after the procedure F_Cir1 or F_Cir2. It is completely transparent for the operator)
Filtration Unit General	CL1200_SCI_Stop	BOOL	000285	Stop the entire filtration unit (retentate and filtrate side)
Filtration Unit General	CL1200_TB_Stop	BOOL	000092	Tracing bit set when the filtration unit is stopped
Filtration Unit General	CL1200_F_Stop_error	UDINT	400251	error number in procedure F_Stop
Filtration Unit General	CL1200_SCI_Nom	BOOL	000280	trigger the filtration from recycle mode to nominal mode
Filtration Unit General	CL1200_TB_Nom	BOOL	000344	tracing bit set when filtration is in nominal mode
Filtration Unit General	CL1200_F_Nom_error	UDINT	400259	error number in procedure F_Nom
Filtration Unit General	CL1200_SCI_Recycle_mode	BOOL	000281	trigger the filtration from nominal mode to recycle mode
Filtration Unit General	CL1200_Reset _F_Rec_Proc	BOOL	000786	During the recycle mode, if the operator decides to cancel the sterilisation of the recycle line, the procedure "F_Rec"is reset by a pulse sending from the HMI to this tag
Filtration Unit General	CL1200_TB_Rec	BOOL	000343	tracing bit set when filtration is in recycle mode
Filtration Unit General	CL1200_F_Rec_error	UDINT	400265	error number in procedure F_Rec
Filtration Unit General	CL1200_SCI_S12	BOOL	000283	trigger the filtration from membrane 1 to membrane 2 (membrane1-->stop-->membrane2)
Filtration Unit General	CL1200_F_S12_error	UDINT	400263	error number in procedure F_S12
Filtration Unit General	CL1200_SCI_S21	BOOL	000284	trigger the filtration from membrane 2 to membrane 1 (membrane2-->stop-->membrane1)
Filtration Unit General	CL1200_F_S21_error	UDINT	400261	error number in procedure F_S21
Filtration Unit General	CL1200_SCI_Stop_FCS	BOOL	000286	stop filtration cleaning and sterilization at the same time
Filtration Unit General	CL1200_SCI_Membr1_present	BOOL	000289	need to be set to start the filtration through membrane 1
Filtration Unit	CL1200_TB_Rec	BOOL	000290	need to be set to start the filtration

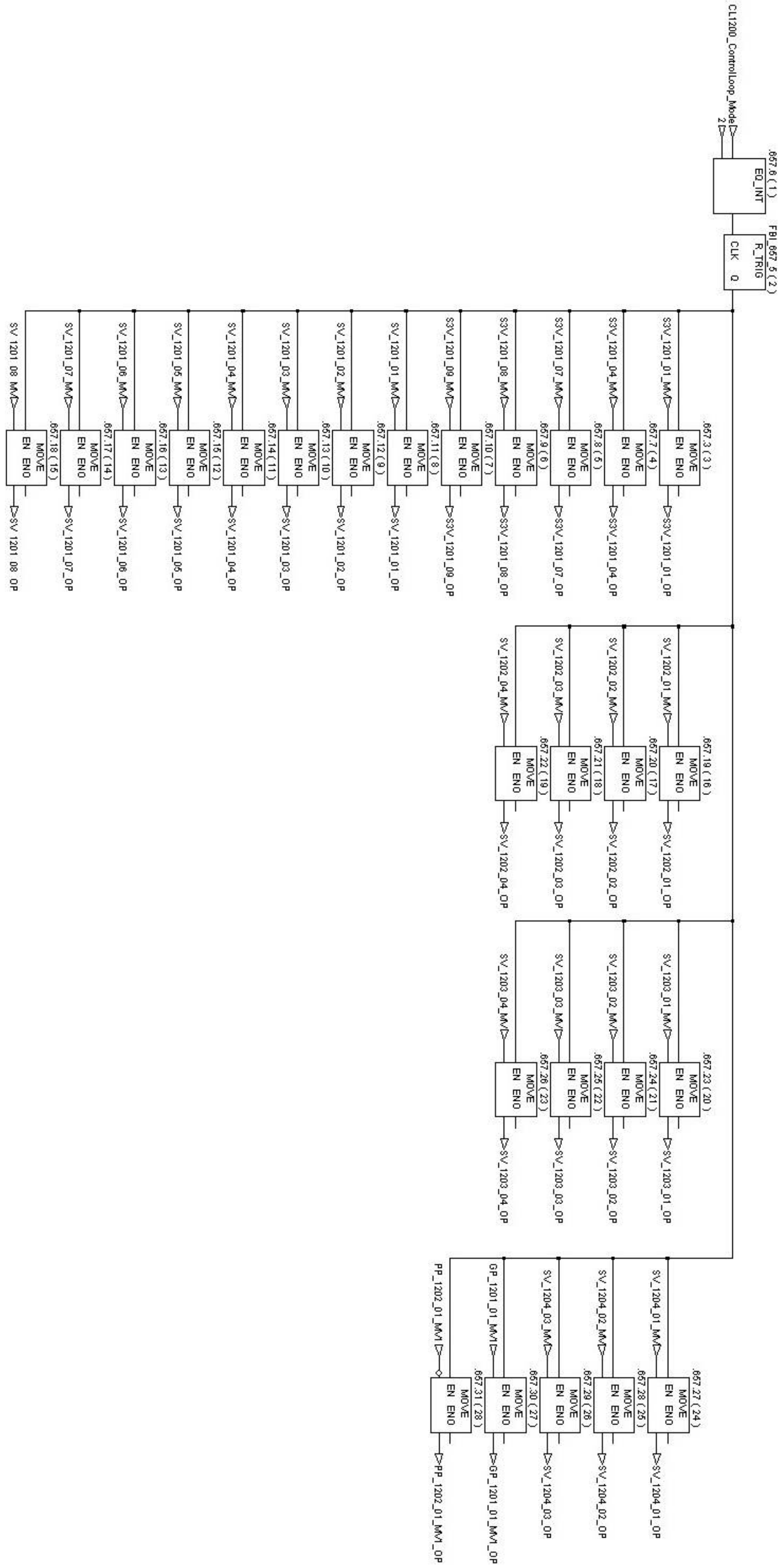
PLC Section name	Button tag	Type	Address	Comment
General				through membrane 2

Figure 60: Filtration Unit General– USER INDICATOR / INPUT

4.21.2.Block Diagram

4.21.2.1. *From Automatic mode to Manual mode*

In any filtration state, when the operator triggers the Filtration from automatic mode to manual, the filtration valve states are copied in the valve variables dedicated to the manual mode. It is a whole image of the valves positions in order to maintain the current filtration state.
After this transition, the operator manipulates only the manual variable to manage equipment in manual mode.



4.21.2.2. *From automatic mode to OFF mode*

If the OFF MODE is triggered during the execution of one of the filtration procedure, the procedure “CL1200_RESET_PROC” is activated. This procedure ensures that the automatic input of the equipment (pin auto of the block permitting the mode selection: ODMPBOOL/OPMDREAL/VALVBOOL) are reset. It prevents undefined state of filtration equipment when operator returns to automatic mode.
This new procedure, which provides other function, is detailed in the chapter 4: user manual procedure.

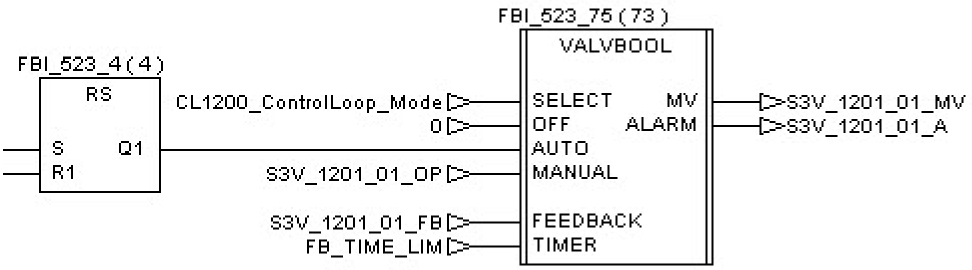
4.21.2.3. *Stop filtration function management*

4.21.2.3.1. Calling the stop of the filtration function

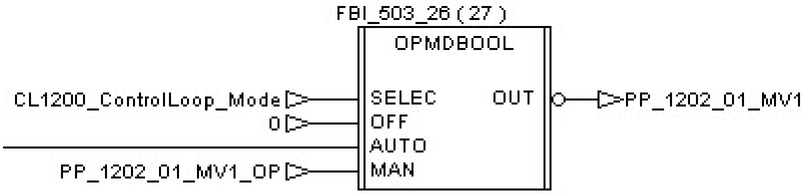
The stop of the filtration function can be called by many different ways.

- The first function which permits to do it is the “Control loop mode button”. By triggering the filtration to OFF mode, each equipment linked to the filtration function is triggered in default position. This function is implemented thanks to the block VALVBOOL or OPMDBOOL (Described in annex). To summarize these blocks, they work with selector block. Depending on the value of the “Control loop mode button” (0 / 1 / 2), the selected pin of the block changed to OFF (default position of the equipment), Automatic (managed by procedures) or manual (managed by the operator). The difference between OPMDBOOL block and VALVBOOL Block is the management of the alarm. VALVBOOL block is dedicated to the valve management and permits to monitor the feedback of the valve and to trigger an alarm thanks to an elapsed time (FB_TIME_LIM = 5s).

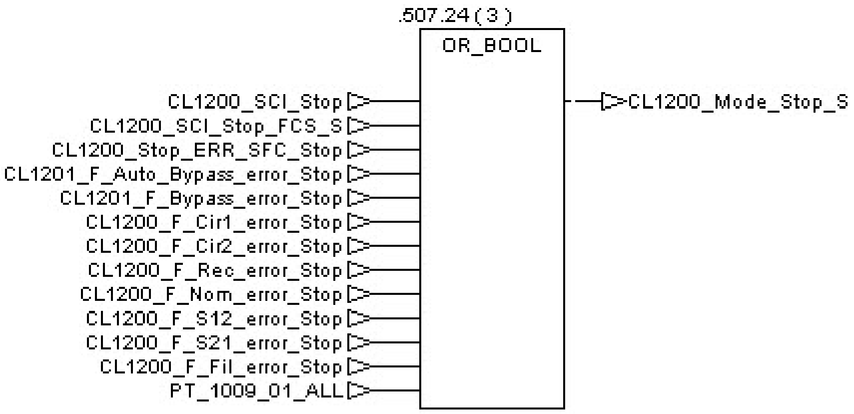
<u>“VALVBOOL” Block example:</u>



<u>“OPMDBOOL” Block example:</u>

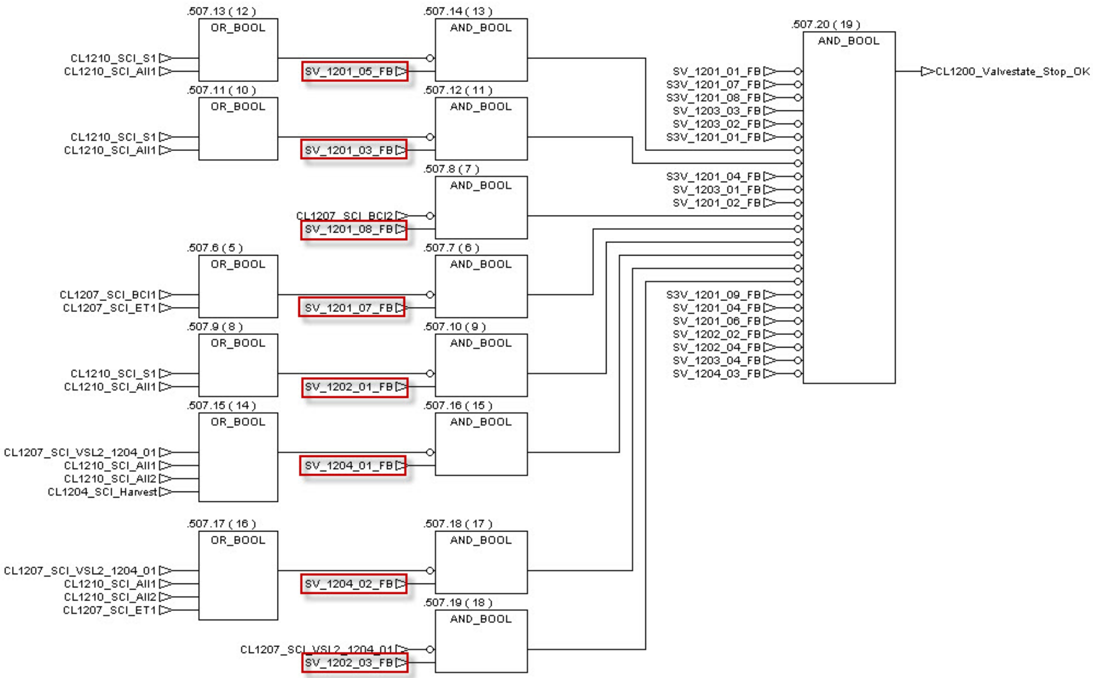


- In automatic mode, the operator is able to stop the filtration from any state by using the dedicated button named “Stop filtration” from the HMI. This HMI button set the tag called “CL1200_SCI_Stop”.
  A global stop button (FU/CIP/SIP) can also be used from HMI. This HMI button set the tag called “CL1200_SCI_Stop_FCS_S”.
  The other conditions which will automatically ask for the stop of the filtration are linked to the procedures. Each changing state of the filtration is done thanks to procedures. During their execution, each sequential step is monitored by a defined time. If this time is elapsed, an error is set then the stop of the filtration is called.
  The last condition which can trigger the stop of the filtration is linked to the bioreactor pressure. If the bioreactor “Very Low Pressure Alarm” is triggered, the stop is called to avoid under pressure.



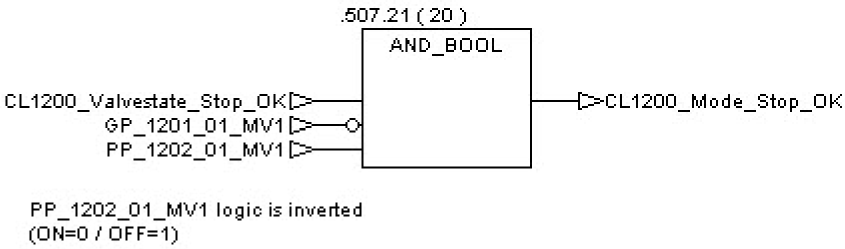
4.21.2.3.2. Actions following the “Stop Filtration” Function

Once the stop filtration function is asked by one of the condition enounced above, the tag CL1200_Mode_Stop_S is set.
This tag reset all the procedure and starts the procedure “F_stop” (detailed in chapter 4).**This procedure can only be used in automatic mode.**
The first action sends a pulse on the reset branch of all valves linked to the filtration function.
When valves are in stop position, the tag “CL1200_Valvestate_Stop_OK” is set :

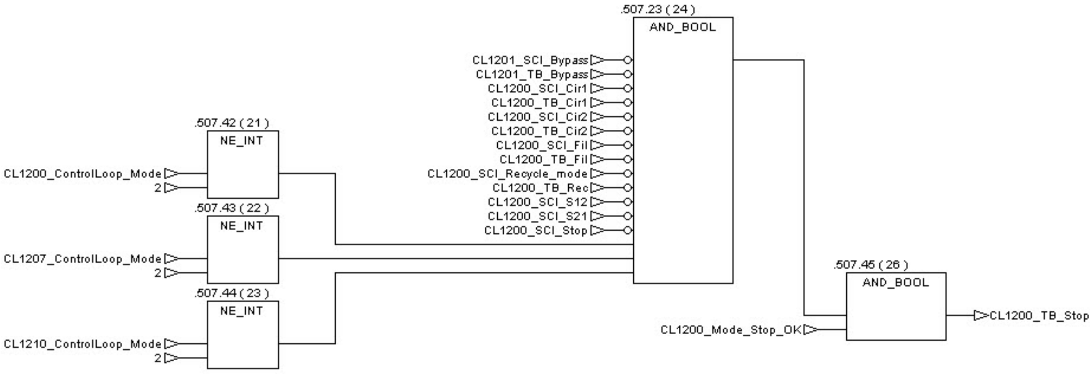


Because some filtration valves are also managed by Cleaning or sterilization procedure, the variable “CL1200_Valvestate_Stop_OK” can be set even if some valves are not in default position. These valves are surrounding by a red rectangle.

Once the valves status is OK, the retentate and the filtrate pump are reset. When all equipments are in default position, the tag “CL1200_Mode_Stop_OK” is set.



Finally, when “CL1200_Mode_Stop_OK” and all procedures are reset, the Tracing Bit “CL1200_TB_Stop” is set.

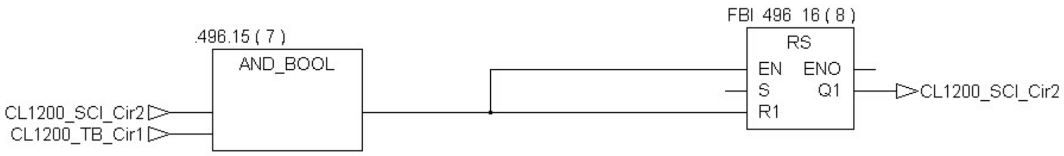


4.21.2.4. *Procedure Start buttons management*

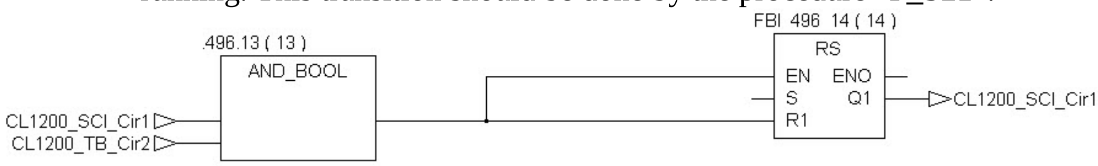
When a procedure is running, nothing prevents the operator to click on other "start procedure" button. In that case, the button is permanently set (until the CIP mode changes or the stop function starts). If all the conditions become true, the procedure will instantaneously start. Due to this, some cautions need to be taken in order to prevent wrong manipulation.

Here are they:

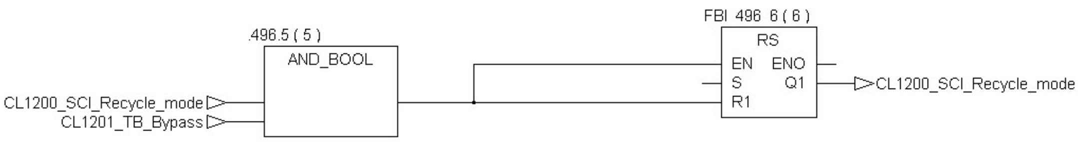
- Reset the "filtration membrane 2" button if filtration membrane 1 is running. This transition should be done by the procedure "F_S12".

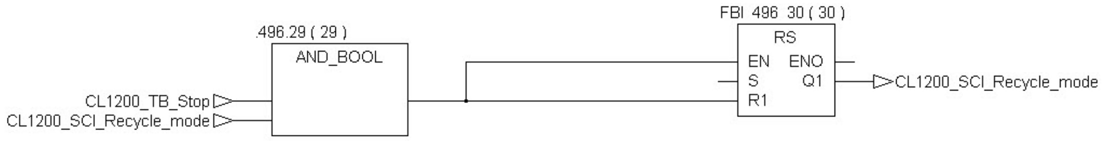


- Reset the "filtration membrane 1" button if filtration membrane 2 is running. This transition should be done by the procedure "F_S21".

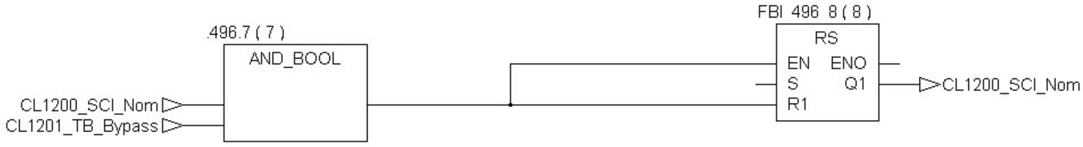


- Reset of the "Recycle mode" button if the filtration is in bypass or in stop mode. The recycle mode can only be obtained from the nominal mode.

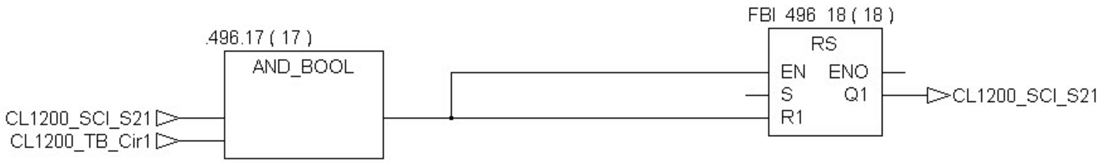




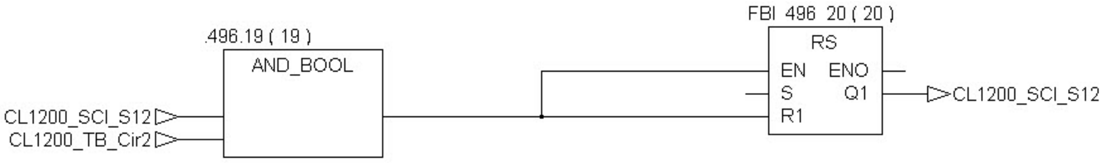
- Reset of the “nominal mode” button if the filtration unit is in bypass mode. The nominal mode is called automatically by the procedure F_Cir1 or F_Cir2



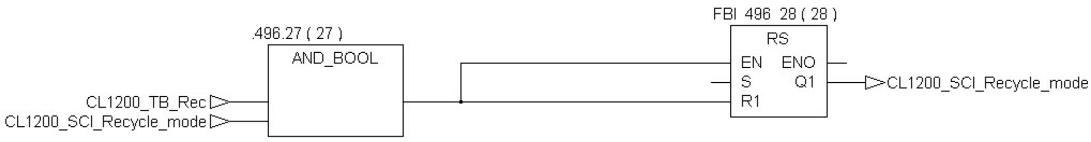
- Reset of the “switch from membrane 2 to 1” button when the filtration unit is in Filtration membrane 1.



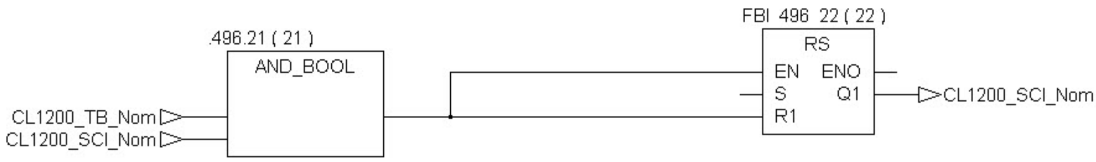
- Reset of the “switch from membrane 1 to 2” button when the filtration unit is in Filtration membrane 2.



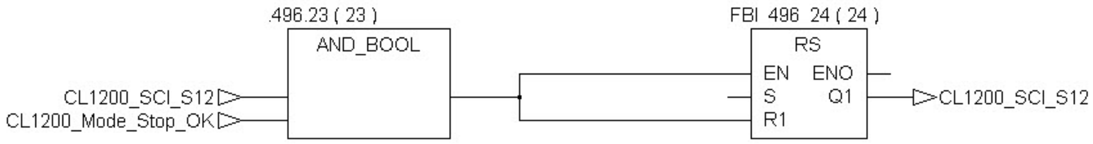
- Reset of the “Recycle mode” button if the filtration unit is already in recycle mode



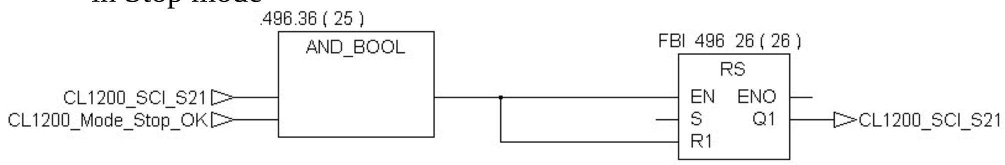
- Reset of the “Nominal mode” button if the filtration unit is already in Nominal mode



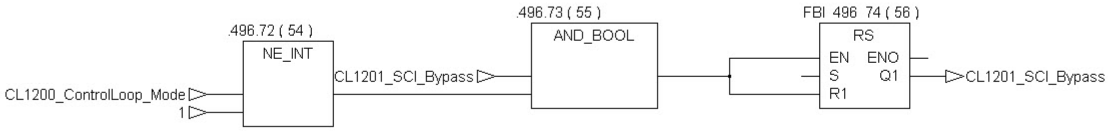
- Reset of the “switch from membrane 1 to 2” button if the filtration unit is in Stop mode



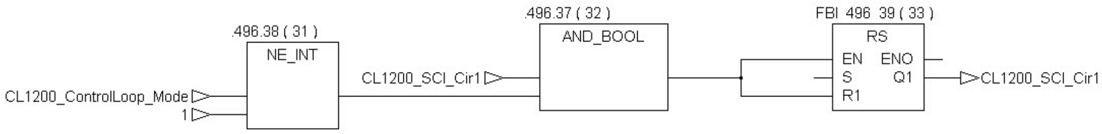
- - Reset of the “switch from membrane 2 to 1” button if the filtration unit is in Stop mode



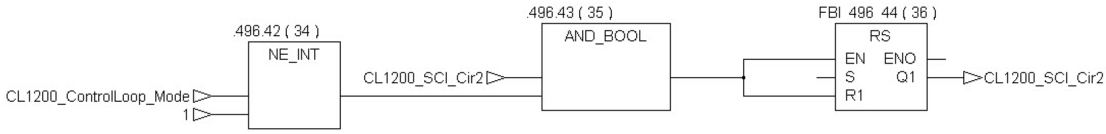
- Reset of the “Bypass mode” button if the filtration unit is not in Automatic mode.



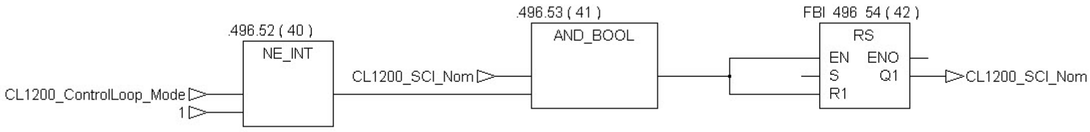
- Reset of the “Filtration membrane 1” button if the filtration unit is not in Automatic mode.



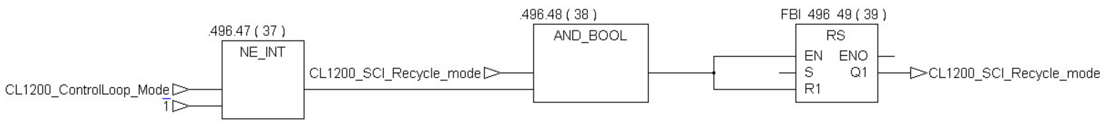
- Reset of the “Filtration membrane 2” button if the filtration unit is not in Automatic mode.



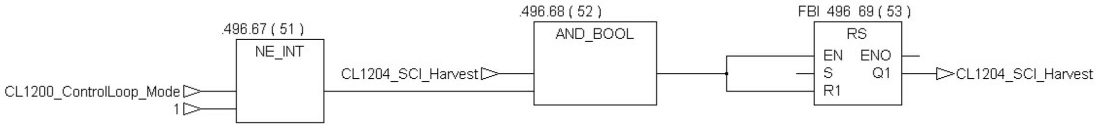
- Reset of the “Nominal mode” button if the filtration unit is not in Automatic mode.



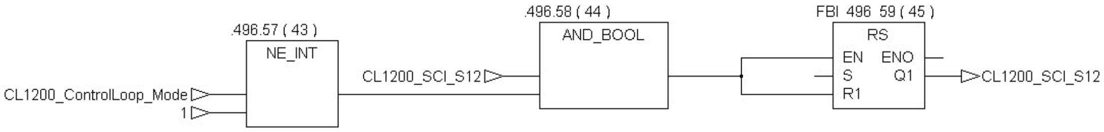
- Reset of the “Recycle mode” button if the filtration unit is not in Automatic mode.



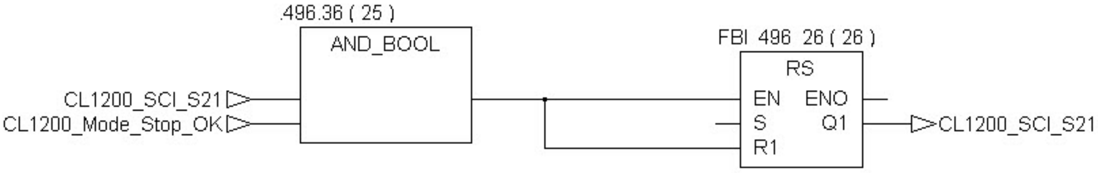
- Reset of the “Harvest mode” button if the filtration unit is not in Automatic mode.



- Reset of the “Switch from membrane 1 to membrane 2” button if the filtration unit is not in Automatic mode.



- Reset of the “Switch from membrane 2 to membrane 1” button if the filtration unit is not in Automatic mode.



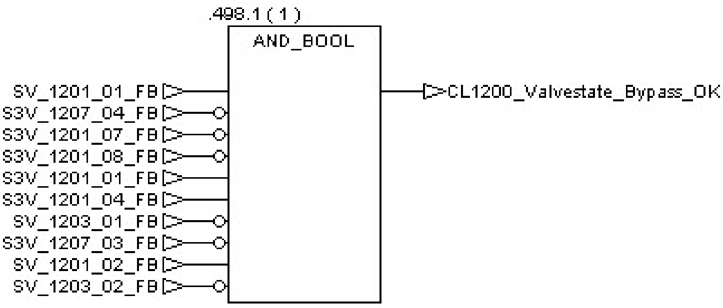
4.21.2.5. *Valve state, mode and tracing bit*

The same logic is respected for all the filtration function. When a procedure is triggered by the operator:

- First the valves are configured in defined position. Once done, the tag referencing the valve process state is set.
- Second, the pump(s) starts. Once done, the tag referencing the valve + the pump is set. This tag is called “mode”. When the mode is set, the tracing bit (used for HMI) is directly set.

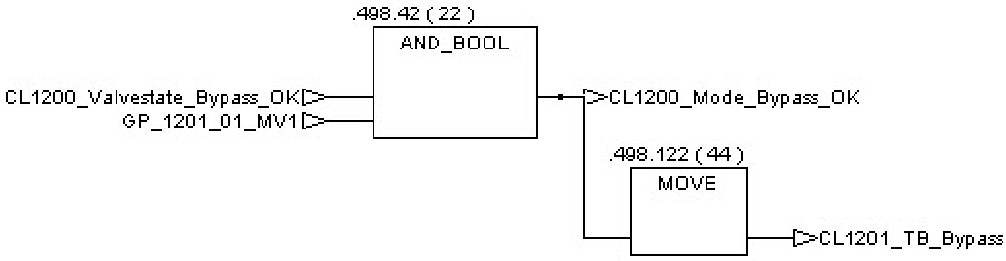
4.21.2.5.1. Bypass management

<u>Valve state:</u>



Once done, the pump is started by the procedure. If no failure happens, the tag CL1200_Mode_Bypass_OK is set at the same time than the Tracing bit.

Mode and Tracing Bit:



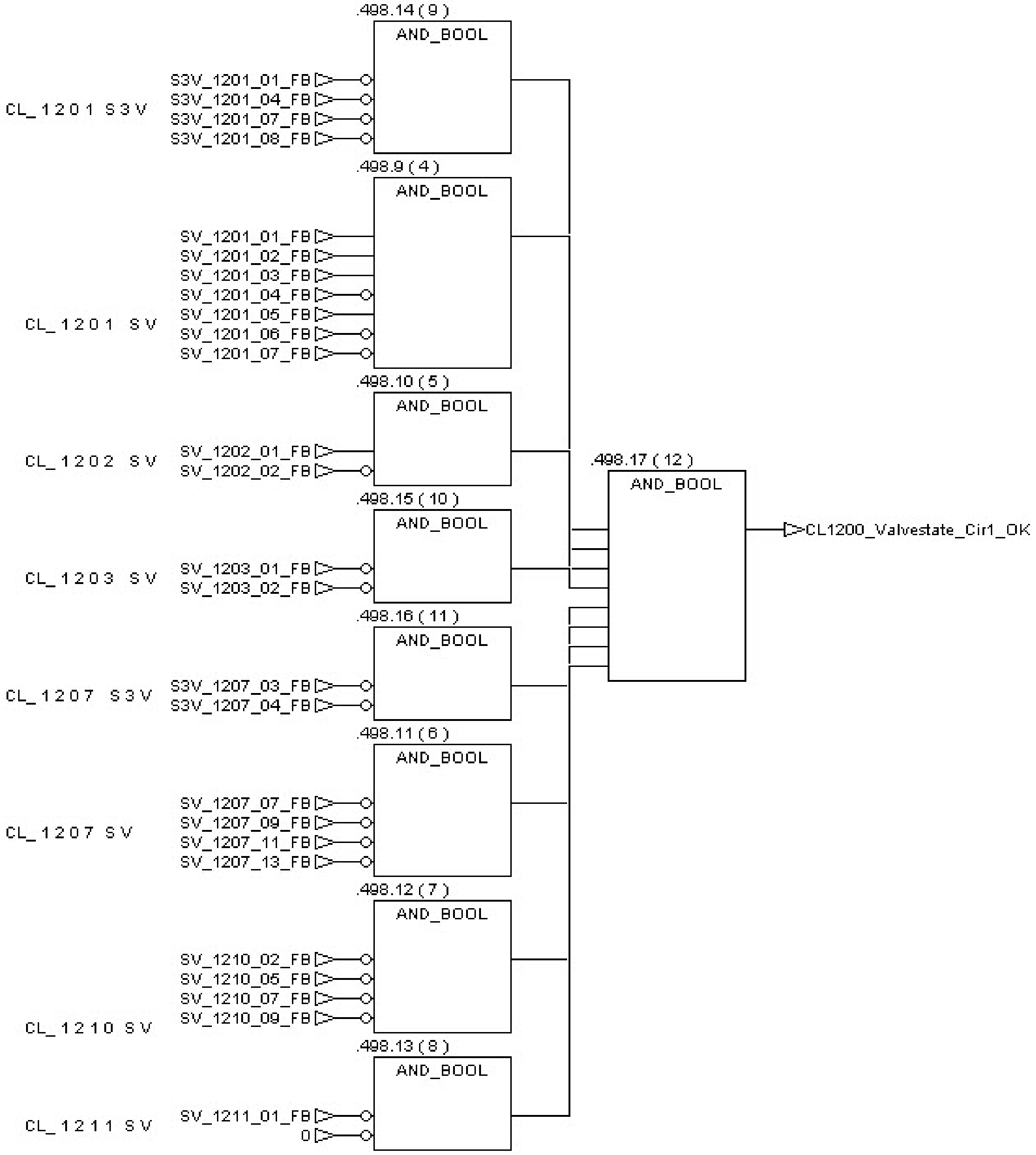
4.21.2.5.2. Filtration Management

Some explanations need to be provided to have a good understanding of the filtration function.

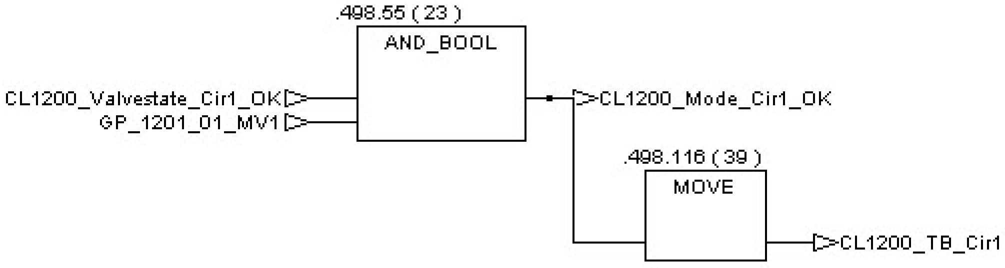
1- The "circulation membrane 1 or 2" means all equipment from output of the bioreactor (Valve + retentate pump) to the filtrate pump (PP_1202_01 not included)
2- The " filtration membrane 1 or 2" means all equipments from bioreactor output to the filtrate pump (Included)
3- The nominal mode means all equipments from bioreactor to effluent tank. It is the main function of the filtration unit.
4- The "recycle mode of membrane 1 or 2" means all equipments from bioreactor output to the valve situated downstream the filtrate pump (SV_1202_03 & SV_1202_04)

4.21.2.5.2.1. Circulation Membrane 1

Valvestate:

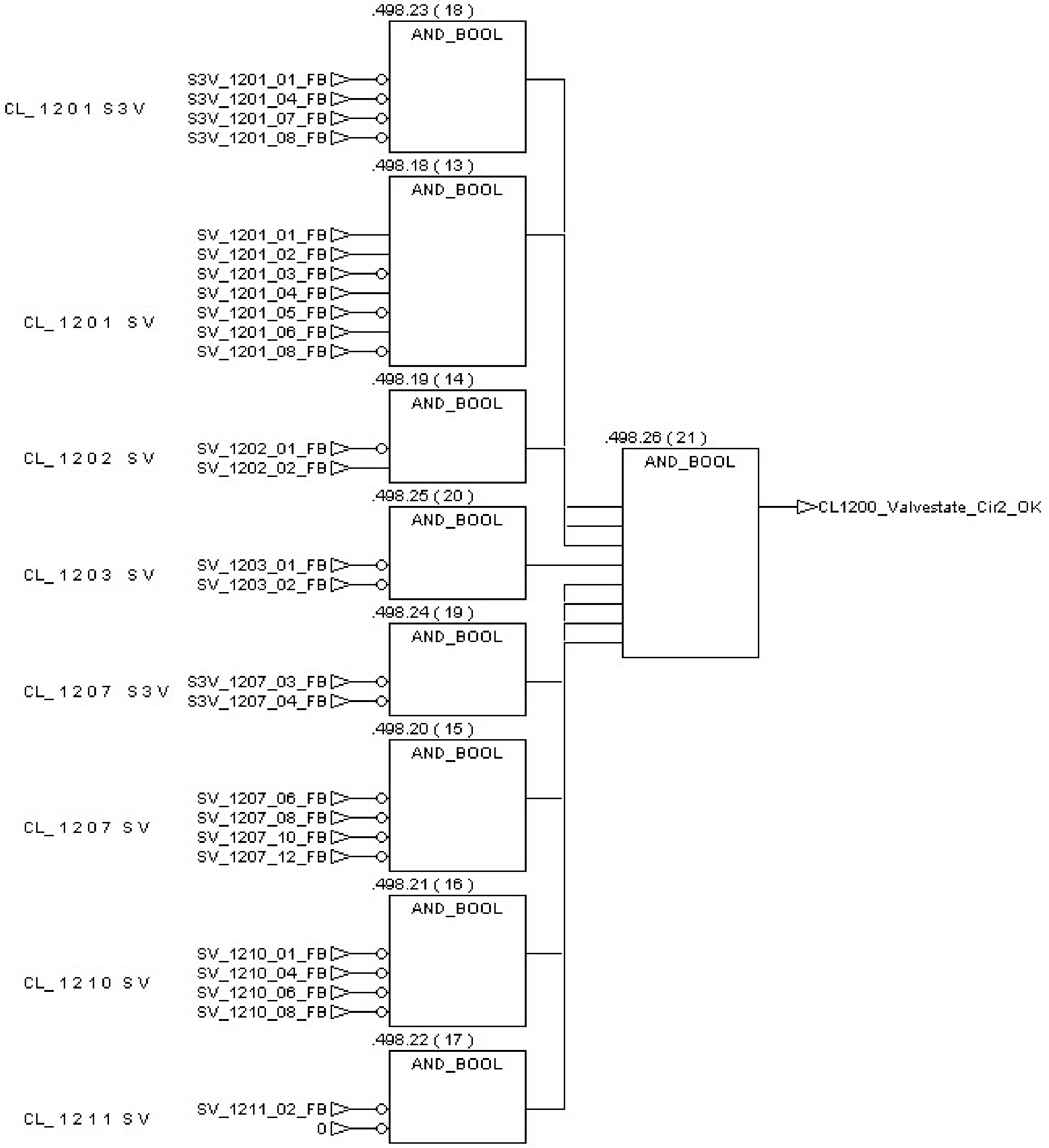

.498.14 (9)
AND_BOOL
CL_1201 S3V
S3V_1201_01_FB
S3V_1201_04_FB
S3V_1201_07_FB
S3V_1201_08_FB
.498.9 (4)
AND_BOOL
CL_1201 SV
SV_1201_01_FB
SV_1201_02_FB
SV_1201_03_FB
SV_1201_04_FB
SV_1201_05_FB
SV_1201_06_FB
SV_1201_07_FB
.498.10 (5)
AND_BOOL
CL_1202 SV
SV_1202_01_FB
SV_1202_02_FB
.498.15 (10)
AND_BOOL
CL_1203 SV
SV_1203_01_FB
SV_1203_02_FB
.498.16 (11)
AND_BOOL
CL_1207 S3V
S3V_1207_03_FB
S3V_1207_04_FB
.498.11 (6)
AND_BOOL
CL_1207 SV
SV_1207_07_FB
SV_1207_09_FB
SV_1207_11_FB
SV_1207_13_FB
.498.12 (7)
AND_BOOL
CL_1210 SV
SV_1210_02_FB
SV_1210_05_FB
SV_1210_07_FB
SV_1210_09_FB
.498.13 (8)
AND_BOOL
CL_1211 SV
SV_1211_01_FB
0
.498.17 (12)
AND_BOOL
CL1200_Valvestate_Cir1_OK

Mode and tracing bit

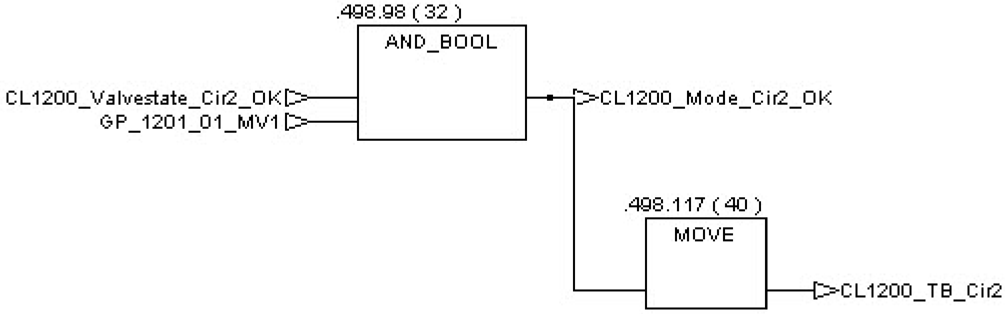


4.21.2.5.2.2. Circulation Membrane 2

Valvestate:

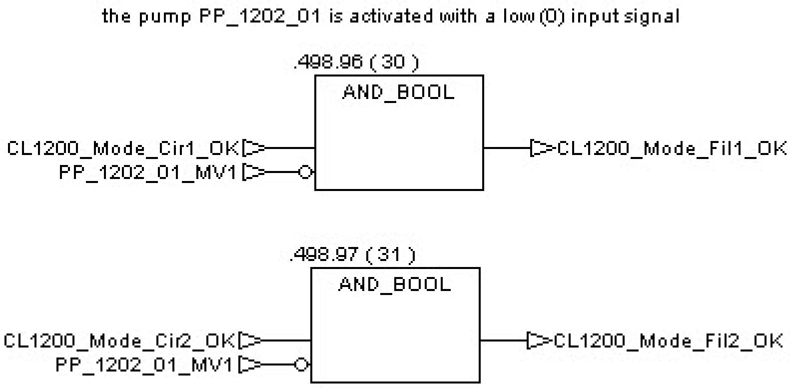


Mode and Tracing Bit:

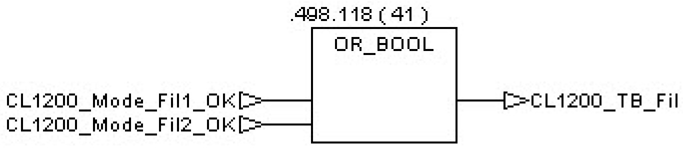


4.21.2.5.2.3.Filtration Mode Membrane 1 & 2

No valve state exists, only mode linked to the circulation membrane 1 or 2 with the addition of the filtrate pump PP_1202_01.



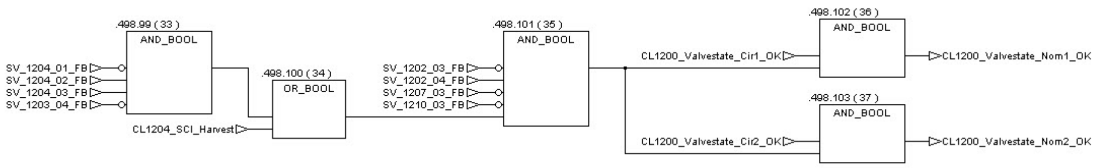
If one of the two modes is set, the following tracing bit is directly set.



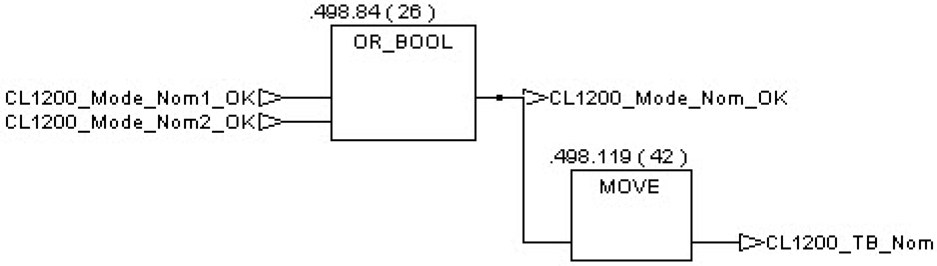
4.21.2.5.2.4.Nominal mode membrane 1 & 2

Vave state:

Two distinct valve states exist in the nominal mode. As the filtration function is separated from the harvesting function, the tags "CL1200_Valvestate_nom1" and "CL1200_Valvestate_nom2" are maintained even if the harvest function is ongoing.



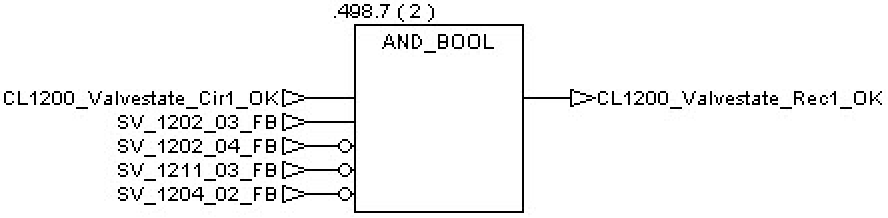
Mode and Tracing Bit:

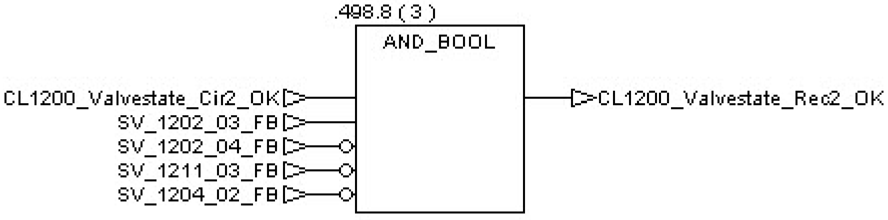


4.21.2.5.2.5. Recycle mode membrane 1 and 2

Valve state:

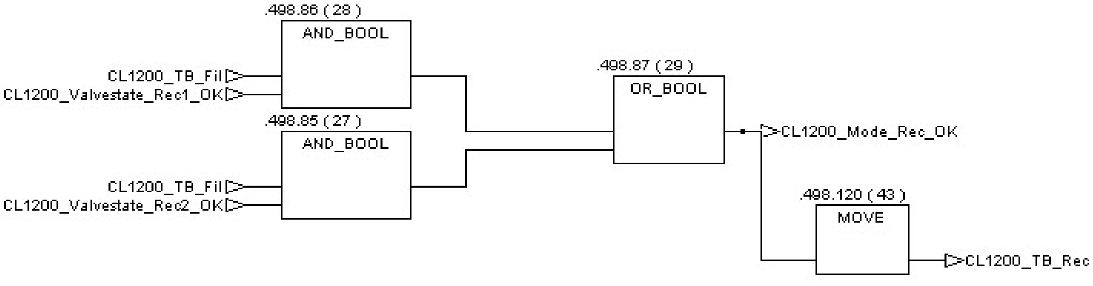
The valve state of the recycle function is provided by the switch of two valves compared to the nominal mode. SV_1202_04 becomes closed and SV_1202_03 becomes opened.





Mode and Tracing Bit:

When the filtration mode is set (circulation mode + filtrate pump) with the valves in recycle position, the recycle mode and the recycle tracing bit is set.



4.21.3.Alarms and Thresholds

Alarm tag Name	type	Address	description
TT_1200_01_AH	BOOL	000564	High temperature alarm ACTION : DISPLAY ALARM ON HMI THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
TT_1200_01_AHH	BOOL	000565	Very High temperature alarm ACTION : DISPLAY ALARM ON HMI THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
TT_1200_01_AL	BOOL	000566	Low temperature alarm ACTION : DISPLAY ALARM ON HMI THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
TT_1200_01_ALL	BOOL	000567	Very Low temperature alarm ACTION : DISPLAY ALARM ON HMI THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
TT_1200_01_ERR	BOOL	000568	broken wire alarm ACTION : DISPLAY ALARM ON HMI
TT_1200_02_AH	BOOL	000569	High temperature alarm ACTION : DISPLAY ALARM ON HMI THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
TT_1200_02_AHH	BOOL	000570	Very High temperature alarm ACTION : DISPLAY ALARM ON HMI THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
TT_1200_02_AL	BOOL	000571	Low temperature alarm ACTION : DISPLAY ALARM ON HMI THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
TT_1200_02_ALL	BOOL	000572	Very Low temperature alarm ACTION : DISPLAY ALARM ON HMI THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
TT_1200_02_ERR	BOOL	000573	broken wire alarm ACTION : DISPLAY ALARM ON HMI
TT_1200_03_AH	BOOL	000574	High temperature alarm ACTION : DISPLAY ALARM ON HMI THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
TT_1200_03_AHH	BOOL	000575	Very High temperature alarm ACTION : DISPLAY ALARM ON HMI THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
TT_1200_03_AL	BOOL	000576	Low temperature alarm ACTION : DISPLAY ALARM ON HMI THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
TT_1200_03_ALL	BOOL	000577	Very Low temperature alarm ACTION : DISPLAY ALARM ON HMI THE ALARM IS OPERATIONNAL ONLY IF NO STERILIZATION PROCEDURE ARE ONGOING
TT_1200_03_ERR	BOOL	000578	broken wire alarm ACTION : DISPLAY ALARM ON HMI

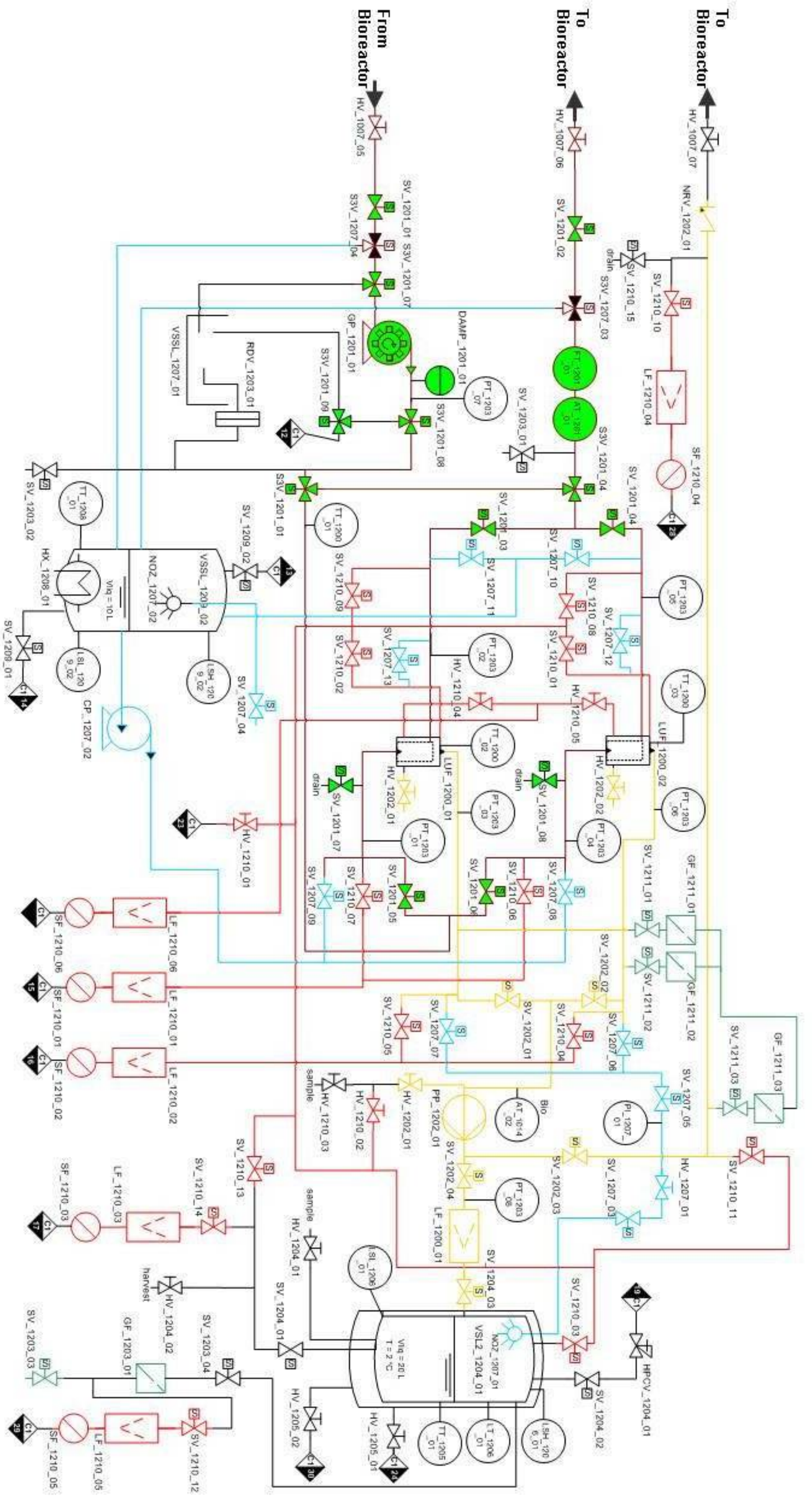
Figure 61: Filtration Unit General– ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
TT_1200_01_LIM_AH	REAL	401072	55 Only during nominal or recycle mode / membrane 1 and 2	°C	Display an alarm

TT_1200_01_LIM_AHH	REAL	401074	60 Only during nominal or recycle mode / membrane 1 and 2	°C	Display an alarm
TT_1200_01_LIM_AL	REAL	401076	40 Only during nominal or recycle mode / membrane 1 and 2	°C	Display an alarm
TT_1200_01_LIM_ALL	REAL	401078	35 Only during nominal or recycle mode / membrane 1 and 2	°C	Display an alarm
TT_1200_02_LIM_AH	REAL	401080	55 Only during nominal or recycle mode / membrane 1	°C	Display an alarm
TT_1200_02_LIM_AHH	REAL	401082	60 Only during nominal or recycle mode / membrane 1	°C	Display an alarm
TT_1200_02_LIM_AL	REAL	401084	40 Only during nominal or recycle mode / membrane 1	°C	Display an alarm
TT_1200_02_LIM_ALL	REAL	401086	35 Only during nominal or recycle mode / membrane 1	°C	Display an alarm
TT_1200_03_LIM_AH	REAL	401088	55 Only during nominal or recycle mode / membrane 2	°C	Display an alarm
TT_1200_03_LIM_AHH	REAL	401090	60 Only during nominal or recycle mode / membrane 2	°C	Display an alarm
TT_1200_03_LIM_AL	REAL	401092	40 Only during nominal or recycle mode / membrane2	°C	Display an alarm
TT_1200_03_LIM_ALL	REAL	401094	35 Only during nominal or recycle mode / membrane2	°C	Display an alarm

Figure 62: Filtration Unit General– THRESHOLDS

4.22. Filtration Unit Retentate Flow Control (CL1201)



4.22.1.Function

This loop concerns the retentate part of the filtration unit. The aim is to create a continuous flow of waste passing inside the selected membrane and permitting liquid exchange with the filtrate side. Concerning the Control loop management and as explained in the “Filtration Unit General” chapter, the entire filtration unit is considered as one entity.
Depending on the chosen mode (defined by the tag “CL1200_ControlLoop_Mode”), the operator can do the following actions.

OFF Mode: All equipments are in default position. The filtration unit is stopped and no procedure can be started.

Auto mode: The procedure linked to the filtration unit can be started (With the CIP AND SIP control loop also in automatic). The equipment status are checked when the process state is changing (When automatic procedure is called). The alarm thresholds make sure the process runs smoothly.

Manu mode: The operator can manipulate valves and pumps but can’t change the filtration state until he switches to automatic mode. **Important point: If the operator decides to switch from manual to automatic mode with a valve linked to the filtration function in a wrong position, the process will recover the good position instantaneously. This is true for FU/CIP/SIP when they are triggered in automatic.**

PLC Section name	Equipment tag	Type	Address	Comment
Filtration Unit Retentate Flow Control	FT_1201_01	AI	400077	Flow meter Measures the retentate flow
Filtration Unit Retentate Flow Control	AT_1201_01	AI	400151	Turbidity sensor Measures turbidity of retentate
Filtration Unit Retentate Flow Control	GP_1201_01_MV1	DO	000032	Pump Pumps reactor content through membranes LUF_1200_01 and LUF_1200_02 in retentate loop. Is also used during cleaning of the retentate loop
Filtration Unit Retentate Flow Control	GP_1201_01_MV2	AO	400002	pump speed
Filtration Unit Retentate Flow Control	DAMP_1201_01	NC		Pressure pulse silencer Reduces pressure variations in the retentate loop
Filtration Unit Retentate Flow Control	S3V_1201_01_MV	DO	000061	Powered 3-way valve Used to bypass the FU
Filtration Unit Retentate Flow Control	S3V_1201_01_FB	DI	100088	valve feedback
Filtration Unit Retentate Flow Control	S3V_1201_04_MV	DO	000064	Powered 3-way valve Used to bypass the FU
Filtration Unit Retentate Flow Control	S3V_1201_04_FB	DI	100085	valve feedback

PLC Section name	Equipment tag	Type	Address	Comment
Filtration Unit Retentate Flow Control	S3V_1201_07_MV	DO	000042	Powered 3-way valve Used to pump back retentate from VSSL_1207_01 to retentate line in FU
Filtration Unit Retentate Flow Control	S3V_1201_07_FB	DI	100075	valve feedback
Filtration Unit Retentate Flow Control	S3V_1201_08_MV	DO	000043	Powered 3-way valve Used to drain retentate from FU retentate line in VSSL_1207_01 or in a vessel
Filtration Unit Retentate Flow Control	S3V_1201_08_FB	DI	100074	valve feedback
Filtration Unit Retentate Flow Control	S3V_1201_09_MV	DO	000044	Powered 3-way valve Used to drain retentate from FU retentate line in VSSL_1207_01 or in a vessel
Filtration Unit Retentate Flow Control	S3V_1201_09_FB	DI	100073	valve feedback
Filtration Unit Retentate Flow Control	SV_1201_01_MV	DO	000060	Powered 2-way valve Opens/ closes retentate flow from bioreactor VSL2_1007_01 to Filtration Unit
Filtration Unit Retentate Flow Control	SV_1201_01_FB	DI	100089	valve feedback
Filtration Unit Retentate Flow Control	SV_1201_02_MV	DO	000049	Powered 2-way valve Opens/ closes retentate flow from FU to bioreactor VSL2_1007_01
Filtration Unit Retentate Flow Control	SV_1201_02_FB	DI	100084	valve feedback
Filtration Unit Retentate Flow Control	SV_1201_03_MV	DO	000063	Powered 2-way valve Used to select outlet retentate from membrane LF_1200_01 (must close the SV_1201_04 valve)
Filtration Unit Retentate Flow Control	SV_1201_03_FB	DI	100086	valve feedback
Filtration Unit Retentate Flow Control	SV_1201_04_MV	DO	000098	Powered 2-way valve Used to select outlet retentate from membrane LF_1200_02 (must close the SV_1201_03 valve)
Filtration Unit Retentate Flow Control	SV_1201_04_FB	DI	100130	valve feedback
Filtration Unit Retentate Flow Control	SV_1201_05_MV	DO	000062	Powered 2-way valve Used to select inlet retentate of membrane LF_1200_01 (must close the SV_1201_06 valve)
Filtration Unit Retentate Flow Control	SV_1201_05_FB	DI	100087	valve feedback
Filtration Unit Retentate Flow Control	SV_1201_06_MV	DO	000097	Powered 2-way valve Used to select inlet retentate of membrane LF_1200_02 (must close the SV_1201_05 valve)
Filtration Unit Retentate Flow Control	SV_1201_06_FB	DI	100129	valve feedback
Filtration Unit Retentate Flow Control	SV_1201_07_MV	DO	000041	Powered 2-way valve Used to drain the retentate side of membrane LF_1200_01
Filtration Unit Retentate Flow Control	SV_1201_07_FB	DI	100076	valve feedback
Filtration Unit Retentate Flow Control	SV_1201_08_MV	DO	000056	Powered 2-way valve Used to drain the retentate side of membrane LF_1200_02
Filtration Unit Retentate Flow Control	SV_1201_08_FB	DI	100077	valve feedback

Figure 63: Filtration Unit Retentate Flow Control – EQUIPMENTS

PLC Section name	Button tag	Type	Address	Comment
Filtration Unit Retentate Flow Control	CL1201_Cross_Flow	REAL	400451	Calculation of the crossing flow through membrane running. (use tag "CL1201_Membr_cross_surface" as parameters Cross flow = flow rate / surface of the internal membrane cross section = FT_1201_01 (L/min) / ((d/2)²*3.1415 * 1000 L/m³ * 60 s/min)
Filtration Unit Retentate Flow Control	CL1201_Membr_cross_surface	REAL	400414	Surface of the internal membrane cross section. Parameter used for the calculation of the crossing flow through the membrane running
Filtration Unit Retentate Flow Control	FT_1201_01_in_L_per_h_Filtered	REAL	400205	Retentate Flow per hour (used as process value for the controller)
Filtration Unit Retentate Flow Control	CL1201_SCI_Flowrate_SP	REAL	400412	Flow rate Set point of retentate.
Filtration Unit Retentate Flow Control	GP_1201_01_MV1_OP	BOOL	000589	Start / stop the pump in manual mode
Filtration Unit Retentate Flow Control	GP_1201_01_MV2_OP	REAL	400059	Pump speed in manual mode
Filtration Unit Retentate Flow Control	S3V_1201_01_OP	BOOL	000592	Operator can change the position of the 3 way valve in manual mode.
Filtration Unit Retentate Flow Control	S3V_1201_04_OP	BOOL	000594	Operator can change the position of the 3 way valve in manual mode.
Filtration Unit Retentate Flow Control	S3V_1201_07_OP	BOOL	000596	Operator can change the position of the 3 way valve in manual mode.
Filtration Unit Retentate Flow Control	S3V_1201_08_OP	BOOL	000598	Operator can change the position of the 3 way valve in manual mode.
Filtration Unit Retentate Flow Control	S3V_1201_09_OP	BOOL	000600	Operator can change the position of the 3 way valve in manual mode.
Filtration Unit Retentate Flow Control	SV_1201_01_OP	BOOL	000602	Opens / closes the valve in manual mode
Filtration Unit Retentate Flow Control	SV_1201_02_OP	BOOL	000604	Opens / closes the valve in manual mode
Filtration Unit Retentate Flow Control	SV_1201_03_OP	BOOL	000606	Opens / closes the valve in manual mode
Filtration Unit Retentate Flow Control	SV_1201_04_OP	BOOL	000608	Opens / closes the valve in manual mode
Filtration Unit Retentate Flow Control	SV_1201_05_OP	BOOL	000610	Opens / closes the valve in manual mode
Filtration Unit Retentate Flow Control	SV_1201_06_OP	BOOL	000612	Opens / closes the valve in manual mode
Filtration Unit Retentate Flow Control	SV_1201_07_OP	BOOL	000616	Opens / closes the valve in manual mode
Filtration Unit Retentate Flow Control	SV_1201_08_OP	BOOL	000614	Opens / closes the valve in manual mode
Filtration Unit Retentate Flow	CL1201_SCI_Bypass	BOOL	000270	Trigger the filtration unit in bypass mode

PLC Section name	Button tag	Type	Address	Comment
Control				
Filtration Unit Retentate Flow Control	CL1201_TB_Bypass	BOOL	000090	Tracing bit of the filtration Unit bypass mode
Filtration Unit Retentate Flow Control	CL1201_F_Bypass_error	UDINT	400269	error number in procedure F_Bypass
Filtration Unit Retentate Flow Control	CL1201_F_Auto_Bypass_error	UDINT	400271	error number in procedure F_Auto_Bypass

Figure 64: Filtration Unit Retentate Flow Control – USER INDICATOR / INPUT

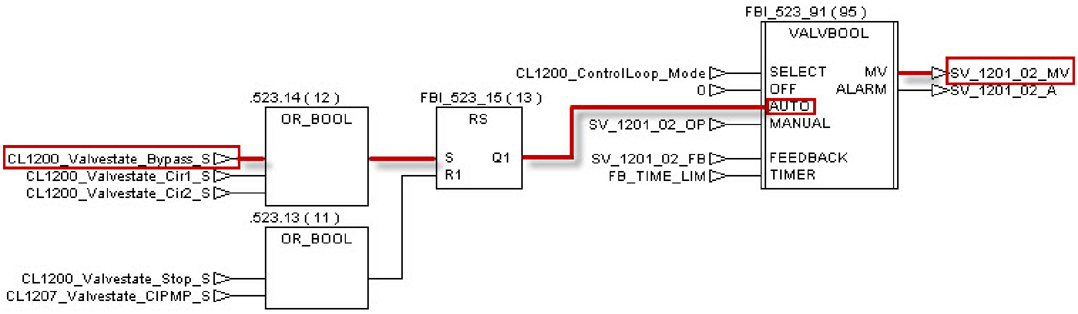
4.22.2.Block Diagram

4.22.2.1. *Valves management*

Important point:
The “Valvbool” block has been created to manage the Boolean valve. This block allows the mode management thanks to internal selector block (OFF/ AUTO / MANU) and the valve alarm linked to the feedback. The complete description is detailed in the annex chapter.
In automatic mode, depending on the procedure activated, the valves are set or reset to provide desired functions. The way to change the valves status is a pulse sent by the procedure to a defined tag. To be easily recognizable, all these kind of tags are named with the same logic.
Here is this named logic:

5- The control loop number
6- “_valvestate_”
7- The name of the procedure which triggers the valve
8- “_S” or “_R

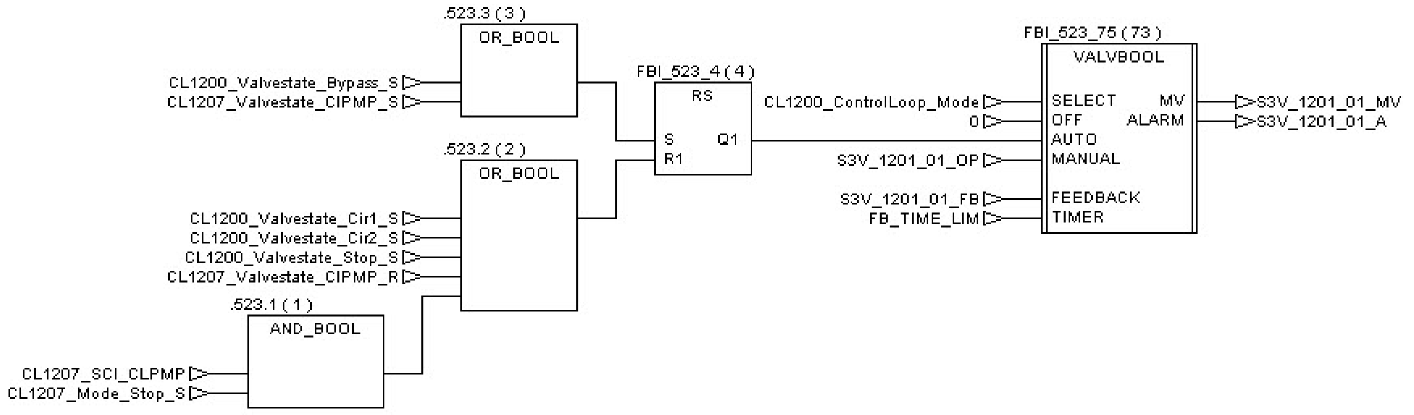
Example:
During the procedure F_Bypass, “CL1200_Valvestate_Bypass_S” triggers the valve SV_1201_02 in bypass position. This tag will be find on each valves linked the bypass mode of the Filtration Unit.



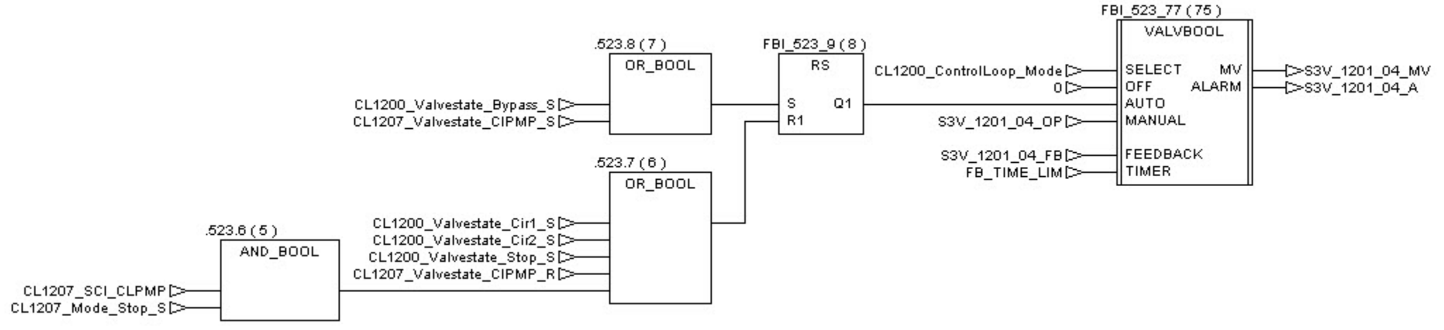
Depending on the procedure step needs, the “_S”, situated at the end of the tag name, will set the valves in good position (either open or close), as well for the “_R” which will reset the valves in the default position.
Most of the procedure follows this logic.
However, sometimes, when only one valve needs to be triggered inside the procedure, the pulse is named as “*name of the valve*_S” for the opening and “*name of the valve*_R” for the closing.

4.22.2.1.1. 3 ways valves

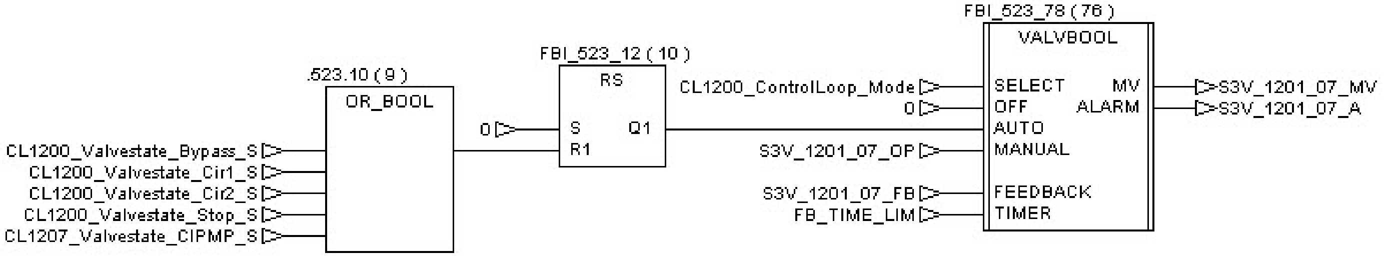
S3V_1201_01:



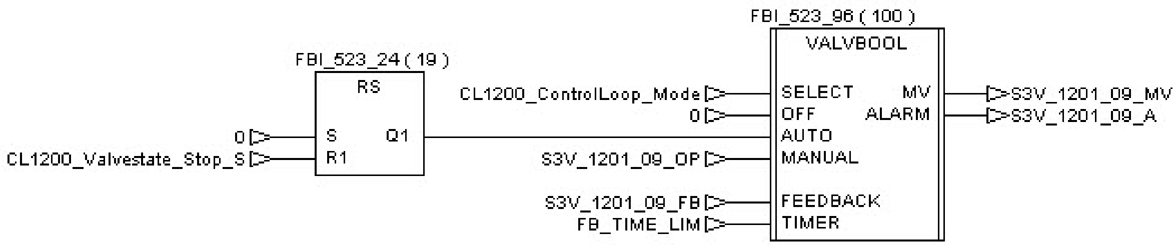
S3V_1201_04:



S3V_1201_07:

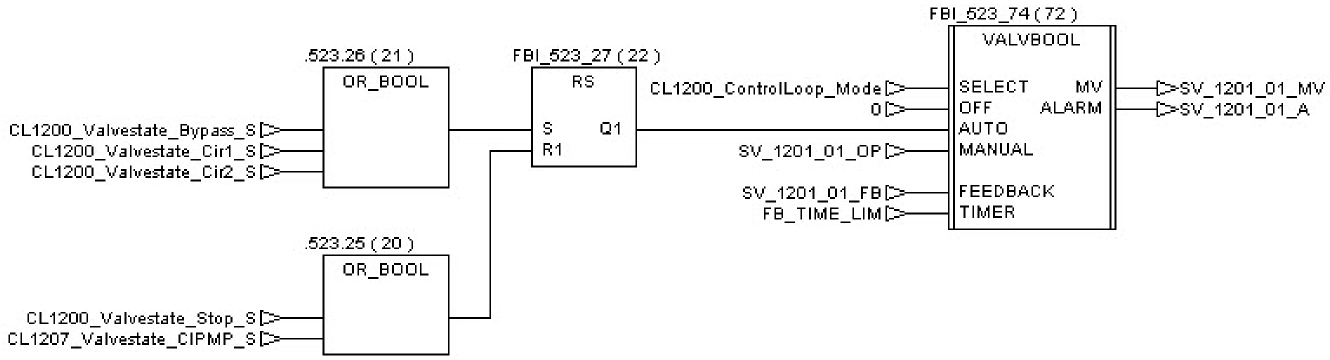


S3V_1201_08:

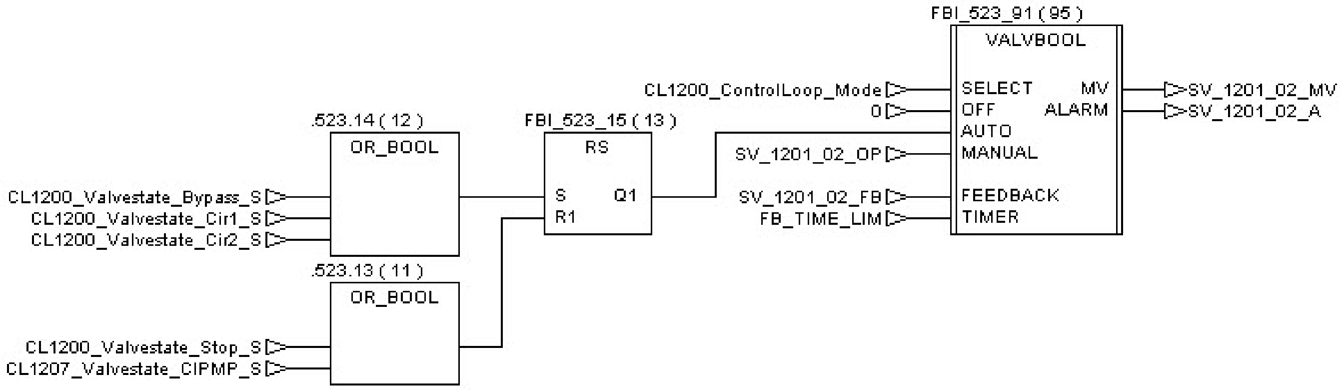


4.22.2.1.2. 2 ways valves

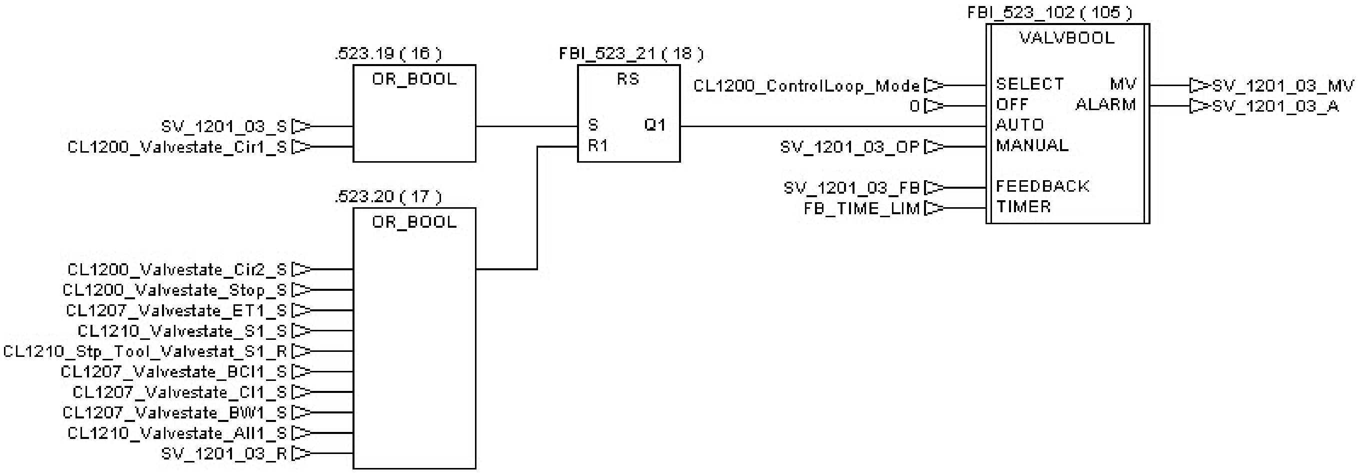
<u>SV_1201_01:</u>



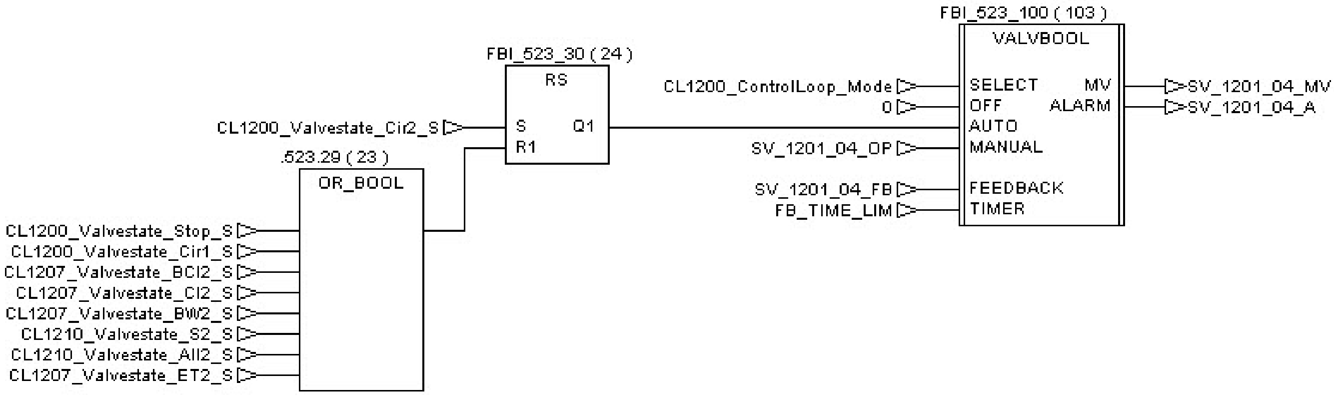
<u>SV_1201_02:</u>



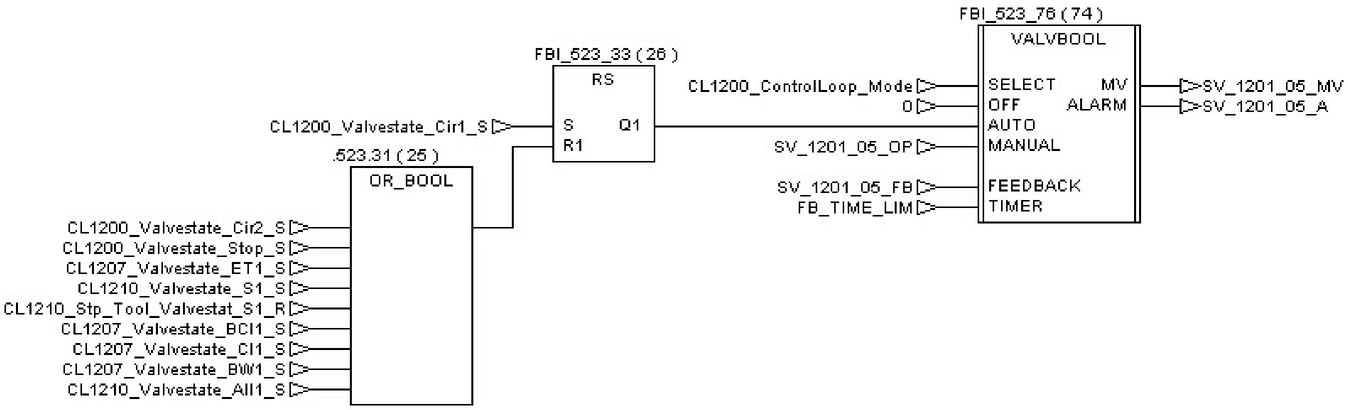
<u>SV_1201_03:</u>



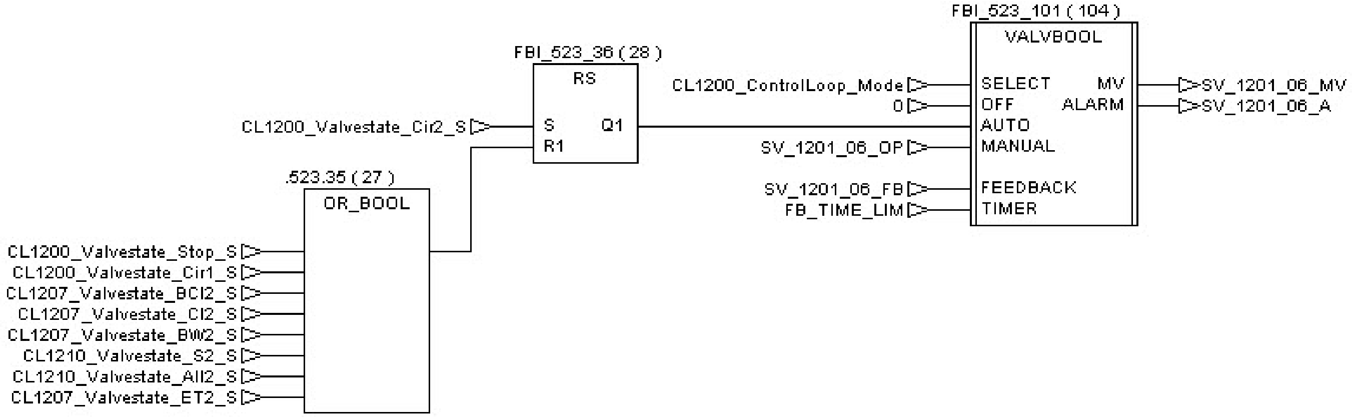
SV_1201_04:



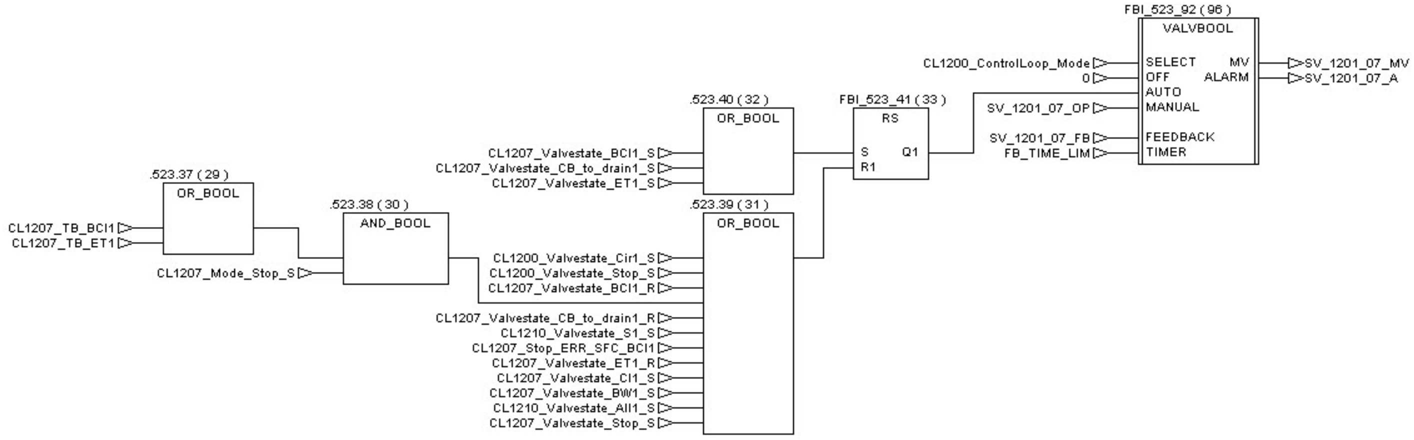
SV_1201_05:



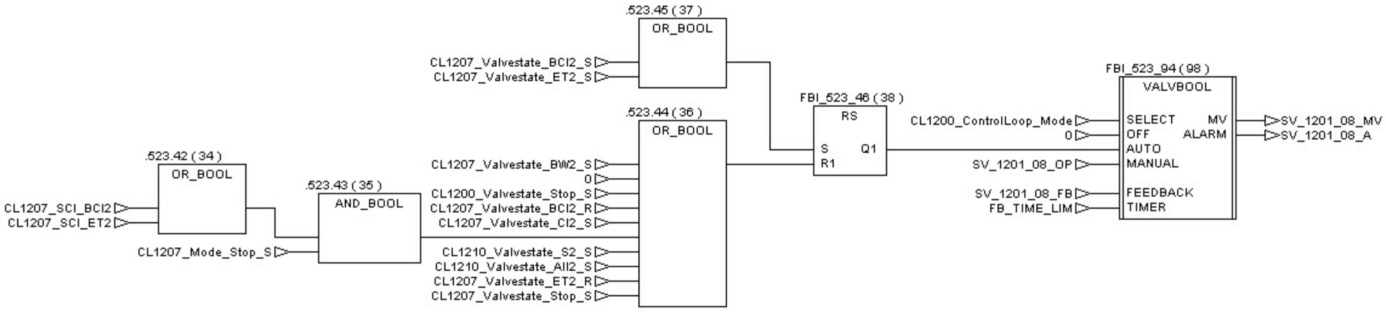
SV_1201_06:


FBI_523_101 (104)
VALVBOOL
FBI_523_36 (28)
RS
CL1200_ControlLoop_Mode
SELECT
MV
SV_1201_06_MV
0
OFF
ALARM
SV_1201_06_A
CL1200_Valvestate_Cir2_S
S
Q1
AUTO
R1
SV_1201_06_OP
MANUAL
.523.35 (27)
SV_1201_06_FB
FEEDBACK
OR_BOOL
FB_TIME_LIM
TIMER
CL1200_Valvestate_Stop_S
CL1200_Valvestate_Cir1_S
CL1207_Valvestate_BCl2_S
CL1207_Valvestate_Cl2_S
CL1207_Valvestate_BW2_S
CL1210_Valvestate_S2_S
CL1210_Valvestate_All2_S
CL1207_Valvestate_ET2_S

SV_1201_07:

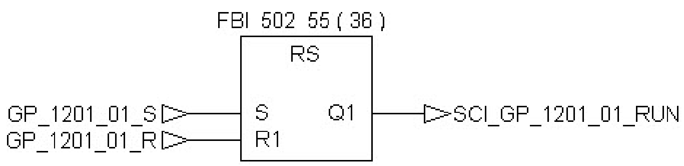


SV_1201_08:



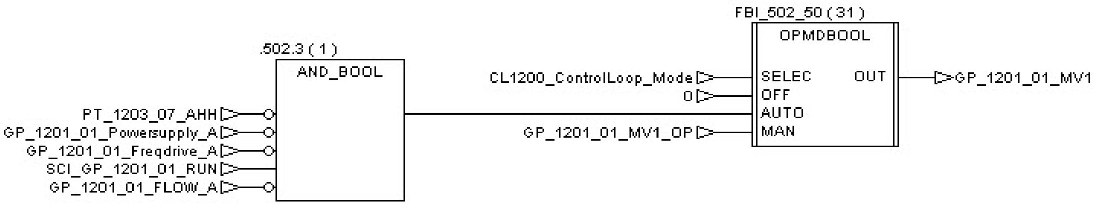
4.22.2.2. *Pump management (GP_1201_01)*

In automatic mode, the retentate pump is managed by the filtration procedure. To start or to stop the pump, a pulse is sent by the procedure on a “Set / Reset” block.



The tag “SCI_GP_1201_01_RUN” is the condition to start or stop the pump if no error is detected.
The pump stops if:

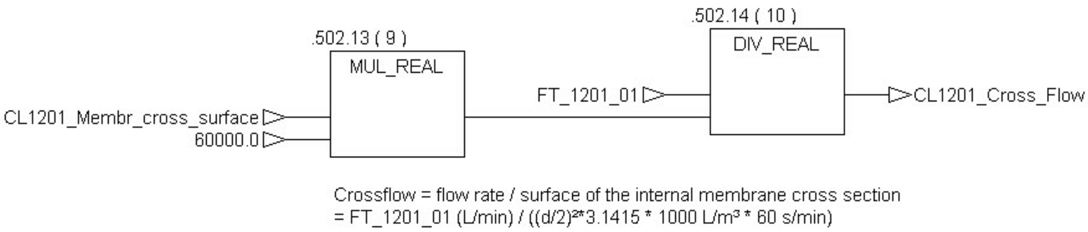
- Pressure of retentate line reaches 2 bars (very High pressure alarm)
- The power supply alarm is set
- The frequency drive alarm is set
- The flow in the retentate line is lower than 50 L/h during 5 minutes



4.22.2.3. *Membrane Cross flow calculation*

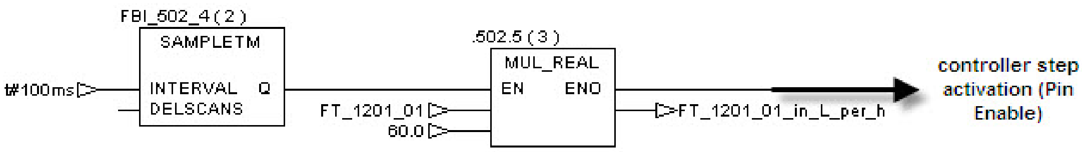
<u>Important point:</u>
This calculation has been implemented by EPAS. Since this implementation, the membrane surface has changed.
As the membrane cross surface parameter is not known, the tag is not display on the HMI at the current time.
This point needs to be discussed with MPP

Here is the implementation of the membrane cross flow calculation:



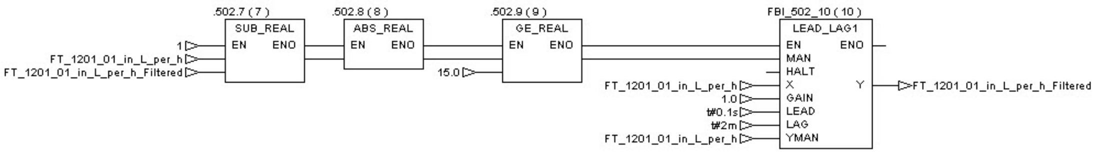
4.22.2.4. *Retentate flow measurement Filter*

The retentate flow meter gives measurement in Litre /min. Each time that the controller is activated, the flow meter measurement is multiplied by 60 to convert the flow in Litre/hour.

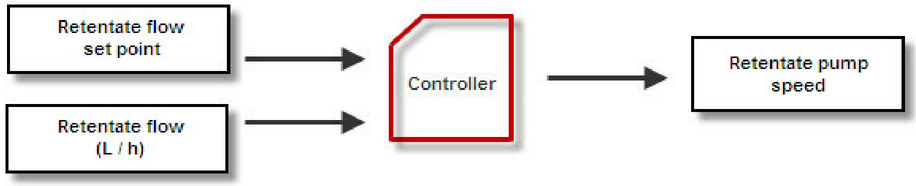


This tag, called “FT_1201_in_L_per_h”, is filtered by a “LEAD_LAG1” block. The value calculates by the filter, called “FT_1201_in_L_per_h_filtered” is the process value of the retentate flow controller.

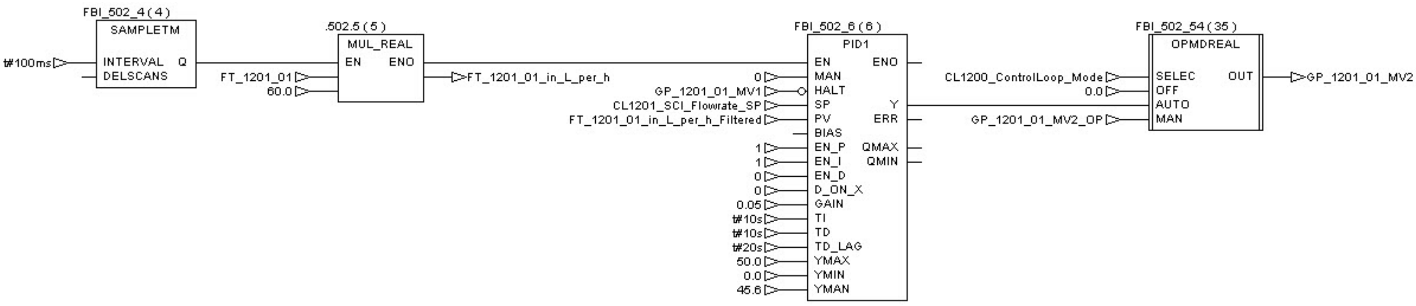
If the value between the tag “FT_1201_in_L_per_h” and the tag “FT_1201_in_L_per_h_filtered” exceeds 15 litres per hour , the tag “FT_1201_in_L_per_h_filtered” becomes “FT_1201_in_L_per_h”.
The filter parameters are:
Gain :1
LEAD: 0.1second (Derivative time constants)
LAG: 2 minutes (Delayed time constants)



4.22.2.5. *Controller*



The retentate flow is controlled by a PI controller. Depending on the set point, the controller will adjust the retentate flow thanks to the speed of the pump GP_1201_01.



4.22.2.6. *Controller Parameters*

Controlled Variable	CONTROLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT

Bioreactor retentate flow	PI	NO	NO	NO	Controller : 100 ms	FT_1201_01_in_L_per_h_Filtered	CL1201_SCI_flowrate_SP

Controlled Variable	INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
Bioreactor retentate flow	No internal model. The controller is not a predictive one	Gain : 0.05 TI : 10 s TD : configured but not used (EPAS implantation)	Y MAX : 50 % Y MIN : 0	NO	NO	No variable (the branch goes directly in the selector block)	GP_1201_01_MV2

4.22.3.Alarms and Thresholds

Alarm tag Name	type	Address	description
FT_1201_01_AH	BOOL	000579	High Flow alarm ACTION : DISPLAY ALARM ON HMI
FT_1201_01_AHH	BOOL	000580	Very High flow alarm ACTION : DISPLAY ALARM ON HMI
FT_1201_01_AL	BOOL	000581	Low flow alarm ACTION : DISPLAY ALARM ON HMI
FT_1201_01_ALL	BOOL	000582	very low flow alarm ACTION : DISPLAY ALARM ON HMI
FT_1201_01_ERR	BOOL	000583	broken wire alarm ACTION : DISPLAY ALARM ON HMI
AT_1201_01_AH	BOOL	000584	High turbidity alarm in retentate line ACTION : DISPLAY ALARM ON HMI
AT_1201_01_AHH	BOOL	000585	Very turbidity alarm in retentate line ACTION : DISPLAY ALARM ON HMI
AT_1201_01_AL	BOOL	000586	Low turbidity alarm in retentate line ACTION : DISPLAY ALARM ON HMI
AT_1201_01_ALL	BOOL	000587	very low turbidity alarm in retentate li ne ACTION : DISPLAY ALARM ON HMI
AT_1201_01_ERR	BOOL	000588	broken wire alarm ACTION : DISPLAY ALARM ON HMI
GP_1201_01_Freqdrive_A	BOOL	000590	OLD TAG: "ERR_GP_1201_01_Freq_Drive" ACTION : DISPLAY ALARM ON HMI
GP_1201_01_Powersupply_A	BOOL	000591	OLD TAG: "ERR_GP_1201_01_Fuse” ACTION : DISPLAY ALARM ON HMI
GP_1201_01_FLOW_A	BOOL		Flow of retentate line is below 50 L/H. --> The control Loop is triggered to OFF mode after 5 minutes ACTION : DISPLAY ALARM ON HMI
S3V_1201_01_A	BOOL	000593	valve alarm ACTION : DISPLAY ALARM ON HMI
S3V_1201_04_A	BOOL	000595	valve alarm ACTION : DISPLAY ALARM ON HMI
S3V_1201_07_A	BOOL	000597	valve alarm ACTION : DISPLAY ALARM ON HMI
S3V_1201_08_A	BOOL	000599	valve alarm ACTION : DISPLAY ALARM ON HMI
S3V_1201_09_A	BOOL	000601	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1201_01_A	BOOL	000603	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1201_02_A	BOOL	000605	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1201_03_A	BOOL	000607	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1201_04_A	BOOL	000609	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1201_05_A	BOOL	000611	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1201_06_A	BOOL	000613	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1201_07_A	BOOL	000617	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1201_08_A	BOOL	000615	valve alarm ACTION : DISPLAY ALARM ON HMI

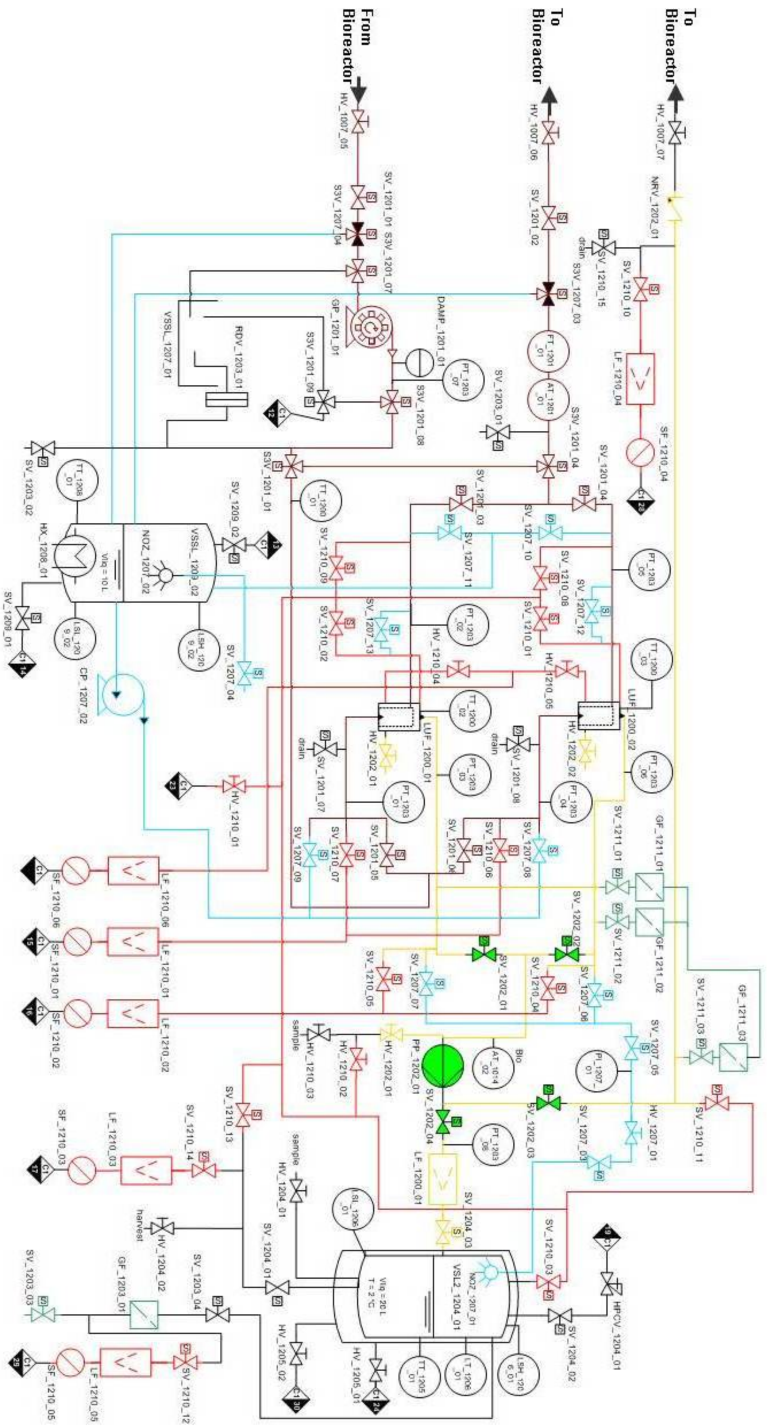
Figure 65: Filtration Unit Retentate Flow Control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
FB_TIME_LIM	TIME	400900	5	seconds	Display an alarm
FT_1201_01_LIM_AH	REAL	401096	+5% compared to the set point	L/h	Display an alarm

			Only in automatic mode		
FT_1201_01_LIM_AHH	REAL	401098	+10% compared to the set point Only in automatic mode	L/h	Display an alarm
FT_1201_01_LIM_AL	REAL	401100	-5% compared to the set point Only in automatic mode	L/h	Display an alarm
FT_1201_01_LIM_ALL	REAL	401102	-10% compared to the setpoint Only in automatic mode	L/h	Display an alarm
AT_1201_01_LIM_AH	REAL	401104	90 Fixed value Only during Bypass mode AND nominal or recycle mode / membrane 1 & 2	NTU	Display an alarm
AT_1201_01_LIM_AHH	REAL	401106	95 Fixed value Only during Bypass mode AND nominal or recycle mode / membrane 1 & 2	NTU	Display an alarm
AT_1201_01_LIM_AL	REAL	401108	55 Fixed value Only during Bypass mode AND nominal or recycle mode / membrane 1 & 2	NTU	Display an alarm
AT_1201_01_LIM_ALL	REAL	401110	50 Fixed value Only during Bypass mode AND nominal or recycle mode / membrane 1 & 2	NTU	Display an alarm

Figure 66: Filtration Unit Retentate Flow Control – THRESHOLDS

4.23. Filtration Unit Filtrate Flow Control (CL1202)



4.23.1.Function

This loop concerns the filtrate part of the filtration unit. The objective in nominal mode is to collect the filtrate liquid (Volatile fatty acids / Minerals / NH4) into the effluent vessel. As explained in the "Filtration Unit General" chapter, the entire filtration unit is considered as one entity. Depending on the chosen mode (defined by the tag "CL1200_ControlLoop_Mode"), the operator can do the following actions.

3 modes are available:

OFF Mode: All equipments are in default position. The filtration unit is stopped and no procedure can be started.

Auto mode: The procedure linked to the filtration unit can be started (With the CIP AND SIP control loop also in automatic). The equipment status are checked when the process state is changing (When automatic procedure is called). The alarm thresholds make sure the process runs smoothly.

Manu mode: The operator can manipulate valves and pumps but can't change the filtration state until he switches to automatic mode. **Important point: If the operator decides to switch from manual to automatic mode with a valve linked to the filtration function in a wrong position, the process will recover the good position instantaneously. This is true for FU/CIP/SIP when they are triggered in automatic.**

PLC Section name	Equipment tag	Type	Address	Comment
Filtration Unit Filtrate Flow Control	PP_1202_01_MV1	DO	000024	Filtrate pump Pumps filtrate out of membranes LUF_1200_01 and LUF_1200_02 to filtrate tank (VSSL_1204_01) and keeps the flux constant
Filtration Unit Filtrate Flow Control	PP_1202_01_MV2	AO	400001	pump speed.
Filtration Unit Filtrate Flow Control	SV_1202_01_MV	DO	000050	Powered 2-way valve Used to select outlet filtrate from membrane LF_1200_01
Filtration Unit Filtrate Flow Control	SV_1202_01_FB	DI	100083	valve feedback
Filtration Unit Filtrate Flow Control	SV_1202_02_MV	DO	000099	Powered 2-way valve Used to select outlet filtrate from membrane LF_1200_02
Filtration Unit Filtrate Flow Control	SV_1202_02_FB	DI	100131	valve feedback
Filtration Unit Filtrate Flow Control	SV_1202_03_MV	DO	000051	Powered 2-way valve Used to send back filtrate to bioreactor (VSSL_1007_01)
Filtration Unit Filtrate Flow Control	SV_1202_03_FB	DI	100082	valve feedback
Filtration Unit Filtrate Flow Control	SV_1202_04_MV	DO	000100	Powered 2-way valve Used to send back to collect filtrate in filtrate tank

PLC Section name	Equipment tag	Type	Address	Comment
				VSSL_1204_01
Filtration Unit Filtrate Flow Control	SV_1202_04_FB	DI	100132	valve feedback

Figure 67: Filtration Unit Filtrate Flow Control – EQUIPMENTS

PLC Section name	Button tag	Type	Address	Comment
Filtration Unit Filtrate Flow Control	PP_1202_01_MV1_OP	BOOL	000618	Start stop the filtrate pump
Filtration Unit Filtrate Flow Control	PP_1202_01_flowrate_SP	REAL	400408	filtration flowrate set point in automatic mode. This tag is multiplied by the parameter "CL1202_Filtr_flowrate_cal_factor" to adjust the speed of PP_1202_01 initial value 5 L/ days
Filtration Unit Filtrate Flow Control	CL1202_Filtr_flowrate_cal_factor	REAL	400461	parameter used for the calculation of the pump speed (PP_1202_01_MV2). This parameter is multiply by the desired flow set point
Filtration Unit Filtrate Flow Control	CL1202_Flux	REAL	400229	calculation of the filtrate flux : Flux = Filtrate flow rate [L/h] / membrane surface [m²]
Filtration Unit Filtrate Flow Control	CL1202_Membr_surface	REAL	400416	parameter enter by the operator : membrane surface [m²]
Filtration Unit Filtrate Flow Control	PP_1202_01_MV2_OP	BOOL	400031	Speed of the filtrate pump in manual mode
Filtration Unit Filtrate Flow Control	SV_1202_01_OP	BOOL	000620	Open / close the valve in manual mode
Filtration Unit Filtrate Flow Control	SV_1202_02_OP	BOOL	000622	Open / close the valve in manual mode
Filtration Unit Filtrate Flow Control	SV_1202_03_OP	BOOL	000624	Open / close the valve in manual mode
Filtration Unit Filtrate Flow Control	SV_1202_04_OP	BOOL	000626	Open / close the valve in manual mode

Figure 68: Filtration Unit Filtrate Flow Control – USER INDICATOR / INPUT

4.23.2.Block Diagram

4.23.2.1. *Valves Management*

Important point:

The "Valvbool" block has been created to manage the Boolean valve. This block allows the mode management thanks to internal selector block (OFF/ AUTO / MANU) and the valve alarm linked to the feedback. The complete description is detailed in the annex chapter.

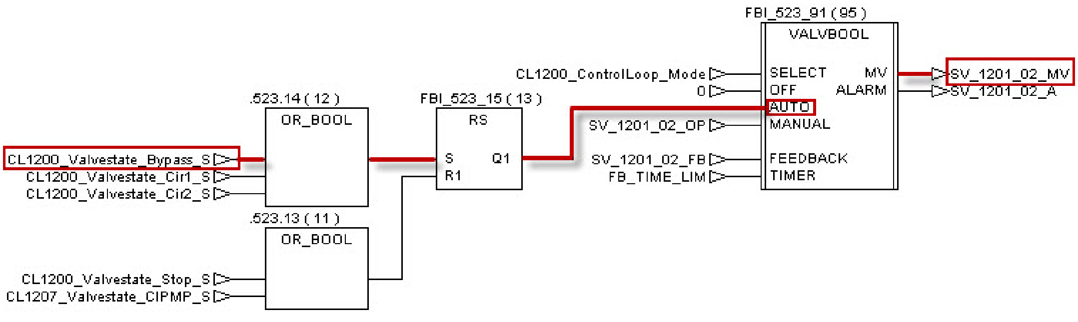
In automatic mode, depending on the procedure activated, the valves are set or reset to provide desired functions. The way to change the valves status is a pulse sent by the procedure to a defined tag. To be easily recognizable, all these kind of tags are named with the same logic.

Here is this named logic:

1- The control loop number
2- "_valvestate_"
3- The name of the procedure which triggers the valve
4- "_S" or "_R

Example:

During the procedure F_Bypass, "CL1200_Valvestate_Bypass_S" triggers the valve SV_1201_02 in bypass position. This tag will be find on each valves linked the bypass mode of the Filtration Unit.

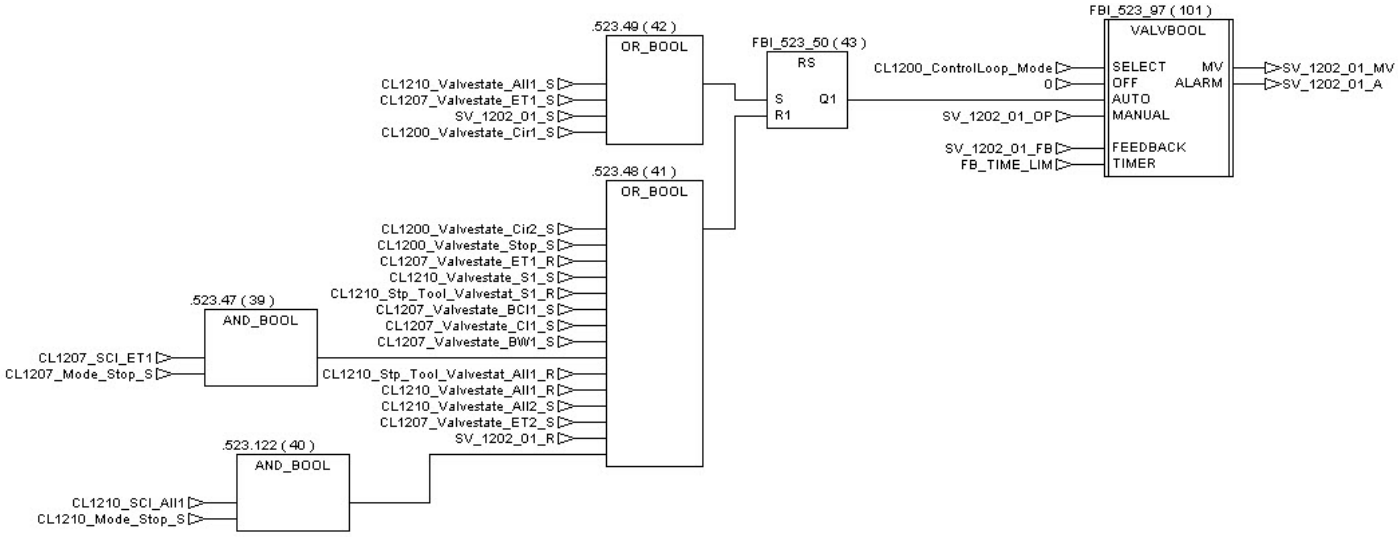


Depending on the procedure step needs, the "_S", situated at the end of the tag name, will set the valves in good position (either open or close), as well for the "_R" which will reset the valves in the default position.

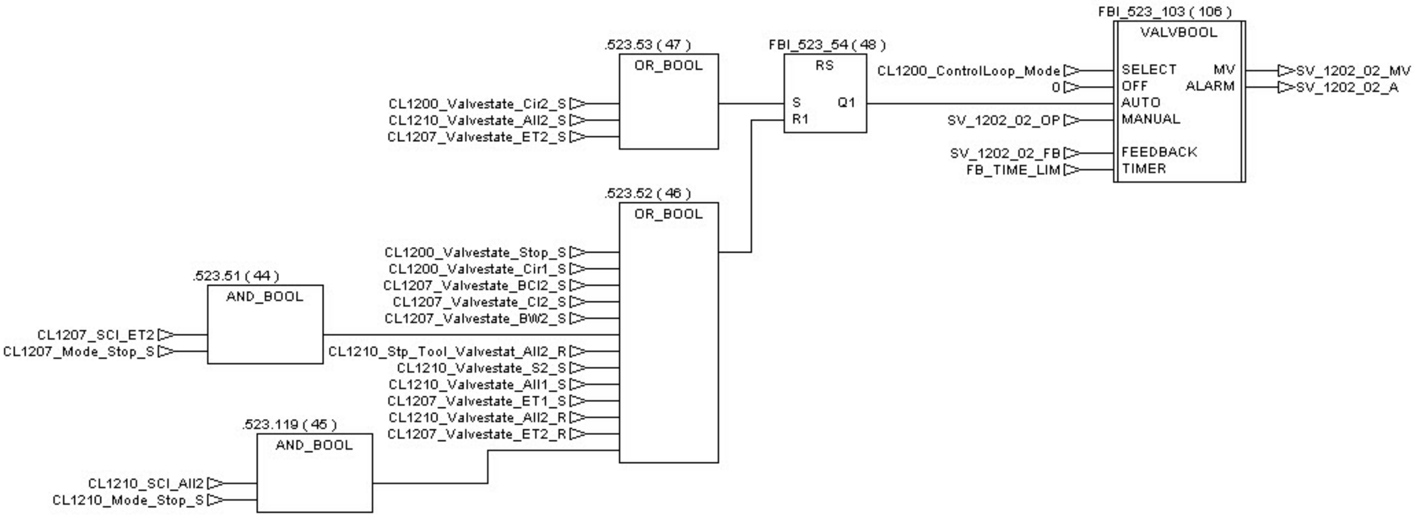
Most of the procedure follows this logic.

However, sometimes, when only one valve needs to be triggered inside the procedure, the pulse is named as "*name of the valve*_S" for the opening and "*name of the valve*_R" for the closing.

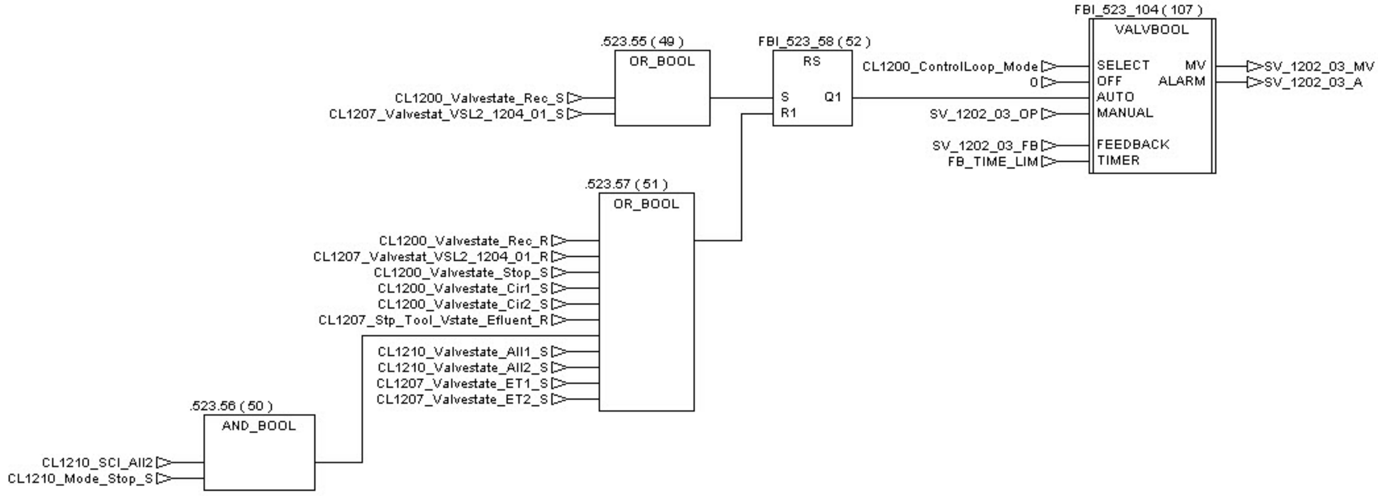
SV_1202_01:



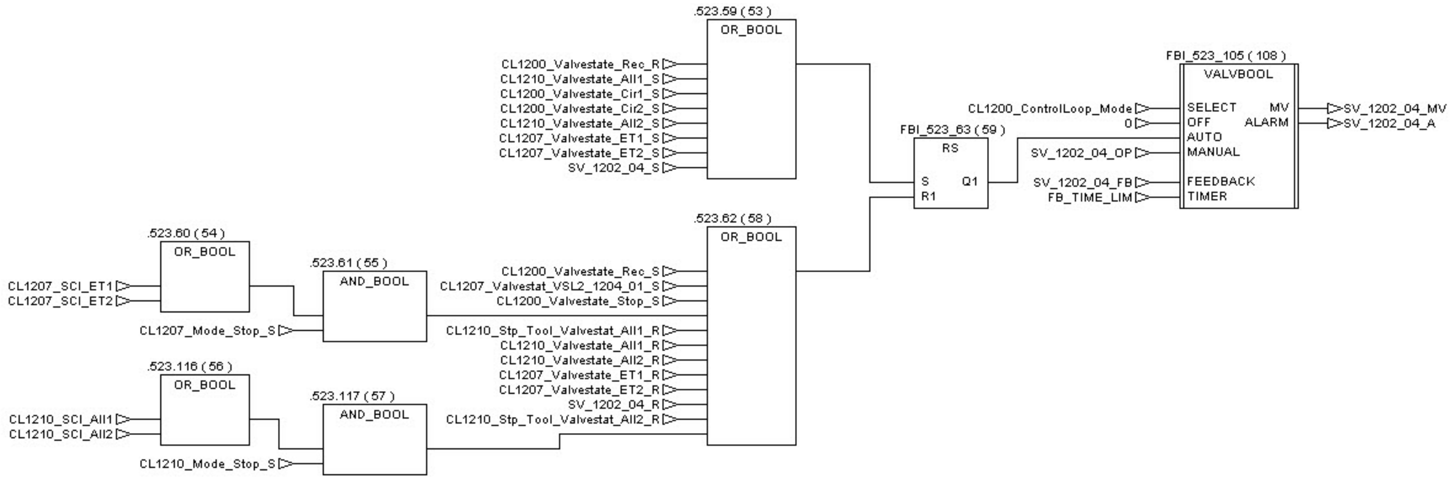
SV_1202_02:



SV_1202_03:

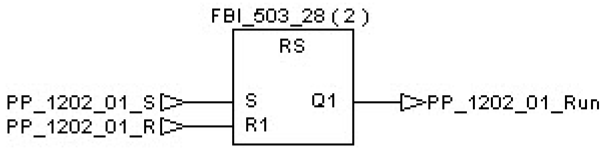


SV_1202_04:

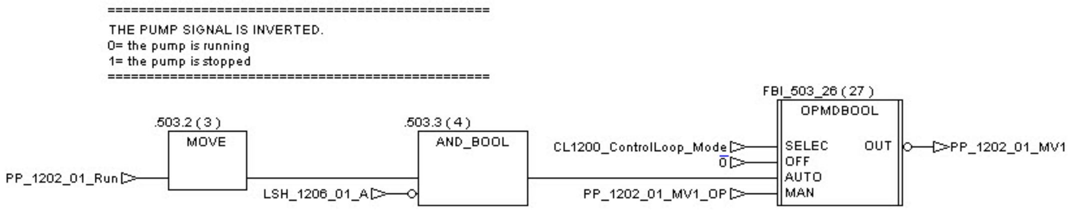


4.23.2.2. *Filtrate pump management*

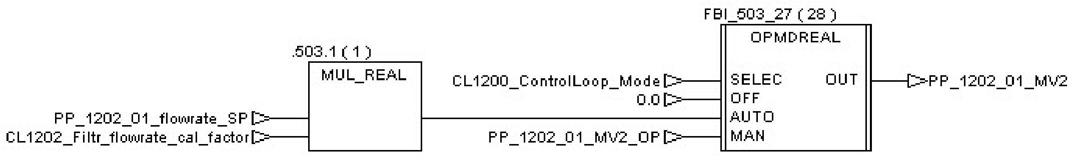
In automatic mode, the filtrate pump is managed by the filtration procedure. To start or to stop the pump, a pulse is sent by the procedure on a “Reset/ Set” block.



The tag “PP_1202_01_RUN” is the condition to start or stop the pump if the effluent tank level switch high is not set.



Depending on the Set point entered by the operator (in Litre per day) and the Flow rate calibration factor (see “important point” below), the speed of the pump is configured.



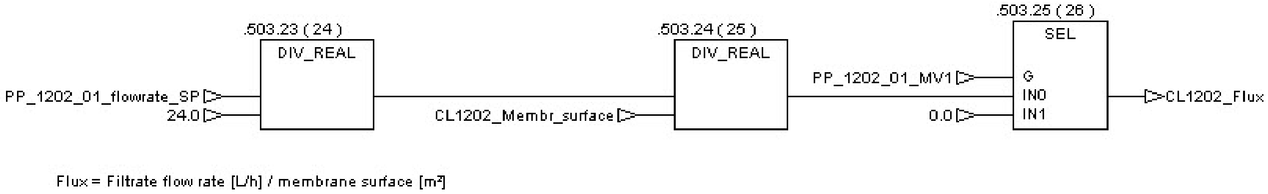
Important point:
At the current time, the tag “CL1202_Filtr_Flowrate_cal_factor” is frozen to “2”. The previous way to calculate this calibration factor (implemented by EPAS) done after each harvest was too simple to be efficient.
Different ways can be foreseen:

1- **To record some test on the filtrate pump in order to calculate precisely a fixed factor.**
2- **To define an efficient way to calibrate this factor depending on all parameter of the filtration (retentate + filtrate).**
3- **To buy and to implement a flow meter in the filtrate line (this solution permit to implement a real control of the filtrate flow.**

This point needs to be discussed with MPP.

4.23.2.3. *Filtrate flux calculation*

Important point:
This calculation has been implemented by EPAS. Since this implementation, the membrane surface has changed.
As the membrane cross surface parameter is not known, the tag is not display on the HMI at the current time.
This point needs to be discussed with MPP



4.23.3.Alarms and Thresholds

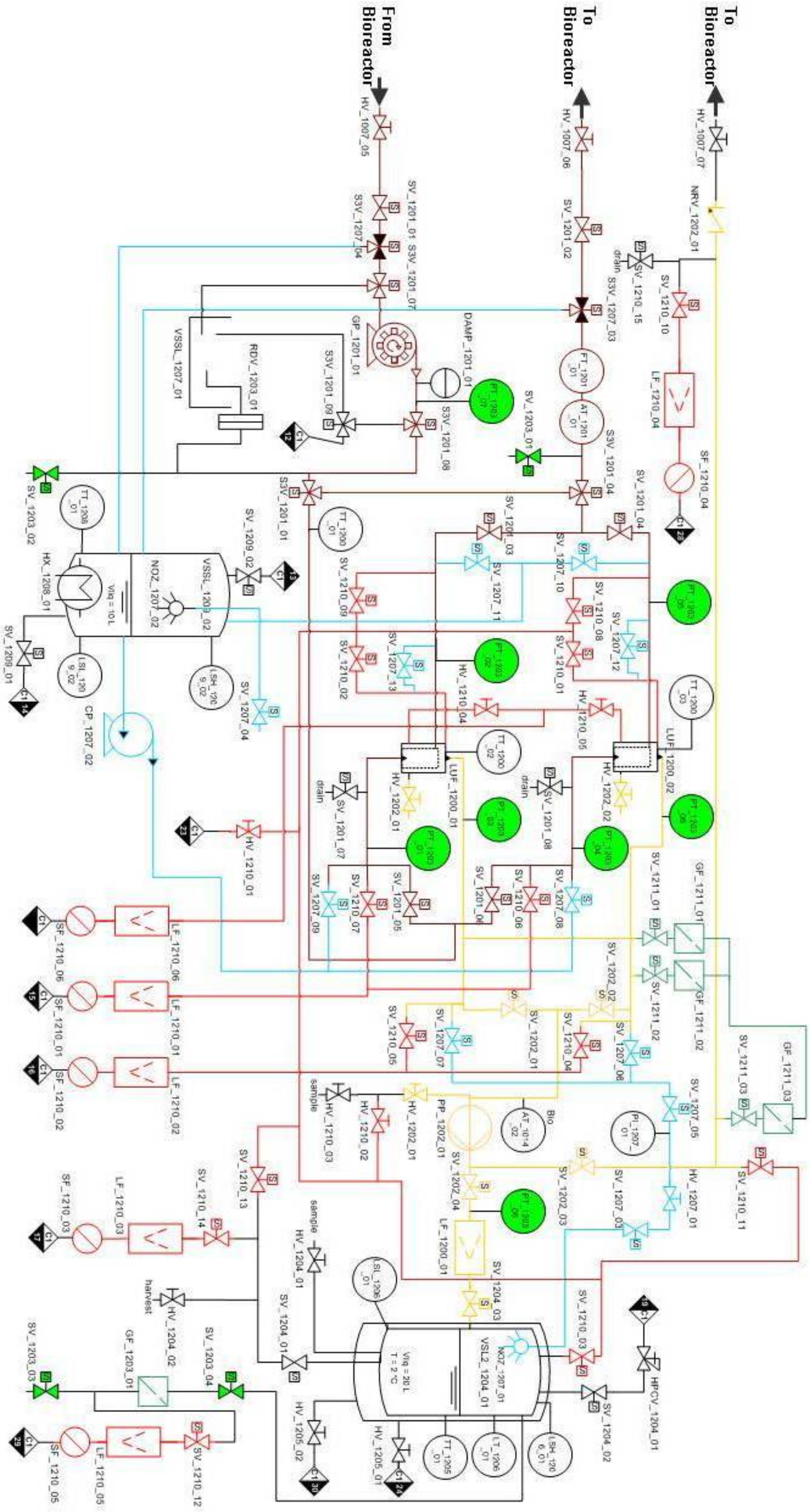
Alarm tag Name	type	Address	description
SV_1202_01_A	BOOL	000621	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1202_02_A	BOOL	000623	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1202_03_A	BOOL	000625	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1202_04_A	BOOL	000627	valve alarm ACTION : DISPLAY ALARM ON HMI

Figure 69: Filtration Unit Filtrate Flow Control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
FB_TIME_LIM	TIME	400900	5	seconds	Display an alarm

Figure 70: Filtration Unit Filtrate Flow Control – THRESHOLDS

4.24. Filtration Unit Pressure control (CL1203)



4.24.1.Function

Except monitoring the pressure all around the filtration unit, this control loop is used to calculate the differential membrane pressure. This is used during the sterilization of both membrane sides.
As explained in the "Filtration Unit General" chapter, the entire filtration unit is considered as one entity. Depending on the chosen mode (defined by the tag "CL1200_ControlLoop_Mode"), the operator can do the following actions.

3 modes are available:

OFF Mode: All equipments are in default position. The filtration unit is stopped and no procedure can be started.

Auto mode: The procedure linked to the filtration unit can be started (With the CIP AND SIP control loop also in automatic). The equipment status are checked when the process state is changing (When automatic procedure is called). The alarm thresholds make sure the process runs smoothly.

Manu mode: The operator can manipulate valves and pumps but can't change the filtration state until he switches to automatic mode. **Important point: If the operator decides to switch from manual to automatic mode with a valve linked to the filtration function in a wrong position, the process will recover the good position instantaneously. This is true for FU/CIP/SIP when they are triggered in automatic.**

PLC Section name	Equipment tag	Type	Address	Comment
Filtration Unit Pressure Control	SV_1203_01_MV	DO	000055	Powered 2-way valve Used to keep atmospheric pressure in the retentate line by letting enter/escape air when draining/ filling the tubes
Filtration Unit Pressure Control	SV_1203_01_FB	DI	100078	valve feedback
Filtration Unit Pressure control	SV_1203_02_MV	DO	000037	Powered 2-way valve Used to flush N2 in the retentate loop of the FU in order to prevent under pressure in the loop
Filtration Unit Pressure control	SV_1203_02_FB	DI	100064	valve feedback
Filtration Unit Pressure control	SV_1203_03_MV	DO	000038	Powered 2-way valve Used to flush N2 in the filtrate tank
Filtration Unit Pressure control	SV_1203_03_FB	DI	100063	valve feedback
Filtration Unit Pressure control	SV_1203_04_MV	DO	000107	Powered 2-way valve Used to perform the vacuum breaking by filling pipes with N2
Filtration Unit Pressure control	SV_1203_04_FB	DI	100137	valve feedback
Filtration Unit Pressure Control	PT_1203_01	AI	400217	Pressure transducer Measures pressure of retentate at inlet of membrane LUF_1200_01

PLC Section name	Equipment tag	Type	Address	Comment
Filtration Unit Pressure Control	PT_1203_02	AI	400219	Pressure transducer Measures pressure of retentate at outlet of membrane LUF_1200_01
Filtration Unit Pressure Control	PT_1203_03	AI	400221	Pressure transducer Measures pressure of filtrate at outlet of membrane LUF_1200_01
Filtration Unit Pressure control	PT_1203_04	AI	400143	Pressure transducer Measures pressure of retentate at inlet of membrane LUF_1200_02
Filtration Unit Pressure control	PT_1203_05	AI	400141	Pressure transducer Measures pressure of retentate at outlet of membrane LUF_1200_02
Filtration Unit Pressure control	PT_1203_06	AI	400139	Pressure transducer Measures pressure of filtrate at outlet of membrane LUF_1200_02
Filtration Unit Pressure Control	PT_1203_07	AI	400137	Pressure transducer Measures pressure of retentate after pump PMP-F-01 (safety pump)
Filtration Unit Pressure control	PT_1203_08	AI	400133	Pressure transducer Measures pressure at inlet of dead end filter Fi-F-03 (to follow clogging)
Filtration Unit Pressure Control	PSH_1203_01	-	-	Pressure switch Disk that breaks in case of overpressure

Figure 71: Filtration Unit Pressure control – EQUIPMENTS

PLC Section name	Button tag	Type	Address	Comment
Filtration Unit Pressure control	SV_1203_01_OP	BOOL	000628	Open / close the valve in manual mode
Filtration Unit Pressure control	SV_1203_02_OP	BOOL	000630	Open / close the valve in manual mode
Filtration Unit Pressure control	SV_1203_03_OP	BOOL	000632	Open / close the valve in manual mode (GN2 loop for underpressure breaking)
Filtration Unit Pressure control	SV_1203_04_OP	BOOL	000634	Open / close the valve in manual mode
Filtration Unit Pressure control	CL1203_TMP1	REAL	400223	calculation of trans membrane pressure (membrane1)
Filtration Unit Pressure control	CL1203_TMP2	REAL	400227	calculation of trans membrane pressure (membrane2)

Figure 72: Filtration Unit Pressure control – USER INDICATOR / INPUT

4.24.2.Block Diagram

4.24.2.1. *Valves management*

Important point:

The “Valvbool” block has been created to manage the Boolean valve. This block allows the mode management thanks to internal selector block (OFF/ AUTO / MANU) and the valve alarm linked to the feedback. The complete description is detailed in the annex chapter.

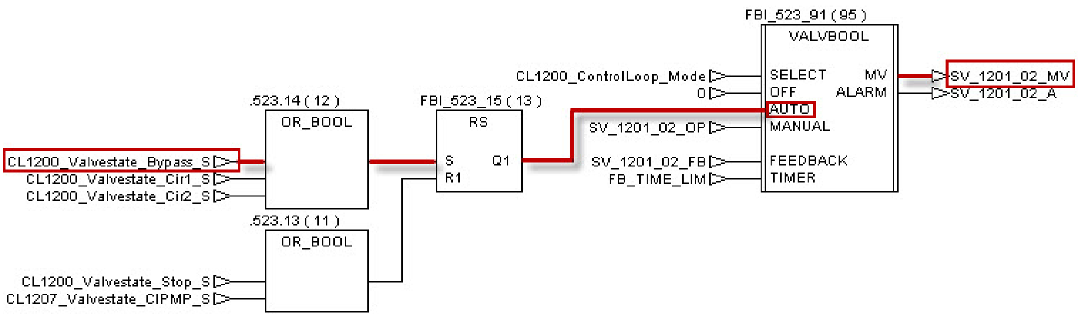
In automatic mode, depending on the procedure activated, the valves are set or reset to provide desired functions. The way to change the valves status is a pulse sent by the procedure to a defined tag. To be easily recognizable, all these kind of tags are named with the same logic.

Here is this named logic:

1- The control loop number
2- "_valvestate_"
3- The name of the procedure which triggers the valve
4- "_S" or "_R

Example:

During the procedure F_Bypass, "CL1200_Valvestate_Bypass_S" triggers the valve SV_1201_02 in bypass position. This tag will be find on each valves linked the bypass mode of the Filtration Unit.

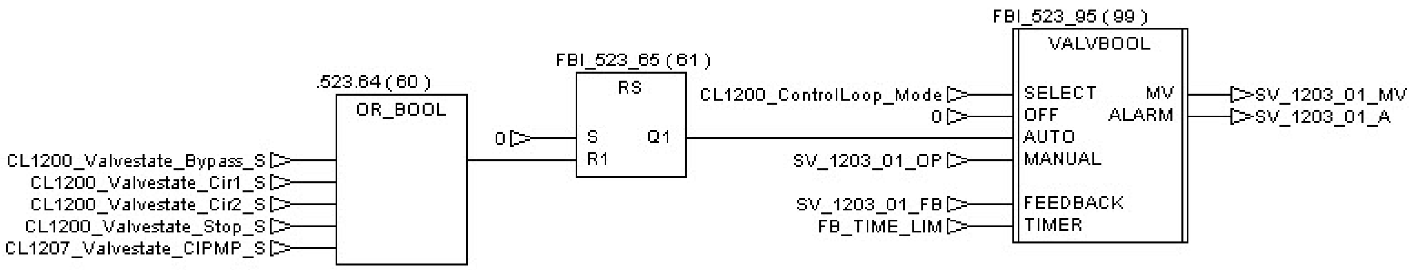


Depending on the procedure step needs, the "_S", situated at the end of the tag name, will set the valves in good position (either open or close), as well for the "_R" which will reset the valves in the default position.

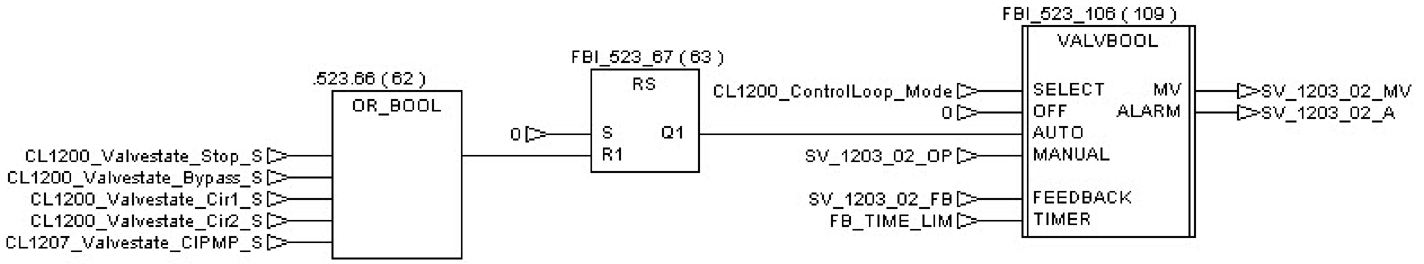
Most of the procedure follows this logic.

However, sometimes, when only one valve needs to be triggered inside the procedure, the pulse is named as "*name of the valve*_S" for the opening and "*name of the valve*_R" for the closing.

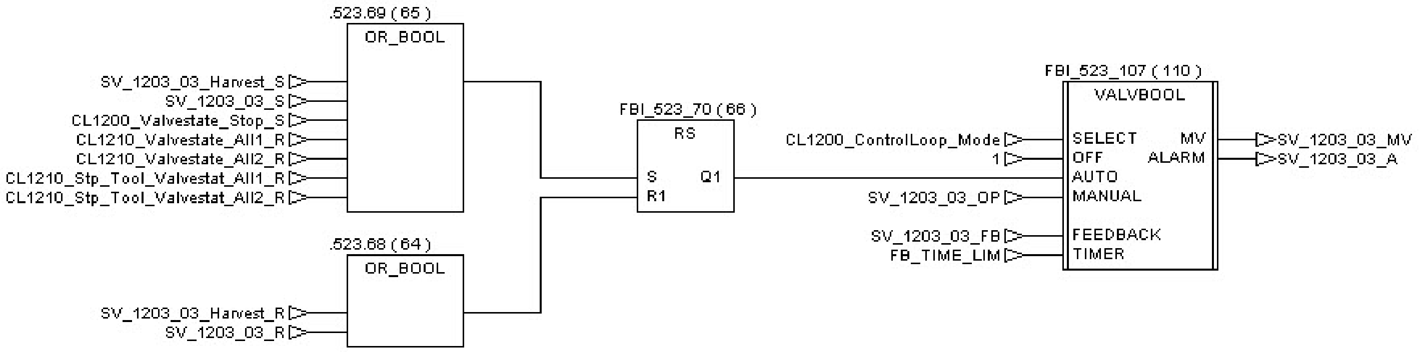
SV_1203_01:



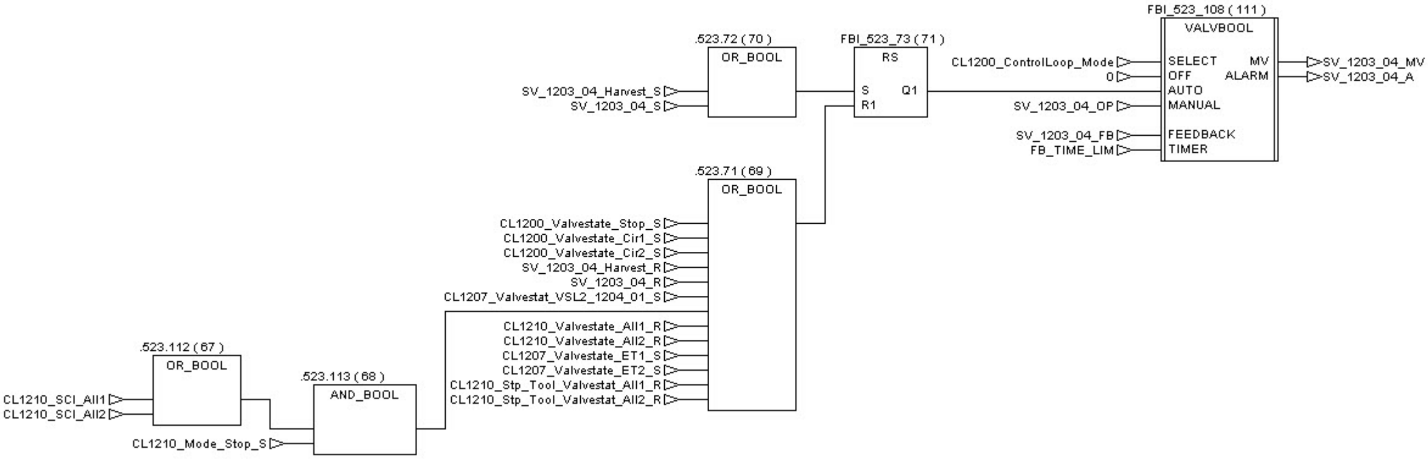
SV_1203_02:


FBI_523_106 (109)
VALVBOOL
FBI_523_67 (63)
RS
.523.66 (62)
OR_BOOL
CL1200_Valvestate_Stop_S
CL1200_Valvestate_Bypass_S
CL1200_Valvestate_Cir1_S
CL1200_Valvestate_Cir2_S
CL1207_Valvestate_CIPMP_S
0
S
Q1
R1
CL1200_ControlLoop_Mode
0
SV_1203_02_OP
SV_1203_02_FB
FB_TIME_LIM
SELECT
MV
OFF
ALARM
AUTO
MANUAL
FEEDBACK
TIMER
SV_1203_02_MV
SV_1203_02_A

SV_1203_03:

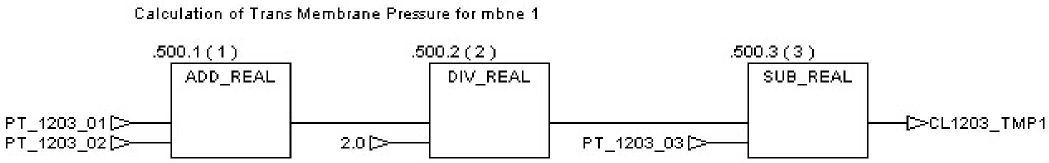

.523.69 (65)
OR_BOOL
SV_1203_03_Harvest_S
SV_1203_03_S
CL1200_Valvestate_Stop_S
CL1210_Valvestate_All1_R
CL1210_Valvestate_All2_R
CL1210_Stp_Tool_Valvestat_All1_R
CL1210_Stp_Tool_Valvestat_All2_R
.523.68 (64)
OR_BOOL
SV_1203_03_Harvest_R
SV_1203_03_R
FBI_523_70 (66)
RS
S
Q1
R1
FBI_523_107 (110)
VALVBOOL
CL1200_ControlLoop_Mode
1
SV_1203_03_OP
SV_1203_03_FB
FB_TIME_LIM
SELECT
MV
OFF
ALARM
AUTO
MANUAL
FEEDBACK
TIMER
SV_1203_03_MV
SV_1203_03_A

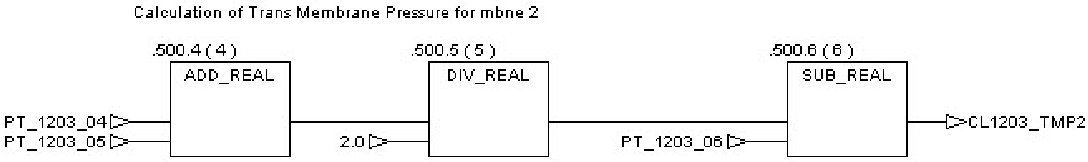
SV_1203_04:



4.24.2.2. *Membrane differential pressure*

To calculate the membrane differential pressure, an average is done on the two retentate side probes. This average is subtracted to the filtrate line pressure probe.





Important point:

The membrane differential pressure is calculated but never used in the software. Because of this, they are not implemented on the HMI.
Depending of the needs of these measurements, they can be added.
This point needs to be discussed with MPP.

4.24.3. Alarms and Thresholds

Alarm tag Name	type	Address	description
SV_1203_01_A	BOOL	000629	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1203_02_A	BOOL	000631	valve alarm ACTION : DISPLAY ALARM ON HMI

Alarm tag Name	type	Address	description
SV_1203_03_A	BOOL	000633	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1203_04_A	BOOL	000635	valve alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_01_AH	BOOL	000636	Pressure transducer High Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_01_AHH	BOOL	000637	Pressure transducer Very High Alarm ACTION : DISPLAY ALARM ON HMI trigger in Bypass mode
PT_1203_01_AL	BOOL	000638	Pressure transducer Low Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_01_ALL	BOOL	000639	Pressure transducer Very Low Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_01_ERR	BOOL	000640	broken wire alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_02_AH	BOOL	000641	Pressure transducer High Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_02_AHH	BOOL	000642	Pressure transducer Very High Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_02_AL	BOOL	000643	Pressure transducer Low Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_02_ALL	BOOL	000644	Pressure transducer Very Low Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_02_ERR	BOOL	000645	broken wire alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_03_AH	BOOL	000646	Pressure transducer High Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_03_AHH	BOOL	000647	Pressure transducer Very High Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_03_AL	BOOL	000648	Pressure transducer Low Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_03_ALL	BOOL	000649	Pressure transducer Very Low Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_03_ERR	BOOL	000650	broken wire alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_04_AH	BOOL	000651	Pressure transducer High Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_04_AHH	BOOL	000652	Pressure transducer Very High Alarm ACTION : DISPLAY ALARM ON HMI trigger in Bypass mode
PT_1203_04_AL	BOOL	000653	Pressure transducer Low Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_04_ALL	BOOL	000654	Pressure transducer Very Low Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_04_ERR	BOOL	000655	broken wire alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_05_AH	BOOL	000656	Pressure transducer High Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_05_AHH	BOOL	000657	Pressure transducer Very High Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_05_AL	BOOL	000658	Pressure transducer Low Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_05_ALL	BOOL	000659	Pressure transducer Very Low Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_05_ERR	BOOL	000660	broken wire alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_06_AH	BOOL	000661	Pressure transducer High Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_06_AHH	BOOL	000662	Pressure transducer Very High Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_06_AL	BOOL	000663	Pressure transducer Low Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_06_ALL	BOOL	000664	Pressure transducer Very Low Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_06_ERR	BOOL	000665	broken wire alarm ACTION : DISPLAY ALARM ON HMI

Alarm tag Name	type	Address	description
PT_1203_07_AH	BOOL	000666	Pressure transducer High Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_07_AHH	BOOL	000667	Pressure transducer Very High Alarm ACTION : DISPLAY ALARM ON HMI The control Loop is triggered to OFF mode after 5 seconds
PT_1203_07_AL	BOOL	000668	Pressure transducer Low Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_07_ALL	BOOL	000669	Pressure transducer Very Low Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_07_ERR	BOOL	000670	broken wire alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_08_AH	BOOL	000671	Pressure transducer High Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_08_AHH	BOOL	000672	Pressure transducer Very High Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_08_AL	BOOL	000673	Pressure transducer Low Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_08_ALL	BOOL	000674	Pressure transducer Very Low Alarm ACTION : DISPLAY ALARM ON HMI
PT_1203_08_ERR	BOOL	000675	broken wire alarm ACTION : DISPLAY ALARM ON HMI

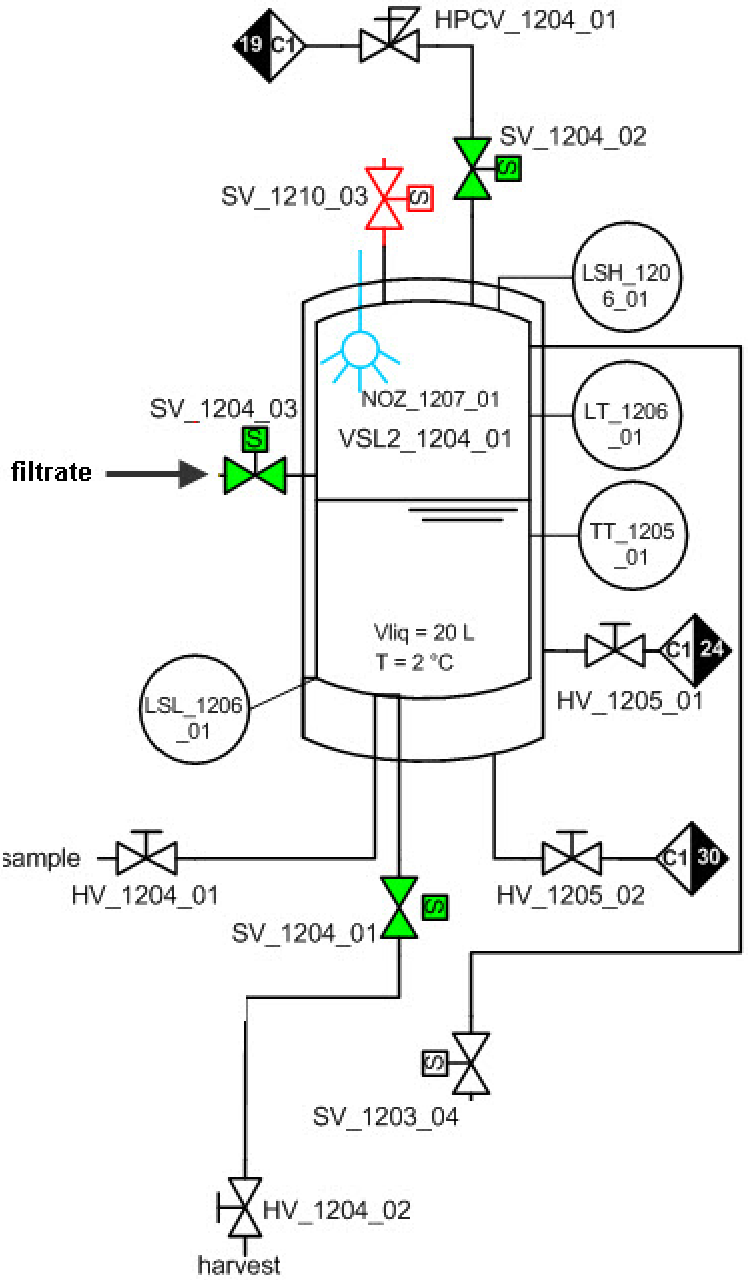
Figure 73: Filtration Unit Pressure control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
FB_TIME_LIM	TIME	400900	5	seconds	Display an alarm
PT_1203_01_LIM_AH	REAL	401112	1.5 Fixed value	Bar	Display an alarm
PT_1203_01_LIM_AHH	REAL	401114	1.7 Fixed value	Bar	Display an alarm trigger in Bypass mode Only if S_ALL1 and S_S1 procedures are not running and the filtration is not in stop mode
PT_1203_01_LIM_AL	REAL	401116	0.4 Fixed value	Bar	Display an alarm
PT_1203_01_LIM_ALL	REAL	401118	0.2 Fixed value	Bar	Display an alarm
PT_1203_02_LIM_AH	REAL	401120	1.5	Bar	Display an alarm
PT_1203_02_LIM_AHH	REAL	401122	1.7 Fixed value	Bar	Display an alarm trigger in Bypass mode Only if S_ALL1 and S_S1 procedures are not running and the filtration is not in stop mode
PT_1203_02_LIM_AL	REAL	401124	0.4 Fixed value	Bar	Display an alarm
PT_1203_02_LIM_ALL	REAL	401126	0.2 Fixed value	Bar	Display an alarm
PT_1203_03_LIM_AH	REAL	401128	0.3 Fixed value	Bar	Display an alarm
PT_1203_03_LIM_AHH	REAL	401130	0.6 Fixed value	Bar	Display an alarm trigger in Bypass mode Only if S_ALL1 and S_S1 procedures are not running and the filtration is not in stop mode
PT_1203_03_LIM_AL	REAL	401132	0 Fixed value	Bar	Display an alarm
PT_1203_03_LIM_ALL	REAL	401134	-0.1 Fixed value	Bar	Display an alarm
PT_1203_04_LIM_AH	REAL	401136	1.5 Fixed value	Bar	Display an alarm

Threshold tag name	Type	Address	Value	Unit	Action
PT_1203_04_LIM_AHH	REAL	401138	1.7 Fixed value	Bar	Display an alarm trigger in Bypass mode Only if S_ALL2 and S_S2 procedures are not running and the filtration is not in stop mode
PT_1203_04_LIM_AL	REAL	401140	0.4 Fixed value	Bar	Display an alarm
PT_1203_04_LIM_ALL	REAL	401142	0.2 Fixed value	Bar	Display an alarm
PT_1203_05_LIM_AH	REAL	401144	1.5 Fixed value	Bar	Display an alarm
PT_1203_05_LIM_AHH	REAL	401146	1.7 Fixed value	Bar	Display an alarm trigger in Bypass mode Only if S_ALL2 and S_S2 procedures are not running and the filtration is not in stop mode
PT_1203_05_LIM_AL	REAL	401148	0.4 Fixed value	Bar	Display an alarm
PT_1203_05_LIM_ALL	REAL	401150	0.2 Fixed value	Bar	Display an alarm
PT_1203_06_LIM_AH	REAL	401152	0.3 Fixed value	Bar	Display an alarm
PT_1203_06_LIM_AHH	REAL	401154	0.6 Fixed value	Bar	Display an alarm trigger in Bypass mode Only if S_ALL2 and S_S2 procedures are not running and the filtration is not in stop mode
PT_1203_06_LIM_AL	REAL	401156	0 Fixed value	Bar	Display an alarm
PT_1203_06_LIM_ALL	REAL	401158	-0.1 Fixed value	Bar	Display an alarm
PT_1203_07_LIM_AH	REAL	401160	1.8 Fixed value	Bar	Display an alarm
PT_1203_07_LIM_AHH	REAL	401162	2 Fixed value	Bar	Display an alarm Stop the filtration control loop. Done on 2010/10/18 after the broth loss.
PT_1203_07_LIM_AL	REAL	401164	0.3 Fixed value	Bar	Display an alarm
PT_1203_07_LIM_ALL	REAL	401166	0.1 Fixed value	Bar	Display an alarm
PT_1203_08_LIM_AH	REAL	401168	0.08 Fixed value	Bar	Display an alarm
PT_1203_08_LIM_AHH	REAL	401170	0.15 Fixed value	Bar	Display an alarm
PT_1203_08_LIM_AL	REAL	401172	0 Fixed value	Bar	Display an alarm
PT_1203_08_LIM_ALL	REAL	401174	-0.1 Fixed value	Bar	Display an alarm

Figure 74: Filtration Unit Pressure control – THRESHOLDS

4.25. Effluent Tank General (CL1204)



4.25.1.Function

As the Effluent tank receives the filtrate liquid, this control loop is deeply linked to the Filtration Unit. In automatic mode, a harvesting function permits to empty the vessel. This function is done automatically in case of High level switch detection.
As explained in the “Filtration Unit General” chapter, the entire filtration unit is considered as one entity. Depending on the chosen mode (defined by the tag “CL1200_ControlLoop_Mode”), the operator can do the following actions.

3 modes are available:

OFF Mode: All equipments are in default position. The filtration unit is stopped and no procedure can be started.

Auto mode: The procedure linked to the filtration unit can be started (With the CIP AND SIP control loop also in automatic). The equipment status are checked when the process state is changing (When automatic procedure is called). The alarm thresholds make sure the process goes smoothly.

Manu mode: The operator can manipulate valves and pumps but can’t change the filtration state until he switches to automatic mode. Important point: If the operator decides to switch from manual to automatic mode with a valve linked to the filtration function in a wrong position, the process will recover the good position instantaneously. This is true for FU/CIP/SIP when they are triggered in automatic.

PLC Section name	Equipment tag	Type	Address	Comment
Effluent Tank General	SV_1204_01_MV	DO	000052	Powered 2-way valve Used to drain the filtrate tank VSSL_1204_01
Effluent Tank General	SV_1204_01_FB	DI	100081	valve feedback
Effluent Tank General	SV_1204_02_MV	DO	000054	Powered 2-way valve Is closed during SIP of effluent vessel VSL2_1204_01 to allow pressure and temperature to rise
Effluent Tank General	SV_1204_02_FB	DI	100079	Valve feedback
Effluent Tank General	SV_1204_03_MV	DO	000101	Powered 2-way valve Used to close the filtered liquid input of the Effluent tank
Effluent Tank General	SV_1204_03_FB	DI	100133	valve feedback

Figure 75: Effluent Tank General – EQUIPMENTS

PLC Section name	Button tag	Type	Address	Comment
Effluent Tank General	SV_1204_01_OP	BOOL	000676	Open / close the valve in manual mode
Effluent Tank General	SV_1204_02_OP	BOOL	000678	Open / close the valve in manual mode

Effluent Tank General	SV_1204_03_OP	BOOL	000680	Open / close the valve in manual mode
Effluent Tank General	VSL2_1204_01_Volume	REAL	400453	Calculation of liquid volume in effluent tank (LT_1206_01 x 0.2183 + 4.1131 = VSL2_1204_01_Volume)
Effluent Tank General	CL1204_SCI_Harvest	BOOL	000277	Start to harvest
Effluent Tank General	CL1200_Reset _F_Harvest_Proc	BOOL	000787	During the recycle mode, if the operator decides to cancel the sterilisation of the Harvest line, the procedure "F_Harvest"is reset by a pulse sending from the HMI to this tag
Effluent Tank General	CL1204_F_Harvest_error	UDINT	400271	error number in procedure F_Harvest
Effluent Tank General	CL1204_TB_Harvest	BOOL	000278	tracing bit set when harvest is on going
Effluent Tank General	CL1204_StopHarvestNow	BOOL	000352	permit to stop the harvest instantaneously
Effluent Tank General	CL1204_OP_LevelHigh	BOOL	000362	Windows triggered to inform the operator that the volume of the harvesting tank is equal to 15 litres.
Effluent Tank General	CL1204_OP_Harvest	BOOL	000391	confirmation windows to ensure that the operator really wants to harvest
Effluent Tank General	CL1204_OP_Harvest_OK	BOOL	000279	Set when the operator confirm his harvesting choice
Effluent Tank General	CL1204_Reset_Havest_Proc	BOOL	000784	Reset only the harvest procedure if the operator cancel the operator panel link to the harvesting procedure.

Figure 76: Effluent Tank General – USER INDICATOR / INPUT

4.25.2.Block Diagram

4.25.2.1. *Valves management*

<u>Important point:</u>

The "Valvbool" block has been created to manage the Boolean valve. This block allows the mode management thanks to internal selector block (OFF/ AUTO / MANU) and the valve alarm linked to the feedback. The complete description is detailed in the annex chapter.

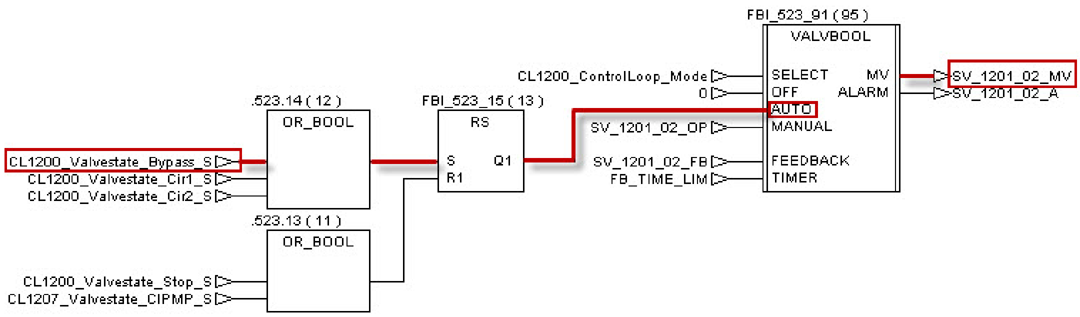
In automatic mode, depending on the procedure activated, the valves are set or reset to provide desired functions. The way to change the valves status is a pulse sent by the procedure to a defined tag. To be easily recognizable, all these kind of tags are named with the same logic.

Here is this named logic:

1- The control loop number
2- "_valvestate_"
3- The name of the procedure which triggers the valve
4- "_S" or "_R

Example:

During the procedure F_Bypass, "CL1200_Valvestate_Bypass_S" triggers the valve SV_1201_02 in bypass position. This tag will be find on each valves linked the bypass mode of the Filtration Unit.

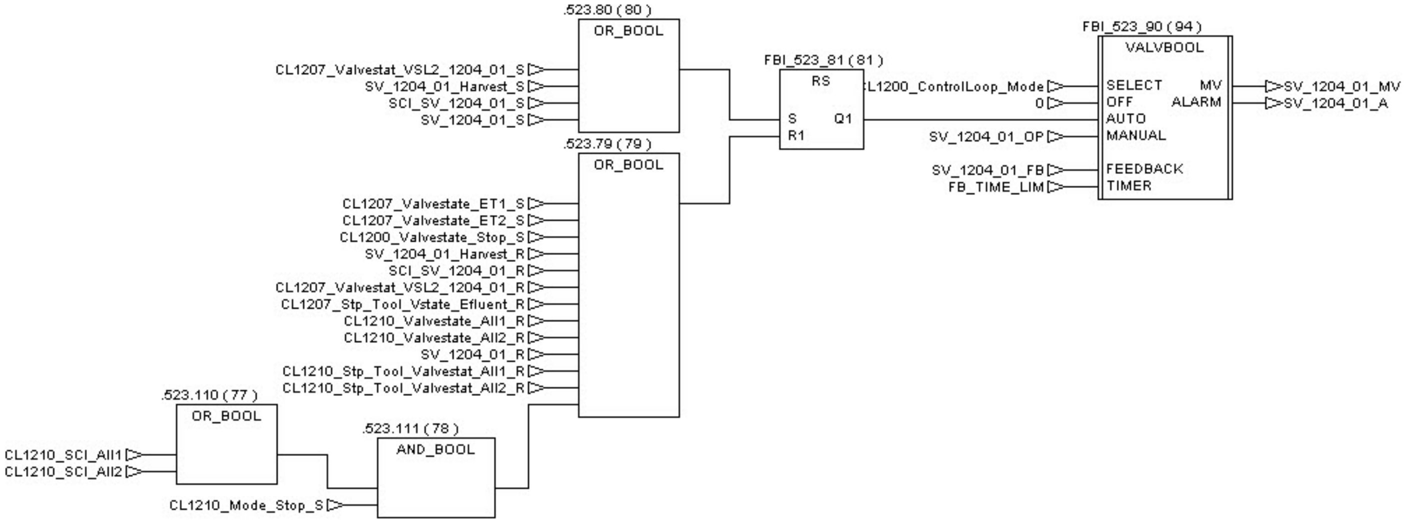


Depending on the procedure step needs, the "_S", situated at the end of the tag name, will set the valves in good position (either open or close), as well for the "_R" which will reset the valves in the default position.

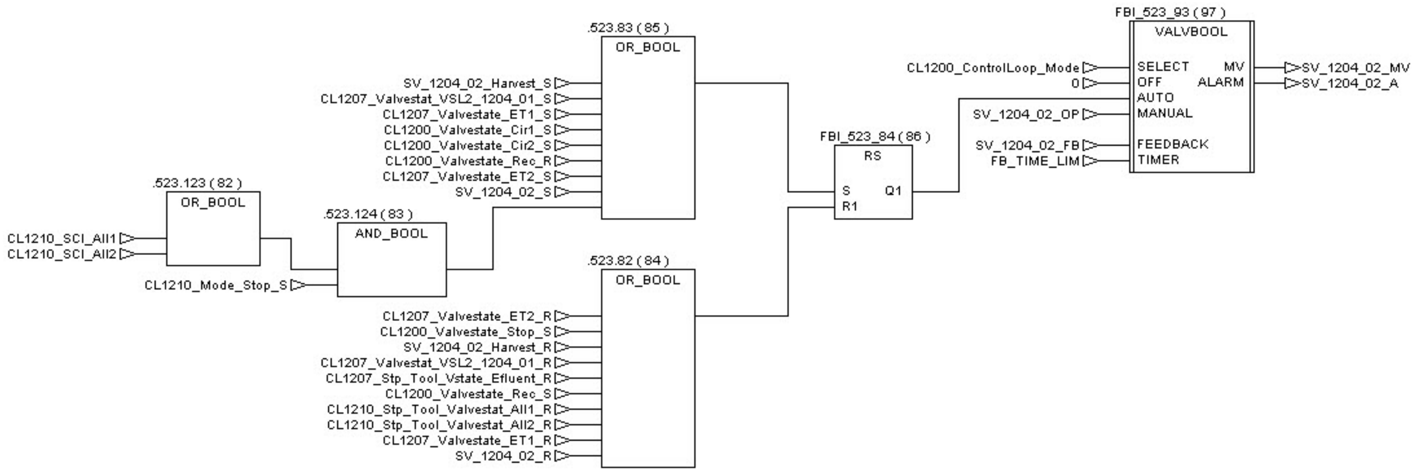
Most of the procedure follows this logic.

However, sometimes, when only one valve needs to be triggered inside the procedure, the pulse is named as "*name of the valve*_S" for the opening and "*name of the valve*_R" for the closing.

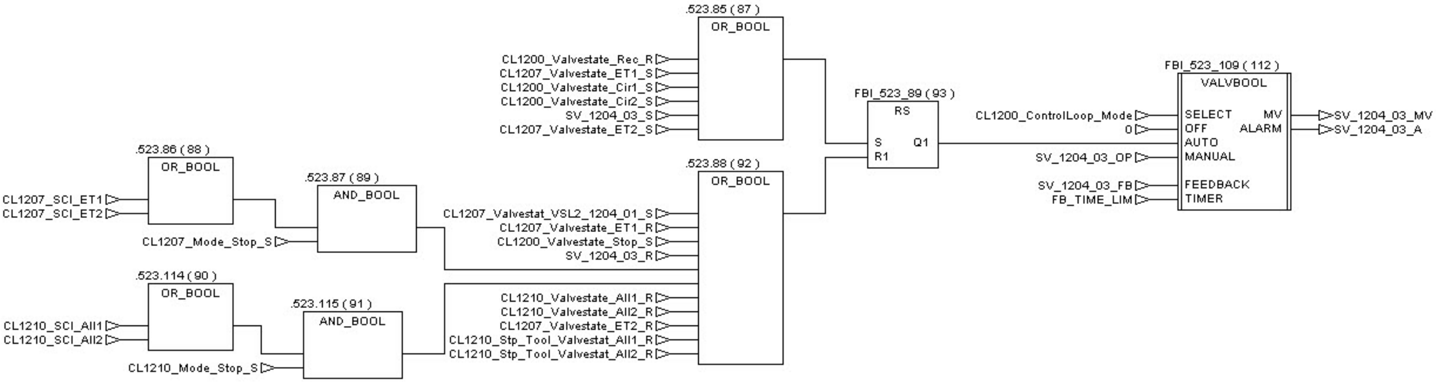
SV_1204_01:



SV_1204_02:

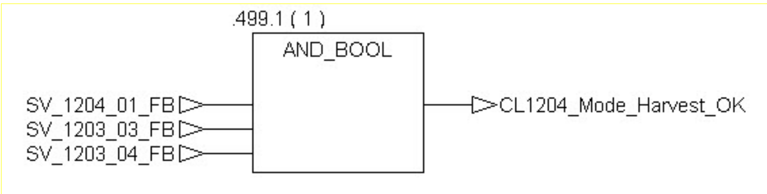


SV_1204_03:



4.25.2.2. *Harvest Mode*

As the harvest function is totally managed by the procedure F_Harvest (detailed in chapter 4: User manual procedure), only the harvest mode OK is implemented as block diagram. When the tag CL1204_Mode_Harvest_OK is set, the effluent tank is in the process of harvesting.



4.25.3.Alarms and Thresholds

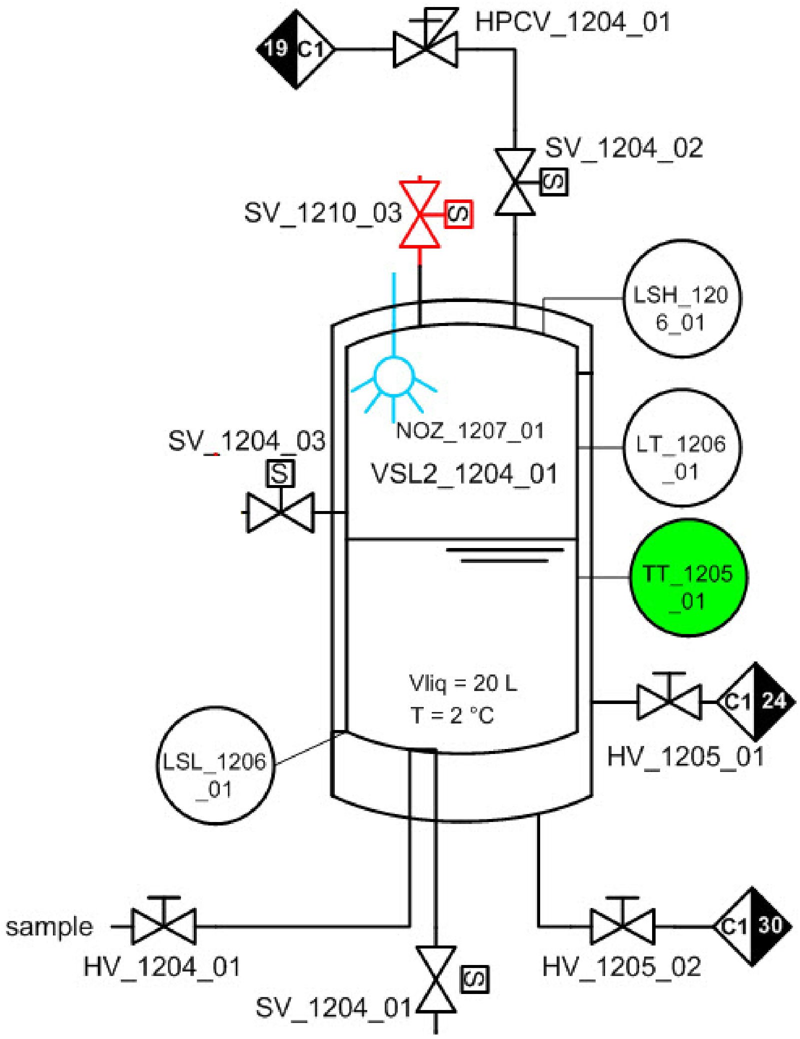
Alarm tag Name	type	Address	description
SV_1204_01_A	BOOL	000677	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1204_02_A	BOOL	000679	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1204_03_A	BOOL	000681	valve alarm ACTION : DISPLAY ALARM ON HMI

Figure 77: Effluent Tank General – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
FB_TIME_LIM	TIME	400900	5	Seconds	Display an alarm

Figure 78: Effluent Tank General – THRESHOLDS

4.26. Effluent Tank Temperature Control (CL1205)



4.26.1.Function

The filtrate liquid should be maintained to 4 °C to prevent any bacteria work. As the heat exchanger is not connected to the PLC, the temperature is not controlled dynamically but only monitored. In case of cooler problem, alarms are triggered.
As no actuator exists for this loop, no mode is implemented.

PLC Section name	Equipment tag	Type	Address	Comment
Effluent Tank Temperature Control	TT_1205_01	AI	400127	Temperature sensor Measures temperature in filtrate tank VSL2_1204_01

Figure 79: Effluent Tank Temperature Control – EQUIPMENTS

NO USER INDICATOR / INPUT

4.26.2.Block Diagram

NO BLOCK DIAGRAM IMPLEMENTED

4.26.3.Alarms and Thresholds

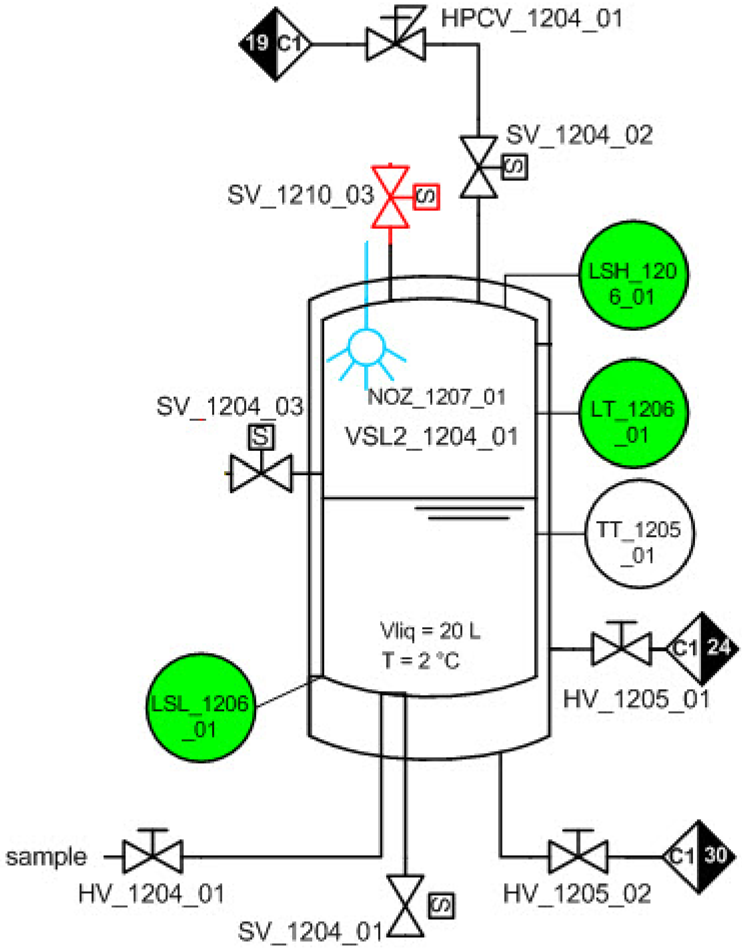
Alarm tag Name	type	Address	description
TT_1205_01_AH	BOOL	000682	High temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1205_01_AHH	BOOL	000683	Very High temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1205_01_AL	BOOL	000684	Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1205_01_ALL	BOOL	000685	Very Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1205_01_ERR	BOOL	000686	broken wire alarm ACTION : DISPLAY ALARM ON HMI

Figure 80: Effluent Tank Temperature Control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
TT_1205_01_LIM_AH	REAL	401176	+1 compared to the set point (4°C)	°C	Display an alarm
TT_1205_01_LIM_AHH	REAL	401178	+2 compared to the set point (4°C)	°C	Display an alarm
TT_1205_01_LIM_AL	REAL	401180	-1 compared to the set point (4°C)	°C	Display an alarm
TT_1205_01_LIM_ALL	REAL	401182	-2 compared to the set point (4°C)	°C	Display an alarm

Figure 81: Effluent Tank Temperature Control – THRESHOLDS

4.27. Effluent Tank Level Control (CL1206)



4.27.1.Function

At the current time, the link between CI and CII is not operational. Because of this, the Effluent tank needs to be emptied by an operator action.
A level transmitter monitors permanently the volume as long as the level is upper than 4,1 litres.
If the level reaches 15 litres, a windows appears on the HMI screen asking to the operator to choose between" harvesting" or "passing the filtration unit in recycle mode".
If no answer happens before the triggering of the level switch high, the procedure "Filtration Unit: Enter in By Pass Mode automatically when LSH_1206_01 is set" is started automatically to prevent any overflow.

PLC Section name	Equipment tag	Type	Address	Comment
Effluent Control Level control	LSH_1206_01	DI	100048	Level switch Measures upper volume in gas phase for volume measurement in filtrate tank (VSSL_1204_01) If triggered during nominal mode, it Starts the procedure "F_Auto_Bypass" which automatically triggers the filtration in bypass mode (Only in automatic mode).
Effluent Control Level control	LSL_1206_01	DI	100053	Level switch Measures pressure in liquid phase for volume measurement in filtrate tank (VSSL_1204_01)
Effluent Control Level control	LT_1206_01	AI	400079	Level sensor Measures pressure in gas phase for volume measurement in filtrate tank (VSSL_1204_01)

Figure 82: Effluent Tank Level Control – EQUIPMENTS

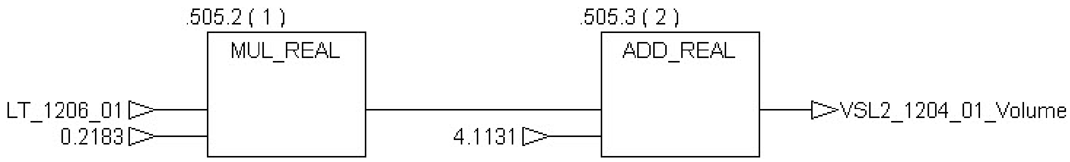
PLC Section name	Button tag	Type	Address	Comment
Effluent Control Level control	LT_1206_01_Av	REAL	400157	Level transmitter average

Figure 83: Effluent Tank Level Control – USER INDICATOR / INPUT

4.27.2.Block Diagram

4.27.2.1. *Volume calculation*

Here are the parameters of the volume calculation. The coefficient "0.2183" has been given by EPAS and corresponds to the transcription between Range and effluent tank internal parameter. The offset added corresponds to the limitation of the level probe. Under 4.1131 liter, the probe is unable to give any measurement.

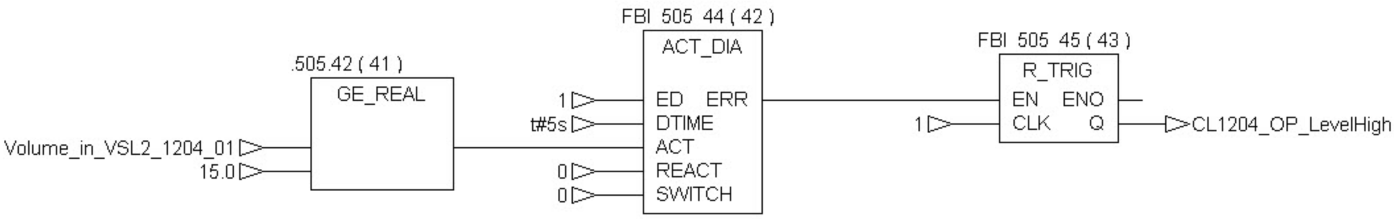


4.27.2.2. *Operator warning*

In order to avoid any overflow of effluent tank, it was decided to warn the operator thanks to a window on HMI inviting to go in recycle mode or to harvest, when the effluent level reaches 15 litres.

For information, if nothing is done before than the level triggers the level switch High LSH_1206_01, the process goes automatically in bypass mode (the FU/CIP and SIP control loop mode button must be in automatic mode).

Display a windows to inform the operator that the Effluent tank Level is 15 litres.
FOR INFORMATION:
When the level switch High LSH_1206_01 is set, the BYPASS MODE is trigger automatically.



4.27.3.Alarms and Thresholds

Alarm tag Name	type	Address	description
LSH_1206_01_A	BOOL	000687	Level switch alarm. Triggered after 10s ACTION : DISPLAY ALARM ON HMI
LSL_1206_01_A	BOOL	000688	Level switch alarm. Trigger after 10s ACTION : DISPLAY ALARM ON HMI
LT_1206_01_AH	BOOL	000689	High level alarm ACTION : DISPLAY ALARM ON HMI
LT_1206_01_AHH	BOOL	000690	Very High level alarm ACTION : DISPLAY ALARM ON HMI
LT_1206_01_AL	BOOL	000691	Low level alarm ACTION : DISPLAY ALARM ON HMI
LT_1206_01_ALL	BOOL	000692	Very Low level alarm ACTION : DISPLAY ALARM ON HMI
LT_1206_01_ERR	BOOL	000693	broken wire alarm ACTION : DISPLAY ALARM ON HMI

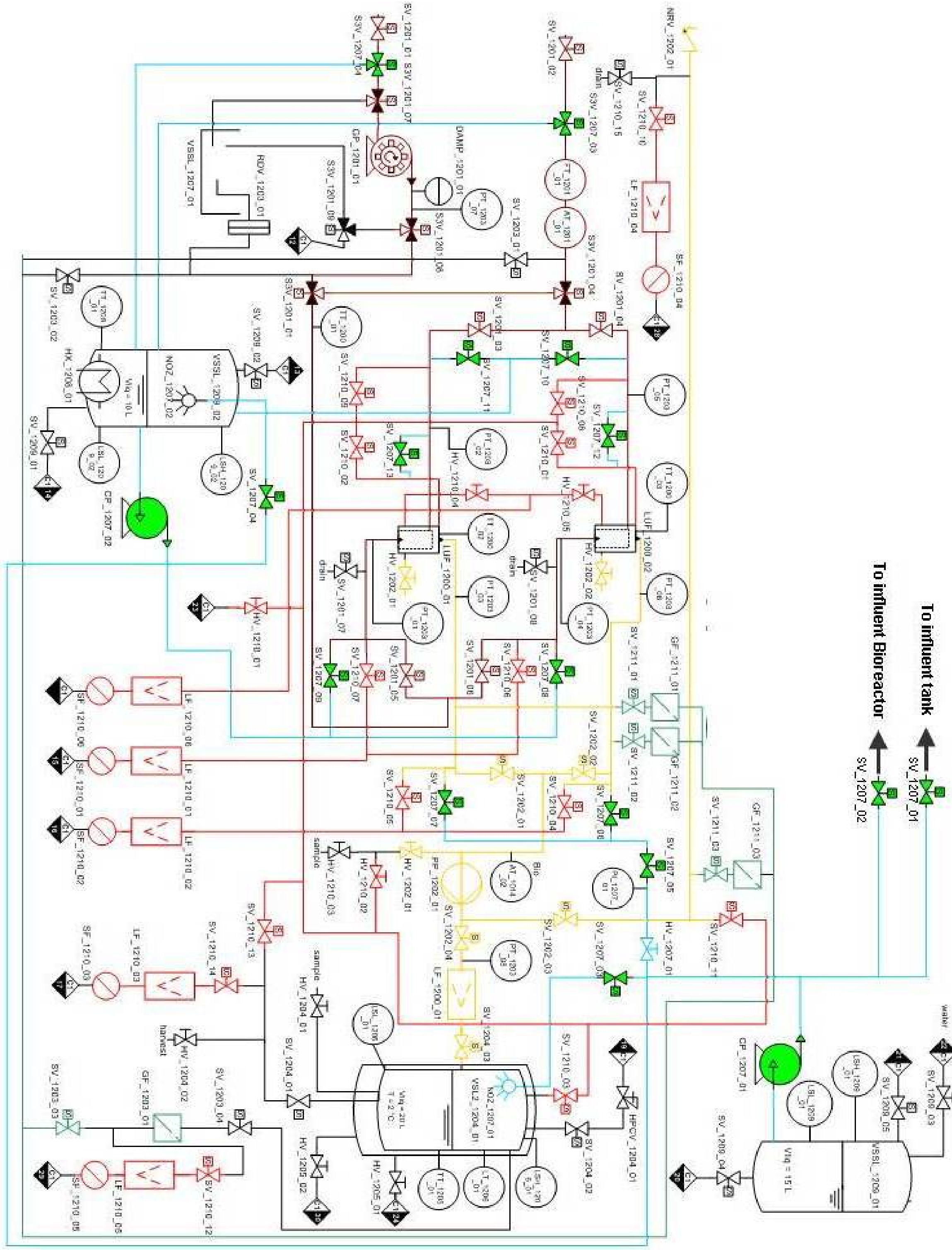
Figure 84: Effluent Tank Level Control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
LT_1206_01_LIM_AH	REAL	401184	15 fixed Value	L	Display an alarm
LT_1206_01_LIM_AHH	REAL	401186	17 fixed Value	L	Display an alarm
LT_1206_01_LIM_AL	REAL	401188	5 fixed Value	L	Display an alarm

LT_1206_01_LIM_ALL	REAL	401190	4.5 fixed Value	L	Display an alarm

Figure 85: Effluent Tank Level Control – THRESHOLDS

4.28. CIP General (CL1207)



4.28.1.Function

The purpose of this control loop is to provide tools for cleaning the different part of the process. For this, many procedures and sub procedures exists and can be called by the operator. The complete list of the procedure and their specific functions are described in the “procedure” chapter.
Contrary to the filtration unit, all procedures can only be executed in automatic mode. A general stop button permits to reset any running procedure. In case of changing mode from automatic to manual during cleaning procedure execution, the PLC calls the stop function then reset all cleaning sequences.

Three modes, applicable from CL1207 to CL1209, are available:

OFF Mode: All equipments are in default position and no procedure can be started.

Auto mode: The procedure linked to the Cleaning of the filtration unit can be started (With the FU AND SIP control loop also in automatic). All the valve positions and pump states are permanently checked. If an error is detected, the “stop cleaning” procedure function is called by the PLC.

Manu mode: The operator can manipulate all cleaning equipment but can’t start any procedure until switching to automatic mode.

PLC Section name	Equipment tag	Type	Address	Comment
CIP General	CP_1207_01_MV	DO	000018	Pumps cleaning agent or water to the tanks
CIP General	CP_1207_02_MV	DO	000020	Pumps cleaning agent from cleaning buffer VSSL_1209_02 to FU retentate line
CIP General	S3V_1207_03_MV	DO	000069	Powered 3-way valve Activated during cleaning of retentate loop
CIP General	S3V_1207_03_FB	DI	100096	valve feedback
CIP General	S3V_1207_04_MV	DO	000070	Powered 3-way valve Activated during cleaning of retentate loop
CIP General	S3V_1207_04_FB	DI	100095	valve feedback
CIP General	SV_1207_01_MV	DO	000074	Powered 2-way valve Allows water to NOZ_1006_01 for rinsing of Feeding Vessel (VSL2_1000_01)
CIP General	SV_1207_01_FB	DI	100110	valve feedback
CIP General	SV_1207_02_MV	DO	000075	Powered 2-way valve Allows water to NOZ_1013_02 for rinsing of bioreactor (VSL2_1007_01)
CIP General	SV_1207_02_FB	DI	100111	valve feedback
CIP General	SV_1207_03_MV	DO	000076	Powered 2-way valve Allows water to NOZ_1207_01 for rinsing of effluent

PLC Section name	Equipment tag	Type	Address	Comment
				vessel (VSSL_1204_01)
CIP General	SV_1207_03_FB	DI	100112	valve feedback
CIP General	SV_1207_04_MV	DO	000077	Powered 2-way valve Allows water to NOZ_1207_02 for rinsing and filling cleaning buffer vessel (VSSL_1209_02)
CIP General	SV_1207_04_FB	DI	100104	valve feedback
CIP General	SV_1207_05_MV	DO	000059	Powered 2-way valve When activated, allows cleaning agent to filtratte side of membranes LUF_1200_01 and -02 during backwashing
CIP General	SV_1207_05_FB	DI	100090	valve feedback
CIP General	SV_1207_06_MV	DO	000067	Powered 2-way valve Activated for backwashing membrane LF_1200_02
CIP General	SV_1207_06_FB	DI	100098	valve feedback
CIP General	SV_1207_07_MV	DO	000068	Powered 2-way valve Activated for backwashing membrane LF_1200_01
CIP General	SV_1207_07_FB	DI	100097	valve feedback
CIP General	SV_1207_08_MV	DO	000072	Powered 2-way valve Activated for cleaning of retentate side of membrane LF_1200_02
CIP General	SV_1207_08_FB	DI	100093	valve feedback
CIP General	SV_1207_09_MV	DO	000071	Powered 2-way valve Activated for cleaning of retentate side of membrane LF_1200_01
CIP General	SV_1207_09_FB	DI	100094	valve feedback
CIP General	SV_1207_10_MV	DO	000057	Powered 2-way valve Activated during backwashing and cleaning of retentate side of membrane LF_1200_02
CIP General	SV_1207_10_FB	DI	100092	valve feedback
CIP General	SV_1207_11_MV	DO	000058	Powered 2-way valve Activated during backwashing and cleaning of retentate side of membrane LF_1200_01
CIP General	SV_1207_11_FB	DI	100091	valve feedback
CIP General	SV_1207_12_MV	DO	000110	Powered 2-way valve Allow bypass between retentate and filtrate sides of LF_1200_02 for cleaning
CIP General	SV_1207_12_FB	DI	100140	valve feedback
CIP General	SV_1207_13_MV	DO	000109	Powered 2-way valve Allow bypass between retentate and filtrate sides of LF_1200_01 for cleaning
CIP General	SV_1207_13_FB	DI	100139	valve feedback

Figure 86: CIP General – EQUIPMENTS

PLC Section name	Button tag	Type	Address	Comment
CIP General	CL1207_ControlLoop_Mode	INT	400817	CIP General mode (0: Off / 1: Auto / 2: Manu)
CIP General	CP_1207_01_OP	BOOL	000694	Start / stop the cleaning pump 1
CIP General	CP_1207_02_OP	BOOL	000696	Start / stop the cleaning pump 2
CIP General	S3V_1207_03_OP	BOOL	000698	Operator can change the position of the 3 way valve in manual mode.
CIP General	S3V_1207_04_OP	BOOL	000700	Operator can change the position of the 3 way valve in manual mode.
CIP General	SV_1207_01_OP	BOOL	000702	Open / close the valve in manual mode
CIP General	SV_1207_02_OP	BOOL	000704	Open / close the valve in manual mode
CIP General	SV_1207_03_OP	BOOL	000706	Open / close the valve in manual mode
CIP General	SV_1207_04_OP	BOOL	000708	Open / close the valve in manual mode
CIP General	SV_1207_05_OP	BOOL	000710	Open / close the valve in manual mode
CIP General	SV_1207_06_OP	BOOL	000712	Open / close the valve in manual mode
CIP General	SV_1207_07_OP	BOOL	000714	Open / close the valve in manual mode
CIP General	SV_1207_08_OP	BOOL	000716	Open / close the valve in manual mode
CIP General	SV_1207_09_OP	BOOL	000718	Open / close the valve in manual mode
CIP General	SV_1207_10_OP	BOOL	000720	Open / close the valve in manual mode
CIP General	SV_1207_11_OP	BOOL	000722	Open / close the valve in manual mode
CIP General	SV_1207_12_OP	BOOL	000724	Open / close the valve in manual mode
CIP General	SV_1207_13_OP	BOOL	000726	Open / close the valve in manual mode
CIP General	CL1207_SCI_Cl1	BOOL	000239	Start the procedure which cleans the retentate side of the membrane 1
CIP General	CL1207_TB_Cl1	BOOL	000225	Tracing bit set during the cleaning of the retentate side of the membrane 1
CIP General	CL1207_C_Cl1_error	UDINT	400281	error number in procedure C_Cl1
CIP General	CL1207_SCI_Cl2	BOOL	000240	Start the procedure which cleans the retentate side of the membrane 1
CIP General	CL1207_TB_Cl2	BOOL	000226	Tracing bit set during the cleaning of the retentate side of the membrane 2
CIP General	CL1207_C_Cl2_error	UDINT	400283	error number in procedure C_Cl2
CIP General	CL1207_SCI_BCl1	BOOL	000229	Start the procedure which clean the retentate and filtrate side of the membrane 1
CIP General	CL1207_TB_BCl1	BOOL	000227	Tracing bit set during the cleaning of the retentate and filtrate side of the membrane 1
CIP General	CL1207_C_BCl1_error	UDINT	400285	error number in procedure C_BCl1
CIP General	CL1207_SCI_BCl2	BOOL	000230	Start the procedure which clean the retentate and filtrate side of the membrane 2
CIP General	CL1207_TB_BCl2	BOOL	000228	Tracing bit set during the cleaning of the retentate and filtrate side of the membrane 2
CIP General	CL1207_C_BCl2_error	UDINT	400287	error number in procedure C_BCl2
CIP General	CL1207_SCI_BW1	BOOL	000233	Start the procedure which backwashes the membrane 1
CIP General	CL1207_TB_BW1	BOOL	000368	Tracing bit set during the backwash procedure of membrane 2
CIP General	CL1207_C_BW1_error	UDINT	400289	error number in procedure C_BW1
CIP General	CL1207_SCI_BW2	BOOL	000234	Start the procedure which backwashes the membrane 2
CIP General	CL1207_TB_BW2	BOOL	000369	Tracing bit set during the backwash procedure of membrane 2
CIP General	CL1207_C_BW2_error	UDINT	400291	error number in procedure C_BW2
CIP General	CL1207_SCI_ET1	BOOL	000246	Start the procedure which clean the filtrate line and the effluent tank through membrane 1
CIP General	CL1207_TB_ET1	BOOL	000372	tracing bit set during the cleaning of the filtrate line and the effluent tank through membrane 1

PLC Section name	Button tag	Type	Address	Comment
CIP General	CL1207_C_ET1_error	UDINT	400293	error number in procedure C_ET1
CIP General	CL1207_SCI_ET2	BOOL	000247	Start the procedure which clean the filtrate line and the effluent tank through membrane 2
CIP General	CL1207_TB_ET2	BOOL	000373	tracing bit set during the cleaning of the filtrate line and the effluent tank through membrane 2
CIP General	CL1207_C_ET2_error	UDINT	400295	error number in procedure C_ET2
CIP General	CL1207_SCI_Rinse_CA	BOOL	000264	Start the procedure which rinses the cleaning buffer 1 (VSSL_1209_01)
CIP General	CL1207_TB_Rinse_CA	BOOL	000382	Tracing bit set during the rinsing procedure of cleaning buffer 2 (VSSL_1209_01)
CIP General	CL1207_C_Rinse_CA_error	UDINT	400275	error number in procedure C_Rinse_CA
CIP General	CL1207_SCI_Rinse_CB	BOOL	000265	Start the procedure which rinses the cleaning buffer 2 (VSSL_1209_02)
CIP General	CL1207_TB_Rinse_CB	BOOL	000383	Tracing bit set during the rinsing procedure of cleaning buffer 2 (VSSL_1209_02)
CIP General	CL1207_C_Rinse_CB_error	UDINT	400277	error number in procedure C_Rinse_CB
CIP General	CL1207_SCI_VSL2_1204_01	BOOL	000266	Start the procedure which cleans or rinses the effluent vessel (VSL2_1204_01)
CIP General	CL1207_TB_VSL2_1204_01	BOOL	000371	Tracing bit set during the cleaning (or rinsing) the effluent tank
CIP General	CL1207_C_R_F_01_error	UDINT	400299	error number in procedure C_R_F_01
CIP General	CL1207_SCI_CLPMP	BOOL	000242	Start the procedure which cleans the pump GP_1201_01 (retentate pump)
CIP General	CL1207_TB_CLPMP	BOOL	000370	Tracing bit set during the cleaning of the pump GP_1201_01 (retentate pump)
CIP General	CL1207_CLPMP_error	UDINT	400299	error number in procedure CLPMP
CIP General	CL1207_SCI_Stop	BOOL	000268	Stop every procedure of cleaning
CIP General	CL1207_TB_Stop	BOOL	000339	When stopped the tracing bit is set
CIP General	CL1207_C_Stop_error	UDINT	400279	error number in procedure C_Stop
CIP General	CL1207_SCI_Clean_CAB	BOOL	000241	Start the procedure which cleans both cleaning vessel
CIP General	CL1207_TB_Clean_CAB	BOOL	000378	tracing bit set during the cleaning of both cleaning vessel
CIP General	CL1207_C_Clean_CAB_error	UDINT	400273	error number in procedure C_Clean_CAB
CIP General	CL1207_SCI_P	BOOL	000256	Start the protocol of cleaning every day at a define time depending on the membrane present. This protocol has never been finished by EPAS and need to be specified by UAB.
CIP General	CL1207_SCI_P_TIME	TIME	400406	Time of the day which starts the cleaning protocol in an automatic way. This protocol has never been finished by EPAS and need to be specified by UAB.
CIP General	CL1207_SCI_P_Enable	BOOL	000261	Variable which locks the automatic cleaning protocol (1= protocol starts every day at the defined time / 0=protocol locked)
CIP General	CL1207_SCI_P_Cl1	BOOL	000258	Start the cleaning protocol of membrane 1
CIP General	CL1207_TB_P_Cl1	BOOL	000374	Tracing bit set during the cleaning protocol of membrane 1
CIP General	CL1207_C_P_Cl1_error	UDINT	400301	error number in procedure C_P_Cl1
CIP General	CL1207_SCI_P_Cl2	BOOL	000259	Start the cleaning protocol of membrane 2
CIP General	CL1207_TB_P_Cl2	BOOL	000375	Tracing bit set during the cleaning protocol of membrane 2
CIP General	CL1207_C_P_Cl2_error	UDINT	400303	error number in procedure C_P_Cl2
CIP General	CL1207_P_Cl_cntr_Times_1	INT	400463	used during procedure56 : protocol of cleaning (number of time ask for cleaning the Retentate side of FU with clear water (Procedure 49))
CIP General	CL1207_P_Cl_cntr_Times_2	INT	400465	used during procedure56 : protocol of cleaning (number of time ask for cleaning the Retentate side of FU with cleaning agent

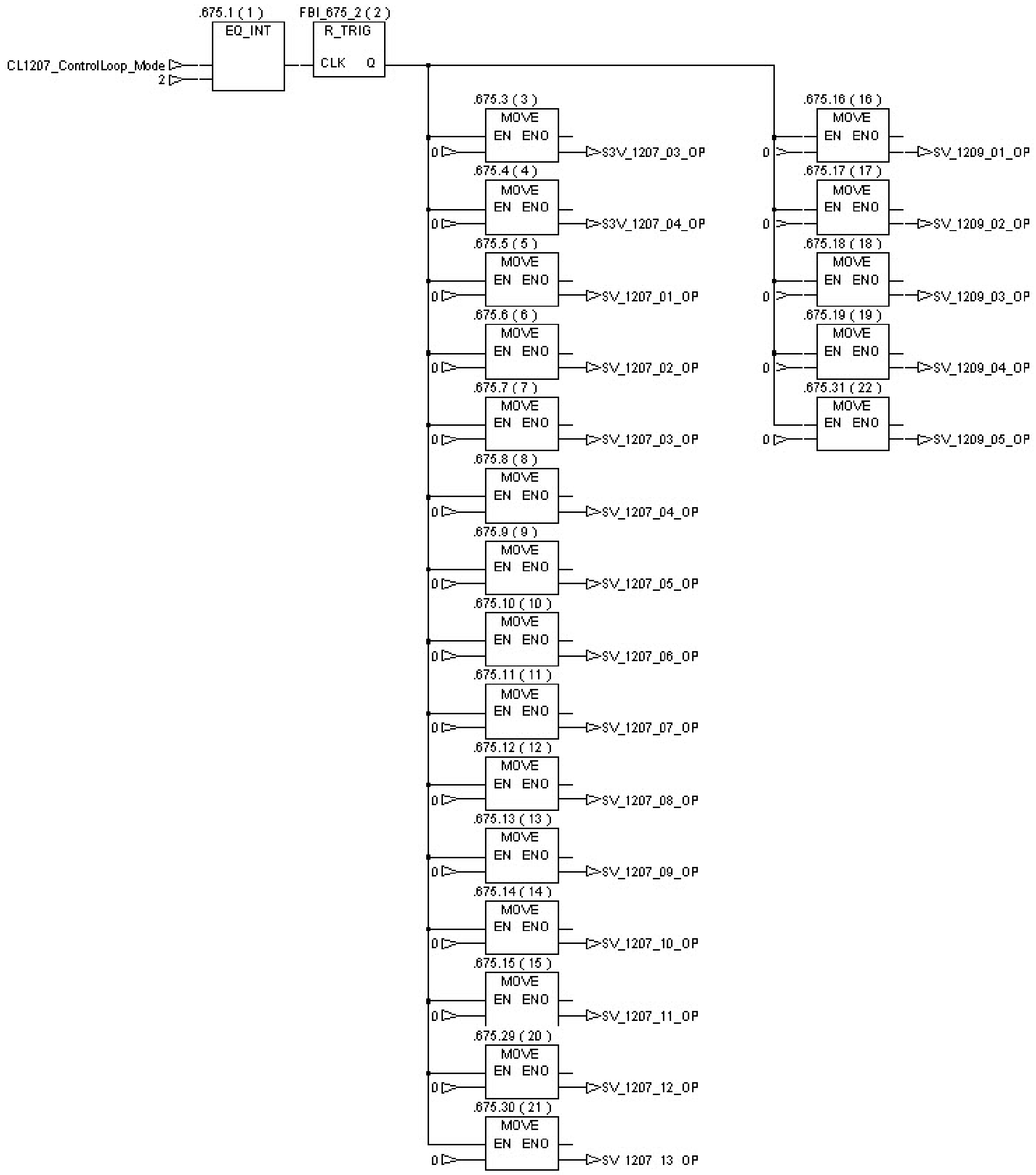
PLC Section name	Button tag	Type	Address	Comment
				(Procedure 49))
CIP General	CL1207_P_Cl_cntr_Times_3	INT	400467	used during procedure56 : protocol of cleaning (number of time ask for cleaning the Filtrate side of FU with cleaning agent (Procedure 50))
CIP General	CL1207_P_Cl_cntr_Times_4	INT	400469	used during procedure56 : protocol of cleaning (number of time ask for cleaning the Retentate side of FU with clear water (Procedure 49))
CIP General	CL1207_P_Cl_cntr_Times_5	INT	400471	used during procedure56 : protocol of cleaning (number of time ask for cleaning the Filtrate side of FU with clear water (Procedure 50))

Figure 87: CIP General – USER INDICATOR / INPUT

4.28.2.Block Diagram

4.28.2.1. *From Automatic mode to Manual mode*

When the operator triggers the Cleaning part of the Filtration from automatic mode to manual, the Cleaning valve states are reset. It means that the entire variable named "*name_of_the_valve*_op" takes the value "0"
After this transition, the operator manipulates only the manual tags which allow to manage equipments in manual mode.



If the manual mode has been triggered during the execution of one of the cleaning procedure, the automatic input of cleaning equipments must be reset to prevent the undefined state of the automatic mode. This complete reset of is provided by the procedure "CL1207_RESET_PROC". This procedure starts each time than the automatic mode is suspended (detailed in the chapter 4: User manual procedure).

4.28.2.2. *From Automatic mode to OFF MODE*

The entire cleaning equipments switch to the default position defined by the OFF mode input (same as the stop status). The procedure "CL1207_RESET_PROC" is activated and configures the automatic inputs in the stop status (detailed in chapter 4: User manual procedure).

4.28.2.3. *Stop Cleaning procedure management*

4.28.2.3.1. Calling the stop of the Cleaning procedure

The stop of the Cleaning function can be called by many different ways.

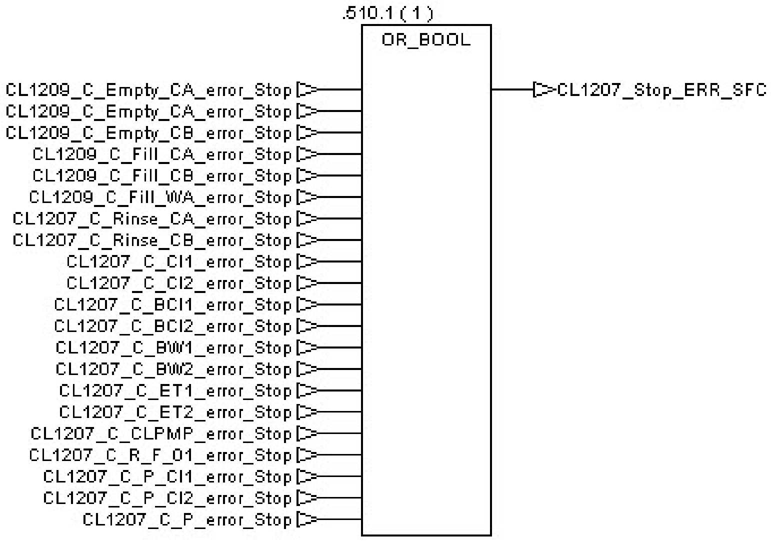
- The first function which permits to do it is the "Control loop mode button". By triggering the Cleaning to OFF mode or to manual mode, each equipment linked to the Cleaning function is triggered in default position. This function is implemented thanks to the block VALVBOOL or OPMDBOOL (Described in the annex chapter). Both modes activate also the procedure "CL1207_RESET_PROC" (See chapter 4 User manual procedure) which restarts the automatic mode in default position.

- In automatic mode, the operator is able to stop the cleaning procedure from any state by using the dedicated button named "Stop cleaning" from the HMI. This HMI button set the tag called "CL1207_SCI_Stop".

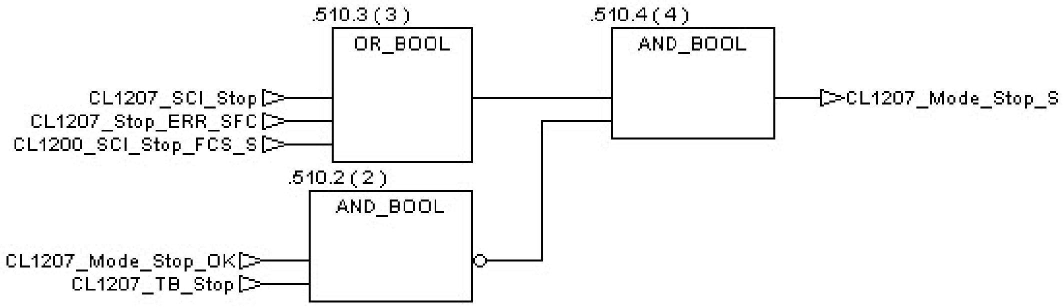
- A global stop button (FU/CIP/SIP) can also be used from HMI. This HMI button set the tag called "CL1200_SCI_Stop_FCS_S".

- The other conditions which will automatically stop the cleaning are linked to the CIP procedures. During their execution, each sequential step is monitored by a defined time. If this time is elapsed, an error is set then the stop of the cleaning is called.
  These four previous conditions set the tag "CL1207_Mode_Stop_S" which is the initial condition to start the procedure "C_Stop" (detailed in Chapter 4: User manual procedure).

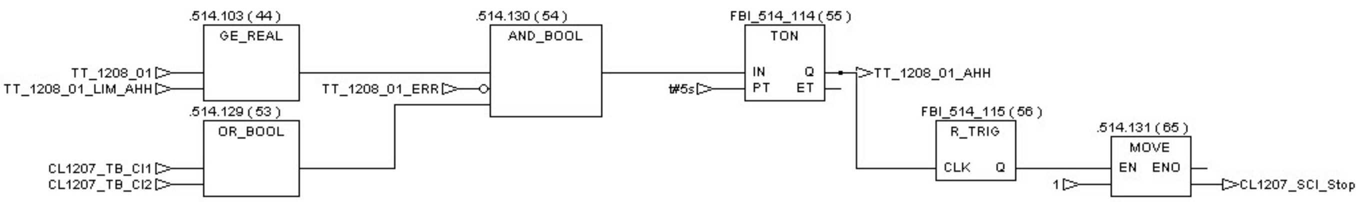
  <u>Procedure elapsed time errors:</u>



<u>Waiting transition of “C_Stop” procedure:</u>

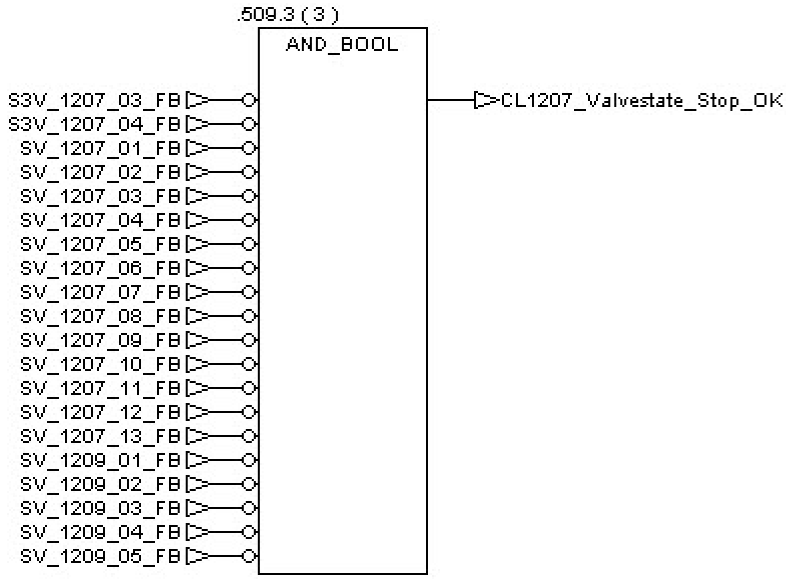


The last condition which can trigger the stop of the Cleaning is linked to very high temperature alarm (TT_1208_01_LIM_AHH) inside the cleaning buffer 2 (VSSL_1209_02). During the execution of C_Cl1 or C_Cl2 procedures (cleaning of the effluent tank, filtrate line and filtrate part of the membrane 1 or 2), the alarm stops the running procedure to avoid cleaning solution boiling.

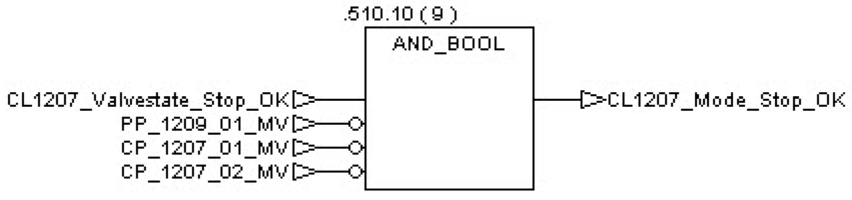


4.28.2.3.2. Actions following the “Stop Cleaning” Function

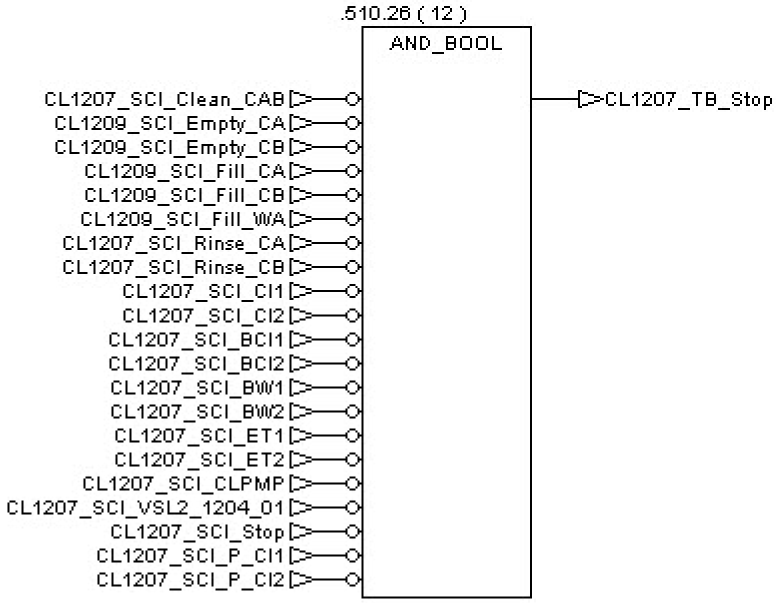
Once the stop of the Cleaning procedure is called (condition enounced in the previous section) , the tag CL1207_Mode_Stop_S is set.
This tag reset all the procedures and starts the procedure “C_stop” (detailed in chapter 4).
This procedure can only be used in automatic mode.
The first action of the procedure “C_Stop” is to send a pulse to all valves linked to the cleaning function.
When valves are in stop position, the tag “CL1207_Valvestate_Stop_OK” is set :



Once the valve status is OK, cleaning pumps are reset.
When all equipments are in default position, the tag “CL1207_Mode_Stop_OK” is set.



Finally, when “CL1207_Mode_Stop_OK” and all procedures are reset, the Tracing Bit “CL1207_TB_Stop” is set.

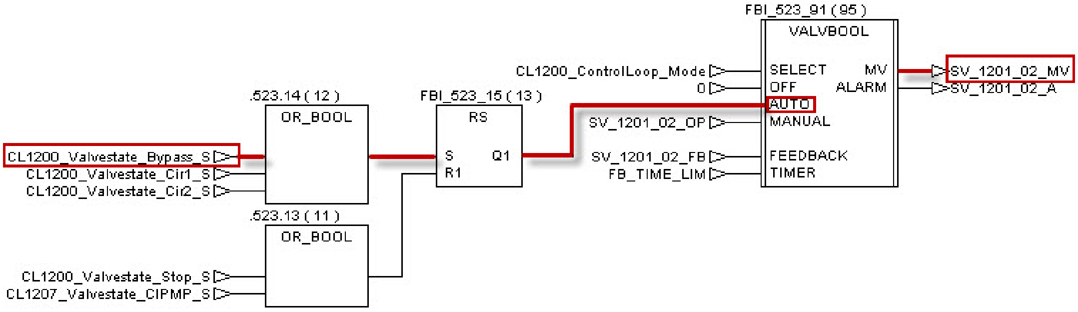


4.28.2.4. *Cleaning valves management*

Important point:
The "Valvbool" block has been created to manage the Boolean valve. This block allows the mode management thanks to internal selector block (OFF/ AUTO / MANU) and the valve alarm linked to the feedback. The complete description is detailed in the annex chapter.
In automatic mode, depending on the procedure activated, the valves are set or reset to provide desired functions. The way to change the valves status is a pulse sent by the procedure to a defined tag. To be easily recognizable, all these kind of tags are named with the same logic.
Here is this named logic:

5- The control loop number
6- "_valvestate_"
7- The name of the procedure which triggers the valve
8- "_S" or "_R

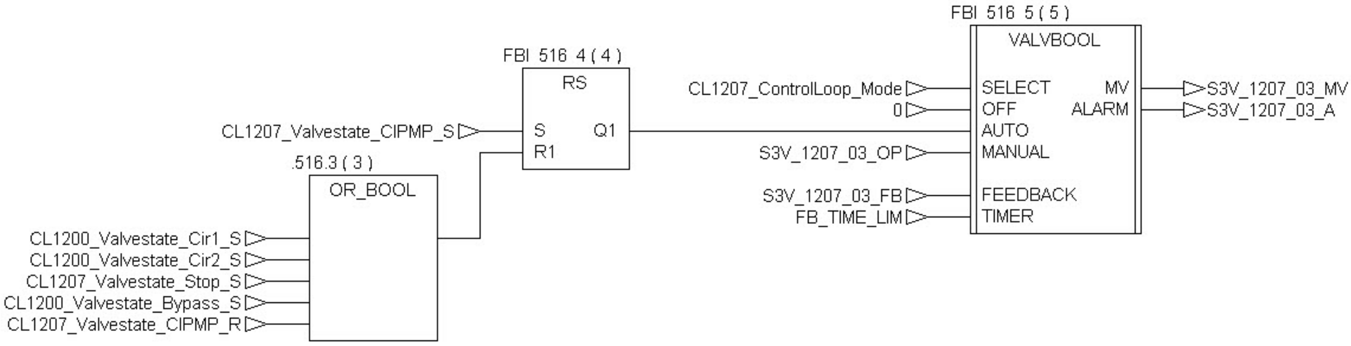
Example:
During the procedure F_Bypass, "CL1200_Valvestate_Bypass_S" triggers the valve SV_1201_02 in bypass position. This tag will be find on each valves linked the bypass mode of the Filtration Unit.



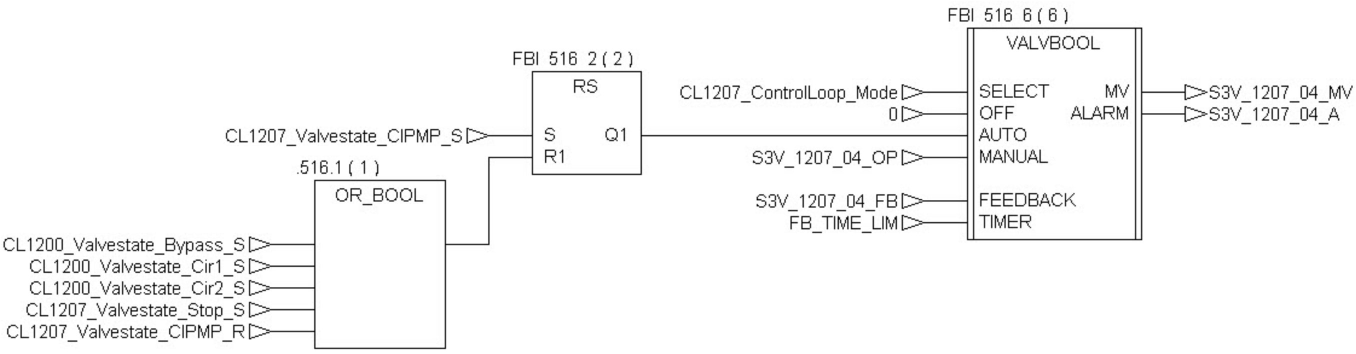
Depending on the procedure step needs, the "_S", situated at the end of the tag name, will set the valves in good position (either open or close), as well for the "_R" which will reset the valves in the default position.
Most of the procedure follows this logic.
However, sometimes, when only one valve needs to be triggered inside the procedure, the pulse is named as "*name of the valve*_S" for the opening and "*name of the valve*_R" for the closing.

4.28.2.4.1. 3 ways valves

S3V_1207_03:

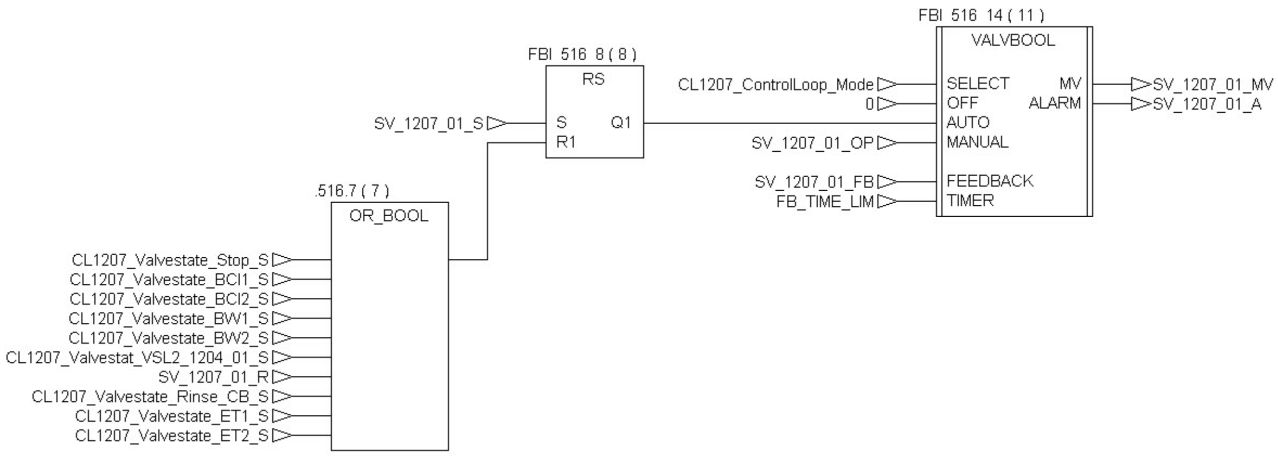


S3V_1207_04:

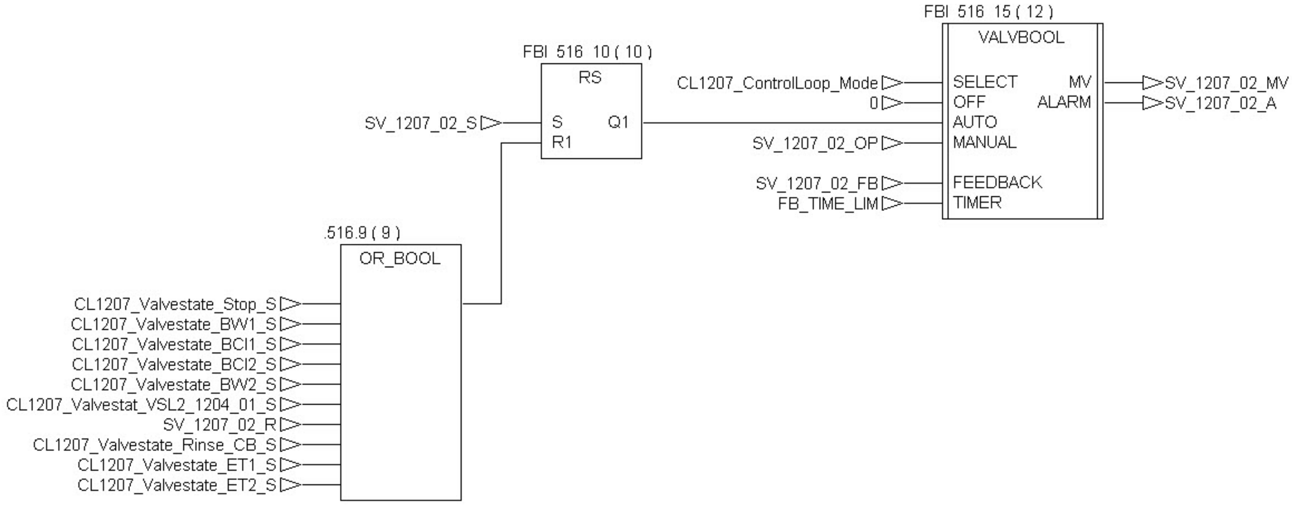


4.28.2.4.2. 2 ways valves

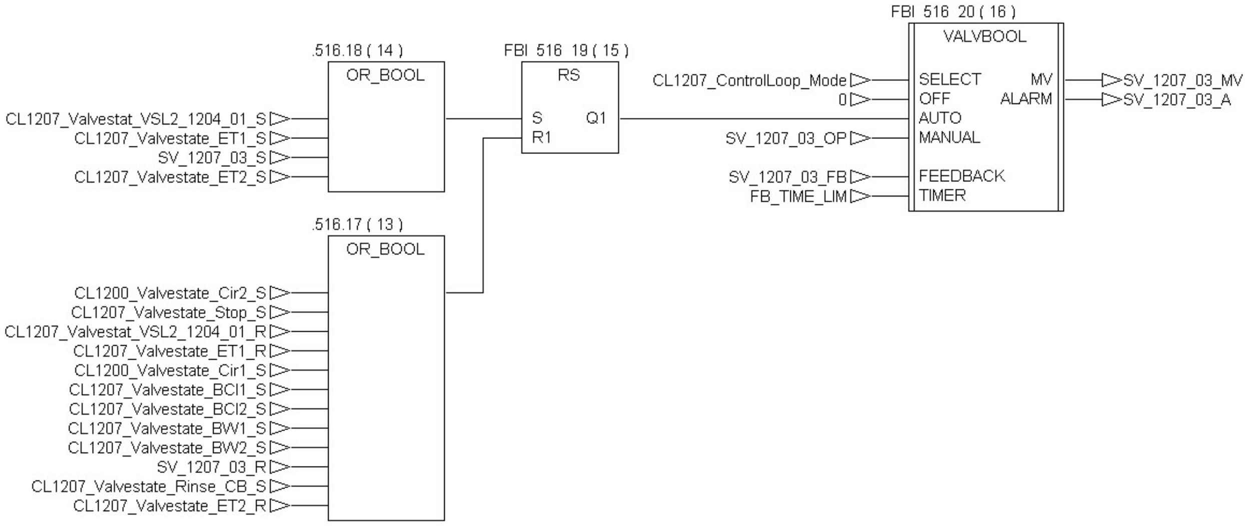
SV_1207_01:



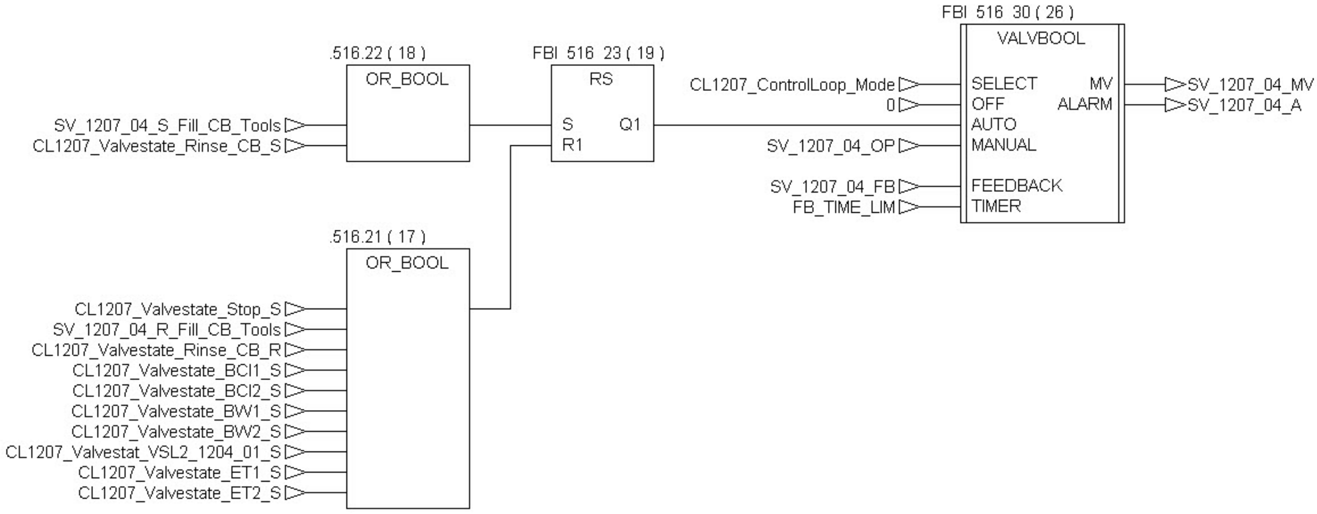
SV_1207_02:



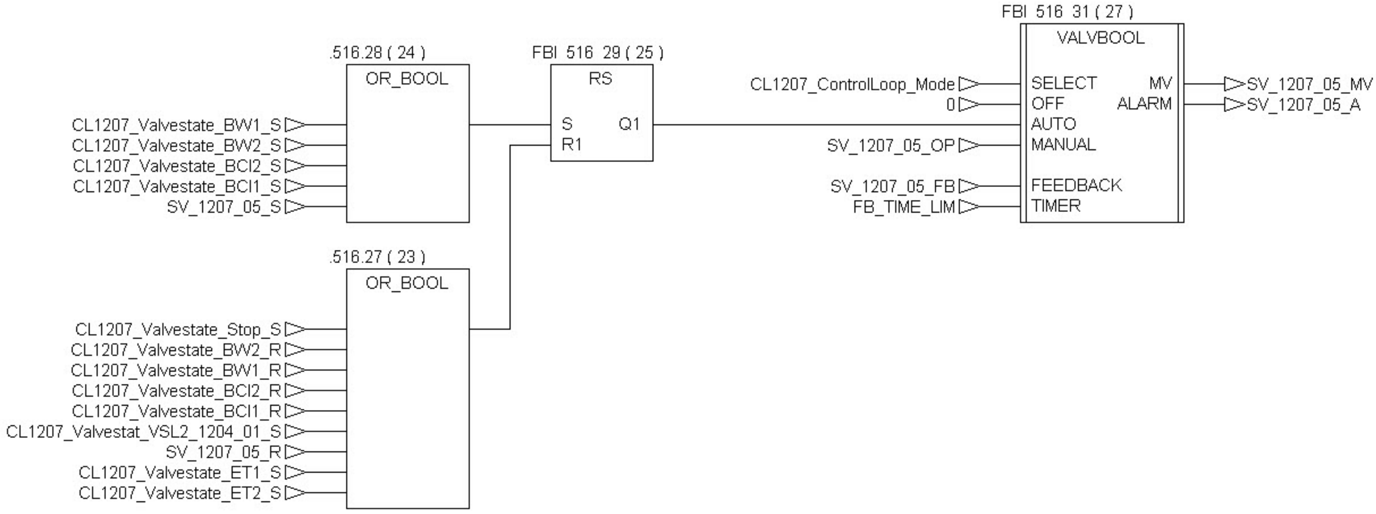
SV_1207_03:



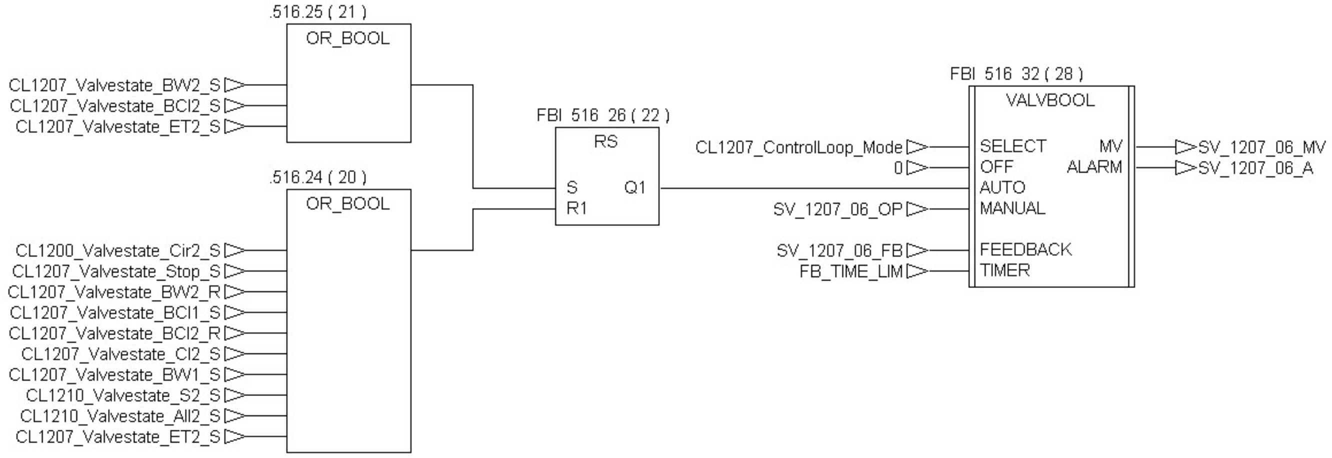
SV_1207_04:


FBI_516_30 (26)
VALVBOOL
.516.22 (18)
OR_BOOL
FBI_516_23 (19)
RS
CL1207_ControlLoop_Mode
SELECT
MV
SV_1207_04_MV
0
OFF
ALARM
SV_1207_04_A
SV_1207_04_S_Fill_CB_Tools
S
Q1
AUTO
CL1207_Valvestate_Rinse_CB_S
R1
SV_1207_04_OP
MANUAL
SV_1207_04_FB
FEEDBACK
FB_TIME_LIM
TIMER
.516.21 (17)
OR_BOOL
CL1207_Valvestate_Stop_S
SV_1207_04_R_Fill_CB_Tools
CL1207_Valvestate_Rinse_CB_R
CL1207_Valvestate_BCI1_S
CL1207_Valvestate_BCI2_S
CL1207_Valvestate_BW1_S
CL1207_Valvestate_BW2_S
CL1207_Valvestat_VSL2_1204_01_S
CL1207_Valvestate_ET1_S
CL1207_Valvestate_ET2_S

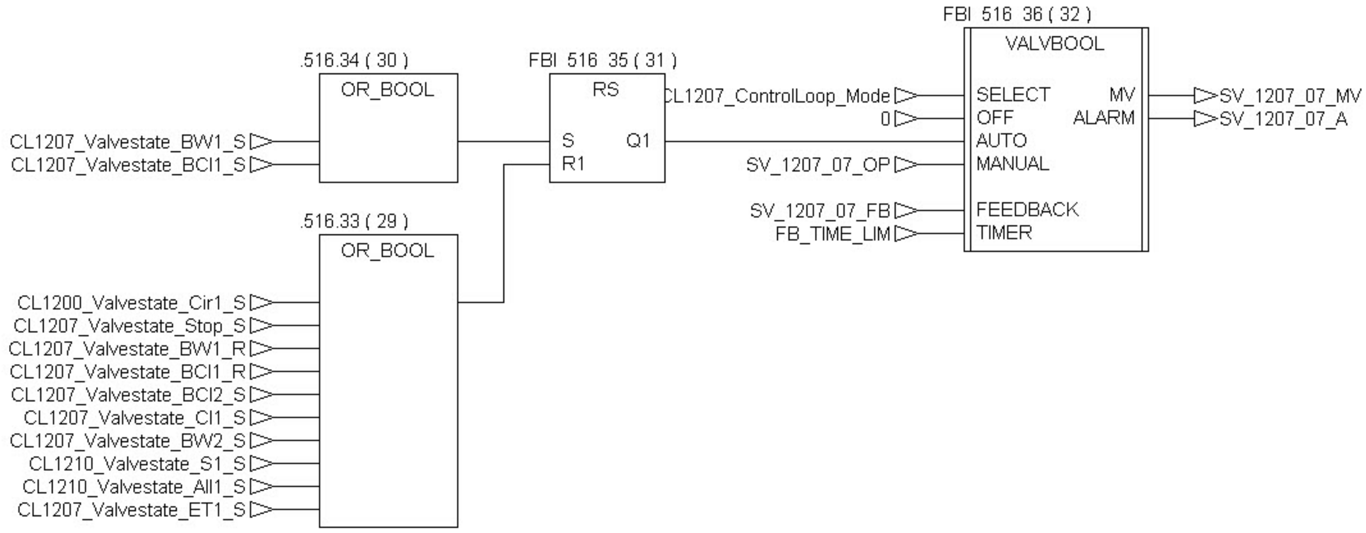
SV_1207_05:


FBI_516_31 (27)
VALVBOOL
.516.28 (24)
OR_BOOL
FBI_516_29 (25)
RS
CL1207_ControlLoop_Mode
SELECT
MV
SV_1207_05_MV
0
OFF
ALARM
SV_1207_05_A
CL1207_Valvestate_BW1_S
S
Q1
AUTO
CL1207_Valvestate_BW2_S
R1
SV_1207_05_OP
MANUAL
CL1207_Valvestate_BCI2_S
CL1207_Valvestate_BCI1_S
SV_1207_05_FB
FEEDBACK
SV_1207_05_S
FB_TIME_LIM
TIMER
.516.27 (23)
OR_BOOL
CL1207_Valvestate_Stop_S
CL1207_Valvestate_BW2_R
CL1207_Valvestate_BW1_R
CL1207_Valvestate_BCI2_R
CL1207_Valvestate_BCI1_R
CL1207_Valvestat_VSL2_1204_01_S
SV_1207_05_R
CL1207_Valvestate_ET1_S
CL1207_Valvestate_ET2_S

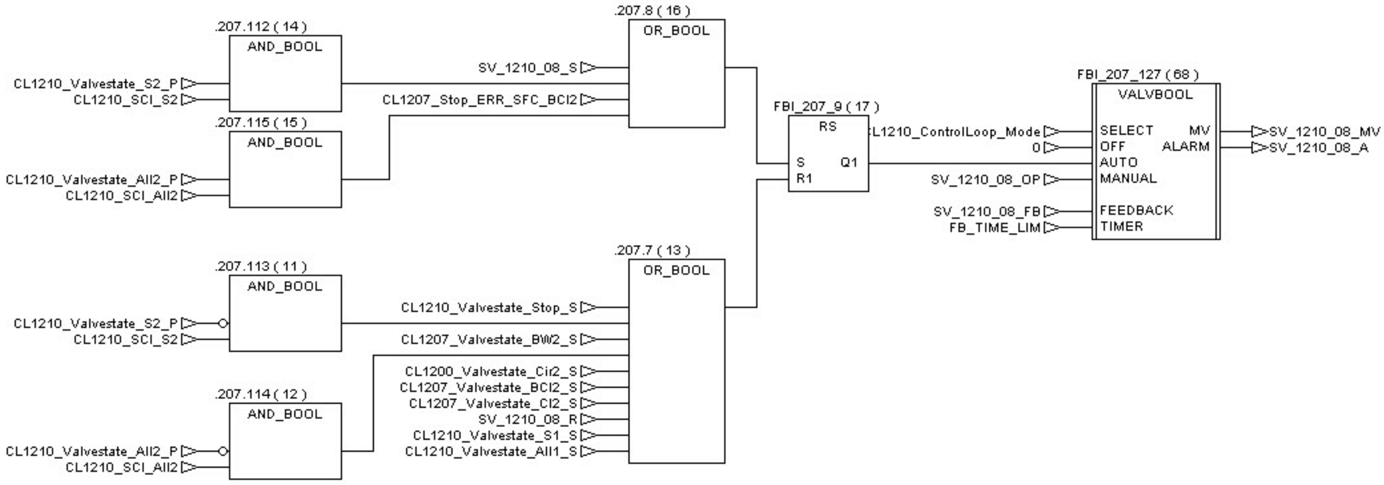
SV_1207_06:



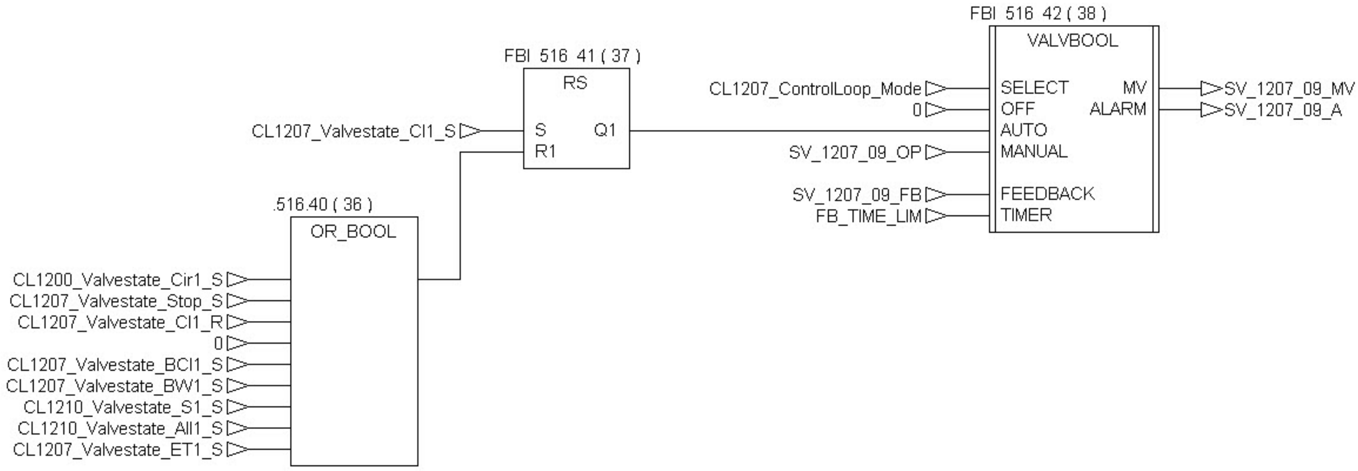
SV_1207_07:



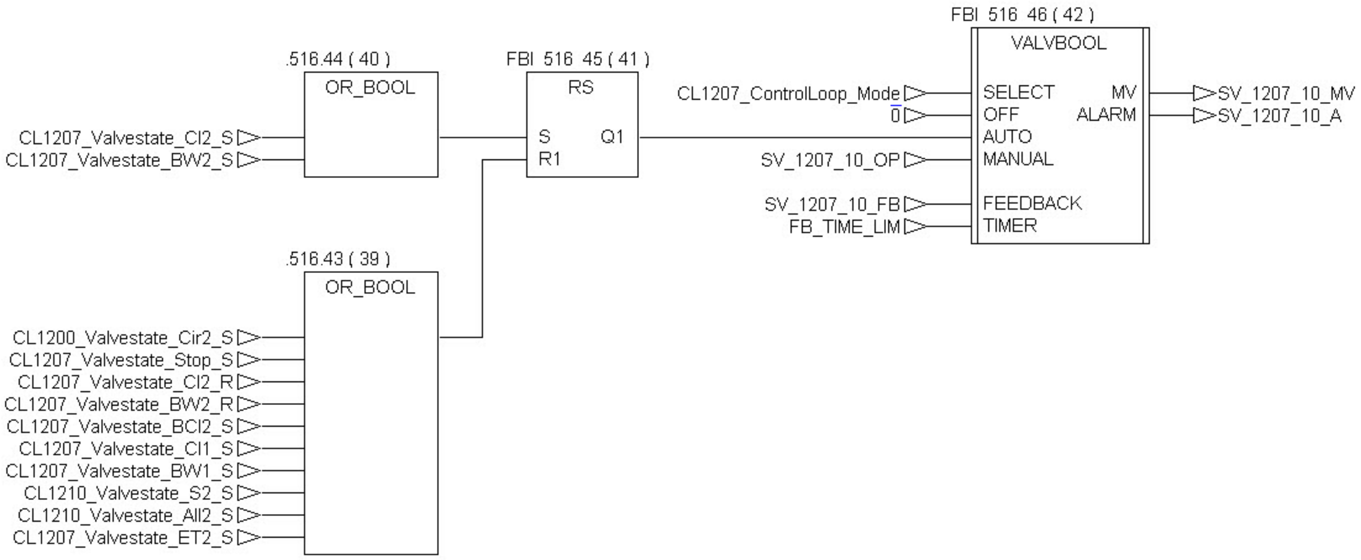
SV_1207_08:



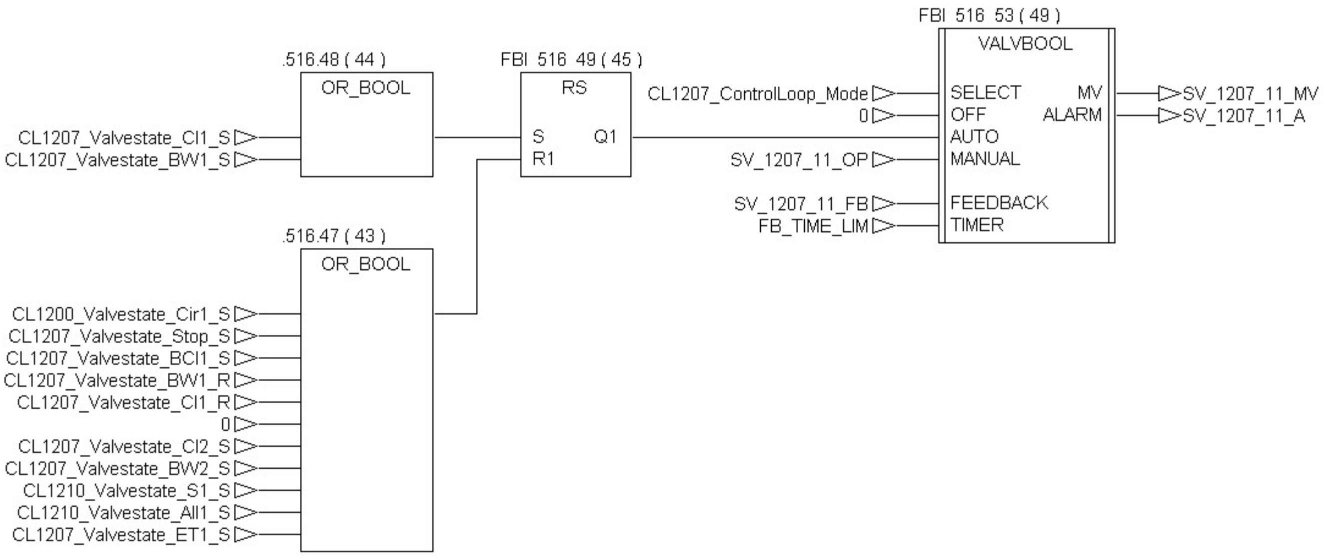
SV_1207_09:



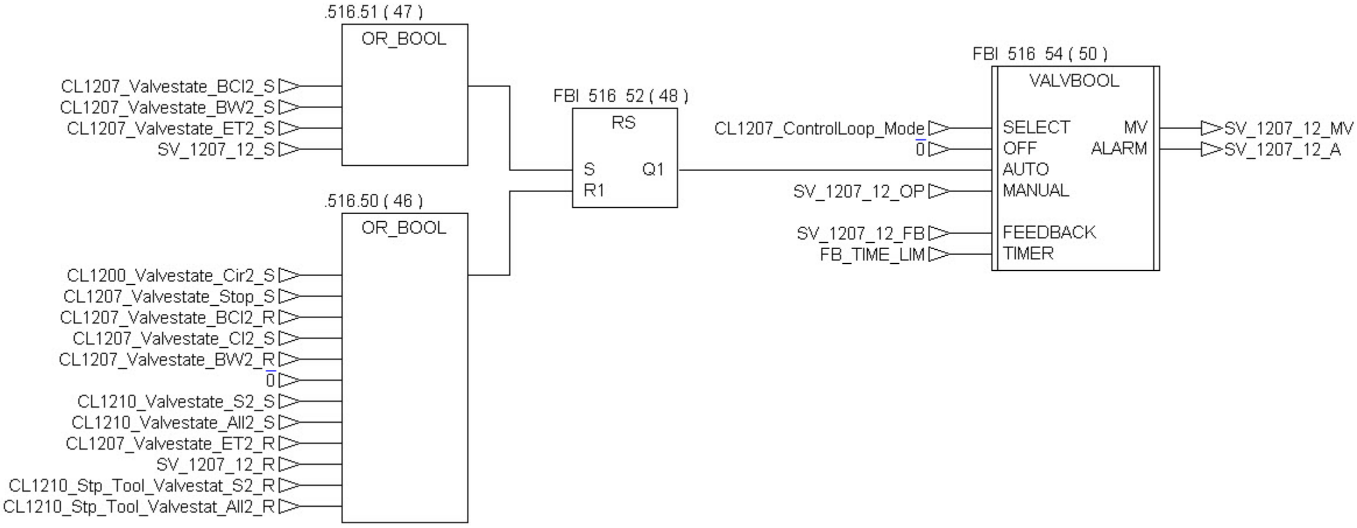
SV_1207_10:



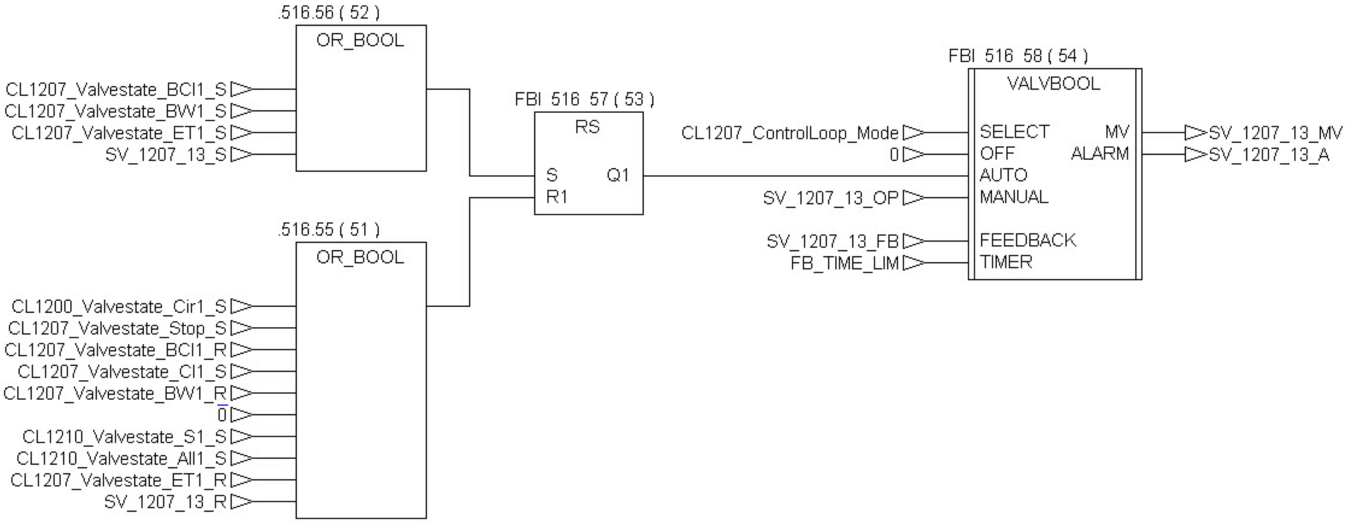
SV_1207_11:



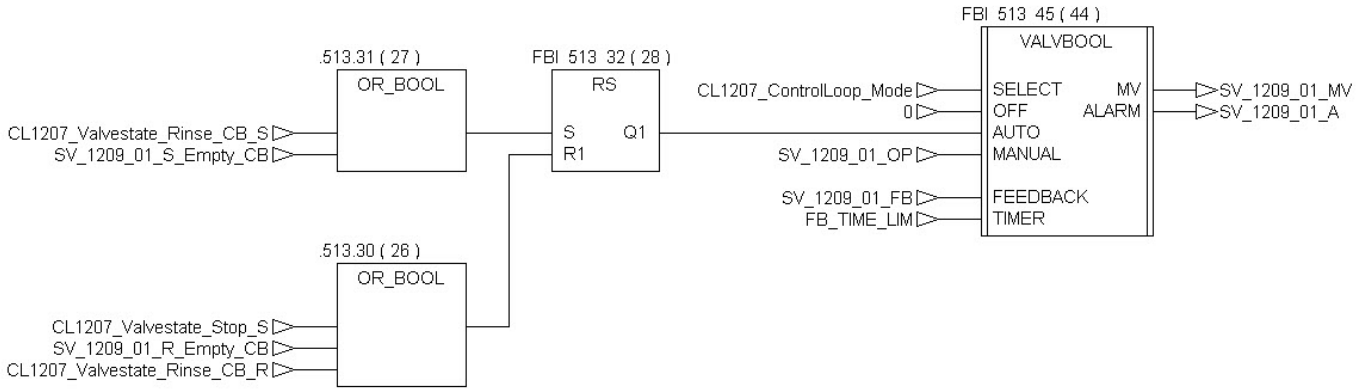
SV_1207_12:



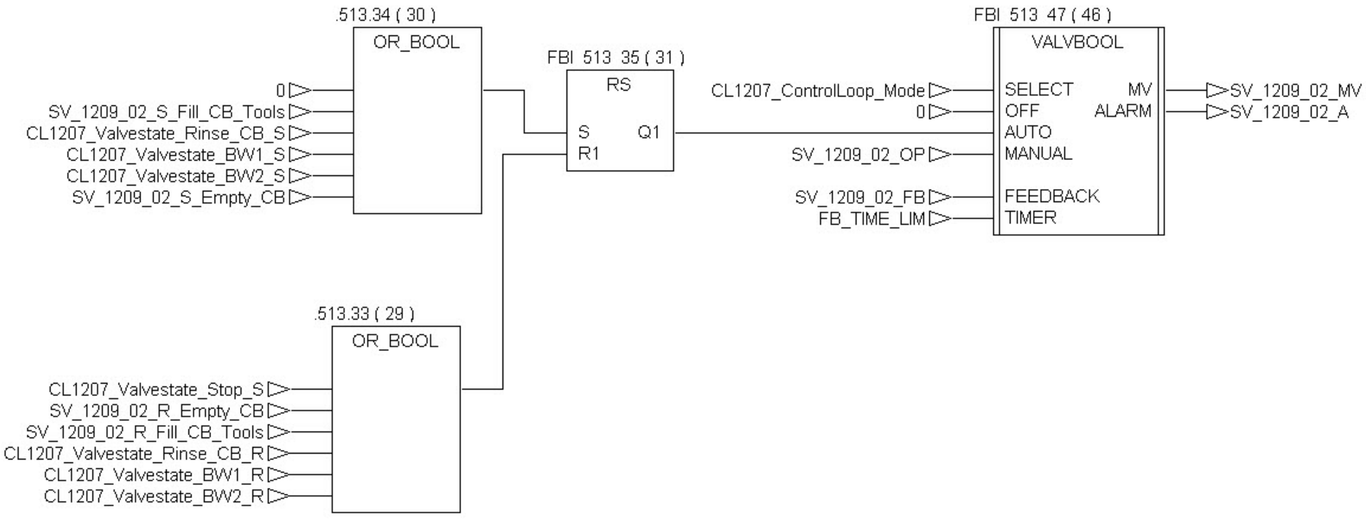
SV_1207_13:



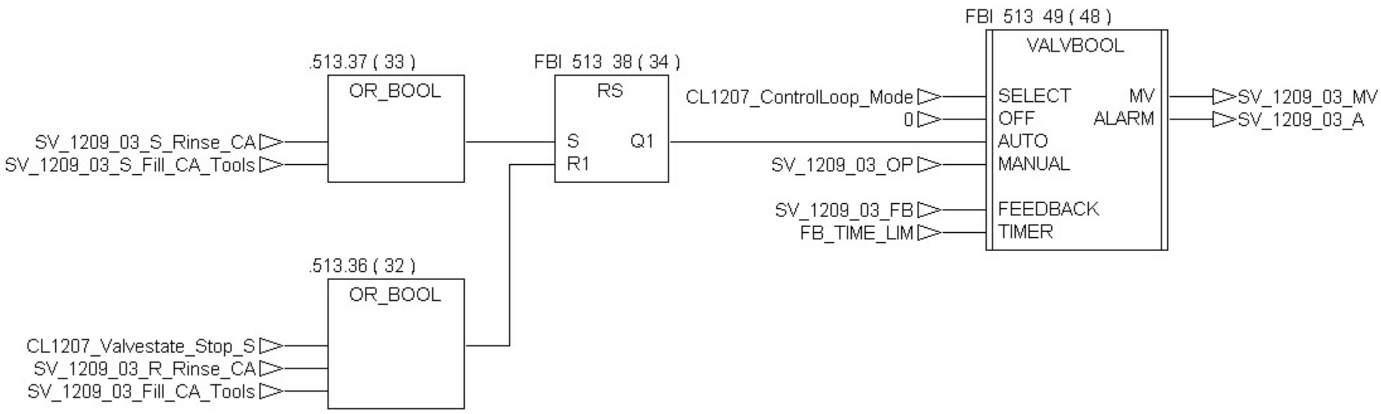
SV_1209_01:



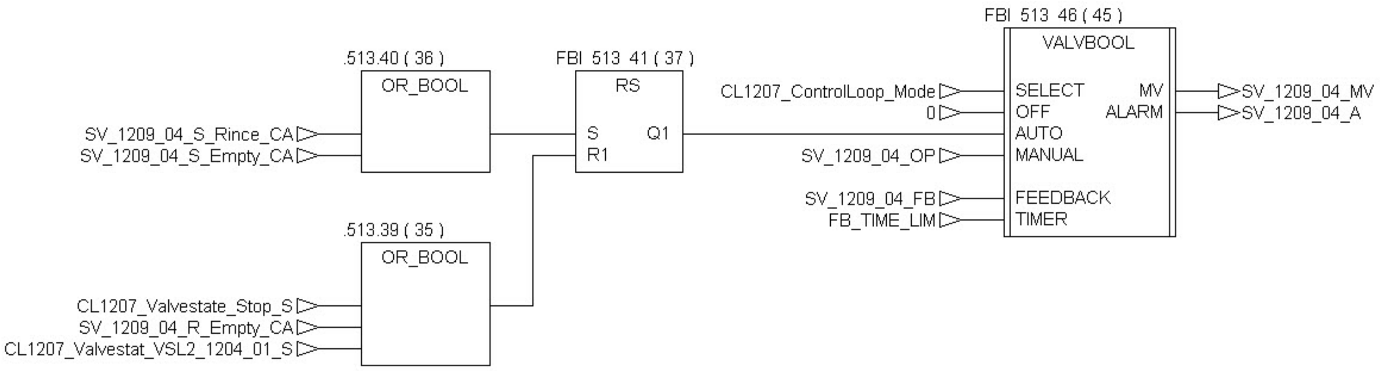
SV_1209_02:



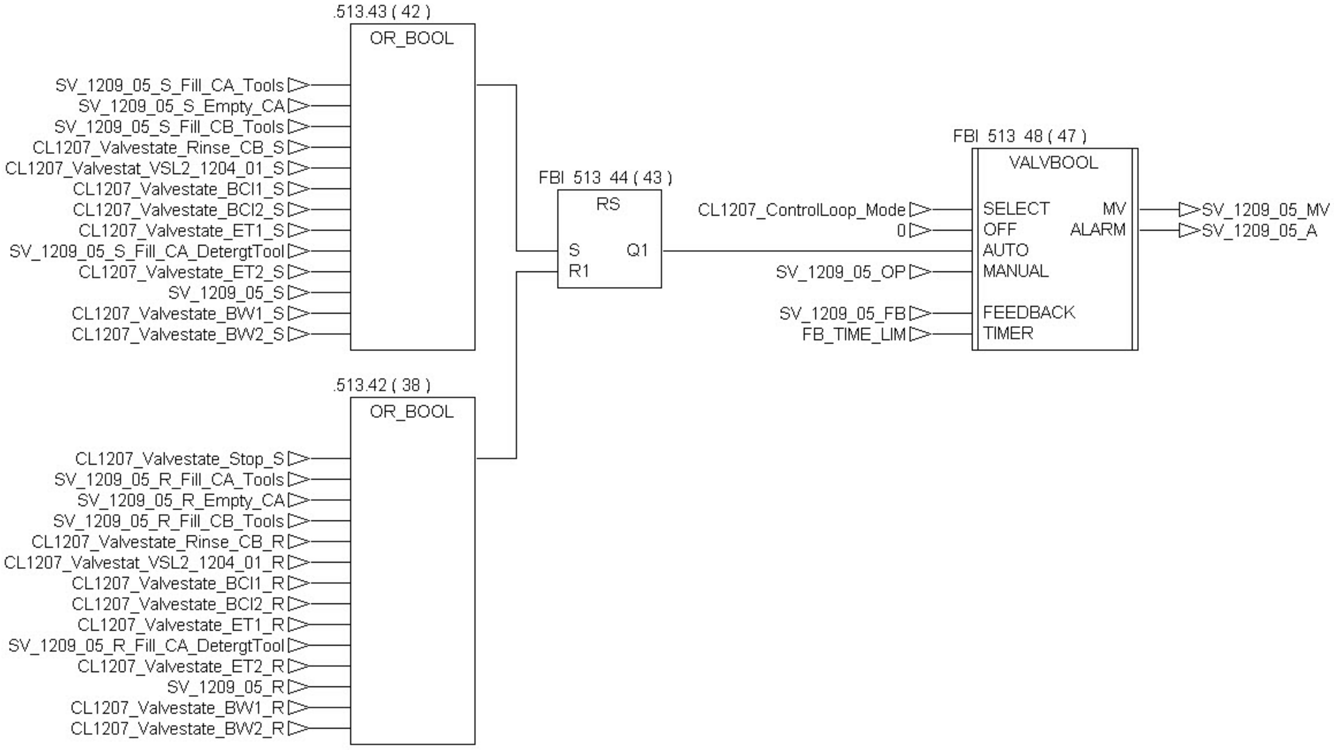
SV_1209_03:



SV_1209_04:



SV_1209_05:

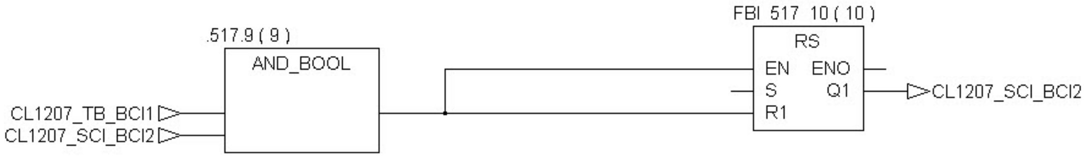


4.28.2.5. *Procedure Start buttons management*

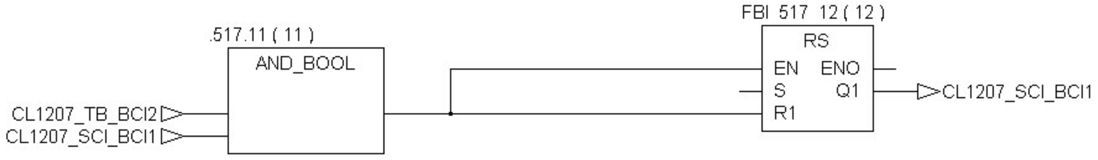
When a procedure is running, nothing prevents the operator to click on other “start procedure” button. In that case, the button is permanently set (until the CIP mode changes or the stop function starts). If all the conditions become true, the procedure will instantaneously start. Due to this, some cautions need to be taken in order to prevent wrong manipulation.

Here are they:

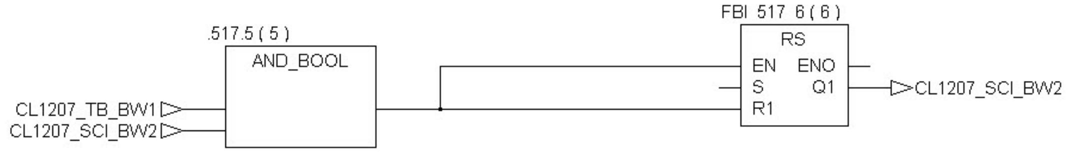
- Reset the “C_CL2” start button if “C_CL1” procedure is running.



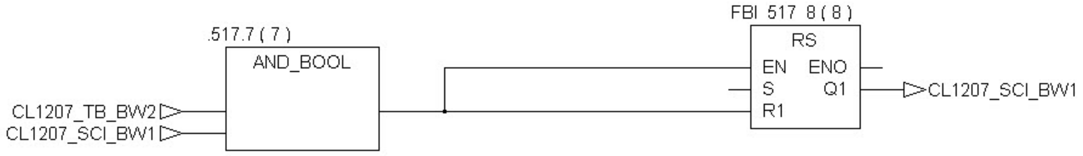
- Reset the “C_CL1” start button if “C_CL2” procedure is running.



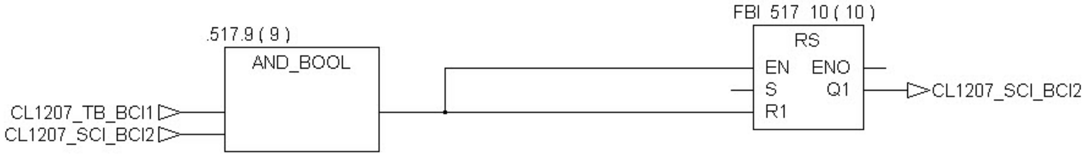
- Reset the “C_BW2” start button if “C_BW1” procedure is running.



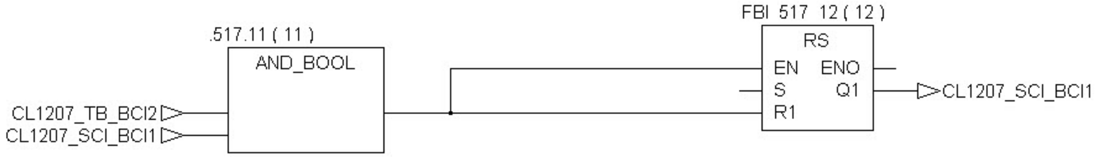
- Reset the “C_BW1” start button if “C_BW2” procedure is running.



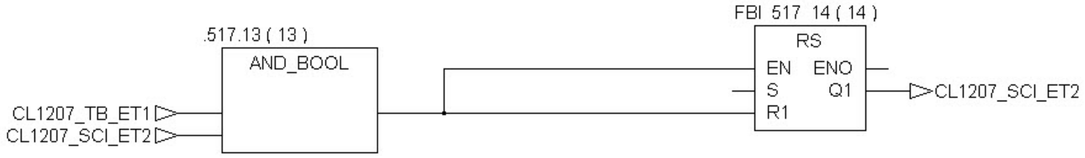
- Reset the “C_BCl1” start button if “C_BCl2” procedure is running.



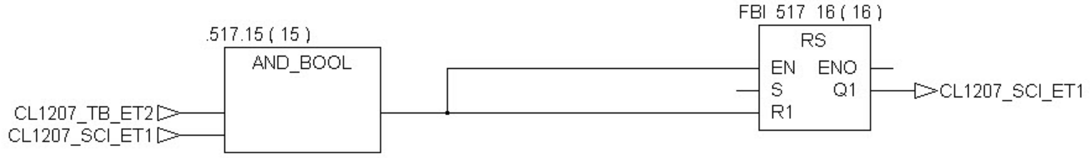
- Reset the “C_BCl2” start button if “C_BCl1” procedure is running.



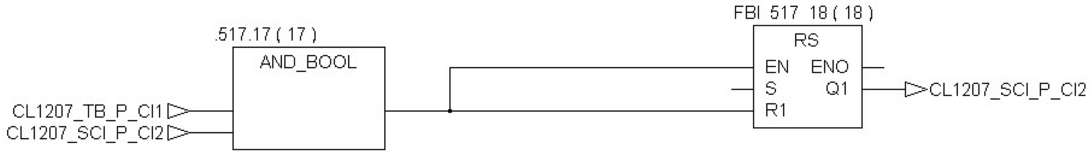
- Reset the “C_ET2” start button if “C_ET1” procedure is running.



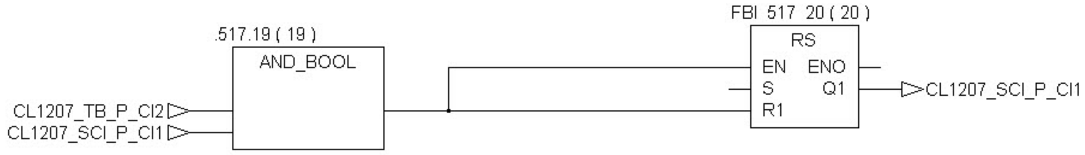
- Reset the “C_ET1” start button if “C_ET2” procedure is running.



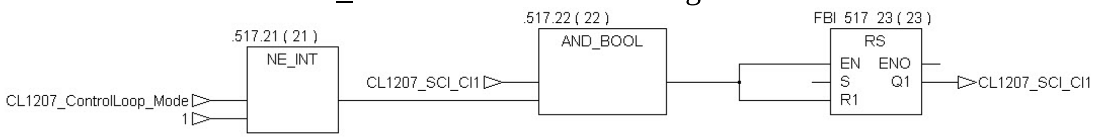
- Reset the “C_P_Cl2” start button if “C_P_Cl1” procedure is running.



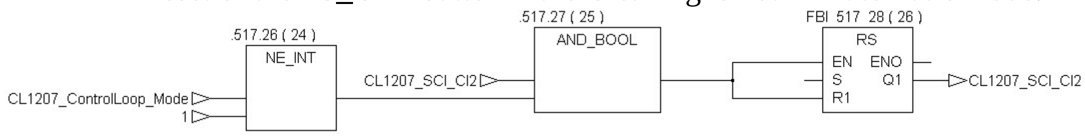
- Reset the “C_P_Cl1” start button if “C_P_Cl2” procedure is running.



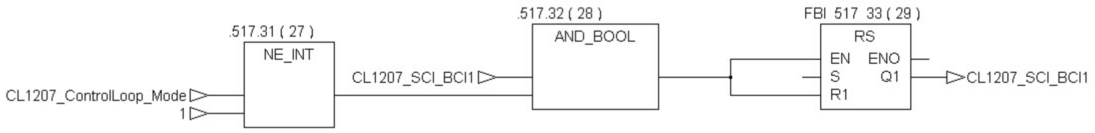
- Reset of the “C_Cl1” button if the Cleaning is not in Automatic mode.



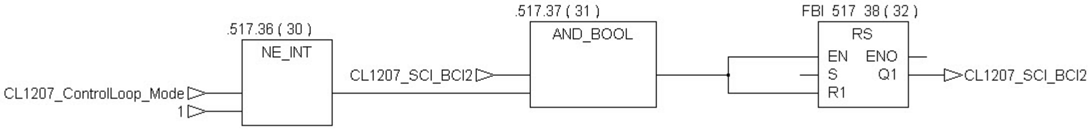
- Reset of the “C_Cl2” button if the Cleaning is not in Automatic mode.



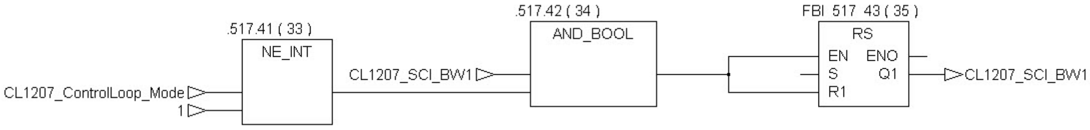
- Reset of the “C_BCl1” button if the Cleaning is not in Automatic mode.



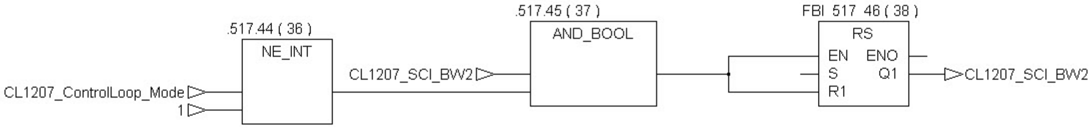
- Reset of the "C_BCl2" button if the Cleaning is not in Automatic mode.



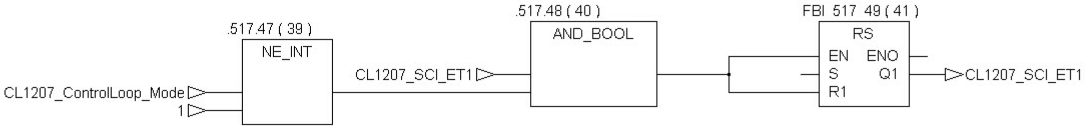
- Reset of the "C_BW1" button if the Cleaning is not in Automatic mode.



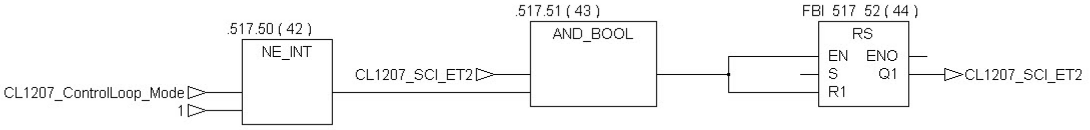
- Reset of the "C_BW2" button if the Cleaning is not in Automatic mode.



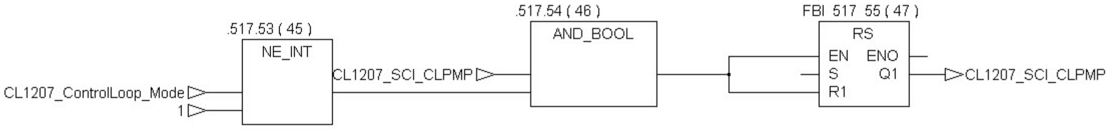
- Reset of the "C_ET1" button if the Cleaning is not in Automatic mode.



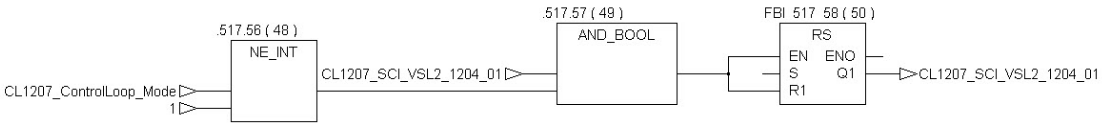
- Reset of the "C_ET2" button if the Cleaning is not in Automatic mode.



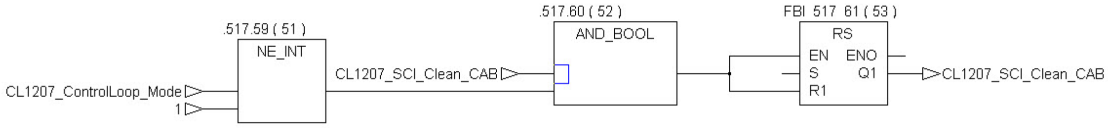
- Reset of the "C_CLPMP" button if the Cleaning is not in Automatic mode.



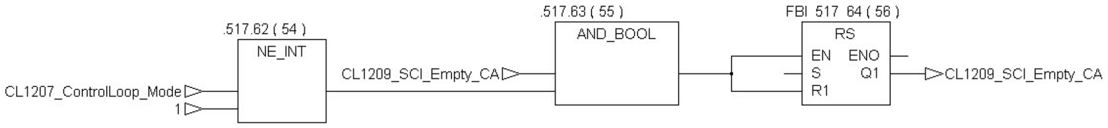
- Reset of the "C_R_F_01" button if the Cleaning is not in Automatic mode.



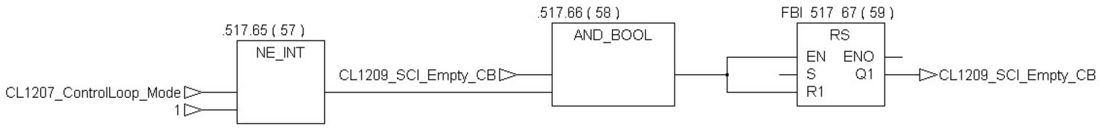
- Reset of the "C_CLEAN_CAB" button if the Cleaning is not in Automatic mode.



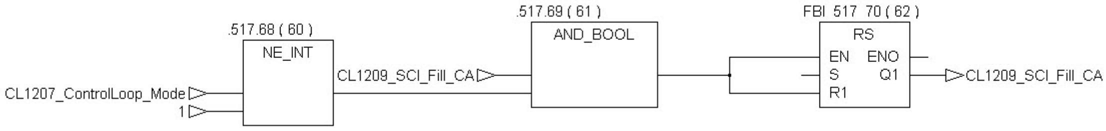
- Reset of the “C_Empty_CA” button if the Cleaning is not in Automatic mode.



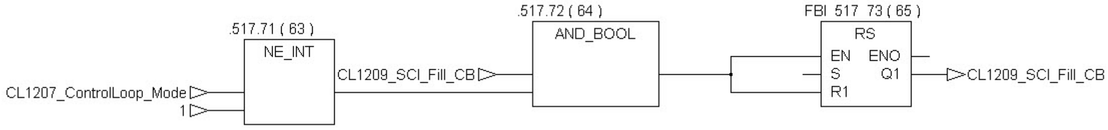
- Reset of the “C_Empty_CB” button if the Cleaning is not in Automatic mode.



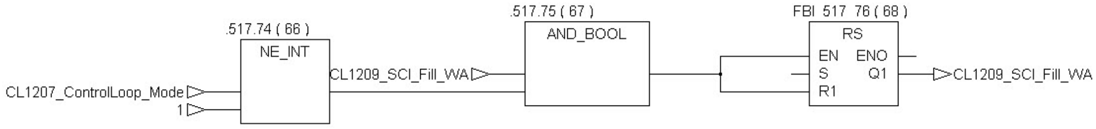
- Reset of the “C_Fill_CA” button if the Cleaning is not in Automatic mode.



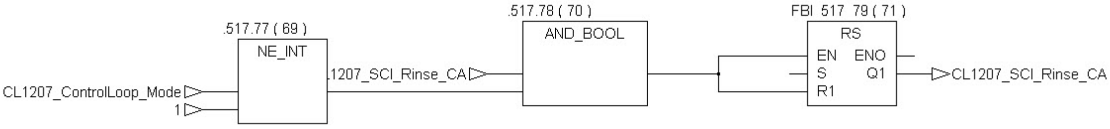
- Reset of the “C_Fill_CB” button if the Cleaning is not in Automatic mode.



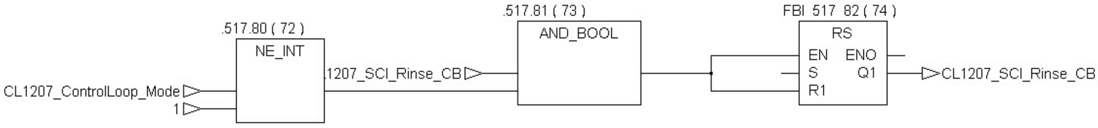
- Reset of the “C_Fill_WA” button if the Cleaning is not in Automatic mode.



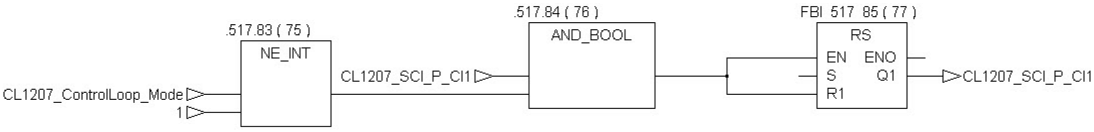
- Reset of the "C_Rinse_CA" button if the Cleaning is not in Automatic mode.



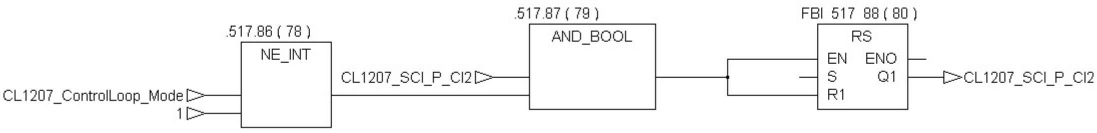
- Reset of the "C_Rinse_CB" button if the Cleaning is not in Automatic mode.



- Reset of the "C_P_Cl1" button if the Cleaning is not in Automatic mode.



- Reset of the "C_P_Cl2" button if the Cleaning is not in Automatic mode.



4.28.3.Alarms and Thresholds

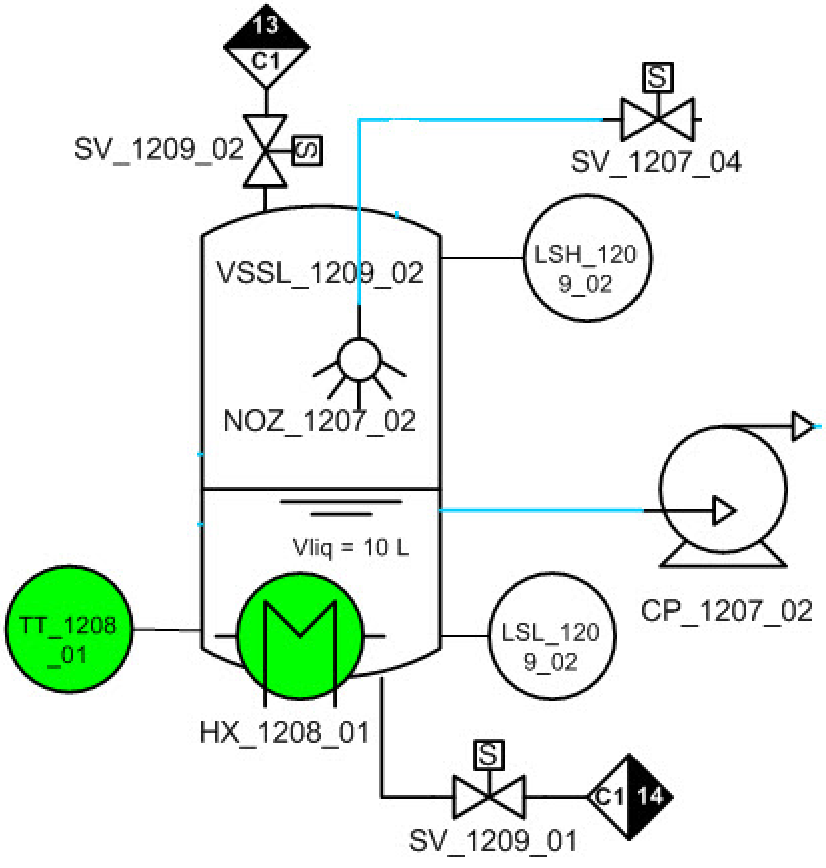
Alarm tag Name	type	Address	description
CP_1207_01_RunDry_A	BOOL	000695	Alarm triggered when LSL_1209_01 is set since 5 s ACTION : DISPLAY ALARM ON HMI
CP_1207_02_RunDry_A	BOOL	000697	Alarm triggered when LSL_1209_02 is set since 5 s ACTION : DISPLAY ALARM ON HMI
S3V_1207_03_A	BOOL	000699	valve alarm ACTION : DISPLAY ALARM ON HMI
S3V_1207_04_A	BOOL	000701	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1207_01_A	BOOL	000703	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1207_02_A	BOOL	000705	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1207_03_A	BOOL	000707	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1207_04_A	BOOL	000709	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1207_05_A	BOOL	000711	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1207_06_A	BOOL	000713	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1207_07_A	BOOL	000715	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1207_08_A	BOOL	000717	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1207_09_A	BOOL	000719	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1207_10_A	BOOL	000721	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1207_11_A	BOOL	000723	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1207_12_A	BOOL	000725	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1207_13_A	BOOL	000727	valve alarm ACTION : DISPLAY ALARM ON HMI

Figure 88: CIP General – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
FB_TIME_LIM	TIME	400900	5	seconds	Display an alarm

Figure 89: CIP General – THRESHOLDS

4.29. CIP Temperature control (CL1208)



4.29.1.Function

To provide efficient cleaning of membranes, the cleaning solution sending through the pipe is warmed before. A heat exchanger (resistor) and a PI controller maintain the temperature to the defined set point. This function is called by filtration unit cleaning procedures C_Cl1 and C_Cl2).
As explained in the “CIP General (CL1207)” chapter, all procedures can only be executed in automatic mode. A general stop button permits to reset any running procedure. In case of changing mode from automatic to manual during cleaning procedure execution, the PLC calls the stop function then reset all cleaning sequential sequences (procedures).

Three modes, applicable from CL1207 to CL1209, are available:

OFF Mode: All equipments are in default position and no procedure can be started.
Auto mode: The procedure linked to the Cleaning of the filtration unit can be started (With the FU AND SIP control loop also in automatic). All the valve positions and pump states are permanently checked. If an error is detected, the “stop cleaning” procedure function is called by the PLC.
Manu mode: The operator can manipulate all cleaning equipment but can’t start any procedure until switching to automatic mode.

PLC Section name	Equipment tag	Type	Address	Comment
CIP Temperature control	HX_1208_01_MV	DO	000017	Heat exchanger Equipment linked to cleaning vessel VSSL_1209_02
CIP Temperature control	TT_1208_01	AI	400129	Temperature sensor Measures temperature in cleaning vessel (VSSL_1209_02)

Figure 90: CIP Temperature control – EQUIPMENTS

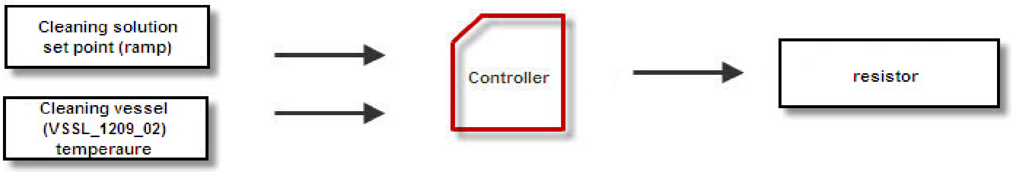
PLC Section name	Button tag	Type	Address	Comment
CIP Temperature control	CL1208_ElapsedTime	TIME	400778	Time elapsed during the cleaning of the membrane with the warmed solution
CIP Temperature control	CL1208_SCI_CB_Temp_SP	REAL	400400	Heat exchanger temperature set point.
CIP Temperature control	HX_1208_01_OP	BOOL	000728	Start / stop the heat exchanger of the cleaning buffer VSSL_1209_02 in manual mode

Figure 91: CIP Temperature control – USER INDICATOR / INPUT

4.29.2.Block Diagram

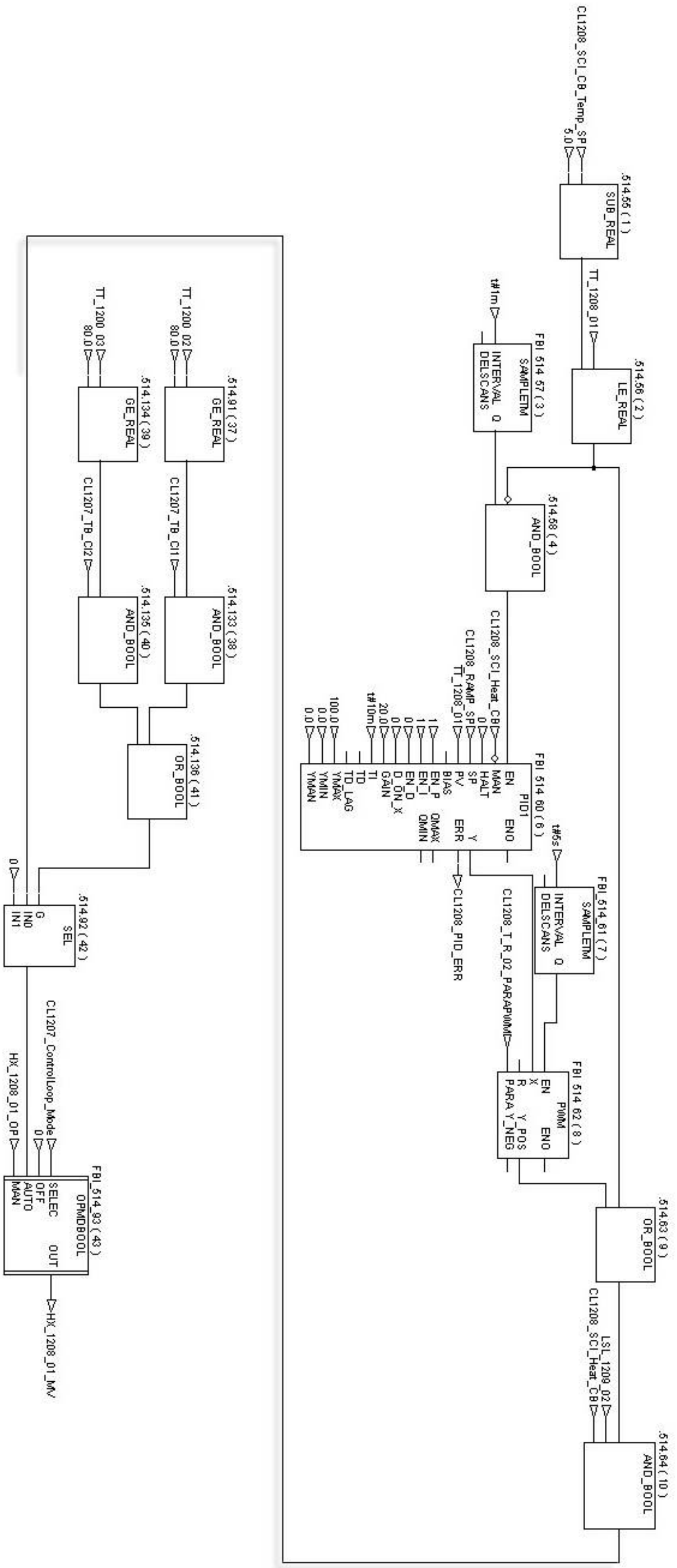
4.29.2.1. *Controller*

Important point:
2010/09/18
At the current time, the warm function of the cleaning solution is still in efficiency test. This function is triggered by the C_Cl1 and C_Cl2 procedures which clean the Retentate side of membrane(Detailed in chapter 4: User Manual Procedure).
The way of implementation can change as long as the definitive validation has not been provided.
Even if the HMI gives the right to change the set point and because the procedure is still in efficiency test, the operator can change the set point only when the warming function is activated. If no set point is configured, the procedure will ask 75 °C then 0°C at the end.



The control is provided by a PI controller. The cleaning solution is warmed until the defined temperature set point thanks to the resistor HX_1208_01. A ramp function ensures that no high temperature shock happens to the membrane (30°C delta-T and 10°C/min). This resistor warms the water circulating in the jacket of the cleaning buffer vessel VSSL_1209_02.
Two other protections are implemented (only in automatic).

1- If the Level switch low of the cleaning vessel is Set, the resistor can not be activated (in the automatic mode only)
2- If the temperature of the cleaned membrane exceeds 80°C, the resistor stops.



Controlled Variable					MPLETM	PROCESS VALUE (input)	SET POINT
Cleaning vessel solution temperature	PI	NO	NO	t_brake : 0s t_min : 0.5s t_max : 10 s up_pos : 1	Controller :1 minute PWM: 5 seconds	TT_1208	CL1208_RAMP_SP

				up_neg : 0			

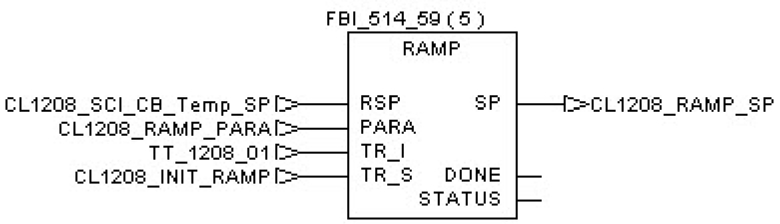
Controlled Variable	**INTERNAL MODEL PROCESS**	**TUNE**	**LIMIT**	**SELF_CMP**	**DECOMP**	**Manipulated Variable (Controller Output in Auto Mode)**	**Controlled Equipment**
Cleaning vessel solution temperature	Not a PCR controller. Thus no internal model.	Gain: 20 TI: 10m	YMIN : 0 YMAX :100 YRATE : 1	NO	NO	No variable (the input goes directly in the PWM block)	HX_1208_01_MV

4.29.2.1.2. Ramp function

In order to protect membranes from high temperature shock (30°C delta-T and 10°C/min), a ramp function manages the temperature set point sends to the controller. The ramp parameters are:

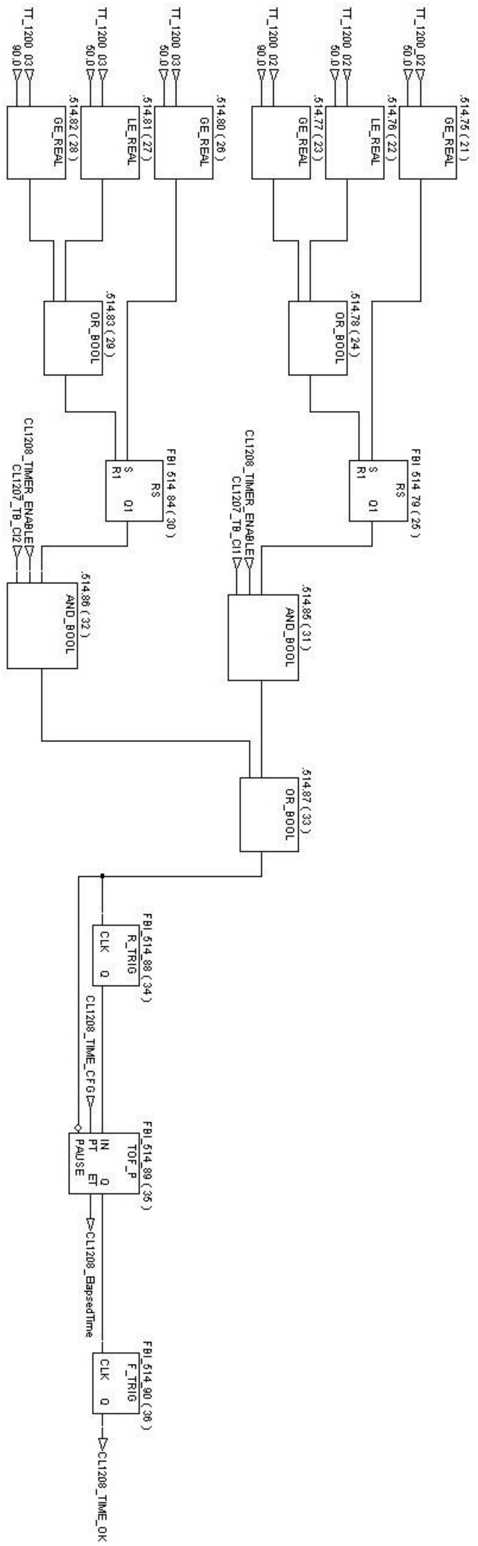
-increasing rate: 0.16°C / s

-decreasing rate: 10 °C / s



4.29.2.2. *Timer Function*

During the Procedure C_Cl1 or C_Cl2, the warmed cleaning solution circulates through the membrane during a defined time. To perform this function, the procedure activates the timer by sending a pulse on “CL1208_TIMER_ENABLE”.
The timer starts to count when the cleaning solution passing through the membrane reaches 50°C. After 30 minutes the tag “CL1208_TIME_OK” is set by the timer and the procedure continues its execution.
If the membrane temperature goes under 50°Cor above 90°C, the timer is restarted.


TT_1200_03
90.0
60.0
TT_1200_02
.514.82 (28)
GE_REAL
.514.81 (27)
LE_REAL
.514.80 (26)
.514.77 (23)
.514.76 (22)
.514.75 (21)
.514.83 (29)
OR_BOOL
.514.78 (24)
FBI_514_84 (30)
RS
S
R1
Q1
FBI_514_79 (25)
CL1208_TIMER_ENABLE
CL1207_TB_CI2
CL1207_TB_CI1
.514.86 (32)
AND_BOOL
.514.85 (31)
.514.87 (33)
FBI_514_88 (34)
R_TRIG
CLK
Q
CL1208_TIME_CFG
FBI_514_89 (35)
TOF_P
IN
PT
PAUSE
ET
CL1208_ElapsedTime
FBI_514_90 (36)
F_TRIG
CL1208_TIME_OK

4.29.3.Alarms and Thresholds

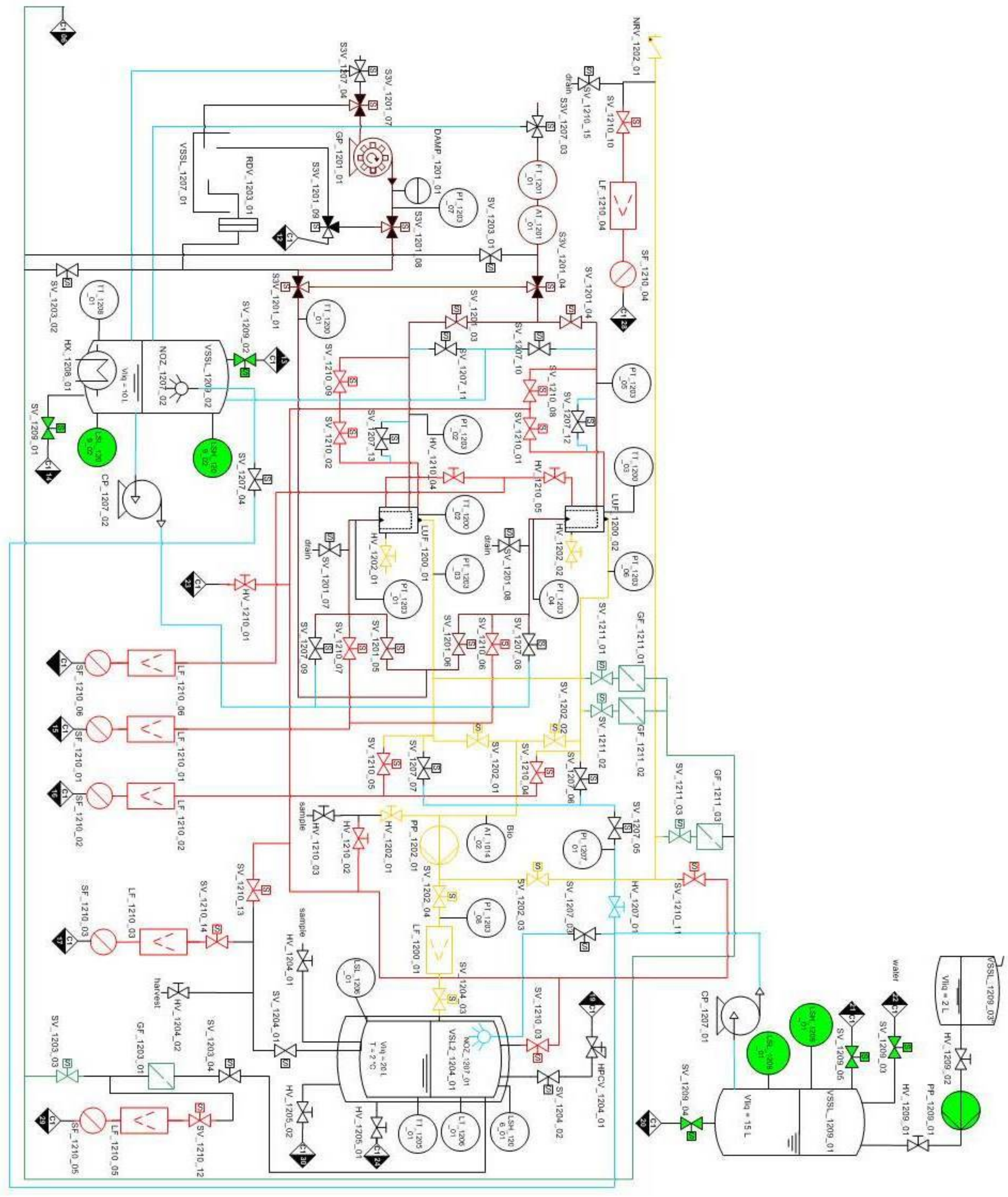
Alarm tag Name	type	Address	description
TT_1208_01_AH	BOOL	000729	High temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1208_01_AHH	BOOL	000730	Very High temperature alarm ACTION : DISPLAY ALARM ON HMI Stop the CIP procedure
TT_1208_01_AL	BOOL	000731	Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1208_01_ALL	BOOL	000732	Very Low temperature alarm ACTION : DISPLAY ALARM ON HMI
TT_1208_01_ERR	BOOL	000733	broken wire alarm ACTION : DISPLAY ALARM ON HMI

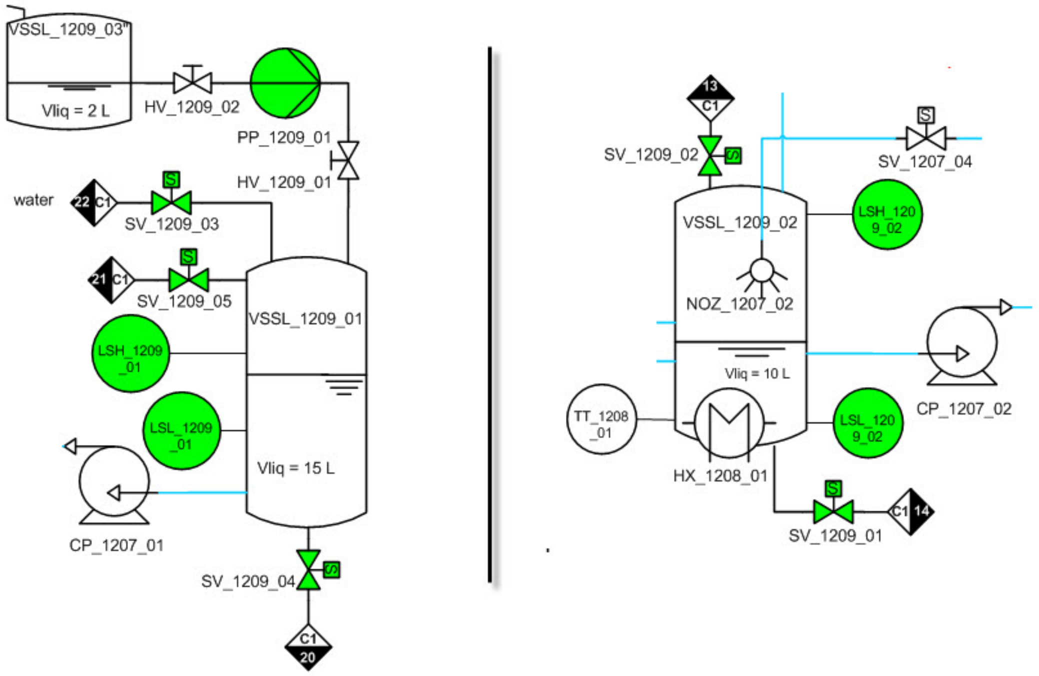
Figure 92: CIP Temperature control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
TT_1208_01_LIM_AH	REAL	401192	Membrane temperature + 30° C Depending on the membrane cleaned	°C	Display an alarm
TT_1208_01_LIM_AHH	REAL	401194	95 fixed Value	°C	Display an alarm Trigger the CIP control Loop to OFF mode
TT_1208_01_LIM_AL	REAL	401196	Membrane temperature - 30° C Depending on the membrane cleaned	°C	Display an alarm
TT_1208_01_LIM_ALL	REAL	401198	10 fixed Value	°C	Display an alarm

Figure 93: CIP Temperature control – THRESHOLDS

4.30. CIP Filling Control (CL1209)




VSSL_1209_03"
Vliq = 2 L
HV_1209_02
PP_1209_01
HV_1209_01
water
22 C1
SV_1209_03
21 C1
SV_1209_05
VSSL_1209_01
LSH_1209_01
LSL_1209_01
Vliq = 15 L
CP_1207_01
SV_1209_04
C1 20
13 C1
SV_1209_02
SV_1207_04
VSSL_1209_02
LSH_1209_02
NOZ_1207_02
Vliq = 10 L
CP_1207_02
TT_1208_01
LSL_1209_02
HX_1208_01
SV_1209_01
C1 14

4.30.1.Function

This control loop groups equipments linked to the cleaning Vessel filling. They are organised as sub-procedures frequently called by main procedure to provide cleaning functions.
As explained in the “CIP General (CL1207)” chapter, all procedures can only be executed in automatic mode. A general stop button permits to reset any running procedure. In case of changing mode from automatic to manual during cleaning procedure execution, the PLC calls the stop function then reset all cleaning sequential sequences (procedures).

Three modes, applicable from CL1207 to CL1209, are available:

OFF Mode: All equipments are in default position and no procedure can be started.
Auto mode: The procedure linked to the Cleaning of the filtration unit can be started (With the FU AND SIP control loop also in automatic). All the valve and pump states are permanently checked. If an error is detected, the “stop cleaning” procedure function is called by the PLC.
Manu mode: The operator can manipulate all cleaning equipment but can’t start any procedure until switching to automatic mode.

PLC Section name	Equipment tag	Type	Address	Comment
CIP Filling Control	PP_1209_01_MV	DO	000019	Peristaltic pump Pumps pure detergent (VSSL_1209_03) to cleaning agent tank (VSSL_1209_01)
CIP Filling Control	SV_1209_01_MV	DO	000078	powered 2-way valve Drains cleaning buffer vessel (VSSL_1209_02) when open
CIP Filling Control	SV_1209_01_FB	DI	100103	valve feedback
CIP Filling Control	SV_1209_02_MV	DO	000079	Powered 2-way valve Allows outside air to enter cleaning buffer vesel (VSSL_1209_02) while it is drained and allows air to leave the vessel when it is being filled
CIP Filling Control	SV_1209_02_FB	DI	100102	valve feedback
CIP Filling Control	SV_1209_03_MV	DO	000080	Powered 2-way valve Used to fill VSSL_1209_01 with water
CIP Filling Control	SV_1209_03_FB	DI	100101	valve feedback
CIP Filling Control	SV_1209_04_MV	DO	000065	Powered 2-way valve Used to drain and during rinsing of cleaning agent vessel (VSSL_1209_01)
CIP Filling Control	SV_1209_04_FB	DI	100100	valve feedback
CIP Filling Control	SV_1209_05_MV	DO	000066	Powered 2-way valve Allows outside air to enter during draining and rinsing

PLC Section name	Equipment tag	Type	Address	Comment
				of cleaning agent vessel (VSSL_1209_01) and allows air to leave the vessel when it is being filled
CIP Filling Control	SV_1209_05_FB	DI	100099	valve feedback
CIP Filling Control	LSL_1209_01	DI	100051	Level switch Detects low level in cleaning agent tank (VSSL_1209_01)
CIP Filling Control	LSH_1209_01	DI	100052	Level switch Detects high level in cleaning agent tank (VSSL_1209_01)
CIP Filling Control	LSL_1209_02	DI	100049	Level switch Detects low level in cleaning buffer tank (VSSL_1209_02)
CIP Filling Control	LSH_1209_02	DI	100050	Level switch Detects high level in cleaning buffer tank (VSSL_1209_02)

Figure 94: CIP Filling Control – EQUIPMENTS

PLC Section name	Button tag	Type	Address	Comment
CIP Filling Control	PP_1209_01_OP	BOOL	000734	Start / stop the Peristaltic pump which Pumps pure detergent (VSSL_1209_03) to cleaning agent tank (VSSL_1209_01) in manual mode
CIP Filling Control	SV_1209_01_OP	BOOL	000735	Open / close the valve in manual mode
CIP Filling Control	SV_1209_02_OP	BOOL	000737	Open / close the valve in manual mode
CIP Filling Control	SV_1209_03_OP	BOOL	000739	Open / close the valve in manual mode
CIP Filling Control	SV_1209_04_OP	BOOL	000741	Open / close the valve in manual mode
CIP Filling Control	SV_1209_05_OP	BOOL	000743	Open / close the valve in manual mode
CIP Filling Control	CL1209_SCI_Empty_CA	BOOL	000244	Start to empty cleaning buffer 1 (VSSL_1209_01)
CIP Filling Control	CL1209_TB_Empty_CA	BOOL	000376	Tracing bit during the emptying of VSSL_1209_01
CIP Filling Control	CL1209_C_Empty_CA_error	UDINT	400305	error number in procedure C_Empty_CA
CIP Filling Control	CL1209_SCI_Empty_CB	BOOL	000245	Start to empty cleaning buffer 2 (VSSL_1209_02)
CIP Filling Control	CL1209_TB_Empty_CB	BOOL	000377	Tracing bit during the emptying of VSSL_1209_02
CIP Filling Control	CL1209_C_Empty_CB_error	UDINT	400307	error number in procedure C_Empty_CB
CIP Filling Control	CL1209_SCI_Fill_CA	BOOL	000248	Start to fill cleaning buffer 1 (VSSL_1209_01) with cleaning agent or water
CIP Filling Control	CL1209_TB_Fill_CA	BOOL	000379	Tracing bit during the filling of VSSL_1209_01
CIP Filling Control	CL1209_C_Fill_CA_error	UDINT	400309	error number in procedure C_Fill_CA
CIP Filling Control	CL1209_SCI_Fill_CB	BOOL	000251	Start to fill cleaning buffer 2 (VSSL_1209_02) the content of VSSL_1209_01
CIP Filling Control	CL1209_TB_Fill_CB	BOOL	000381	Tracing bit during the filling of VSSL_1209_02
CIP Filling Control	CL1209_C_Fill_CB_error	UDINT	400311	error number in procedure C_Fill_CB
CIP Filling Control	CL1209_SCI_Fill_WA	BOOL	000253	Start to fill cleaning buffer 1 (VSSL_1209_01) with water
CIP Filling Control	CL1209_TB_Fill_WA	BOOL	000380	Tracing bit during the filling of VSSL_1209_01
CIP Filling Control	CL1209_C_Fill_WA_error	UDINT	400213	error number in procedure C_Fill_WA
CIP Filling Control	CL1209_OP_CleaningAgent	BOOL	000260	displays a confirmation windows asking to the operator if the cleaning agent is present
CIP Filling Contro	CL1209_OP_CleaningAgent_OK	BOOL	000388	confirmation of the operator (cleaning agent is present)

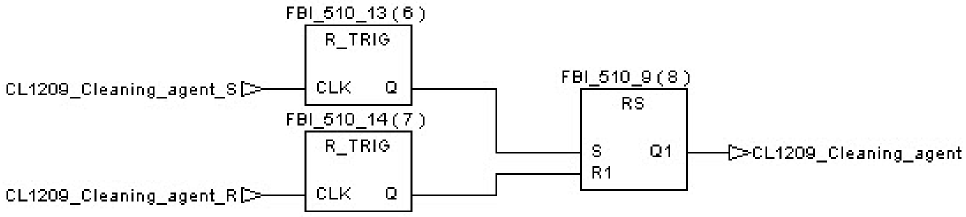
PLC Section name	Button tag	Type	Address	Comment
CIP Filling Contro	CL1209_Cleaning_agent_S	BOOL	000392	button for added cleaning agent in the filling of VSSL_1209_01
CIP Filling Contro	CL1209_Cleaning_agent_R	BOOL	000393	button fill water without cleaning agent in VSSL_1209_01
CIP Filling Contro	CL1209_SCI_Fill_CA_DetergtTime	TIME	400701	enter by the operator to configure the time of detergent injection pump (initial value: 15s)
CIP Filling Contro	CL1209_SCI_Fill_CA_DetergtTimer	TIME	400705	monitor the time of detergent injection pump

Figure 95: CIP Filling Control – USER INDICATOR / INPUT

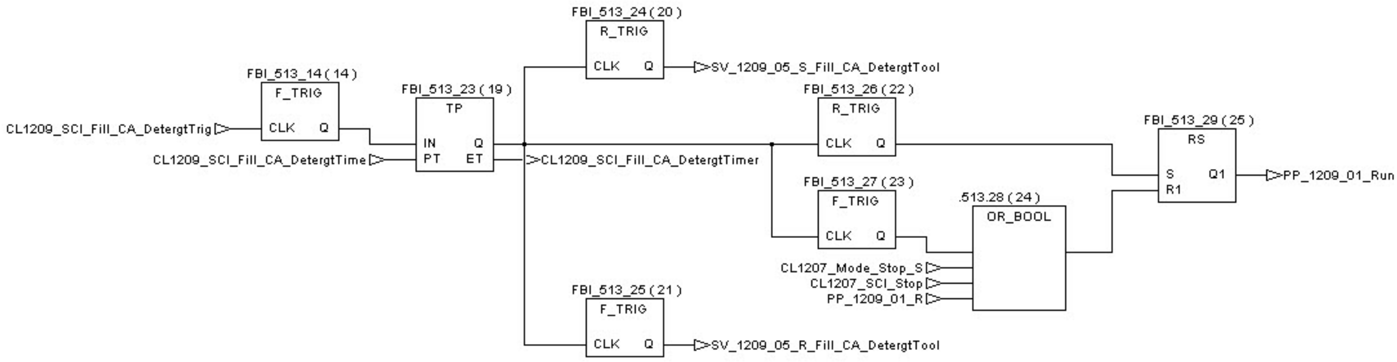
4.30.2.Block Diagram

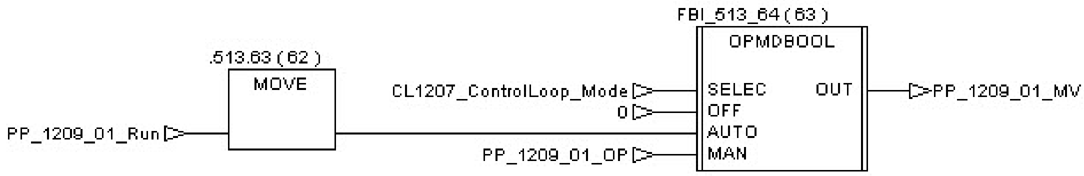
4.30.2.1. *VSSL_1209_01 Filling*

The filling of cleaning vessel 1 (VSSL_1209_01) is done thanks to the procedure C_Fill_CA (cleaning agent and water or water only) and C_Fill_WA (water only).
If operator decides to add cleaning solution, the tag “CL1209_Cleaning_agent” is set.

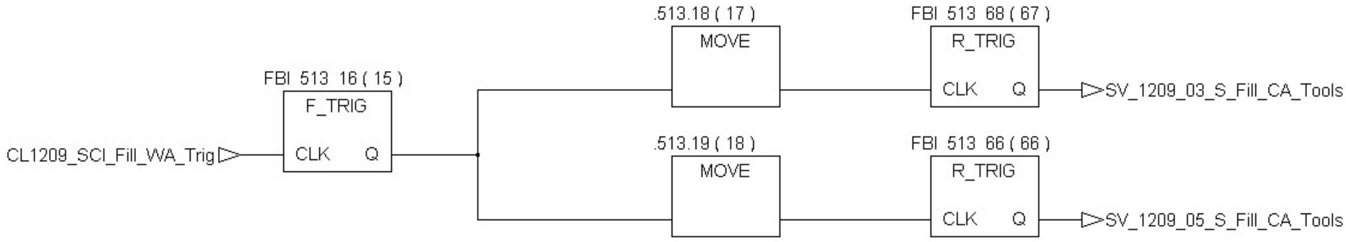


then the pump PP_1209_01 is activated during a defined time (configurable) and the valve SV_1209_05 (Atmosphere entrance) is open

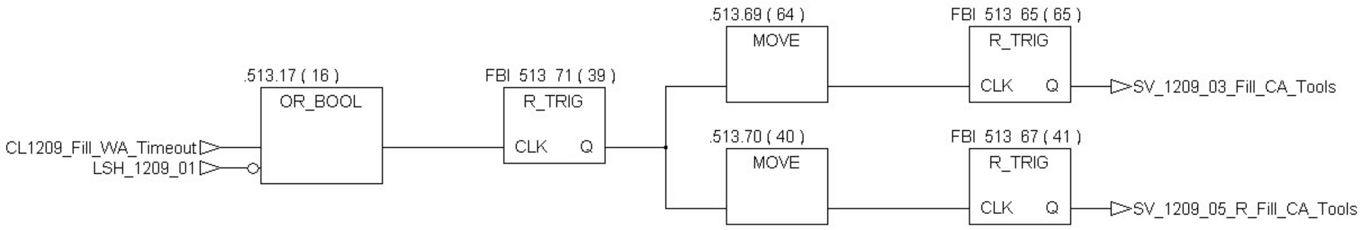




At the end of the time the pump is stopped, then water is added thanks to the procedure C_Fill_WA making a pulse on the tag “CL1209_SCI_Fill_WA_Trig” (SV_1209_03 and SV_1209_05 opening).

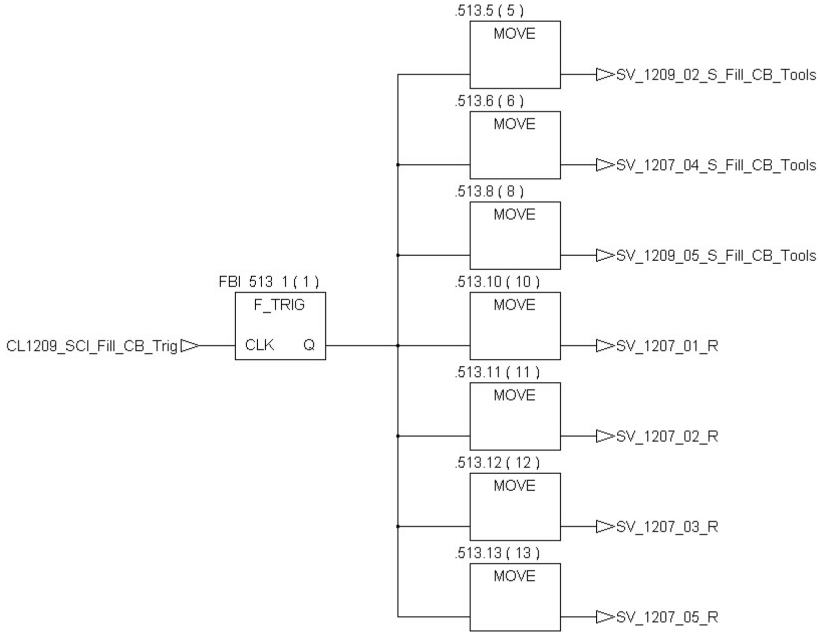


Finally, when VSSL_1209_01 is full, the Level switch high LSH_1209_01 is reset (inverted logic). The valves SV_1209_03 and SV_1209_05 are reset by a pulse.
The tag “CL1207_Fill_WA_Timeout” (which also reset the valves enounced above) is set if the SV_1209_03 (Water entrance) is opened more than 3 minutes.

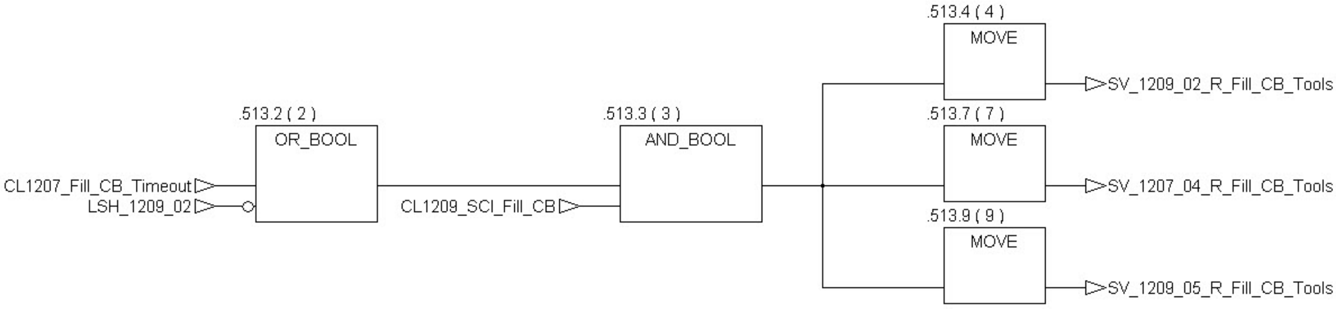


4.30.2.2. *VSSL_1209_02 Filling*

The filling of the cleaning vessel 2 is called by the procedure C_Cl1, C_Cl2 (cleaning both part of the membrane) and the CLPMP (Cleaning of the retentate pump GP_1201_01).
During these procedures, the tag named “CL1209_SCI_Fill_CB_Trig” receives a pulse and opens the valves SV_1209_02, _04, _05 and closes the valves SV_1207_01, _02, _03, _05.



When the VSSL_1209_02 is full, the level switch High LSH_1209_02 is reset (inverted logic) and a pulse is sent to close the atmospheric valve of both cleaning vessels SV_1209_ 02 and SV_1209_05 and the entrance valve of VSSL_1209_02 (SV_1207_04).
The tag “CL1207_Fill_CB_Timeout” (which also reset the valves enounced above) is set if the SV_1207_04 is opened more than 10 minutes.



4.30.3. Alarms and Thresholds

Alarm tag Name	type	Address	description
SV_1209_01_A	BOOL	000736	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1209_02_A	BOOL	000738	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1209_03_A	BOOL	000740	valve alarm ACTION : DISPLAY ALARM ON HMI

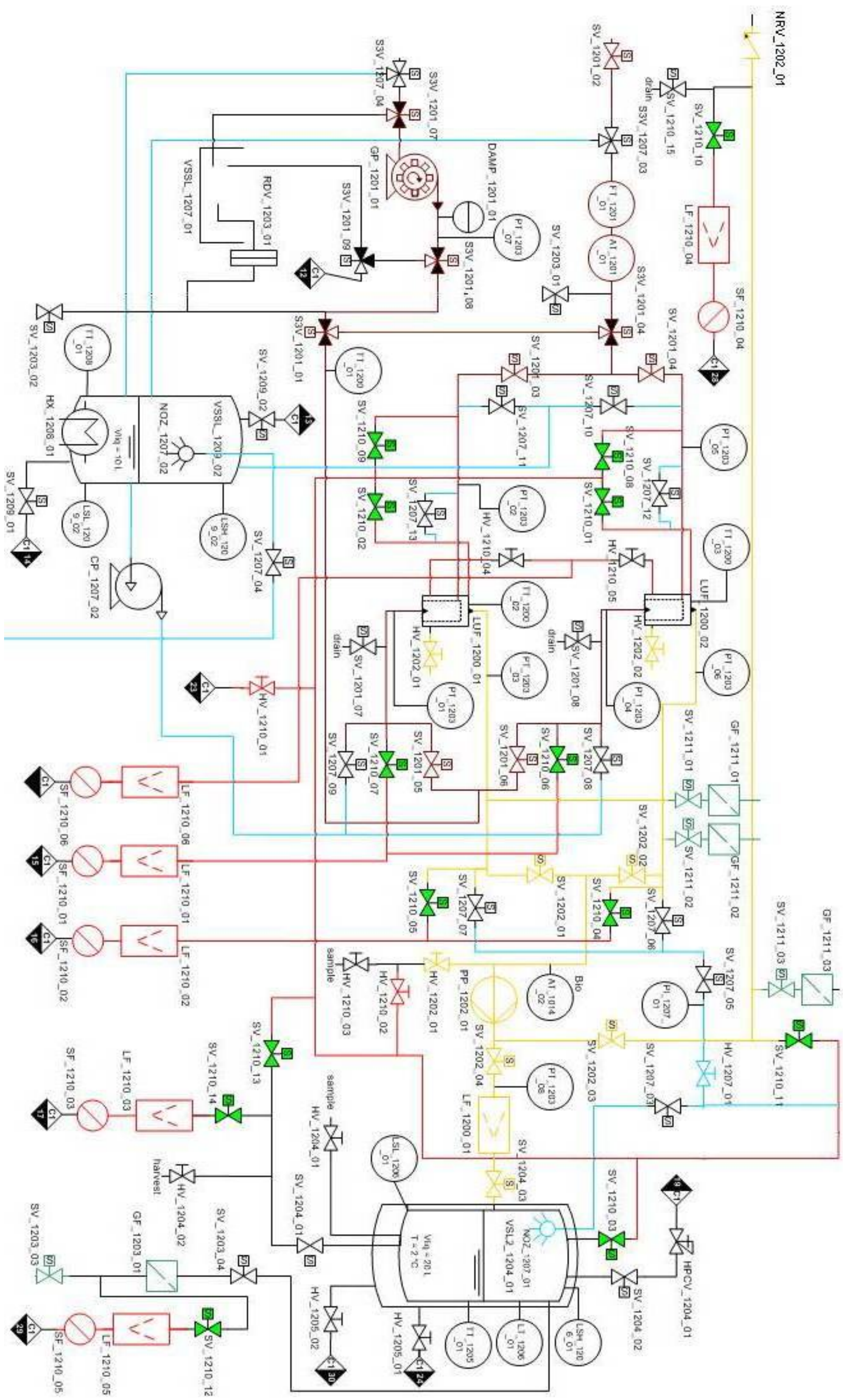
SV_1209_04_A	BOOL	000742	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1209_05_A	BOOL	000744	valve alarm ACTION : DISPLAY ALARM ON HMI
LSL_1209_01_A	BOOL	000746	Level switch Low alarm ACTION : DISPLAY ALARM ON HMI
LSH_1209_01_A	BOOL	000745	Level switch High alarm ACTION : DISPLAY ALARM ON HMI
LSL_1209_02_A	BOOL	000747	Level switch Low alarm ACTION : DISPLAY ALARM ON HMI
LSH_1209_02_A	BOOL	000748	Level switch High alarm ACTION : DISPLAY ALARM ON HMI

Figure 96: CIP Filling Control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
FB_TIME_LIM	TIME	400900	5	seconds	Display an alarm
PS_TIME_LIM	TIME	400902	10	seconds	Display an alarm

Figure 97: CIP Filling Control – THRESHOLDS

4.31. SIP General (CL1210)



4.31.1.Function

After cleaning, the sterilization function is to obtain non contaminated pipe and equipment. The different part of the process can be sterilized using adequate procedure. The complete list of the procedures and their specific functions are described in the “procedure” chapter.

All procedures can only be executed in automatic mode. A general stop button permits to reset any running procedure. In case of changing mode from automatic to manual during sterilization procedure execution, the PLC calls the stop function then reset all sterilization sequences.

Three modes, applicable from CL1210 to CL1211, are available:

OFF Mode: All equipments are in default position and no procedure can be started.

Auto mode: The procedures linked to the sterilization can be started. All the valve position and pump states are permanently checked. If an error is detected, the “stop sterilization” procedure function is called by the PLC.

Manu mode: The operator can manipulate all equipments linked to sterilization but can’t start any procedure until switching to automatic mode.

PLC Section name	Equipment tag	Type	Address	Comment
SIP General	SV_1210_01_MV	DO	000086	Powered 2-way valve Allows steam in filtrate side of membrane LUF_1200_02 when activated
SIP General	SV_1210_01_FB	DI	100106	valve feedback
SIP General	SV_1210_02_MV	DO	000085	Powered 2-way valve Allows steam in filtrate side of membrane LUF_1200_01 when activated
SIP General	SV_1210_02_FB	DI	100105	valve feedback
SIP General	SV_1210_03_MV	DO	000088	Powered 2-way valve Allows steam in effluent vessel VSSL_1204_01 and the filtrate side of LF_1200_01 when activated
SIP General	SV_1210_03_FB	DI	100108	valve feedback
SIP General	SV_1210_04_MV	DO	000030	Powered 2-way valve Allows flow of steam and condensate at the filtration side of membrane LF_1200_02 to steam trap SF_1210_02 and condensate vessel VSSL_1210_02 when activated
SIP General	SV_1210_04_FB	DI	100054	valve feedback
SIP General	SV_1210_05_MV	DO	000029	Powered 2-way valve Allows flow of steam and condensate at the filtration side of membrane LF_1200_01 to steam trap SF_1210_02 and condensate vessel VSSL_1210_02 when activated

PLC Section name	Equipment tag	Type	Address	Comment
SIP General	SV_1210_05_FB	DI	100056	valve feedback
SIP General	SV_1210_06_MV	DO	000026	Powered 2-way valve Allows flow of steam and condensate at the retentate side of membrane LF_1200_02 to steam trap SF_1210_01 and condensate vessel VSSL_1210_01 when activated
SIP General	SV_1210_06_FB	DI	100059	valve feedback
SIP General	SV_1210_07_MV	DO	000025	Powered 2-way valve Allows flow of steam and condensate at the retentate side of membrane LF_1200_01 to steam trap SF_1210_01 and condensate vessel VSSL_1210_01 when activated
SIP General	SV_1210_07_FB	DI	100060	valve feedback
SIP General	SV_1210_08_MV	DO	000028	Powered 2-way valve Allows steam in retentate side of membrane LF_1200_02 when activated
SIP General	SV_1210_08_FB	DI	100057	valve feedback
SIP General	SV_1210_09_MV	DO	000027	Powered 2-way valve Allows steam in retentate side of membrane LF_1200_01 when activated
SIP General	SV_1210_09_FB	DI	100058	valve feedback
SIP General	SV_1210_10_MV	DO	000103	Powered 2-way valve / This valve doesn't have feed back Allows steam in the condensate filter and in the steam trap
SIP General	SV_1210_11_MV	DO	000111	Powered 2-way valve Used to bring steam to the return loop of vessel VSSL_1007_01or to the efluent vessel VSSL_1204_01
SIP General	SV_1210_11_FB	DI	100141	valve feedback
SIP General	SV_1210_12_MV	DO	000104	Powered 2-way valve / This valve doesn't have feed back used to catch steam coming from the Effluent Vessel VSSL_1204_01
SIP General	SV_1210_13_MV	DO	000112	Powered 2-way valve used to inject steam into effluent vessel harvest line
SIP General	SV_1210_13_FB	DI	100142	valve feedback
SIP General	SV_1210_14_MV	DO	000113	Powered 2-way valve used to drain steam after sterilization of the harvest line
SIP General	SV_1210_14_FB	DI	100143	valve feedback
SIP General	SV_1210_15_MV	DO	000102	Powered 2-way valve Used to perform the vacuum breaking by filling pipes with N2
SIP General	SV_1210_15_FB	DI	100134	valve feedback

Figure 98: SIP General– EQUIPMENTS

PLC Section name	Button tag	Type	Address	Comment
SIP General	CL1210_ControlLoop_Mode	INT	400818	SIP General mode (0: Off / 1: Auto / 2: Manu)
SIP General	SV_1210_01_OP	BOOL	000749	Open / close the valve in manual mode

PLC Section name	Button tag	Type	Address	Comment
SIP General	SV_1210_02_OP	BOOL	000751	Open / close the valve in manual mode
SIP General	SV_1210_03_OP	BOOL	000753	Open / close the valve in manual mode
SIP General	SV_1210_04_OP	BOOL	000755	Open / close the valve in manual mode
SIP General	SV_1210_05_OP	BOOL	000757	Open / close the valve in manual mode
SIP General	SV_1210_06_OP	BOOL	000759	Open / close the valve in manual mode
SIP General	SV_1210_07_OP	BOOL	000761	Open / close the valve in manual mode
SIP General	SV_1210_08_OP	BOOL	000763	Open / close the valve in manual mode
SIP General	SV_1210_09_OP	BOOL	000765	Open / close the valve in manual mode
SIP General	SV_1210_10_OP	BOOL	000189	Open / close the valve in manual mode
SIP General	SV_1210_11_OP	BOOL	000767	Open / close the valve in manual mode
SIP General	SV_1210_12_OP	BOOL	000190	Open / close the valve in manual mode
SIP General	SV_1210_13_OP	BOOL	000769	Open / close the valve in manual mode
SIP General	SV_1210_14_OP	BOOL	000771	Open / close the valve in manual mode
SIP General	SV_1210_15_OP	BOOL	000773	Open / close the valve in manual mode
SIP General	CL1210_SCI_S1	BOOL	000310	Start the procedure for sterilizing both side of membrane 1
SIP General	CL1210_TB_S1	BOOL	000345	Tracing set during the sterilization of both side of membrane 1
SIP General	CL1210_SCI_S2	BOOL	000311	Start the procedure for sterilizing both side of membrane 2
SIP General	CL1210_TB_S2	BOOL	000346	Tracing set during the sterilization of both side of membrane 2
SIP General	CL1210_OP_SG	BOOL	000298	displays a confirmation windows asking to the operator if the steam generator is ready (linked to procedure S_S1 and S_S2)
SIP General	CL1210_OP_SG_OK	BOOL	000387	confirmation of the operator (steam generator is ready) / linked to procedure S_S1 and S_S2
SIP General	CL1210_SCI_Stop	BOOL	000312	Stop all the on going SIP procedures
SIP General	CL1210_TB_Stop	BOOL	000384	Tracing bit set when all the SIP procedure are stopped
SIP General	CL1210_SCI_Rec	BOOL	000351	Start the sterilization of the recycle line
SIP General	CL1210_TB_Rec	BOOL	000361	Tracing bit set during the sterilization of the recycle line
SIP General	CL1210_OP_Rec_SG	BOOL	000353	displays a confirmation windows asking to the operator if the steam generator is ready (linked to procedure S_REC)
SIP General	CL1210_OP_Rec_SG_OK	BOOL	000354	confirmation of the operator (steam generator is ready) linked to procedure S_REC
SIP General	CL1210_SCI_Harvest	BOOL	000355	Start the sterilization of the harvesting line and vessel (VSL2_1204_01)
SIP General	CL1210_TB_Harvest	BOOL	000360	Tracing bit set during the sterilization of the harvesting line and vessel (VSL2_1204_01)
SIP General	CL1210_OP_Harvest_SG	BOOL	000356	displays a confirmation windows asking to the operator if the steam generator is ready (linked to procedure S_HARVEST)
SIP General	CL1210_OP_Harvest_SG_OK	BOOL	000357	confirmation of the operator (steam generator is ready) / linked to procedure S_Harvest
SIP General	CL1210_OP_Open_Drain	BOOL	000389	displays a confirmation windows asking to the operator if the harversting valve is opened (HV_1204_02)
SIP General	CL1210_OP_Open_Drain_OK	BOOL	000390	confirmation of the operator (HV_1204_02 is opened)
SIP General	CL1210_OP_Close_Drain	BOOL	000358	displays a confirmation windows asking to the operator if the harversting valve is close (HV_1204_02)
SIP General	CL1210_OP_Close_Drain_OK	BOOL	000359	confirmation of the operator (HV_1204_02 is closed)
SIP General	CL1210_SCI_FlushRec	BOOL	000364	start the steam flush of recycle line after

PLC Section name	Button tag	Type	Address	Comment
				triggering the nominal mode from the recycle mode
SIP General	CL1210_TB_FlushRec	BOOL	000367	Tracing bit set during the flush of recycle line (after triggering the nominal mode from the recycle mode)
SIP General	CL1210_OP_FlushRec_SG	BOOL	000365	displays a confirmation windows asking to the operator if the steam generator is ready (linked to procedure S_Rec_Flush)
SIP General	CL1210_OP_FlushRec_SG_OK	BOOL	000366	confirmation of the operator (steam generator is ready) / linked to procedure S_Harvest S_Rec_Flush)
SIP General	CL1210_SCI_All1	BOOL	000299	start the sterilization procedure of membrane 1, filtrate line en harvesting tank
SIP General	CL1210_TB_All1	BOOL	000347	Tracing set during sterilization procedure of membrane 1, filtrate line en harvesting tank
SIP General	CL1210_SCI_All2	BOOL	000302	start the sterilization procedure of membrane 2, filtrate line en harvesting tank
SIP General	CL1210_TB_All2	BOOL	000348	Tracing set during sterilization procedure of membrane 2, filtrate line en harvesting tank
SIP General	CL1210_OP_All_Begin	BOOL	000301	displays a confirmation windows asking for operator to confirm that HV_1204_02 is protected and opened, PP_1202_01 tubing is unclenched and double jacket of VSL2_1204_01 is emptied / linked to procedure S_ALL1 and S_ALL2
SIP General	CL1210_OP_All_Begin_OK	BOOL	000300	confirmation of the operator (HV_1204_02 is protected and opened, PP_1202_01 tubing is unclenched and double jacket of VSL2_1204_01 is emptied / linked to procedure S_ALL1 and S_ALL2)
SIP General	CL1210_OP_All_Ending	BOOL	000349	displays a confirmation windows asking for operator to confirm that PP_1202_01 tubing is operational (pump closed)
SIP General	CL1210_OP_All_Ending_OK	BOOL	000350	confirmation of the operator (PP_1202_01 tubing is closed)
SIP General	CL1210_SCI_P	BOOL	000305	Start the protocol of sterilization every day at a define time depending on the membrane present. This protocol has never been finished by EPAS and need to be specified by UAB.
SIP General	CL1210_SCI_P_All1	BOOL	000306	Start the protocol which cleans and sterilizes the membrane 1, the filtrate line and the effluent tank
SIP General	CL1210_TB_P_All1	BOOL	000385	Tracing set during the cleaning / sterilization protocol of membrane 1, the filtrate line and the effluent tank
SIP General	CL1210_SCI_P_All2	BOOL	000307	Start the protocol which cleans and sterilizes the membrane 2, the filtrate line and the effluent tank
SIP General	CL1210_TB_P_All2	BOOL	000386	Tracing set during the cleaning / sterilization protocol of membrane 2, the filtrate line and the effluent tank
SIP General	CL1210_Membr_PurgeTime	TIME	400703	Timer for Purge Time of procedure S_S1 and S_S2 (Procedure 68)
SIP General	CL1210_Membr_PurgeTime_CFG	TIME	400707	monitor CL1210_Membr_PurgeTime when running
SIP General	CL1210_Membr_SterilTime	TIME	400711	Timer for sterilization Time of procedure S_S1 and S_S2 (Procedure 68)
SIP General	CL1210_Membr_SterilTime_CFG	TIME	400715	monitor CL1210_Membr_SterilTimeTime when running
SIP General	CL1210_Membr_CoolingTime	TIME	400719	Timer for CoolingTime of procedure S_S1 and S_S2 (Procedure 68)
SIP General	CL1210_Membr_CoolingTime_CFG	TIME	400723	monitor CL1210_Membr_CoolingTime when running
SIP General	CL1210_All_PurgeTime	TIME	400727	Timer for Purge Time of procedure S_All1 and S_All2 (Procedure 69)
SIP General	CL1210_All_PurgeTime_CFG	TIME	400731	monitor CL1210_All_PurgeTime when running

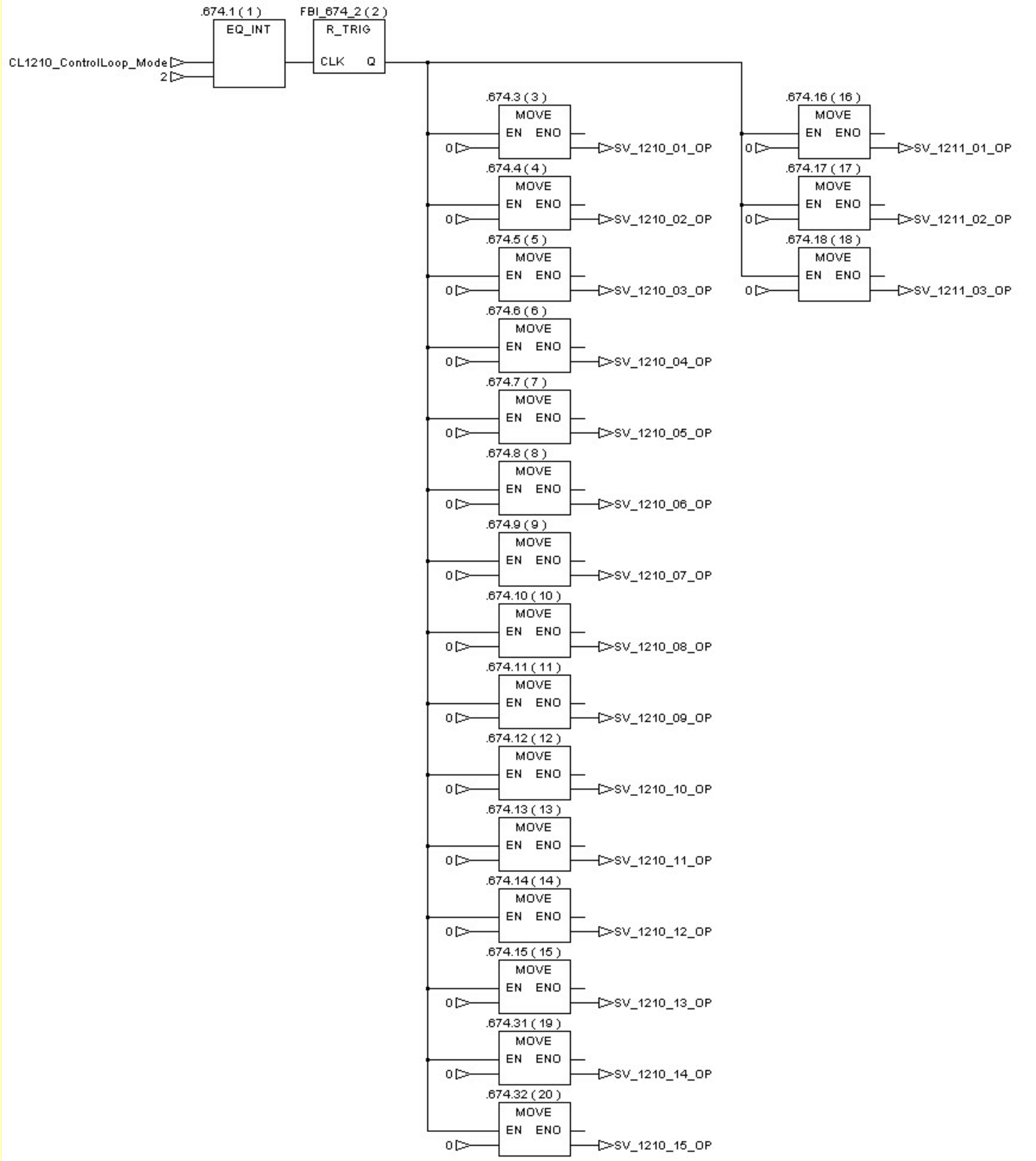
PLC Section name	Button tag	Type	Address	Comment
SIP General	CL1210_All_SterilTime	TIME	400735	Timer forsterilization Time of procedure S_All1 and S_All2 (Procedure 69)
SIP General	CL1210_All_SterilTime_CFG	TIME	400739	monitor CL1210_All_SterilTime when running
SIP General	CL1210_All_CoolingTime	TIME	400743	Timer for Cooling Time of procedure S_All1 and S_All2 (Procedure 69)
SIP General	CL1210_All_CoolingTime_CFG	TIME	400747	monitor CL1210_All_CoolingTime when running
SIP General	CL1210_Rec_DrainTime	TIME	400709	Timer for Drain Time of procedure S_Rec (Procedure 80)
SIP General	CL1210_Rec_DrainTime_CFG	TIME	400713	monitor CL1210_Rec_DrainTime when running
SIP General	CL1210_Rec_SterilisationTime	TIME	400717	Timer for Sterilisation Time of procedure S_Rec (Procedure 80)
SIP General	CL1210_Rec_SterilisationTime_CFG	TIME	400721	monitor CL1210_Rec_SterilisationTime when running
SIP General	CL1210_Rec_CoolingTime_CFG	TIME	400729	Timer for Cooling Time of procedure S_Rec (Procedure 80)
SIP General	CL1210_Rec_CoolingTime	TIME	400725	monitor CL1210_Rec_CoolingTime_CFG when running
SIP General	CL1210_Rec_FlushingTime	TIME	400733	Timer for Flushing Time of procedure S_Rec (Procedure 80)
SIP General	CL1210_Rec_FlushingTime_CFG	TIME	400737	monitor CL1210_Rec_FlushingTime when running
SIP General	CL1210_Harvest_DrainTime	TIME	400741	Timer for Drain Time of procedure S_Harvest (Procedure 81)
SIP General	CL1210_Harvest_DrainTime_CFG	TIME	400745	monitor CL1210_Harvest_DrainTime when running
SIP General	CL1210_Harvest_SterilTime	TIME	400749	Timer for Sterilization Time of procedure S_Harvest (Procedure 81)
SIP General	CL1210_Harvest_SterilTime_CFG	TIME	400753	monitor CL1210_Harvest_SterilTime when running
SIP General	CL1210_Harvest_CoolingTime	TIME	400757	Timer for Cooling Time of procedure S_Harvest (Procedure 81)
SIP General	CL1210_Harvest_CoolingTime_CFG	TIME	400761	monitor CL1210_Harvest_CoolingTime when running

Figure 99: SIP General – USER INDICATOR / INPUT

4.31.2.Block Diagram

4.31.2.1. *From Automatic mode to Manual mode*

When the operator triggers the Sterilization part of the Filtration from automatic mode to manual, the Sterilization valve states (CL1210) and also the under pressure breaking valve (CL1211) are reset. It means that all the variable linked to the sterilization and named "*name_of_the_valve*_op" takes the value "0"
After this transition, the operator manipulates only the manual tags (manage equipments in manual mode).


.674.1 (1)
EQ_INT
FBI_674_2 (2)
R_TRIG
CLK
Q
CL1210_ControlLoop_Mode
2
MOVE
EN
ENO
SV_1210_01_OP
SV_1210_02_OP
SV_1210_03_OP
SV_1210_04_OP
SV_1210_05_OP
SV_1210_06_OP
SV_1210_07_OP
SV_1210_08_OP
SV_1210_09_OP
SV_1210_10_OP
SV_1210_11_OP
SV_1210_12_OP
SV_1210_13_OP
SV_1210_14_OP
SV_1210_15_OP
SV_1211_01_OP
SV_1211_02_OP
SV_1211_03_OP

4.31.2.2. *From Automatic mode to OFF MODE*

All the sterilization equipments switch to the default position defined by the OFF mode input (same as the stop status). The procedure "CL1210_RESET_PROC" is activated (detailed in chapter 4: User manual procedure) and provides a general reset of all the automatic management (equipment and procedure).

4.31.2.3. *Stop Sterilization procedure management*

4.31.2.3.1. Calling the stop of the Sterilization procedure

The stop of the Sterilization function can be called by many different ways.

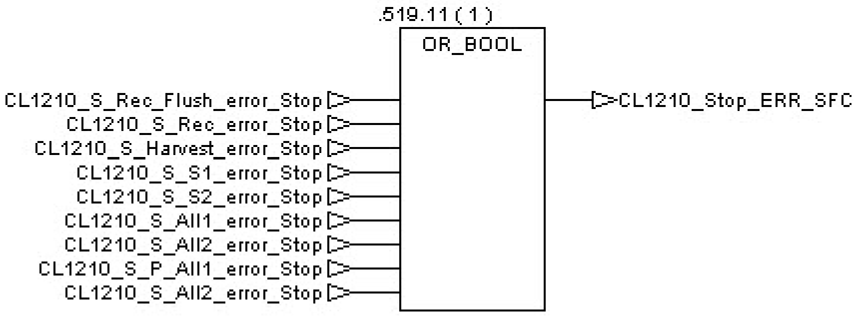
- The first function which permits to do it is the "Control loop mode button". By triggering the Sterilization to OFF mode or to manual mode, each equipment linked to the Sterilization function is triggered in default position. This function is implemented thanks to the block VALVBOOL or OPMDBOOL (Described in the annex chapter). Both modes activate also the procedure "CL1210_RESET_PROC" (See chapter 4 User manual procedure) which restart the automatic mode in default position.

- In automatic mode, the operator is able to stop the Sterilization procedure from any state by using the dedicated button named "Stop Sterilization" from the HMI. This HMI button set the tag called "CL1210_SCI_Stop".

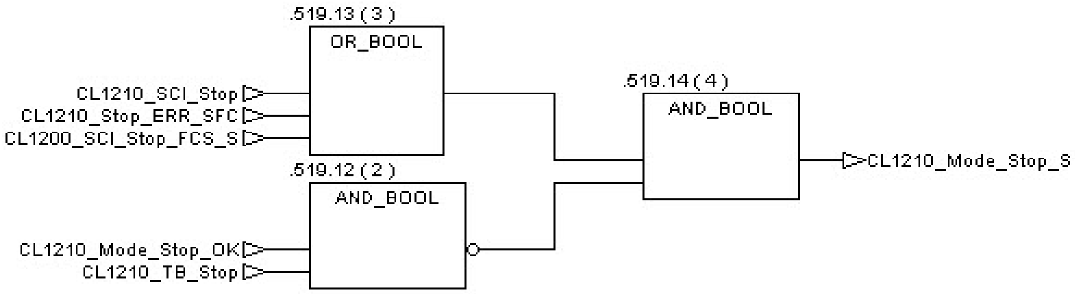
- A global stop button (FU/CIP/SIP) can also be used from HMI. This HMI button set the tag called "CL1200_SCI_Stop_FCS_S".

- The other conditions which will automatically ask for the stop of the Sterilization are linked to the Sterilization procedures. During their execution, each sequential step is monitored by a defined time. If this time is elapsed, an error is set then the stop of the Sterilization is called.
  These four previous conditions set the tag named "CL1210_Mode_Stop_S" which is the initial condition to start the procedure "S_Stop" (detailed in Chapter 4: User manual procedure).

Procedure elapsed time errors:

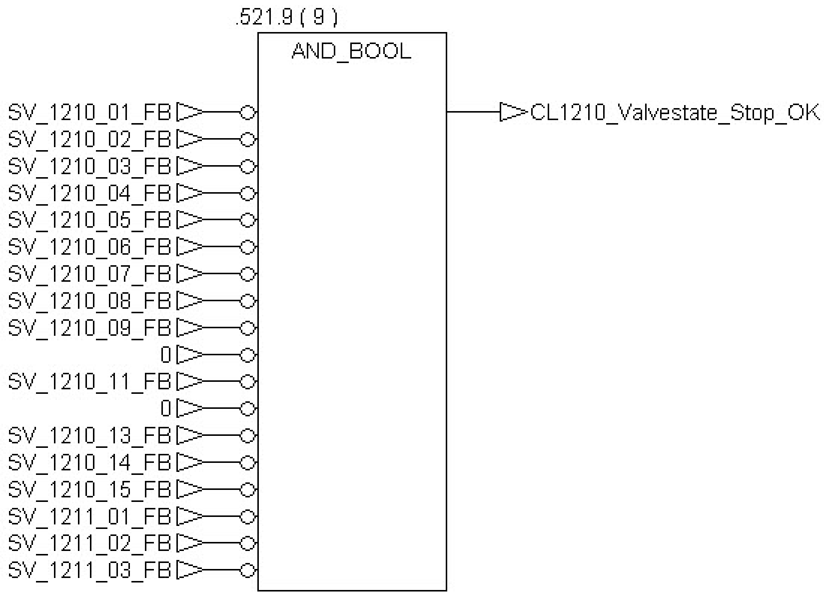


Waiting transition of “S_Stop” procedure:

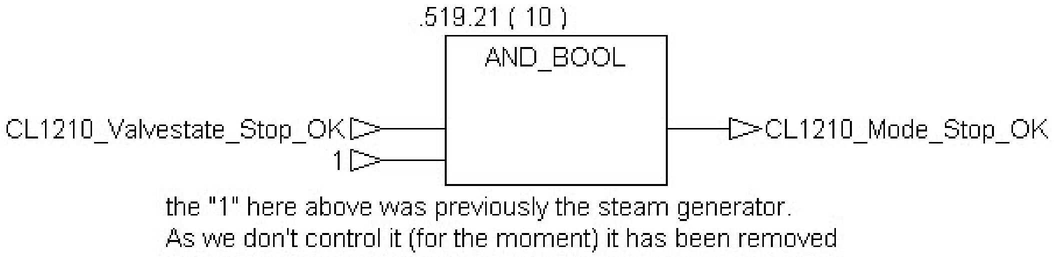


4.31.2.3.2. Actions following the “Stop Sterilization” Function

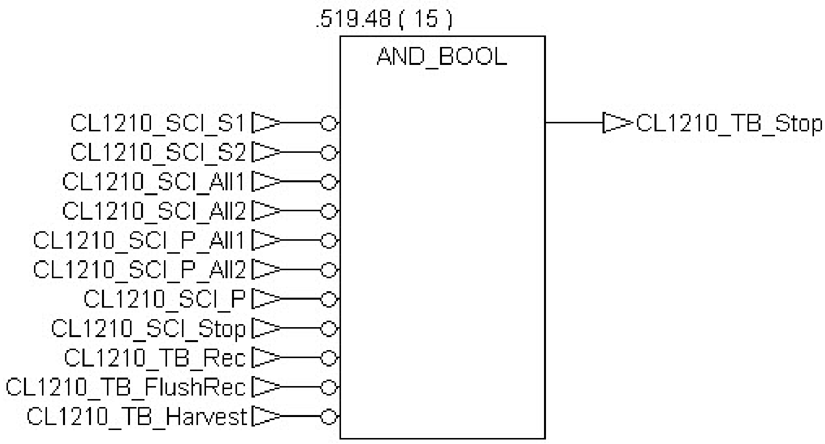
Once the stop of the sterilization procedure is called (condition enounced in the previous section) , the tag CL1210_Mode_Stop_S is set.
This tag reset all the procedure and starts the procedure “S_stop” (detailed in chapter 4).**This procedure can only be used in automatic mode.**
The first action of the procedure “S_Stop” is to send a pulse to all valves linked to the filtration function.
When valves are in stop position, the tag “CL1210_Valvestate_Stop_OK” is set :



When all the valves are in default position, the tag "CL1210_Mode_Stop_OK" is set.



Finally, when "CL1210_Mode_Stop_OK" and all procedures are reset, the Tracing Bit "CL1210_TB_Stop" is set.



4.31.2.4. *Sterilization valves management*

Important point:

The "Valvbool" block has been created to manage the Boolean valve. This block allows the mode management thanks to internal selector block (OFF/ AUTO / MANU) and the valve alarm linked to the feedback. The complete description is detailed in the annex chapter.

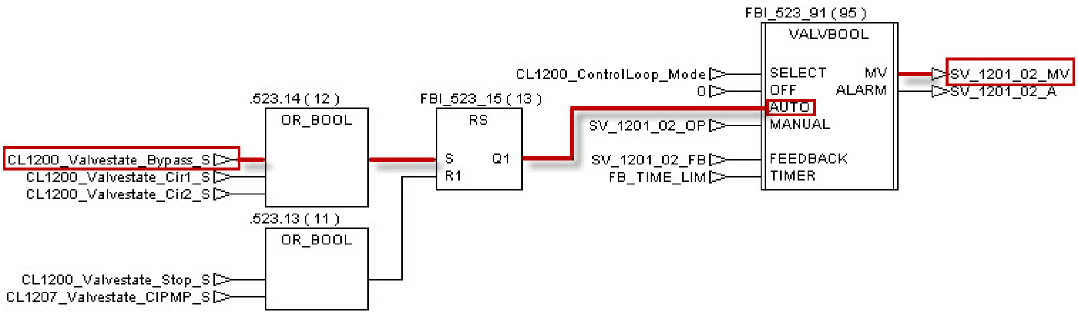
In automatic mode, depending on the procedure activated, the valves are set or reset to provide desired functions. The way to change the valves status is a pulse sent by the procedure to a defined tag. To be easily recognizable, all these kind of tags are named with the same logic.

Here is this named logic:

1- The control loop number
2- "_valvestate_"
3- The name of the procedure which triggers the valve
4- "_S" or "_R

Example:

During the procedure F_Bypass, "CL1200_Valvestate_Bypass_S" triggers the valve SV_1201_02 in bypass position. This tag will be find on each valves linked the bypass mode of the Filtration Unit.

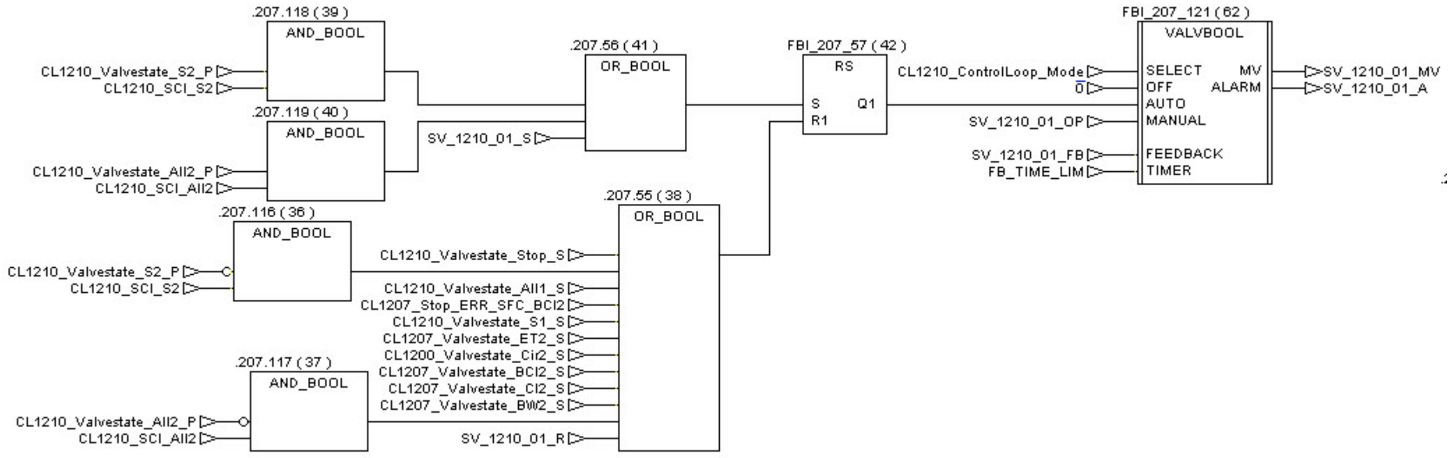


Depending on the procedure step needs, the "_S", situated at the end of the tag name, will set the valves in good position (either open or close), as well for the "_R" which will reset the valves in the default position.

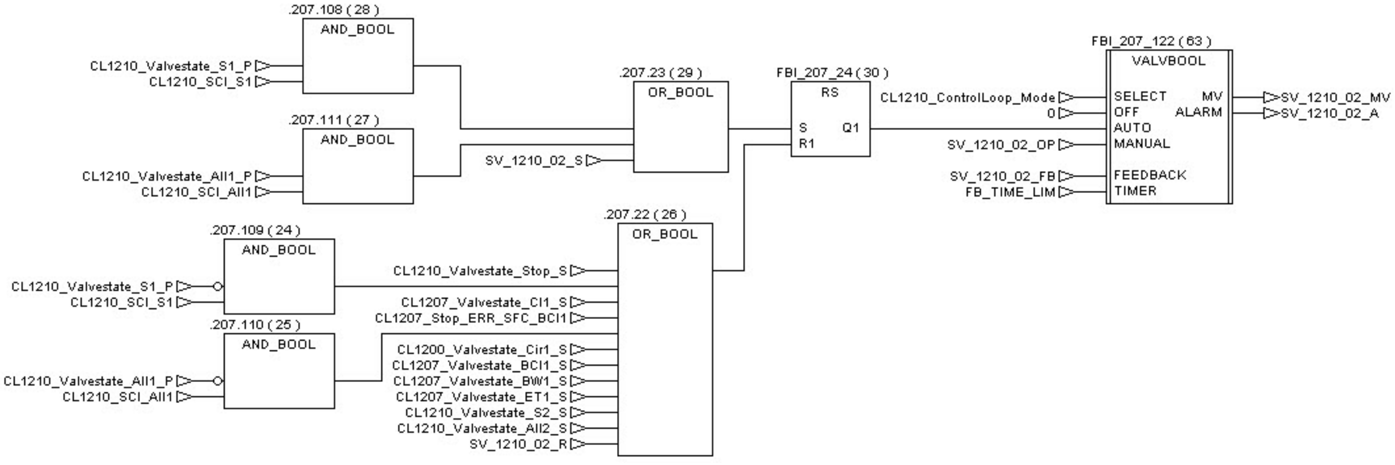
Most of the procedure follows this logic.

However, sometimes, when only one valve needs to be triggered inside the procedure, the pulse is named as "*name of the valve*_S" for the opening and "*name of the valve*_R" for the closing.

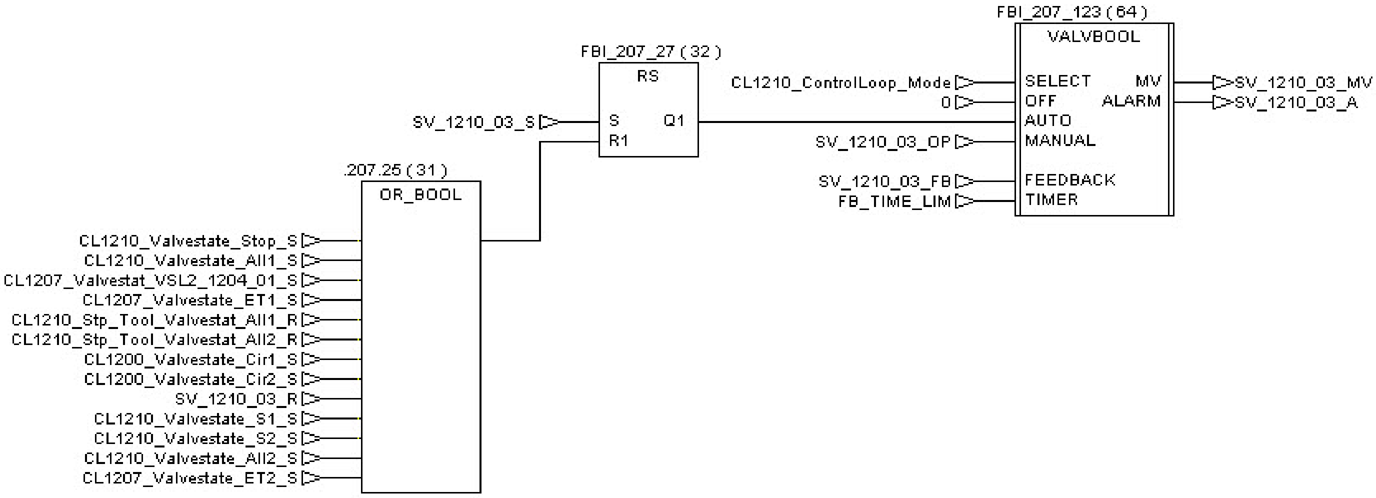
SV_1210_01:


.207.118 (39)
AND_BOOL
CL1210_Valvestate_S2_P
CL1210_SCI_S2
.207.119 (40)
AND_BOOL
CL1210_Valvestate_All2_P
CL1210_SCI_All2
SV_1210_01_S
.207.56 (41)
OR_BOOL
FBI_207_57 (42)
RS
S
Q1
R1
CL1210_ControlLoop_Mode
0
SV_1210_01_OP
SV_1210_01_FB
FB_TIME_LIM
FBI_207_121 (62)
VALVBOOL
SELECT
OFF
AUTO
MANUAL
FEEDBACK
TIMER
MV
ALARM
SV_1210_01_MV
SV_1210_01_A
.207.116 (36)
AND_BOOL
CL1210_Valvestate_S2_P
CL1210_SCI_S2
.207.55 (38)
OR_BOOL
CL1210_Valvestate_Stop_S
CL1210_Valvestate_All1_S
CL1207_Stop_ERR_SFC_BCI2
CL1210_Valvestate_S1_S
CL1207_Valvestate_ET2_S
CL1200_Valvestate_Cir2_S
CL1207_Valvestate_BCI2_S
CL1207_Valvestate_CI2_S
CL1207_Valvestate_BW2_S
.207.117 (37)
AND_BOOL
CL1210_Valvestate_All2_P
CL1210_SCI_All2
SV_1210_01_R

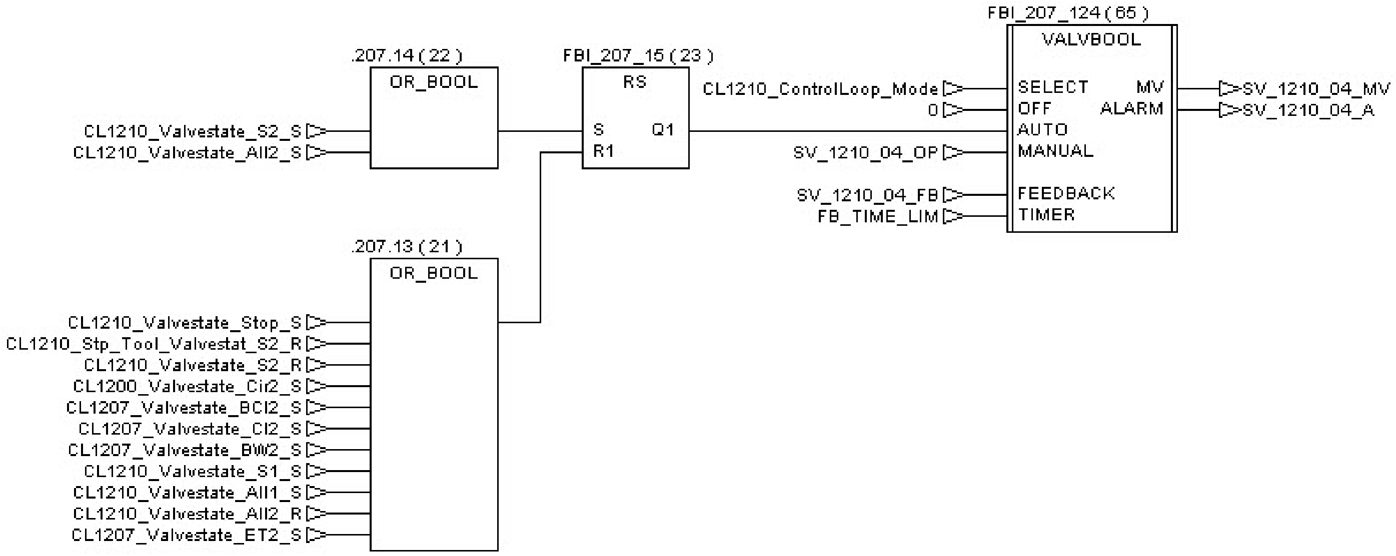
SV_1210_02:



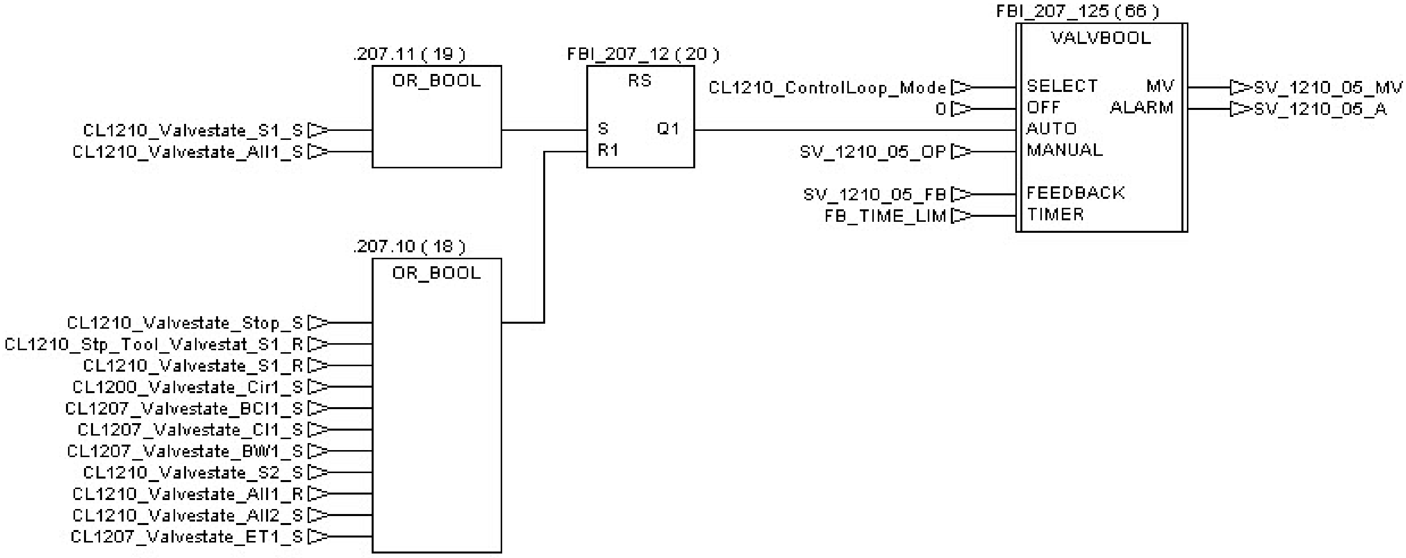
SV_1210_03:



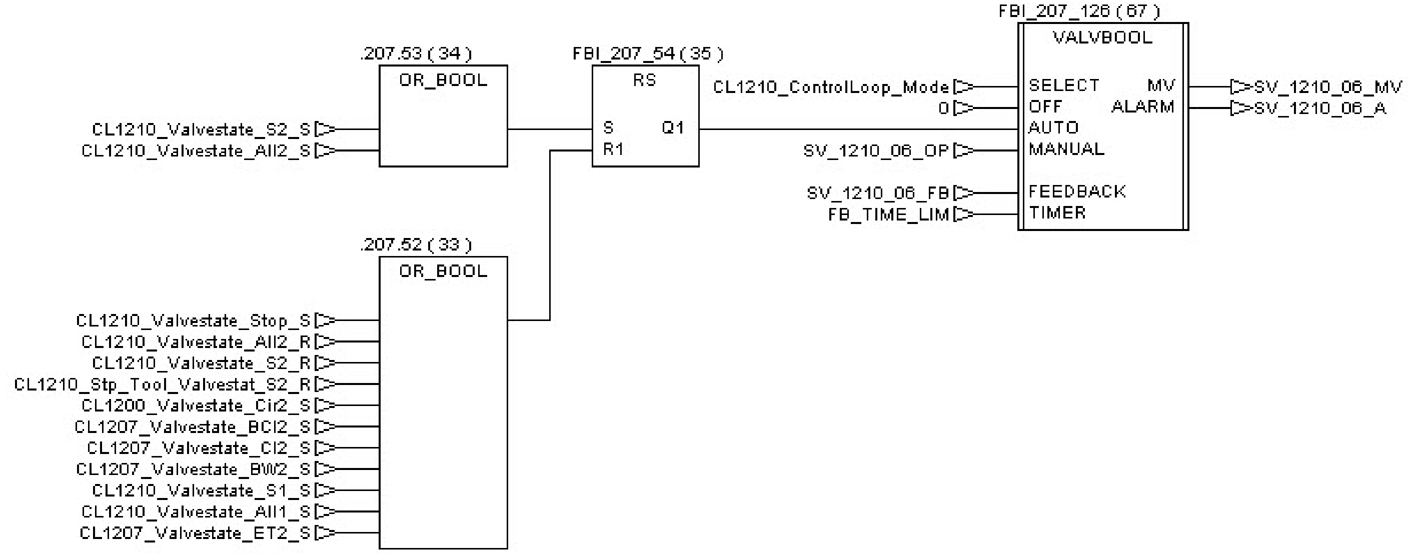
SV_1210_04:



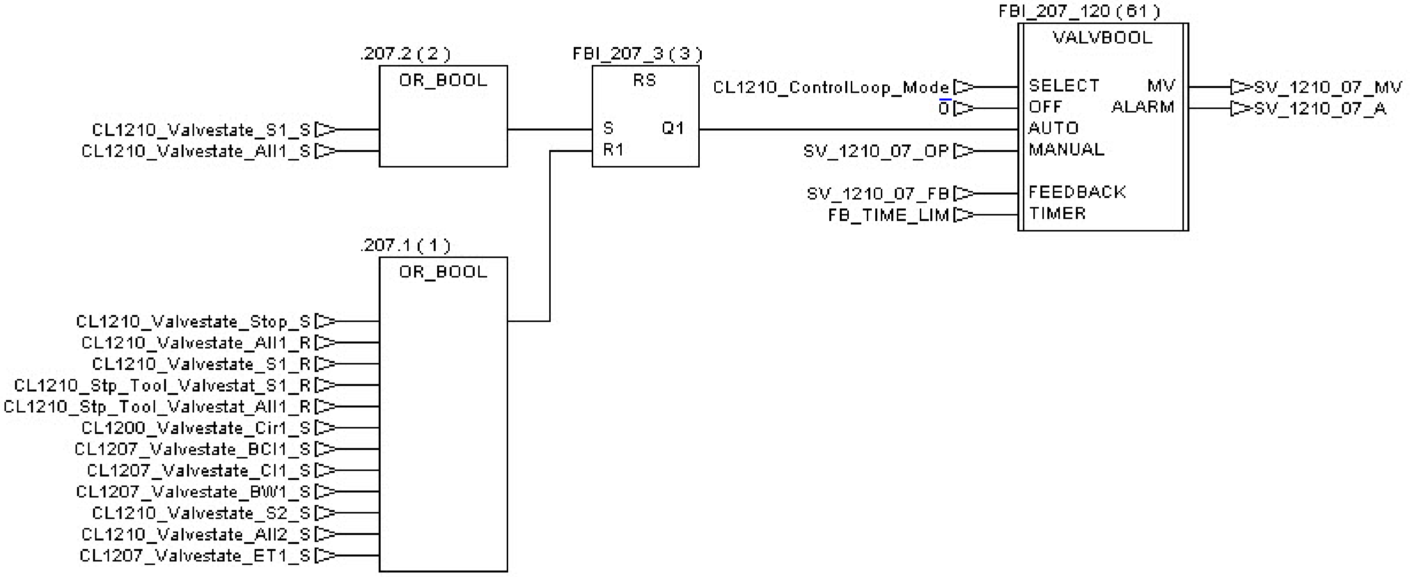
SV_1210_05:



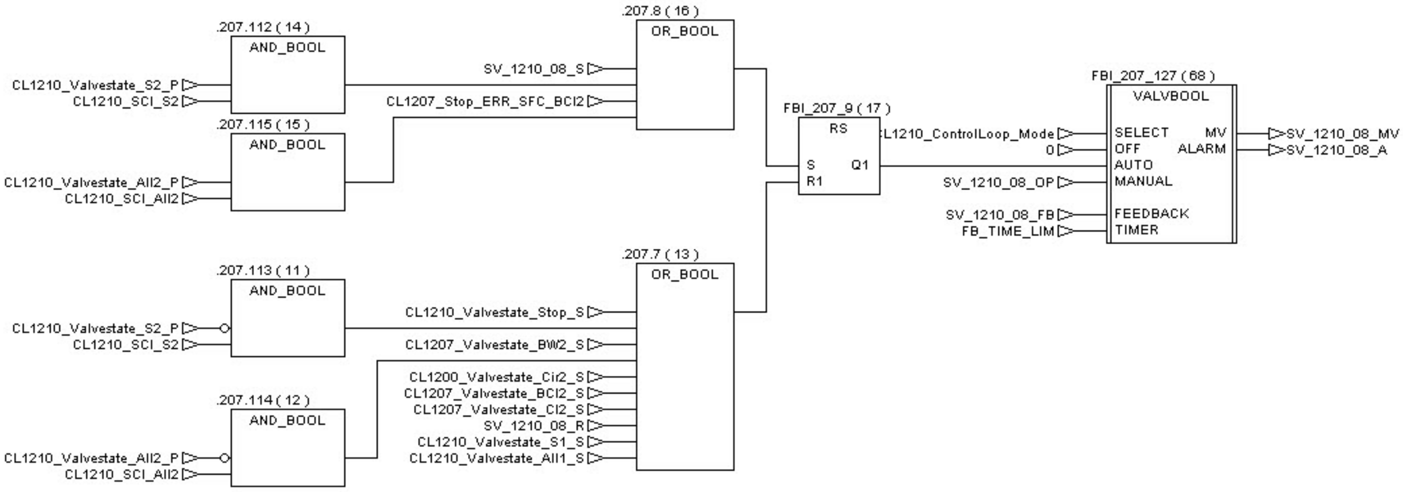
SV_1210_06:



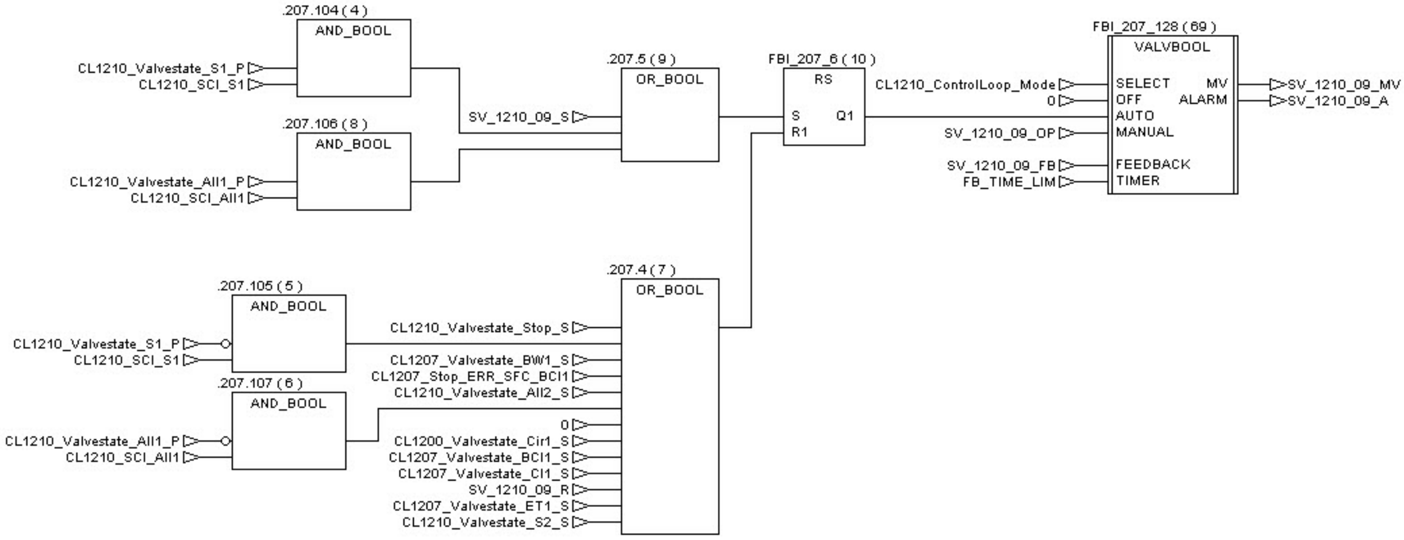
SV_1210_07:



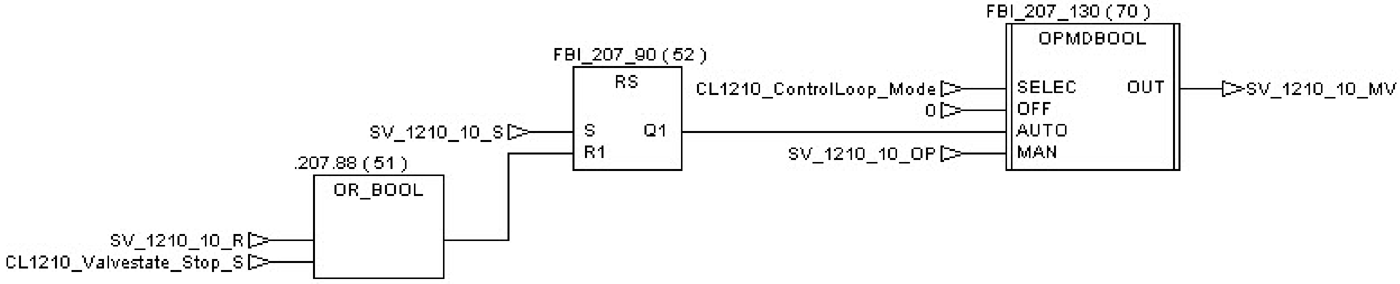
SV_1210_08:



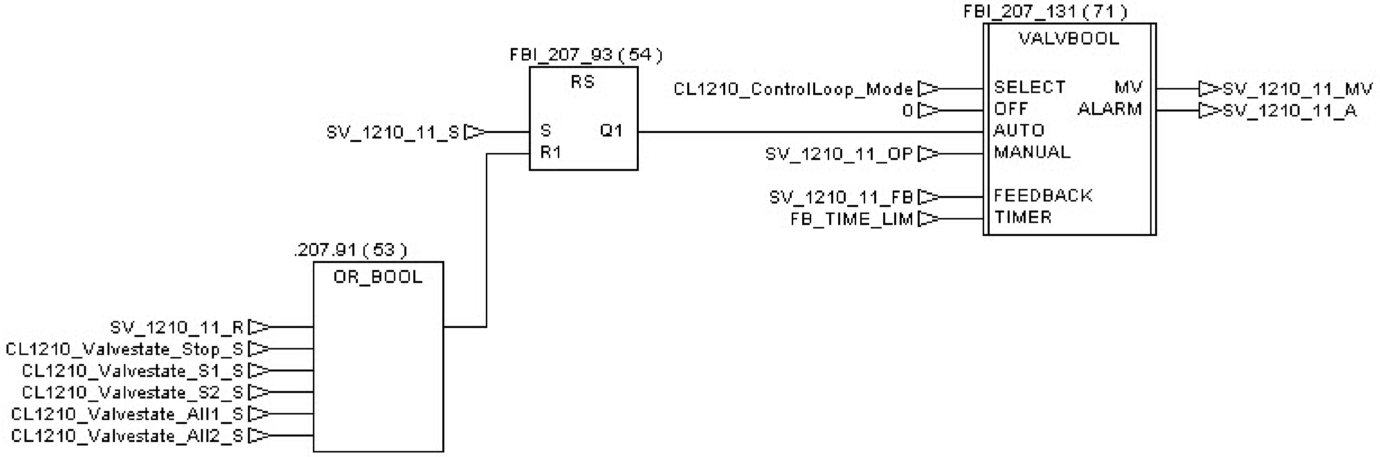
SV_1210_09:



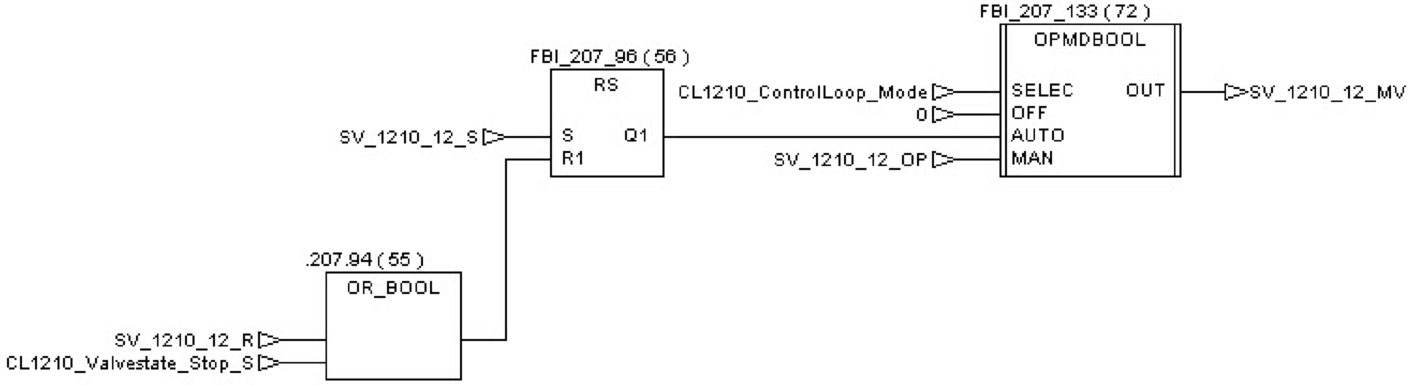
SV_1210_10:



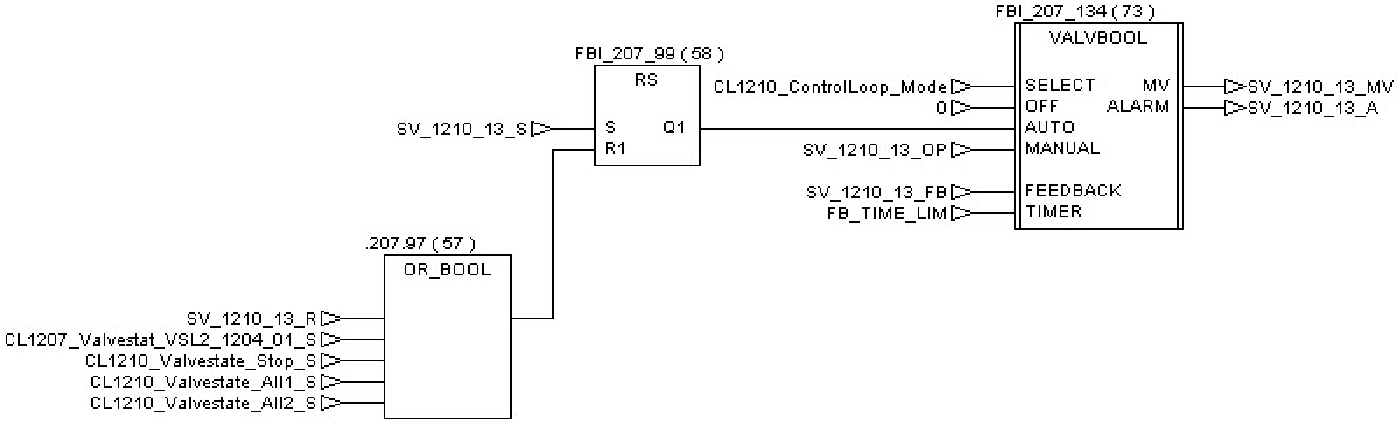
SV_1210_11:



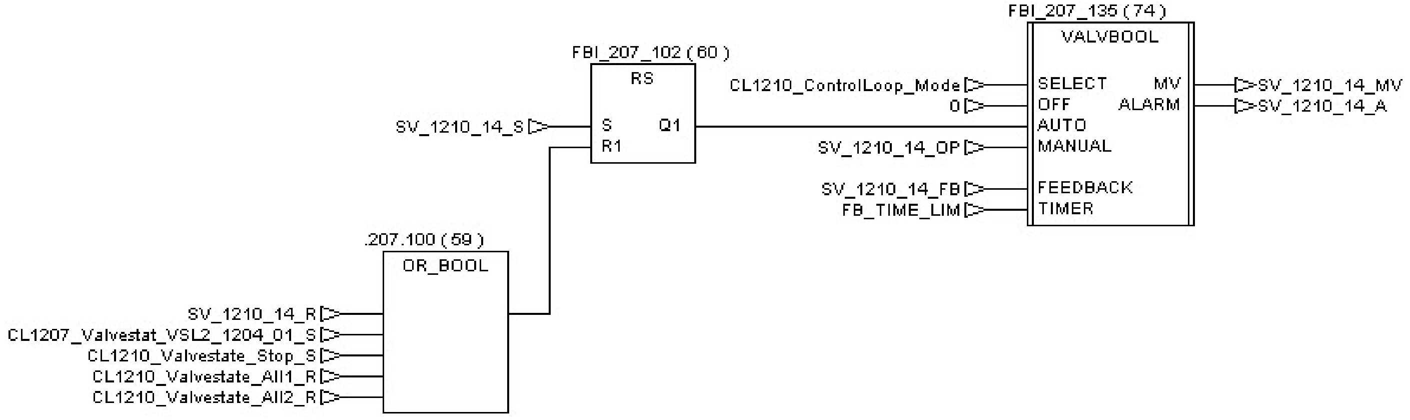
SV_1210_12:



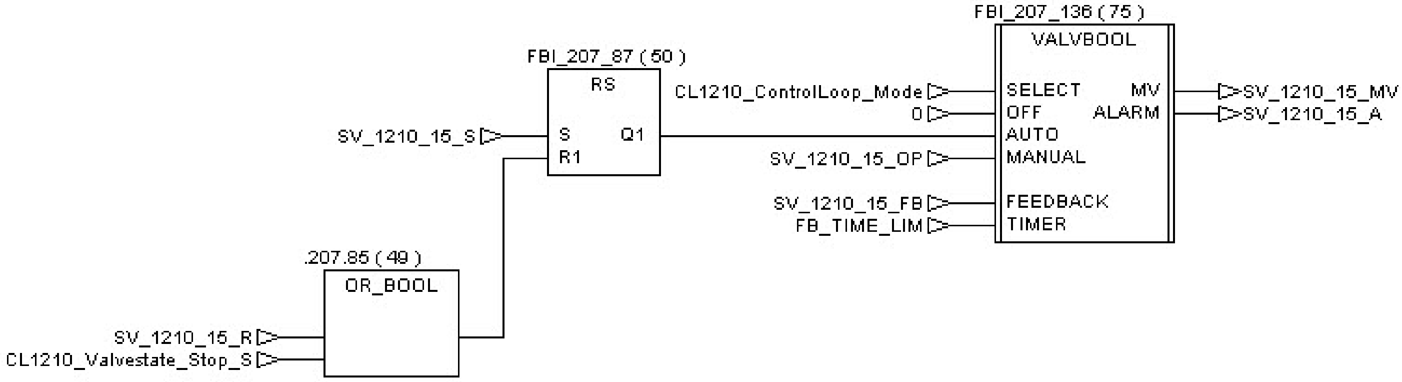
SV_1210_13:



SV_1210_14:



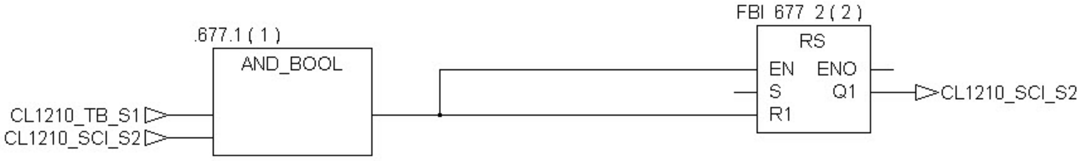
SV_1210_15:



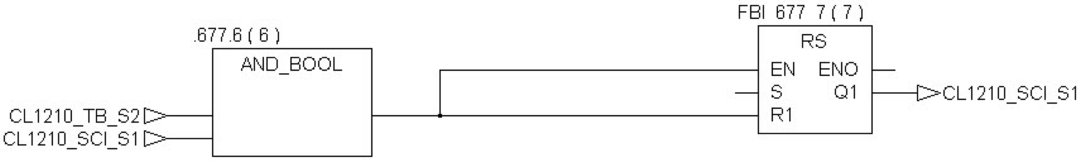
4.31.2.5. *Procedure Start buttons management*

When a procedure is running, nothing prevents the operator to click on other "start procedure" button. In that case, the button is permanently set (until the CIP mode changes or the stop function starts). If all the conditions become true, the procedure will instantaneously start. Due to this, some cautions need to be taken to prevent wrong manipulation.
Here are they:

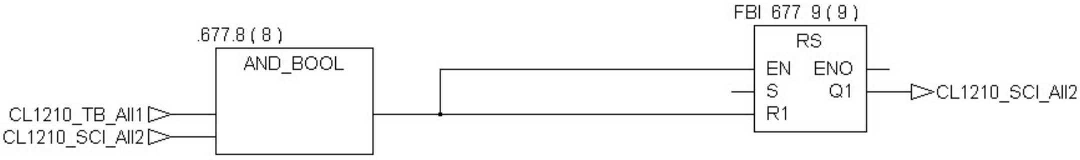
- Reset the "S_S2" start button if "S_S1" procedure is running.



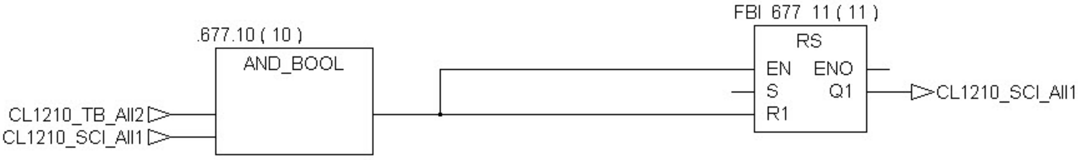
- Reset the “S_S1” start button if “S_S2” procedure is running.



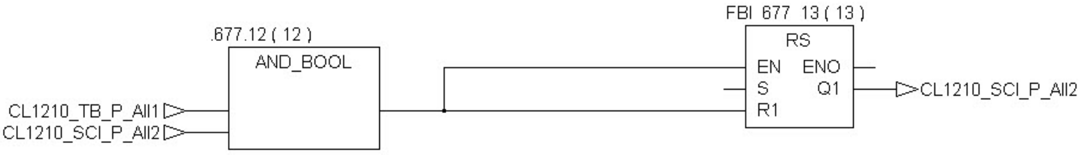
- Reset the “S_All2” start button if “S_All1” procedure is running.



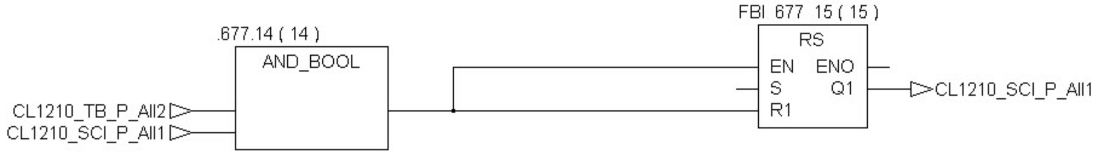
- Reset the “S_All1” start button if “S_All2” procedure is running.



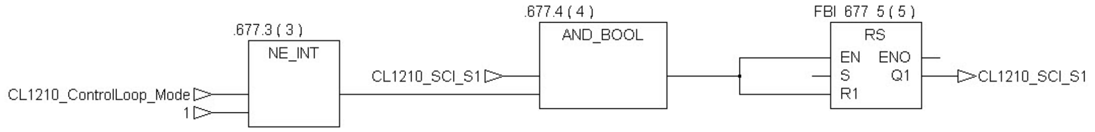
- Reset the “S_P_All2” start button if “S_P_All1” procedure is running.



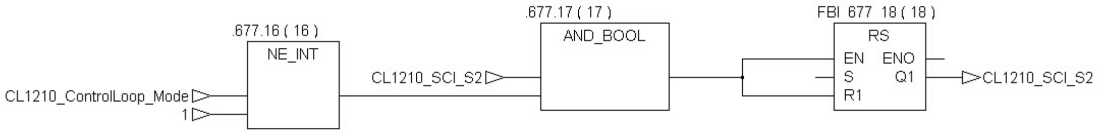
- Reset the “S_P_All1” start button if “S_P_All2” procedure is running.



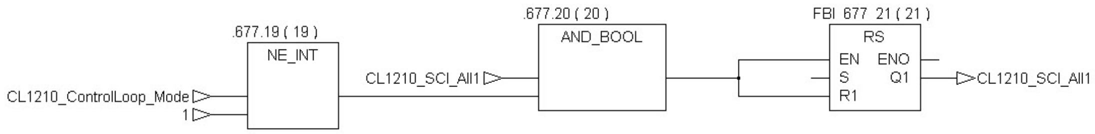
- Reset of the “S_S1” button if the Sterilization is not in Automatic mode.



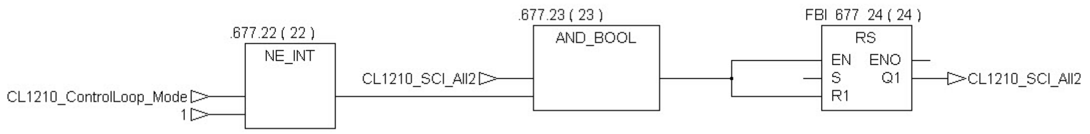
- Reset of the “S_S2” button if the Sterilization is not in Automatic mode.



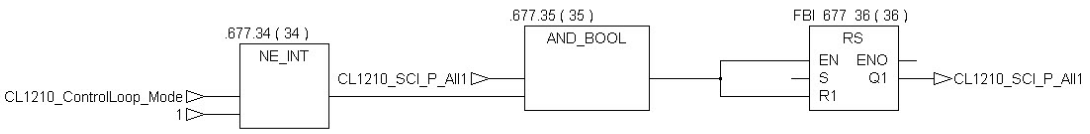
- Reset of the “S_All1” button if the Sterilization is not in Automatic mode.



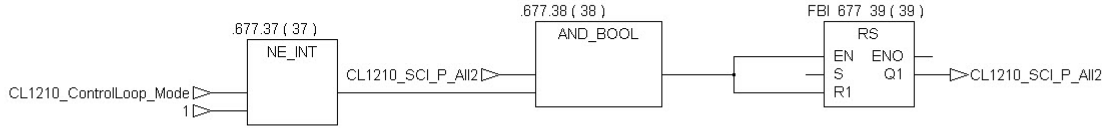
- Reset of the “S_All2” button if the Sterilization is not in Automatic mode.



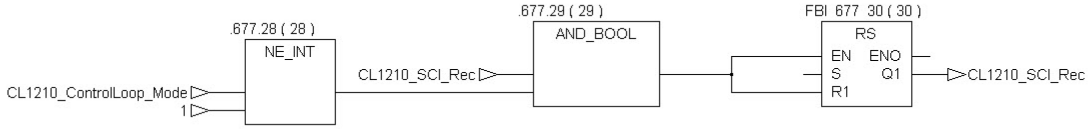
- Reset of the “S_P_All1” button if the Sterilization is not in Automatic mode.



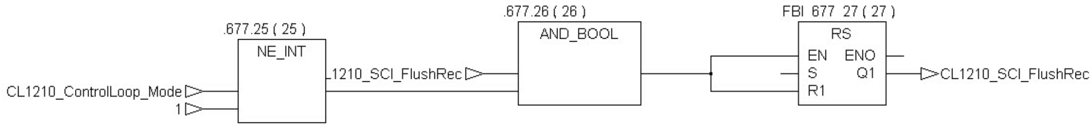
- Reset of the “S_P_All2” button if the Sterilization is not in Automatic mode.



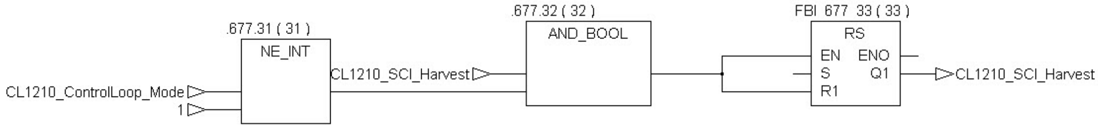
- Reset of the "S_Rec" button if the Sterilization is not in Automatic mode.



- Reset of the "S_Flush_Rec" button if the Sterilization is not in Automatic mode.



- Reset of the "S_Harvest" button if the Sterilization is not in Automatic mode.

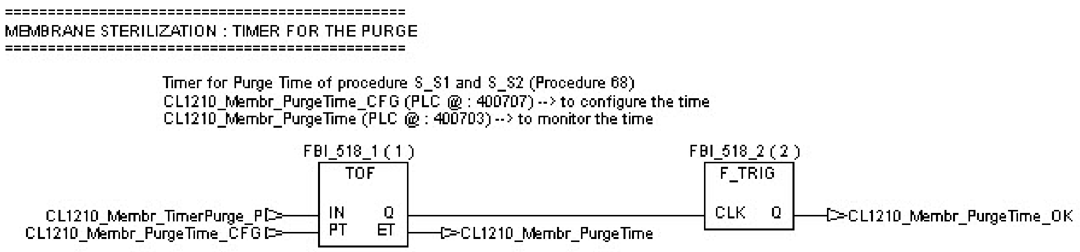


4.31.2.6. *Sterilization Timer Functions*

Many timers are used during sterilization phases. The procedures start them then waits the tag set by the timer (when the defined time is elapsed) to continue their execution. All these timers are configurable by the operator.

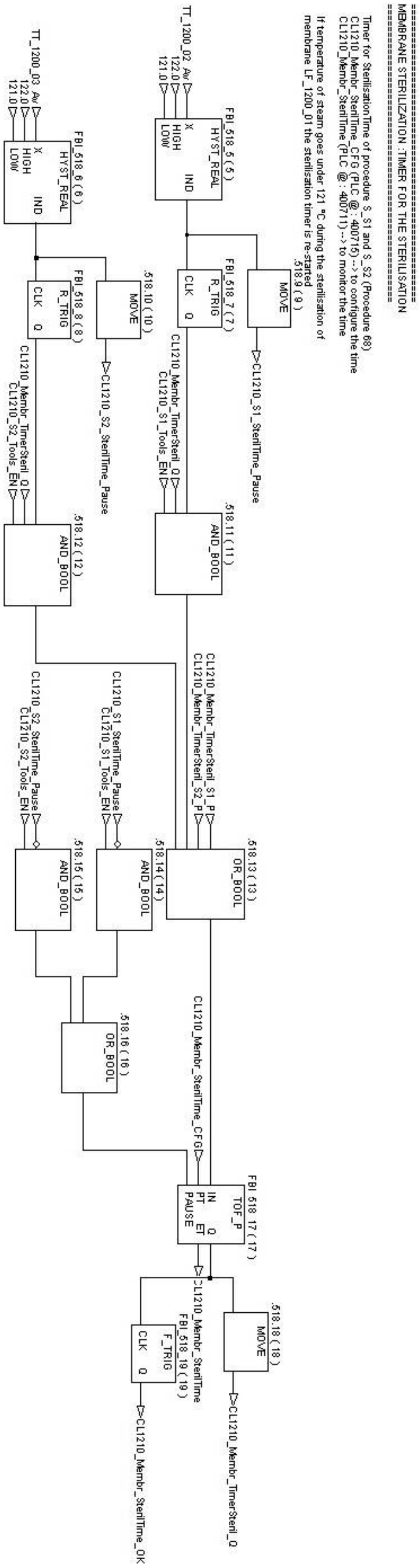
4.31.2.6.1. S_S1 and S_S2 timers

Purge phase:

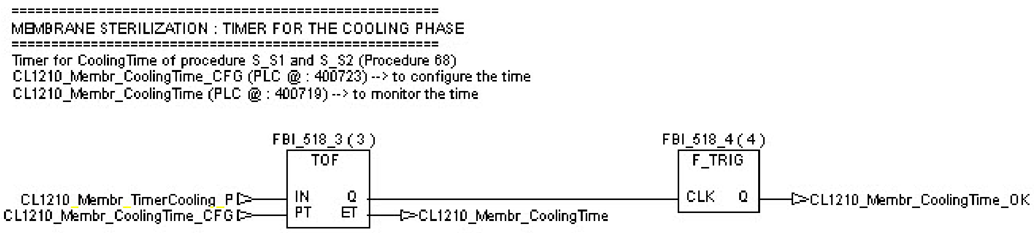


Membrane sterilization phase:

When the temperature reaches 122°C, the timer starts.
If the temperature goes under 121°C, the timer stops to count until the temperature reaches 122°. In that case a new pulse is sent and the timer is reinitialized. When the temperature conditions have been realized, the timer output is reset. The falling trig block sends a pulse on the tag “CL1210_Membr_SterilTime_OK” and the procedure goes to its next action step.

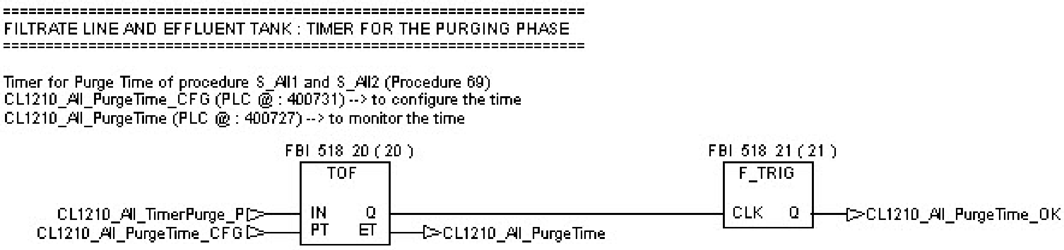

MEMBRANE STERILIZATION :TIMER FOR THE STERILISATION
Timer for SterilisationTime of procedure S_S1 and S_S2 (Procedure 68)
CL1210_Membr_SterilTime_CFG (PLC @ : 400715) --> to configure the time
CL1210_Membr_SterilTime (PLC @ : 400711) --> to monitor the time
If temperature of steam goes under 121 °C during the sterilisation of
membrane LF_1200_01 the sterilisation timer is re-started
TT_1200_02_Av
TT_1200_03_Av
HYST_REAL
R_TRIG
MOVE
AND_BOOL
OR_BOOL
TOF_P
F_TRIG
CL1210_S1_SterilTime_Pause
CL1210_S2_SterilTime_Pause
CL1210_Membr_TimerSteril_Q
CL1210_S1_Tools_EN
CL1210_S2_Tools_EN
CL1210_Membr_TimerSteril_S1_P
CL1210_Membr_TimerSteril_S2_P
CL1210_Membr_SterilTime_CFG
CL1210_Membr_SterilTime
CL1210_Membr_SterilTime_OK

Cooling phase:



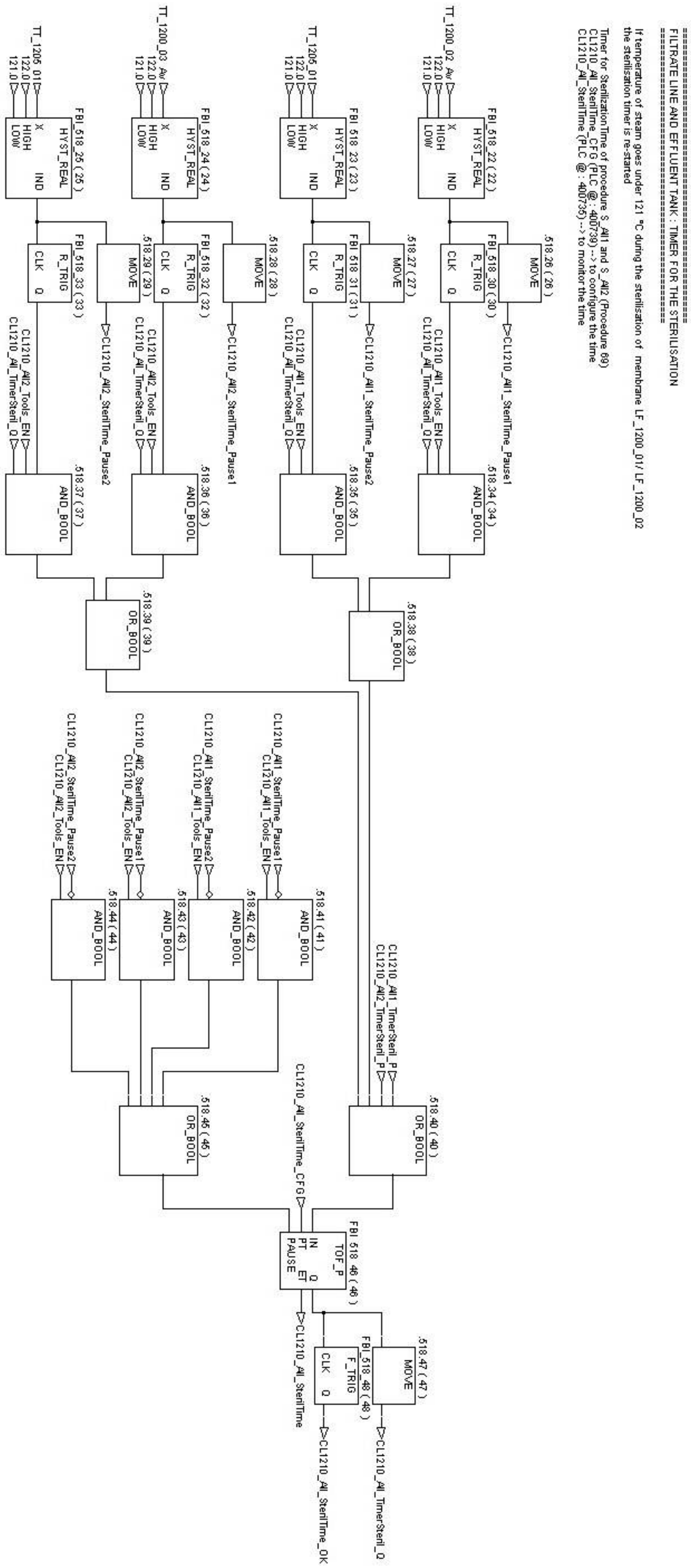
4.31.2.6.2. S_All1 and S_All2 timers

Purge phase:



Membrane sterilization phase:

When the temperature reaches 122°C, the timer starts.
If the temperature goes under 121°C, the timer stops to count (pause function) until the temperature reaches 122°. In that case a new pulse is sent and the timer is reinitialized. When the temperature conditions have been realized, the timer output is reset. The falling trig block sends a pulse on the tag "CL1210_Membr_SterilTime_OK" and the procedure goes to its next action step.


FILTRATE LINE AND EFFLUENT TANK : TIMER FOR THE STERILISATION
If temperature of steam goes under 121 °C during the sterilisation of membrane LF_1200_01/ LF_1200_02
the sterilisation timer is re-started
Timer for SterilizationTime of procedure S_AII1 and S_AII2 (Procedure 69)
CL1210_AII_SteriTime_CFG (PLC @ : 400739) --> to configure the time
CL1210_AII_SteriTime (PLC @ : 400735) --> to monitor the time

Cooling phase:

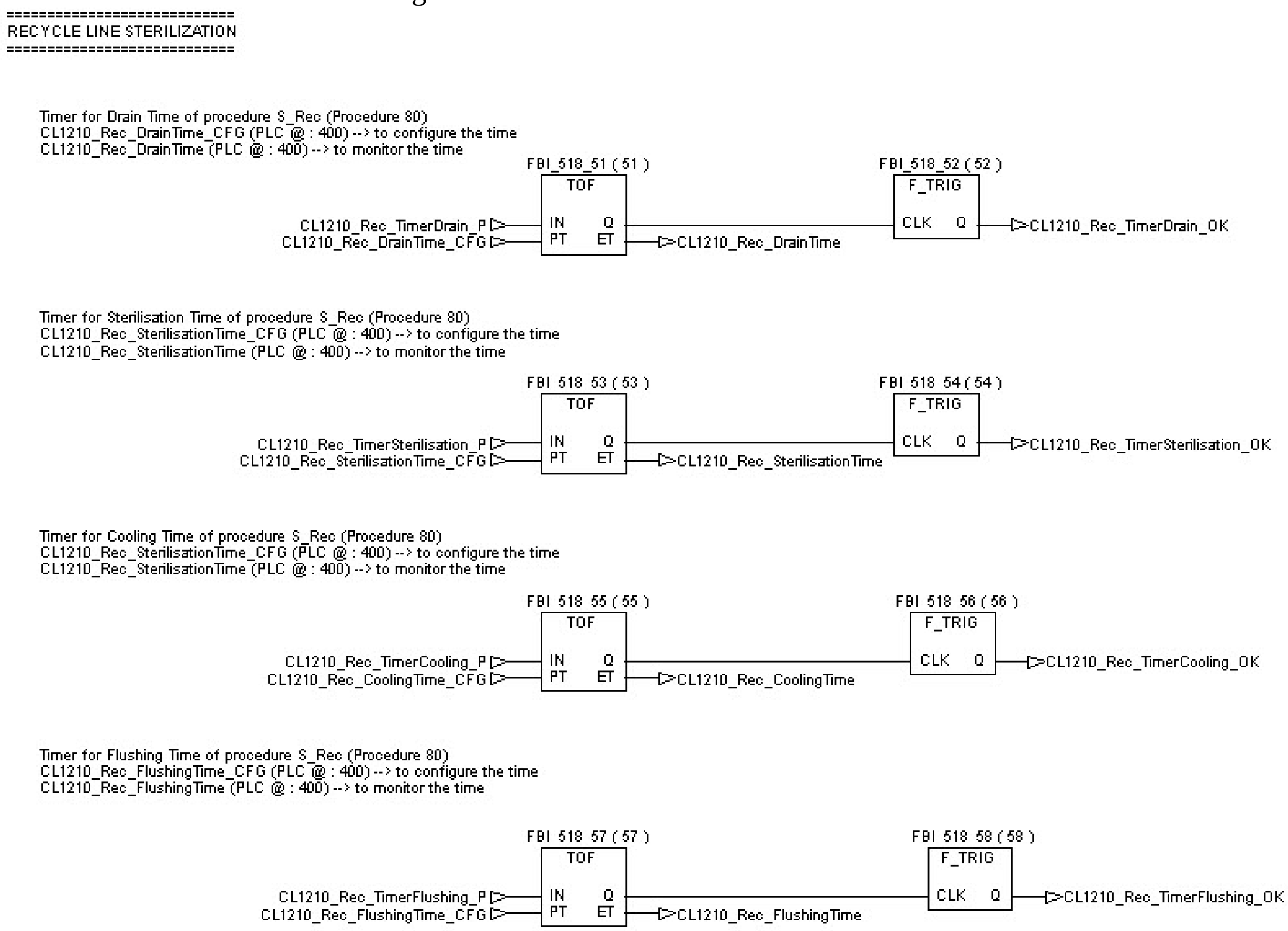
==
FILTRATE LINE AND EFFLUENT TANK :: TIMER FOR THE COOLING PHASE
==

Timer for Cooling Time of procedure S_AII1 and S_AII2 (Procedure 69)
CL1210_AII_CoolingTime_CFG (PLC @ : 400747) --> to configure the time
CL1210_AII_CoolingTime (PLC @ : 400743) --> to monitor the time

4.31.2.6.3. S_Rec timers

The procedure uses four timers during its execution:

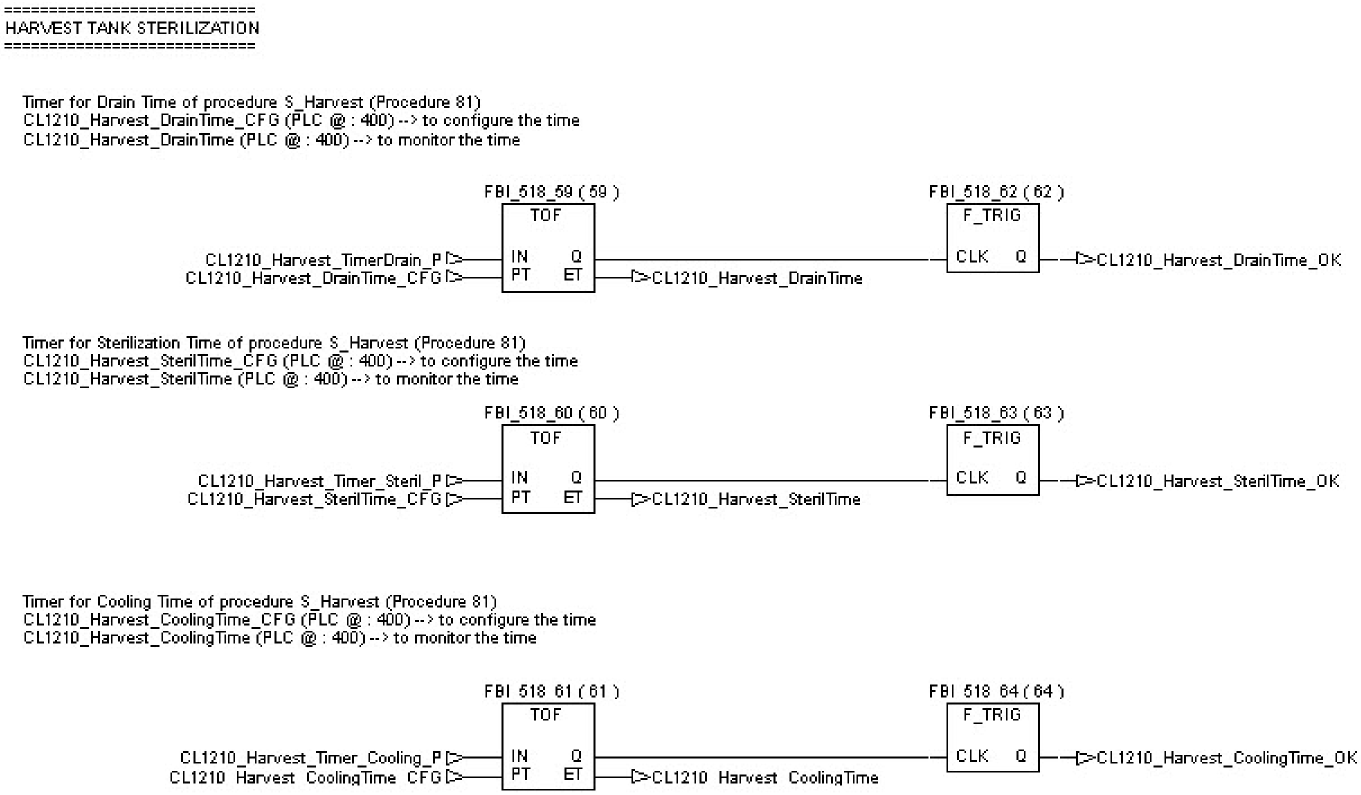
- The drain timer
- The sterilization timer
- The cooling timer
- The flushing timer.



4.31.2.6.4. S_Harvest timers

The procedure uses three timers during its execution:

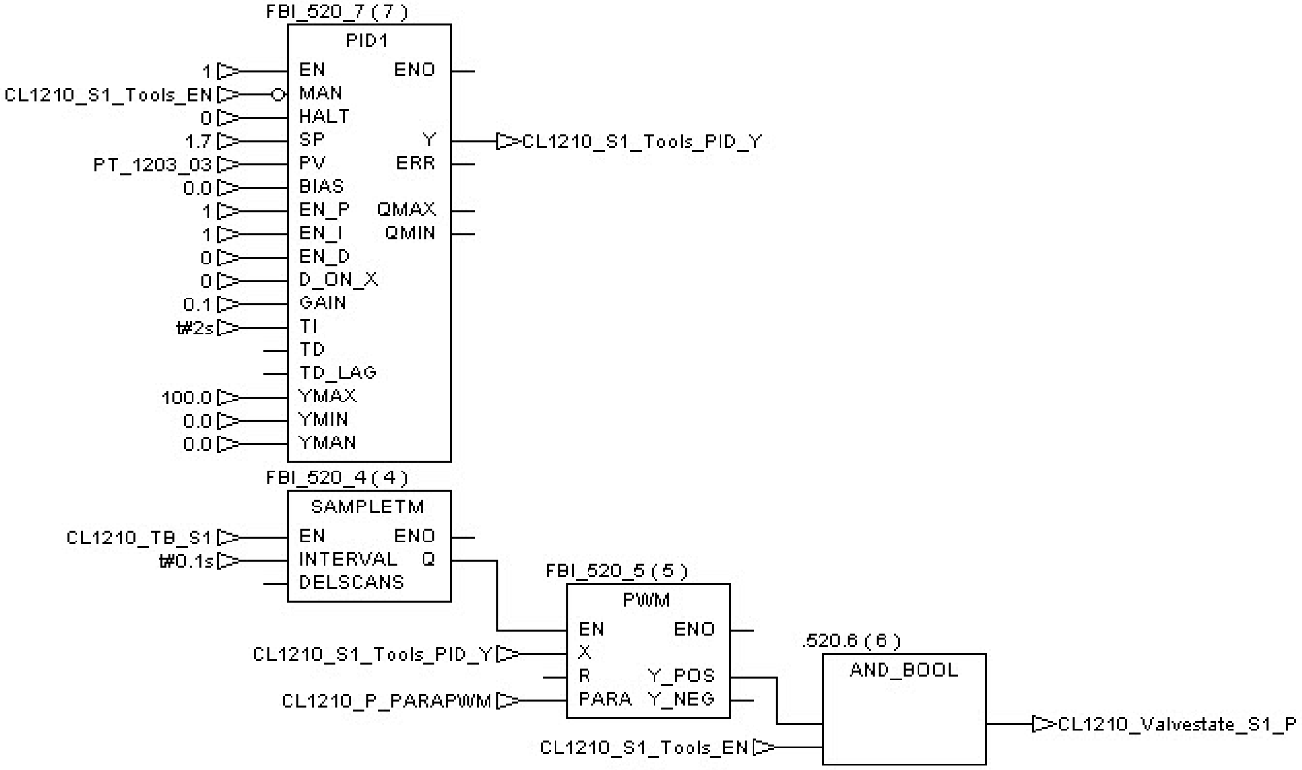
- The drain timer
- The sterilization timer
- The cooling timer



4.31.2.7. *Pressure control during membrane sterilization phases*

4.31.2.7.1. Pressure control during S_S1 procedure

To protect the membrane 1 from excessive the Boolean valves SV_1210_02 and SV_1210_09 are controlled simultaneously by a PI controller thanks to a PWM block. The pressure (PT_1203_03) is maintained to 1,7 bar inside the filtrate line.



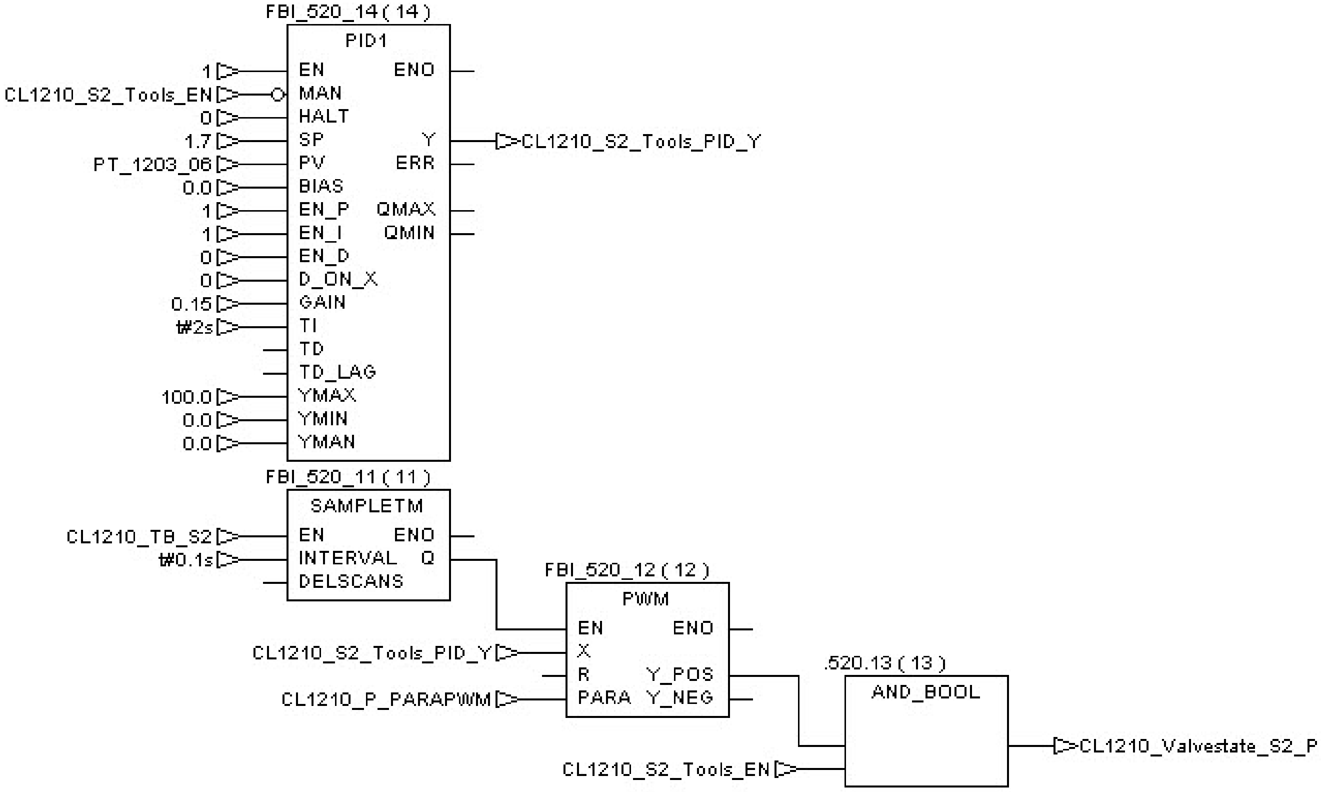
Controller parameters:

Controlled Variable	CONTROLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
pressure of Filtrate line (membrane 1)	PI	NO	NO	CL1210_P_PARAPWM t_period : 3s t_pause : 0s t_brake : 0s t_min : 0.2s t_max : 3 s up_pos : 100 up_neg : 0	Controller: Each PLC Cycle. PWM: 0.1s	PT_1203_03	1,7 bar

Controlled Variable	INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
pressure of Filtrate line (membrane 1)	NO	Gain: 0.1 TI: 2s	YMIN : 0 YMAX : 100	NO	NO	CL1210_S1_Tools_PID_Y	SV_1210_02 and SV_1210_09

4.31.2.7.2. Pressure control during S_S2 procedure

To protect the membrane 2 from excessive pressure, the Boolean valves SV_1210_01 and SV_1210_08 are controlled simultaneously by a PI controller thanks to a PWM block. The pressure (PT_1203_06) is maintained to 1,7 bar inside the filtrate line.



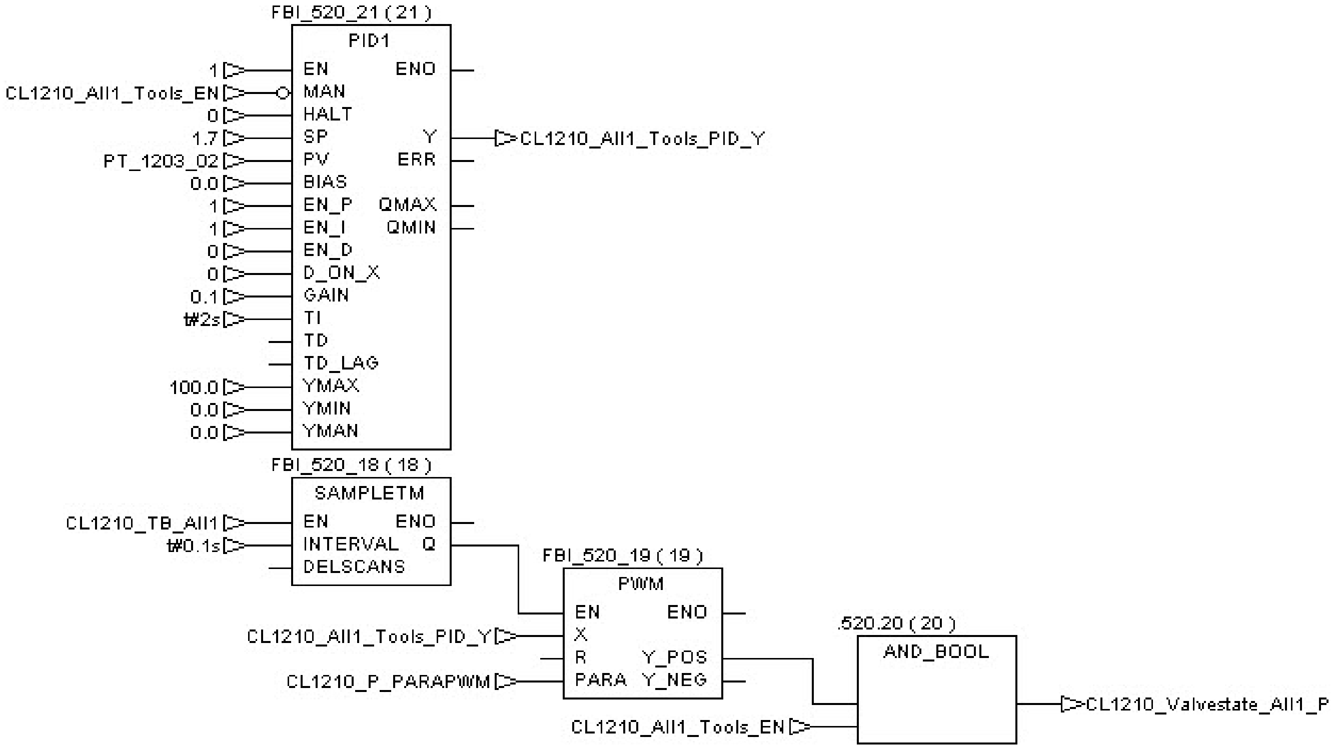
Controller parameters:

Controlled Variable	CONTROLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
pressure of Filtrate line (membrane 2)	PI	NO	NO	CL1210_P_PARAPWM t_period : 3s t_pause : 0s t_brake : 0s t_min : 0.2s t_max : 3 s up_pos : 100 up_neg : 0	Controller: Each PLC Cycle. PWM: 0.1s	PT_1203_06	1,7 bar

Controlled Variable	INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
pressure of Filtrate line (membrane 2)	NO	Gain: 0.15 TI: 2s	YMIN : 0 YMAX : 100	NO	NO	CL1210_S2_Tools_PID_Y	SV_1210_01 and SV_1210_08

4.31.2.7.3. Pressure control during S_All1 procedure

To protect the membrane 2 from excessive pressure, the Boolean valves SV_1210_02 and SV_1210_09 are controlled simultaneously by a PI controller thanks to a PWM block. The pressure (PT_1203_02) is maintained to 1,7 bar inside the filtrate line.



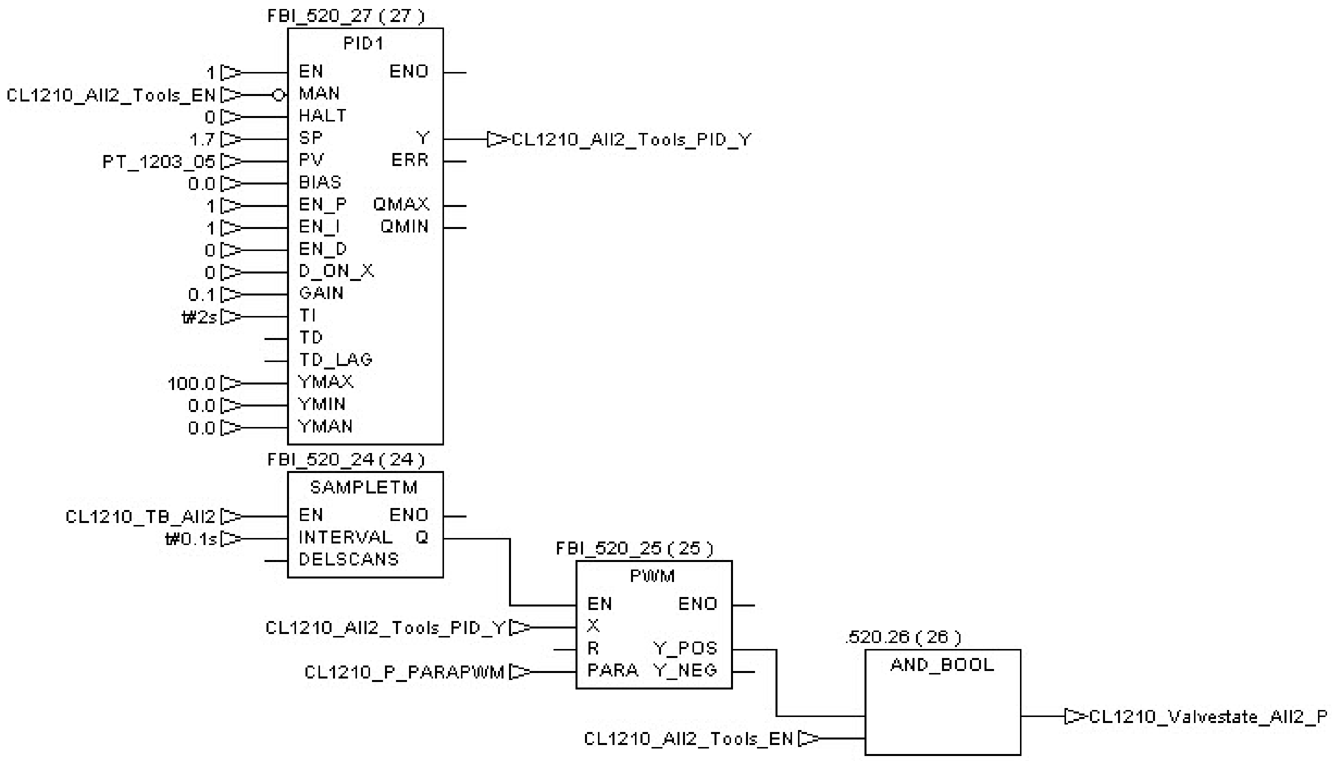
Controller parameters:

Controlled Variable	CONTROLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
pressure of Retentate line (membrane 1)	PI	NO	NO	CL1210_P_PARAPWM t_period : 3s t_pause : 0s t_brake : 0s t_min : 0.2s t_max : 3 s up_pos : 100 up_neg : 0	Controller: Each PLC Cycle. PWM: 0.1s	PT_1203_02	1,7 bar

Controlled Variable	INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
pressure of Retentate line (membrane 1)	NO	Gain: 0.1 TI: 2s	YMIN : 0 YMAX : 100	NO	NO	CL1210_All1_Tools_PID_Y	SV_1210_02 and SV_1210_09

4.31.2.7.4. Pressure control during S_All2 procedure

To protect the membrane 2 from excessive pressure, the Boolean valves SV_1210_01 and SV_1210_08 are controlled simultaneously by a PI controller thanks to a PWM block. The pressure (PT_1203_05) is maintained to 1,7 bar inside the filtrate line.



Controller parameters:

Controlled Variable	CONTROLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
pressure of Retentate line (membrane 2)	PI	NO	NO	CL1210_P_PARAPWM t_period : 3s t_pause : 0s t_brake : 0s t_min : 0.2s t_max : 3 s up_pos : 100 up_neg : 0	Controller: Each PLC Cycle. PWM: 0.1s	PT_1203_05	1,7 bar

Controlled Variable	INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
pressure of Retentate line (membrane 1)	NO	Gain: 0.1 TI: 2s	YMIN : 0 YMAX : 100	NO	NO	CL1210_All2_Tools_PID_Y	SV_1210_01 and SV_1210_08

4.31.3.Alarms and Thresholds

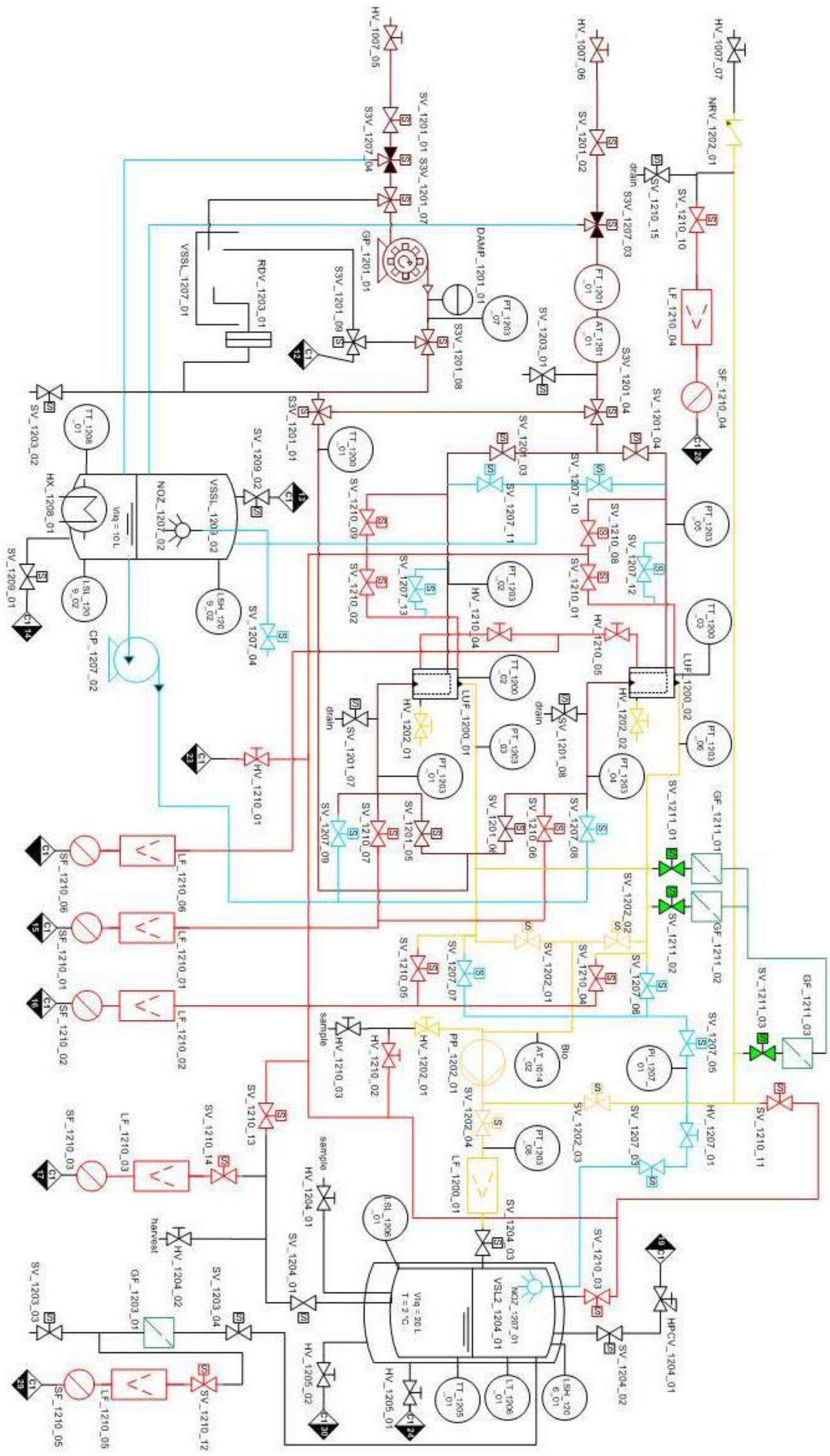
Alarm tag Name	type	Address	description
SV_1210_01_A	BOOL	000750	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1210_02_A	BOOL	000752	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1210_03_A	BOOL	000754	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1210_04_A	BOOL	000756	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1210_05_A	BOOL	000758	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1210_06_A	BOOL	000760	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1210_07_A	BOOL	000762	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1210_08_A	BOOL	000764	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1210_09_A	BOOL	000766	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1210_11_A	BOOL	000768	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1210_13_A	BOOL	000770	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1210_14_A	BOOL	000772	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1210_15_A	BOOL	000774	valve alarm ACTION : DISPLAY ALARM ON HMI

Figure 100: SIP General – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
FB_TIME_LIM	TIME	400900	5	seconds	Display an alarm

Figure 101: SIP General – THRESHOLDS

4.32. GN2 loop for under pressure breaking (CL1211)



4.32.1.Function

After sterilization phase, Nitrogen is flushed to cool down the pipe and to avoid huge differential pressure between each side of the membrane. As theses functions are called during sterilization procedure, the tag "CL1210_ControlLoop_Mode" also defines the mode of this control loop.

All procedures can only be executed in automatic mode. A general stop button permits to reset any running procedure. In case of changing mode from automatic to manual during sterilization procedure execution, the PLC calls the stop function then reset all sequential sequence (procedure).

Three modes, applicable from CL1210 to CL1211, are available:

OFF Mode: All equipments are in default position and no procedure can be started.

Auto mode: The procedure linked to the sterilization can be started. All the valve position and pump state are permanently checked. If an error is detected, the "stop sterilization" procedure function is called by the PLC.

Manu mode: The operator can manipulate all equipments linked to sterilization but can't start any procedure until switching to automatic mode.

PLC Section name	Equipment tag	Type	Address	Comment
GN2 loop for under pressure breaking	SV_1211_01_MV	DO	000105	Powered 2-way valve used to purge the pipes before sterilization of filtrate return to bioreactor
GN2 loop for under pressure breaking	SV_1211_01_FB	DI	100135	valve feedback
GN2 loop for under pressure breaking	SV_1211_02_MV	DO	000106	Powered 2-way valve Used to perform the vacuum breaking by filling pipes with N2
GN2 loop for under pressure breaking	SV_1211_02_FB	DI	100136	valve feedback
GN2 loop for under pressure breaking	SV_1211_03_MV	DO	000108	Powered 2-way valve Used to perform the vacuum breaking by filling pipes with N2
GN2 loop for under pressure breaking	SV_1211_03_FB	DI	100138	valve feedback

Figure 102: GN2 loop for underpressure breaking – EQUIPMENTS

PLC Section name	Button tag	Type	Address	Comment
GN2 loop for under pressure breaking	SV_1211_01_OP	BOOL	000775	Open / close the valve in manual mode
GN2 loop for under pressure breaking	SV_1211_02_OP	BOOL	000777	Open / close the valve in manual mode
GN2 loop for under pressure breaking	SV_1211_03_OP	BOOL	000779	Open / close the valve in manual mode

Figure 103: Effluent Tank Temperature Control – USER INDICATOR / INPUT

4.32.2. Block Diagram

4.32.2.1. *Valves management*

Important point:

The "Valvbool" block has been created to manage the Boolean valve. This block allows the mode management thanks to internal selector block (OFF/ AUTO / MANU) and the valve alarm linked to the feedback. The complete description is detailed in the annex chapter.

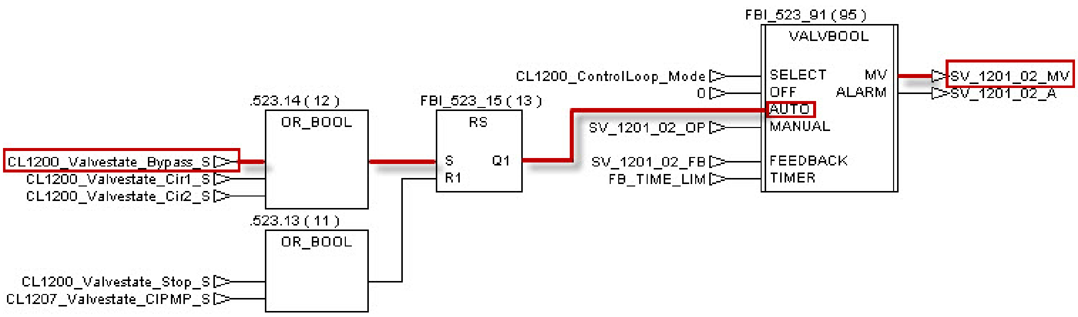
In automatic mode, depending on the procedure activated, the valves are set or reset to provide desired functions. The way to change the valves status is a pulse sent by the procedure to a defined tag. To be easily recognizable, all these kind of tags are named with the same logic.

Here is this named logic:

1- The control loop number
2- "_valvestate_"
3- The name of the procedure which triggers the valve
4- "_S" or "_R

Example:

During the procedure F_Bypass, "CL1200_Valvestate_Bypass_S" triggers the valve SV_1201_02 in bypass position. This tag will be find on each valves linked the bypass mode of the Filtration Unit.

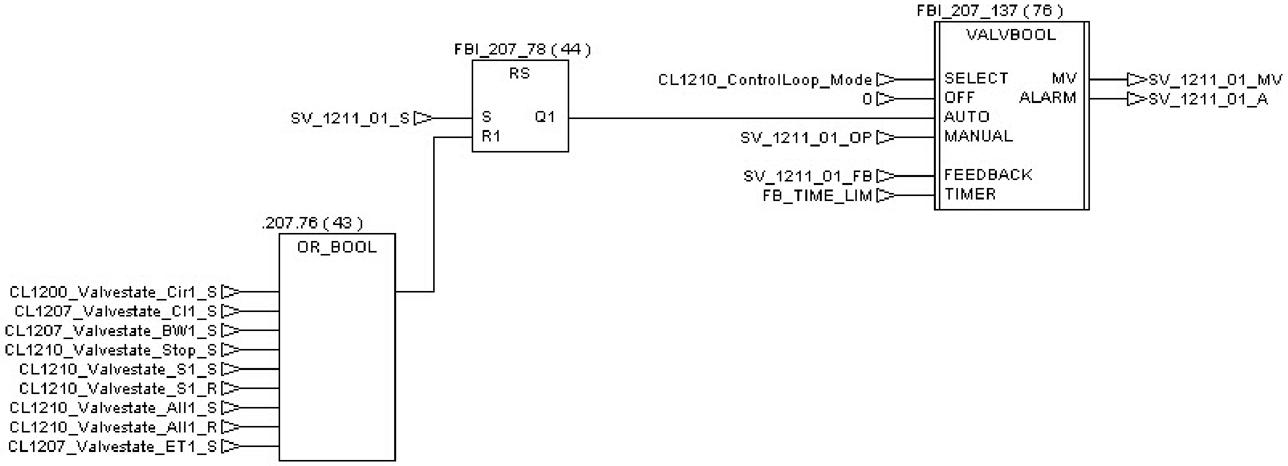


Depending on the procedure step needs, the "_S", situated at the end of the tag name, will set the valves in good position (either open or close), as well for the "_R" which will reset the valves in the default position.

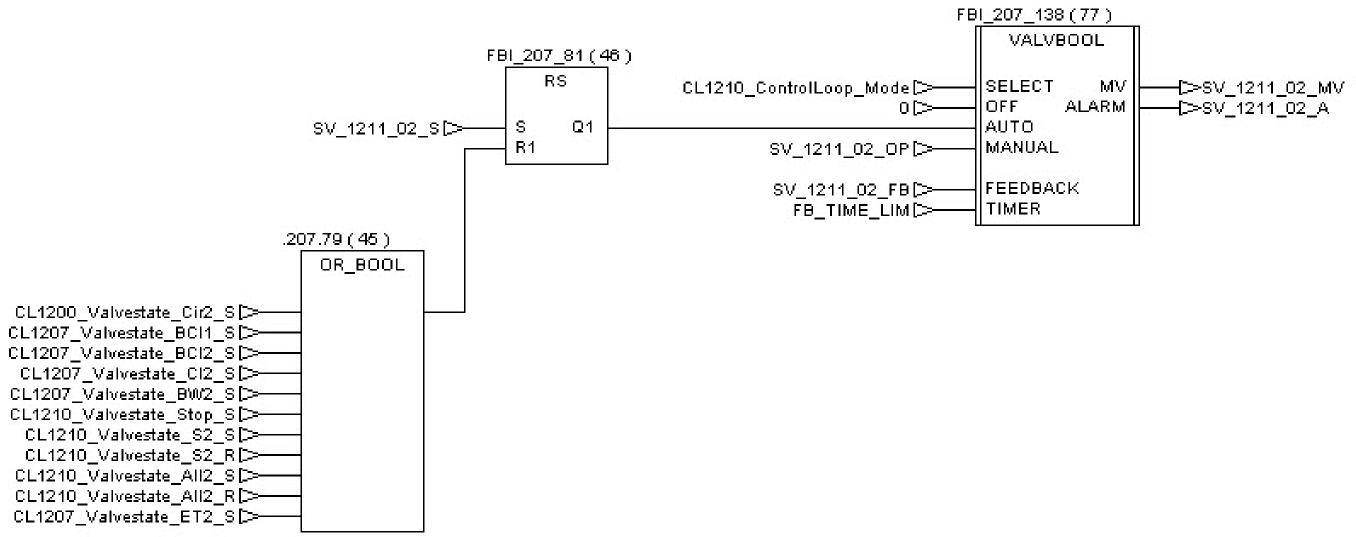
Most of the procedure follows this logic.

However, sometimes, when only one valve needs to be triggered inside the procedure, the pulse is named as "*name of the valve*_S" for the opening and "*name of the valve*_R" for the closing.

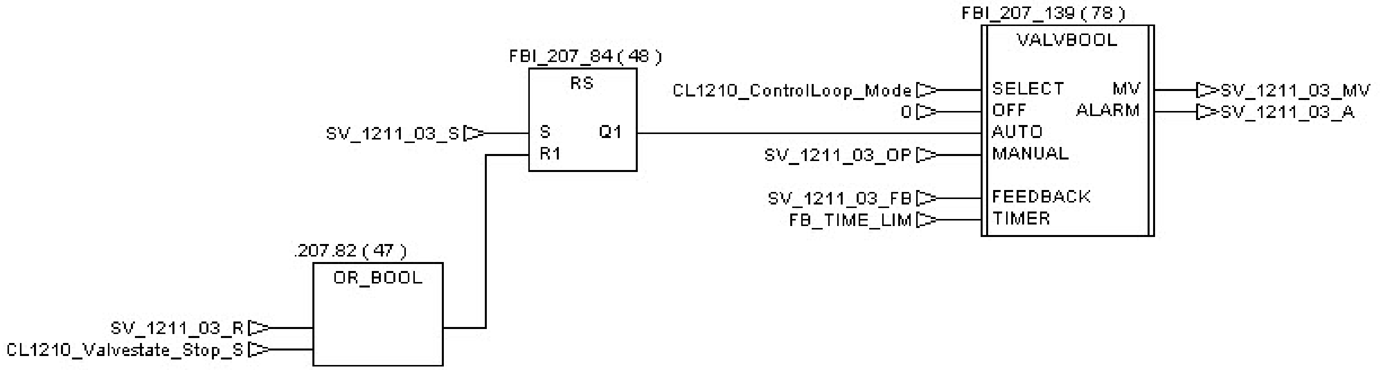
SV_1211_01:


FBI_207_137 (76)
VALVBOOL
FBI_207_78 (44)
RS
CL1210_ControlLoop_Mode
SELECT
MV
SV_1211_01_MV
0
OFF
ALARM
SV_1211_01_A
SV_1211_01_S
S
Q1
AUTO
R1
SV_1211_01_OP
MANUAL
SV_1211_01_FB
FEEDBACK
FB_TIME_LIM
TIMER
.207.76 (43)
OR_BOOL
CL1200_Valvestate_Cir1_S
CL1207_Valvestate_Cl1_S
CL1207_Valvestate_BW1_S
CL1210_Valvestate_Stop_S
CL1210_Valvestate_S1_S
CL1210_Valvestate_S1_R
CL1210_Valvestate_All1_S
CL1210_Valvestate_All1_R
CL1207_Valvestate_ET1_S

SV_1211_02:



SV_1211_03:



4.32.3.Alarms and Thresholds

Alarm tag Name	type	Address	description
SV_1211_01_A	BOOL	000776	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1211_02_A	BOOL	000778	valve alarm ACTION : DISPLAY ALARM ON HMI
SV_1211_03_A	BOOL	000780	valve alarm ACTION : DISPLAY ALARM ON HMI

Figure 104: Effluent Tank Temperature Control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
FB_TIME_LIM	TIME	400900	5	seconds	Display an alarm

Figure 105: Effluent Tank Temperature Control – THRESHOLDS

5. User Manual Procedures

5.1. Procedure Number / Procedure name

N°	*Name from User Manual*
1	Reset of the filtration, CIP and SIP frame after Emergency Stop
2	Preparation of acid for pH control in Bioreactor VSL2_1007_01
3	Preparation of base for pH control in Bioreactor VSL2_1007_01
4	Preparation of cleaning agent for Filtration Unit Cleaning
5	Influent preparation
6	Start-up Influent tank VSL2_1000_01
7	Filling Influent tank VSL2_1000_01
8	Drain Influent tank VSL2_1000_01
9	Shut down Influent tank VSL2_1000_01
10	Filling Bioreactor VSL2_1007_01 with inoculum
11	Start-up Bioreactor VSL2_1007_01
12	Start-up Bioreactor VSL2_1007_01 feeding
13	Preserve overpressure gas in VSL2_1007_01 into VSSL_1100_01
14	Stop Bioreactor VSL2_1007_01 feeding
15	Connect N2 to the system
16	Emergency Stop on the RV frame
17	Emergency Stop on the FU frame
18	Emergency Stop of the FU frame on the HMI
19	Passive Gas Loop: Shut down
20	Passive Gas Loop: Start_up
21	Analysis Gas Loop: Shut down
22	Analysis Gas Loop: Start-up
23	Analysis Gas Loop: adjust flow rates
24	Analysis Gas Loop: Calibration of gas analyzer AT_1101_01
25	Active Gas Loop: Shut down
26	Active Gas Loop: Start-up
27	Filtration Unit: Replacement of tube in pump PP_1202_01
28	Filtration Unit: Calibration of PP_1202_01 flow rate
29	Filtration Unit: (Emergency) Shut down
30	Filtration Unit: Removal of dead-end filter LF_1200_03
31	Filtration Unit: Installation of dead-end filter LF_1200_03
32	Filtration Unit: Removal of ceramic membranes LF_1200_01/LF_1200_02
33	Filtration Unit : Installation of ceramic membranes LF_1200_01/LF_1200_02
34	Filtration Unit: Start-up in Bypass mode
35	Filtration Unit: Start-up of filtration through membrane LF_1200_01/LF_1200_02

36	Filtration Unit: Switch from one membrane to the other LF_1200_01/LF_1200_02
37	Filtration Unit : Enter Recycle mode
38	Filtration Unit : Enter Nominal mode
39	Filtration Unit : Harvest Effluent vessel VSSL_1204_01
40	Drain Filtration Unit : retentate line
41	Drain Filtration Unit : inside membranes LF_1200_01/LF_1200_02
42	Drain Filtration Unit : filtrate line
43	Drain Filtration Unit : entire Filtrate Unit
44	Fill Filtration Unit with water
45	CIP: (Emergency) Shut down of CIP activities
46	Shut down the System, drain, rinse and clean Bioreactor VSL2_1007_01, Feefing vessel VSL2_1000_01 and Filtration Unit
47	Cleaning Influent tank VSL2_1000_01
48	Cleaning Bioreactor VSL2_1007_01
49	Cleaning of Filtration Unit: retentate side of membrane LF_1200_01/LF_1200_02
50	Cleaning of Filtration Unit: both retentate and filtrate side of membrane LF_1200_01/LF_1200_02
51	Cleaning of Filtration Unit: backwash membrane LF_1200_01/LF_1200_02
52	Cleaning of Filtration Unit: backwashing membrane LF_1200_01/LF_1200_02 using water and cleaning agent
53	Cleaning of Filtration Unit: Circulation pump GP_1201_01
54	Cleaning of Filtration Unit: Filtrate tank VSSL_1204_01
55	Cleaning of Filtration Unit: Filtrate tank VSSL_1204_01 and filtrate line through LF_1200_01/LF_1200_02
56	Cleaning of Filtration Unit: automated execution of a sequence of procedures to clean membrane LF_1200_01/LF_1200_02
57	Cleaning of Filtration Unit: setting autonomous daily execution of a sequence of procedures to clean membrane LF_1200_01/LF_1200_02
58	Empty VSSL_1209_01
59	Empty VSSL_1209_02
60	Clean VSSL_1209_01 and VSSL_1209_02
61	Fill cleaning agent into VSSL_1209_01
62	Fill water into VSSL_1209_01
63	Fill cleaning agent into VSSL_1209_02
64	Rinse VSSL_1209_01
65	Rinse VSSL_1209_02
66	(Emergency) Shut down of SIP activities
67	SIP: Release pressure in St_S_01
68	SIP : membrane LF_1200_01/LF_1200_02
69	SIP: membrane LF_1200_01/LF_1200_02, filtrate line and Filtrate tank VSSL_1204_01
70	Influent sampling

71	Bioreactor content sampling
72	Gas sampling
73	Filtrate sampling
74	General follow-up
75	Follow-up Influent tank VSL2_1000_01
76	Follow-up Bioreactor VSL2_1007_01
77	Follow-up Gas Loop
78	Follow up Filtration Unit
79	Calibration of pH sensors AT_1011_01 et AT_1011_02
80	SIP : Purge and sterilize recycle line
81	SIP : Purge and sterilize Harvesting line
82	SIP: Flush recycle line with Steam
83	SIP: Filtration Unit: Enter in By Pass Mode automatically when LSH_1206_01 is set
84	SIP: membrane LF_1200_01 / LF_1200_02, filtrate line and Filtrate tank VSL2_1204_01
85	Reset automatic control of Filtration Unit
86	Reset automatic control of Cleaning Unit
87	Reset automatic control of Sterilization Unit

5.2. Procedure 1: Reset of the filtration, CIP and SIP frame after Emergency Stop

5.2.1. Scope

Restart the system after an emergency stop by an emergency button on the one of the frames or a stop button on the HMI, i.e. one of the procedures hereunder.
PROCEDURE 16: Emergency Stop on the RV frame
PROCEDURE 17: Emergency Stop on the FU frame
PROCEDURE 18: Emergency Stop of the FU frame on the HMI
PROCEDURE 29: Filtration Unit: (Emergency) Shut down
PROCEDURE 45: CIP: (Emergency) Shut down of CIP activities
PROCEDURE 66: (Emergency) shut down of SIP activities

Procedure

1. Make sure all emergency buttons are drawn back (turn in direction of arrow on the Button)
2. Press the reset button on the electrical cabinet

5.3. Procedure 2: Preparation of acid for pH in Bioreactor VSL2_1007_01

5.3.1. Scope

To avoid metanogenisis the pH has to be lower than 6 and has to range between 5,1 and 5,6.
To make sure the pH stays lower than 6, the pH is automatically adjusted with HCl.

Necessities
HCl 12N (37%)
Demineralised water
Volumetric flask

Preparation of 1 liter acid 5 N

1. Wear lab coat, goggles and gloves!
2. Fill a volumetric flask of 1 liter with some demineralised water (300 –400 mL)
3. Do the following steps under the regular exhaust bench flow:
    1. Measure 420 ml HCl 12N (37%)
    2. Add them slowly to the volumetric flask and mix gently
    3. Complete the volume to 1 L with demineralised water
    4. Pour the solution in a labelled bottle for storage if necessary

All the procedure is done by the OPERATOR.

5.4. Procedure 3: Preparation of base for ph in Bioreactor VSL2_1007_01

5.4.1. Scope

The pH has to range between 5,1 and 5,6. To make sure the pH does not drop lower than 5,1, the pH is automatically adjusted with NaOH.

Necessities
NaOH powder
Tap water
Erlenmeyer

Preparation of 1 liter base
Wear lab coat, goggles en gloves!
Fill an Erlenmeyer of 1 L with some demineralised water (500 –700 mL)
Do the following steps under the laminar flow
Weigh 200 g of NaOH
Add them slowly into the Erlenmeyer en mix gently
Complete the volume to 1 L with demineralised water
Pour the solution in a labelled bottle for storage if necessary

All the procedure is done by the OPERATOR.

5.5. Procedure 4: Preparation of cleaning agent for Filtration Unit Cleaning

5.5.1. Scope

Necessities
NaOH powder
Demineralised water
Erlenmeyer

Preparation of cleaning agent for membrane inside cleansing
Wear lab coat, goggles en gloves!
Fill an Erlenmeyer of 2 L with some demineralised water (800 –1000 mL)
Do the following steps under the laminar flow
Weigh 400 g of NaOH
Add them slowly into the Erlenmeyer and mix gently
Complete the volume to 2 L with demineralised water
Pour the solution (NaOH 20%) in a bottle for storage if necessary

All the procedure is done by the OPERATOR.

5.6. Procedure 5: Influent preparation

5.6.1.Influent Composition

The following table is a summary of the substrate necessary for the preparation of one influent batch. The total volume of one influent batch is more or less 70 L. This is the amount of influent used during one week.

Substrate	***Mass***	***Estimation of units number***	***Box content***
Faecal Material	636 g frozen	7 boxes	-
Lettuce	7650 g frozen	30 crops	12 crops
Red Beet	4725 g frozen	20 crops	5 kg
Wheat straw	378 g dry	378 g	-
Toilet paper	126 g dry	126 g	-
Total volume	70 L	70 L	

Susbtrate pre-preparation
Lettuce and Red beet
Weigh the frozen red beet and lettuce to the necessary amount
Cut them frozen into rough pieces with a knife.
Faecal material
Weigh the frozen faecal material to the necessary amount
Wheat straw
Grind it with a small kitchen grinder and a lab mill (Retsch Ultracentrifugal mill ZM100):
Weigh the straw powder to the necessary amount
Toilet paper
Weigh the toilet paper and cut it into small pieces

Procedure
Connect the water flexible tube to the tap and fill the biggest tank to a defined volume (normally the second sensor). Then close the top of the biggest tank.
Start the water circulation by pushing the Z2 button in the electrical cupboard and start the industrial kitchen grinder by pushing the green command button on the right side of the electrical cupboard.
Add the plants from the top: red beet, lettuce, the toilet paper, wheat straw and then faecal material. Control visually the level in the small upper tank: if the plants are added to fast, the level will increase and a level switch will stop the system to prevent

that an overflowing. The flow can be manually adapted by setting the valve V-S-002 (close it to decrease the flow in the upper tank).
Let the system work for at least 5 minutes when everything is in.
Then stop it (Z3), open the top of the biggest tank and add water to complete the volume up to 70L (see mark). You can do this by pushing the Z4 button to start and stop adding water or better manually in order to minimize the forming of foam, because the presence of foam may cause a problem to read the volume.
When the volume is completed, let it circulate again (Z2). While circulating fill a receiver of choice with influent (open the top of the bigger tank to prevent vacuum).
Take a homogenous sample of influent for analysis.
Log the influent batch in the database and label it.
Pump the influent in the influent vessel (+/- 65 L) if necessary. See *PROCEDURE 7*: Filling Influent tank VSL2_1000_01 or store the influent in a fridge.
Rinse the installation several times with tap water using Z4 button. Clean also the outside.

All the procedure is done by the OPERATOR.

5.7. Procedure 6: Start-up Influent tank VSL2_1000_01

5.7.1. Scope

Initiate the functions of the influent tank.

Prerequisite
Bioreactor should contain a certain amount of active waste that is strong enough to digest an influent flow.
S3V_1001_02 must be in position.

Procedure
Use the HMI to
Make sure HV_1003_01 is open and N2 is available at around 1 barg, HPCV_1003_01 is set to approximately 110 mbarg and HPCV_1003_02 to approximately 90 mbarg.
Start blender BLE_1005_01 (set point: 200 rpm): “Influent blender” button to automatic mode
Set temperature set point (to 6°C or another value <= 7°C. Fill HX_1002_01 and double jacket with water and antifreeze compound (glycol) if this is not done yet: TT_1002_SP
Start GP_1001_01 : “Influent feed to bioreactor” button to automatic mode.

On initial start up, when liquid level is below connection to S3V_1001_02, GP_1001_01 will not run due to dry running protection.

5.8. Procedure 7: Filling Influent tank VSL2_1000_01

5.8.1.Scope

Feed influent to the influent tank.

Prerequisite
GP_1001_01 is active except for the initial filling.
HV_1000_01 is closed.
HV_1000_02 is closed.
HV_1000_03 is closed.
SV_1003_01 is on.

Procedure

Initial filling (occurs at start-up, when the influent tank is totally empty)
Connect the dedicated reservoir to valve H3V_1001_01.
Open the valve underneath the reservoir and fill it with influent.
Start-up GP_1001_01: SCI_ GP_1001_01_Right
Turn switch on panel (on the right of the front side of the bioreactor frame) and hold it while pushing the blue button (Get Cake Button) (on the right of the front side of the bioreactor frame) to bring the system into feeding mode. This can be checked on the HMI. S3V_1001_02 switches. The pump now withdraws influent and pumps it into VSL2_1000_01.
Overpressure safety valve SV_1003_01 now works to vent overpressure in the influent tank without generating an alarm
Because HPCV_1003_01 is not able to release the added volume quickly enough, even with the aid of SV_1003_01, the pressure in VSL2_1000_01 increases. S3V_1001_02 switches back and forth to prevent overpressure.
Stir the contents in the reservoir and try to have the floating portion sucked in to minimize the amount of fragments to amass. Fill more influent in the reservoir before it is empty and try to avoid air to be sucked into the system.
When maximum level in the influent tank is reached, the system won't allow any more influent to be added and leaves feeding mode. This can be checked on the HMI. Valve S3V_1001_02 is deactivated. The Valve SV_1003_01 returns to its normal function (safety valve).
Close the valve underneath the reservoir. Remove the reservoir. Empty the remaining influent and rinse it.

Nominal filling (occurs when influent liquid level is above the minimum)
Connect the dedicated reservoir to valve H3V_1001_01.
Open the valve underneath the reservoir and fill it with influent.
Turn switch on panel (on the right of the front side of the bioreactor frame) and hold it while pushing the blue button (Get Cake Button) (on the right of the front side of the bioreactor frame) to bring the system into feeding mode. This can be checked on

the HMI. S3V_1001_02 switches. The pump now withdraws influent and pumps it into VSL2_1000_01. Overpressure safety valve SV_1003_01 now works to vent overpressure in the influent tank without generating an alarm. Because HPCV_1003_01 is not able to release the added volume quickly enough, even with the aid of SV_1003_01, the pressure in VSL2_1000_01 increases. S3V_1001_02 switches back and forth to prevent overpressure.

Stir the contents in the reservoir and try to have the floating portion sucked in to minimize the amount of fragments to amass. Fill more influent in the reservoir before it is empty and try to avoid air to be sucked into the system.

When maximum level in the influent tank is reached (60 L), the system won’t allow any more influent to be added and leaves feeding mode. This can be checked on the HMI. Valve S3V_1001_02 is deactivated. The valve SV_1003_01 returns to its normal function of safety valve.

Close the valve underneath the reservoir. Remove the reservoir. Empty the remaining influent and rinse it.

PLC Interface :

See Block diagram section of “Influent tank feed to bioreactor” chapter.

5.9. Procedure 8: Drain Influent tank VSL2_1000_01

5.9.1. Scope

Drain an amount of influent from the influent vessel VSL2_1000_01.

Procedure

Wear lab coat, goggles and gloves!
Connect a sampling residue to a hose on HV_1000_01
Open valve HV_1000_04 on the bottom of the reactor
The drained influent is collected in a sampling residue

All the procedure is done by the OPERATOR.

5.10. Procedure 9: Shut down Influent tank VSL2_1000_01

5.10.1.Scope

Shut down influent tank VSL2_1000_01.

Prerequisite
Blender and cooling should not be deactivated when there is still content in the reactor.
Influent tank and piping to circulate its contents and feed VSL2_1007_01 are to be cleaned thoroughly afterwards, unless the influent tank is shut down only during a short period for maintenance reasons.

Procedure
Use the HMI to
Set temperature set point to a high value (higher than room temperature) to save energy. This will disable the cooler HX_1002_01
The pump CP_1002_01 can be deactivated. Switch off fuse F16 in the electrical cabinet.
Stop blender BLE_1005_01 or do this after cleaning VSL2_1000_01
Stop GP_1001_01 or do this after cleaning VSL2_1000_01 and feeding piping
Disable feeding.
Close HV_1003_01 and leave HV_1000_01 open if influent tank is empty.

5.11. Procedure 10: Filling Bioreactor VSL2_1007_01 with inoculums

5.11.1. Scope

Before start up, the bioreactor is to be inoculated.

Prerequisite
During this procedure the bioreactor is opened. N2 addition should therefore be prevented. If this is already active please close HV_1009_01

Procedure
Wear lab coat, goggles and gloves!
Open two of the connections at the top of the bioreactor. (Except SV_1009_01 and RV_1009_01)
Put a funnel into one open connection.
Fill the unfrozen inoculum into the funnel.
Remove the funnel and close the open connections on the top of the bioreactor.
Open HV_1009_01.

All the procedure is done by the OPERATOR.

5.12. Procedure 11: Start-up Bioreactor VSL2_1007_01

5.12.1. Scope

Initiate the functions of the bioreactor VSL2_1007_01.

Prerequisite
Bioreactor should contain inoculums or an amount of active waste (minimum 50 L).

Procedure
Use the HMI to
Make sure HV_1009_01 is open and N2 is available at around 1 barg
Flush N2 in the bioreactor by opening SCV_1103_01
Start blender BLE_1012_01 (set point: 220 rpm): put the Control Loop mode CL1012 in Automatic. Set temperature set point to 55°C. Fill HX_1008_01 and double jacket with demineralized water if this is not done yet
Make sure Acid bottle contains acid and base bottle contains base. Set pH set point to 5.2 or another value if specified. Use the manual mode to reach the good value.

5.13. Procedure 12: Start-up Bioreactor VSL2_1007_01 feeding

5.13.1. Scope

Start the feeding function.

Prerequisite
Both bioreactor and influent vessel should be working. Bioreactor should contain a certain amount of active waste that is strong enough to digest an influent flow.

Procedure
Use the HMI to set the feeding function to be timer based or volume based. As long as VSL2_1007_01 doesn't contain its nominal volume of liquid, timer based feeding should be applied to feed a certain amount per day (e.g. 2.5 L/d). Once nominal liquid volume is reached, operator should switch over to volume based control. Nominal volume is around 100L.
Enable feeding Thanks to the HMI control Loop mode button. The edit value button permits to configure the feeding mode.
Use the HMI to set feeding to timer based and to set the amount to feed per day: CL1001_SCI_Feed_mode_timer_S, CL1001_SCI_Feed_Amount_per_day
When nominal volume (100L) is reached, use the HMI to set the volume to switch to feed to 100 and set feeding to volume based mode.

PLC Interface:

See "Influent tank feed to Bioreactor" chapter

5.14. Procedure 13: Preserve overpressure gas in VSL2_1007_01 into VSSL_1100_01 before opening bioreactor VSL2_1007_01

5.14.1.Scope

Preserve as much gas from the bioreactor before opening it for service or maintenance activities. As much gas as possible will be pumped into VSSL_1100_01 and if pressure in VSSL_1100_01 is not too high (3.6 barg) and the volume of gas phase in VSL2_1007_01 is not too high, pressure in VSL2_1007_01 will become near the atmospheric one.

Prerequisite
Active gas loop must be running.

Procedure
Use the HMI to activate this function: Active Gas loop control Loop mode button. Wait until pressure in bioreactor doesn't go lower anymore:
Close valves that connect to the gas loop. (HV_1007_08, HV_1007_10, HV_1007_11, HV_1007_12, HV_1007_13, HV_1007_14, HV_1009_01): all these valves are manual type.

PLC Subroutine : **G_Active_Loop**
This subroutine is detailed in *Procedure* 26: Active Gas Loop: Start-up

Used Variables:
All variables involved in PROCEDURE 26.

5.15. Procedure 14: Stop Bioreactor VSL2_1007_01 feeding

5.15.1.Scope

Disable the feeding function.

Procedure
Put the control Loop mode button to OFF mode

Used Variables:
CL1001_ControlLoop_Mode

5.16. Procedure 15: Connect N2 to the system

5.16.1.Scope

N2 must be present before any function of the Pilot is activated. This will permit pressure regulation and flushing in VSL2_1000_01 and VSL2_1007_01. It is also necessary for calibration of the analyzers, some draining procedures for the filtration unit, for harvesting of VSL2_1204_01 and for prevention of under pressure in the later vessel after SIP.

Procedure

Set the regulation of the N2 supply around 1 barg (at no or low flow rate).
Connect the frame's N2 connection I-06 to the N2 supply I-06.

This procedure is done by the OPERATOR.

5.17. Procedure 16: Emergency Stop on the Influent and Bioreactor frame

5.17.1. Scope

This is an emergency stop and should normally never be used. It stops the power equipment with rotating parts on the bioreactor frame:
BLE_1012_01
BLE_1005_01
HX_1008_01
GP_1001_01

Procedure
Press the nearest emergency button on the frame.

This procedure is done by the OPERATOR.

5.18. Procedure 17: Emergency Stop on the FU frame

5.18.1. Scope

This is an emergency stop and should normally never be used. It stops the power equipment on both FU and GL frames.

Procedure
Press the nearest emergency button on one of the two frames.

This procedure is done by the OPERATOR.

5.19. Procedure 18: Nominal Stop of the FU frame on the HMI

5.19.1.Scope

Stop all actions running on the FU and put all the valves in stop position. This is an emergency stop and should normally never be used. It might be useful in case major problem.
This function triggers the 3 Control Loop Mode buttons (FU/CIP/SIP) to OFF Mode, then calls the procedure F_Stop, C_Stop and S_Stop to reset all the automatic pin of equipments..

Procedure
Use the button CL1200_SCI_Stop_FCS on the HMI:
CL1200_SCI_Stop_FCS (PLC Address: 000286). This button is situated on the left bottom of each HMI screen.
The PLC put the FU, CIP and SIP in OFF mode and calls the three stop routine.
F_Stop stops the filtration unit
C_Stop stops the cleaning unit
S_Stop stops the sterilization unit

Used Variables:

CL1200_SCI_Stop_FCS (PLC Address: 000286)

PLC Subroutine:
The HMI variable CL1200_SCI_Stop_FCS calls three PLC subroutines:
F_Stop described in Procedure 29
C_Stop described in Procedure 45
S_Stop described in Procedure 66

Variables Used (I/O):
All variables used in Procedure 29 (F_Stop), Procedure 45 (C_Stop) and Procedure 66 (S_Stop).

5.20. Procedure 19: Passive Gas Loop: Shut down

5.20.1.Scope

Stop the passive gas loop.
This will automatically put the Active Gas Loop to OFF Mode

Procedure
Put the control Loop Mode button to OFF or MANUAL

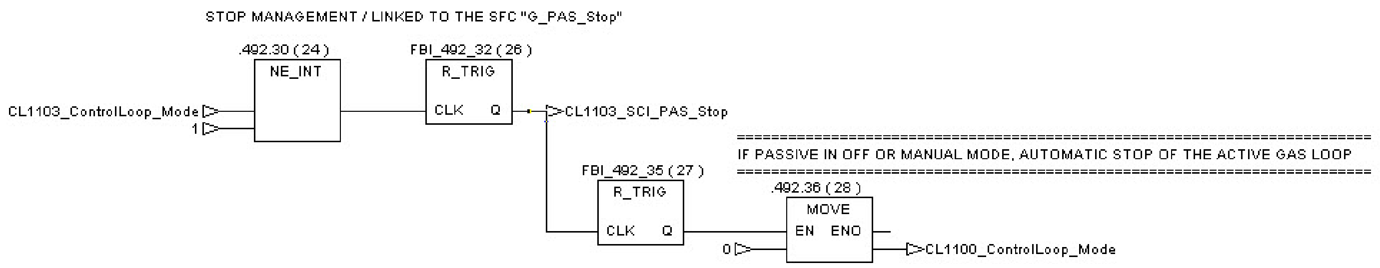
PLC Interface :

Used Variables:
CL1103_SCI_PAS_Stop
CL1103_ControlLoop_Mode

5.20.2.PLC Subroutines: G_PAS_Stop

When the operator triggers the mode to OFF or Manual, the Procedure G_PAS_Stop is called. This will automatically put the Active Gas Loop to OFF Mode.

As the procedure is extremely simple, no error time function is provided.



STOP THE PASSIVE GAS LOOP

==

The PASSIVE IS STOPPED WHEN THE MODE OFF OR MANU IS TRIGGERED

==

GENERAL MAX TIME: 5 SECONDS

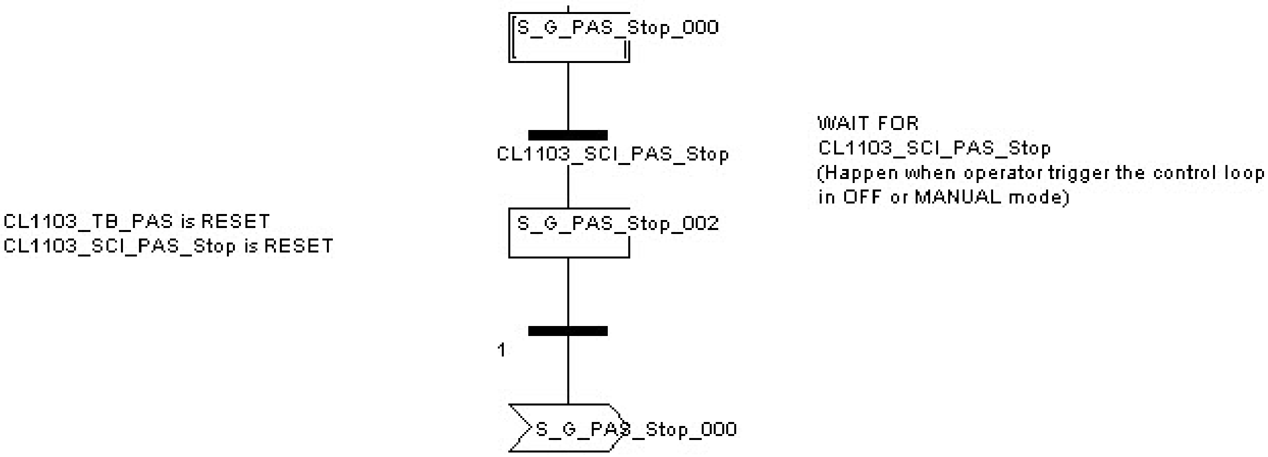


Figure 106 : PLC procedure G_PAS_Stop

Variables Used (I/O):
CL1103_SCI_PAS_Stop
CL1103_TB_PAS_Stop
CL1103_ControlLoop_Mode

5.21. Procedure 20: Passive Gas Loop: Start up

5.21.1.Scope

Start the passive gas loop.
Once started, the bioreactor pressure is maintained to 70 mbars thanks to the valve SCV_1103_01. It also allows the activation of the procedure G_PAS_Esc which permits to SV_1100_02 and SV_1100_03 (linked to the CL1103 for gas calculation) to calculate and to release the excess of biogas from VSL2_1007_01. The G_PAS_Esc procedure is called when pressure measured by PT_1009_01 is higher than 95 mbarg.
The complete explanation of the biogas calculation is detailed in the "CL1104_Gas_Outlet" chapter.

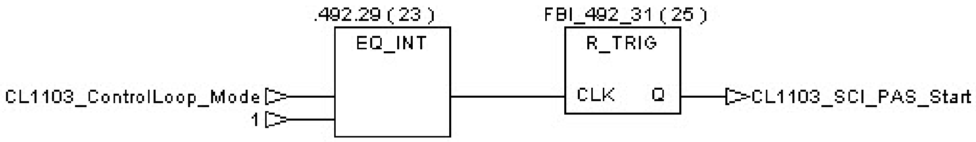
Pre-requisite
HV_1009_01 is open
HV_1007_08 is open

Procedure
Put the HMI control Loop Mode button "Passive Gas" to AUTOMATIC MODE

Used Variables:
CL1103_ControlLoop_Mode (Passive Gas Loop)

5.21.2.PLC Subroutines: G_PAS_Start.

As the procedure is extremely simple, no error time function is provided.



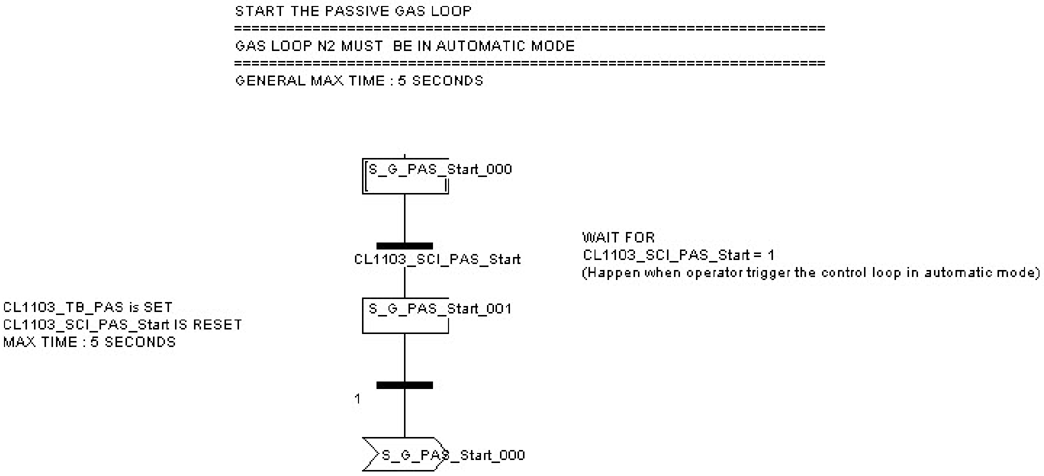


Figure 107: PLC procedure: G_PAS_Start

5.21.3.PLC Subroutines: G_PAS_Esc

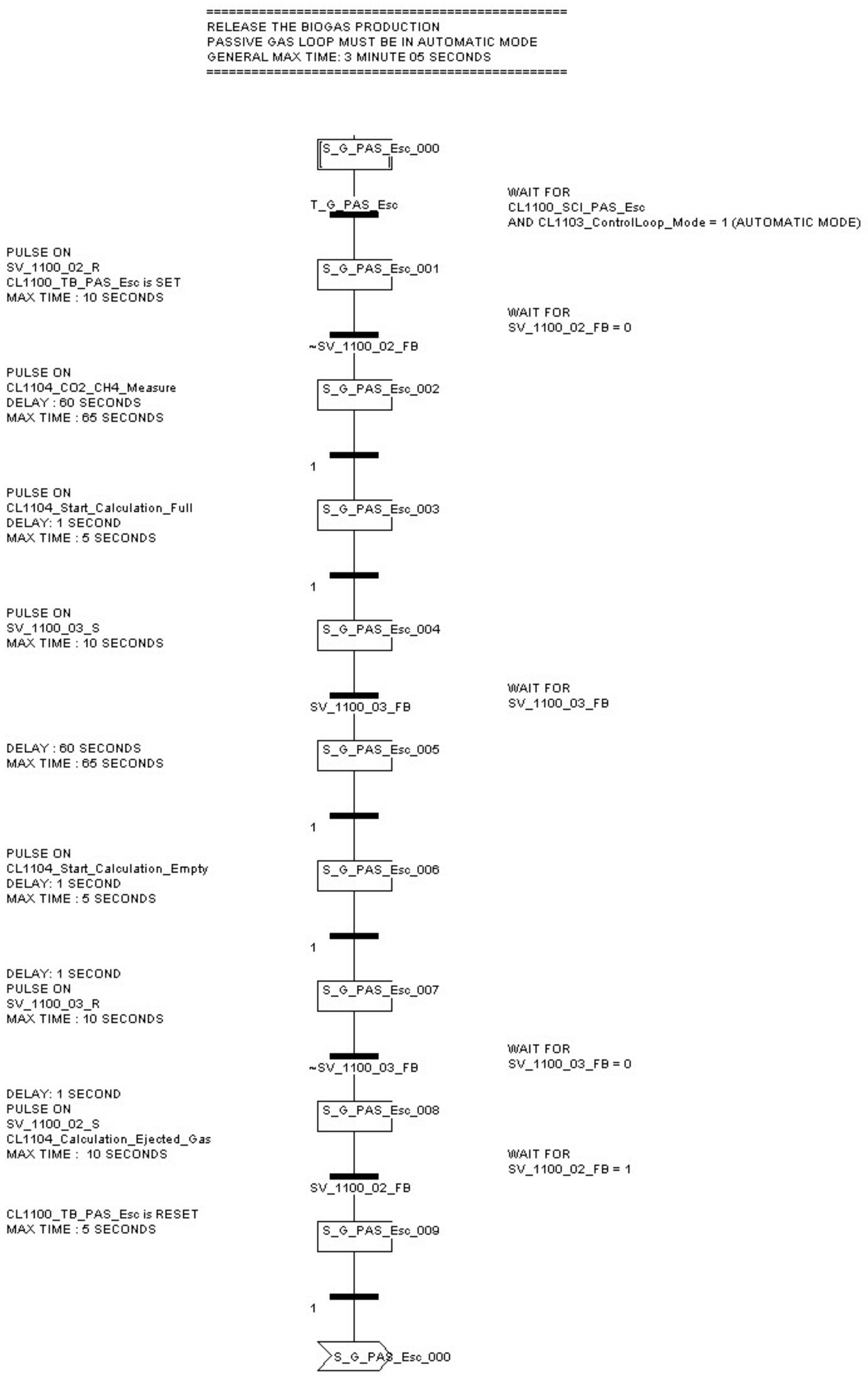
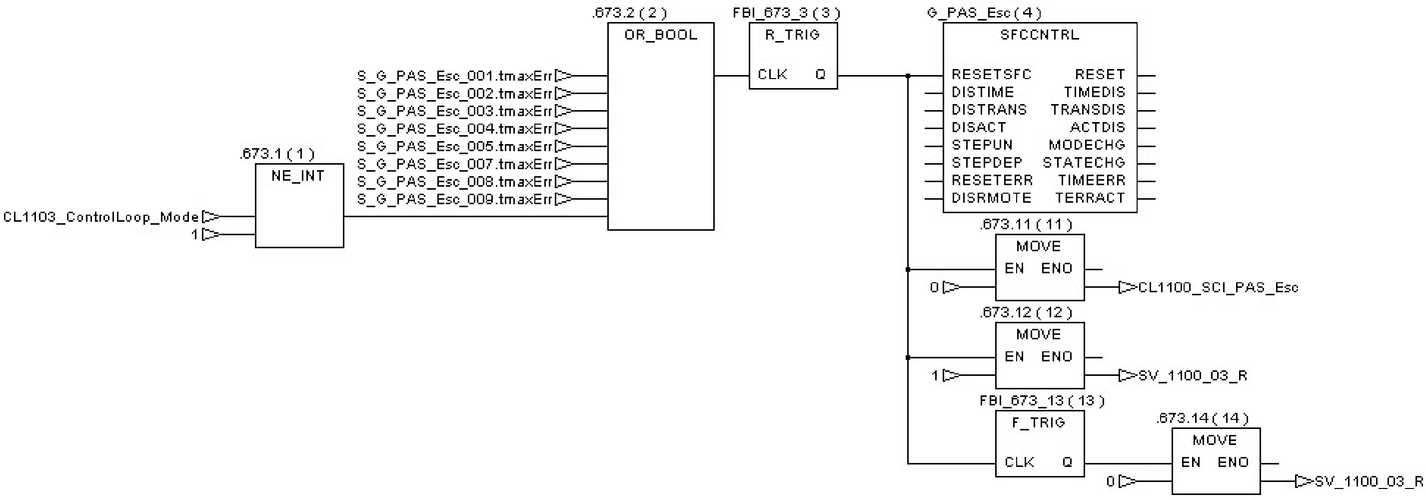


Figure 108: PLC procedure: G_PAS_Esc

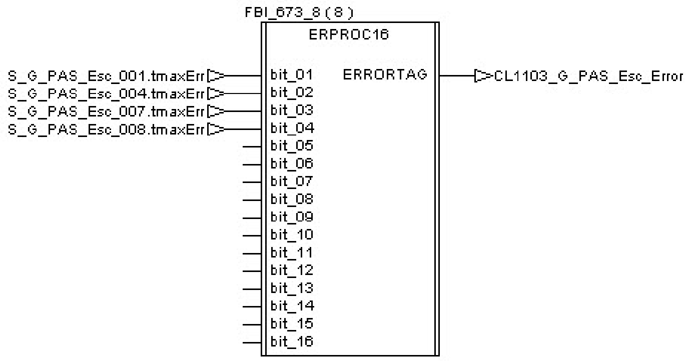
5.21.4.Procedure management

<u>Reset of the procedure:</u>
If a time error occurs during the execution of the procedure, SFC_CNTRL reset the procedure, the equipment (valve SV_1100_03) and tag linked to the procedure.

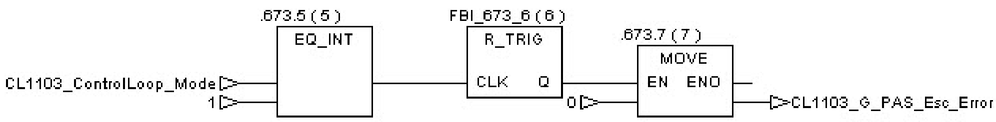
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode.



<u>Procedure error management:</u>
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, it records and displays this number on the HMI (error code procedure window). This has been created to diagnostic internal procedure problem.



The error number is displayed until the procedure is re-started.



5.21.5.Error number description

Error number	Procedure Action Step	problem description

1	**S_G_PAS_Esc_001**	SV_1100_02 closing problem
8	**S_G_PAS_Esc_004**	SV_1100_03 opening Problem
64	**S_G_PAS_Esc_007**	SV_1100_03 closing problem
128	**S_G_PAS_Esc_008**	SV_1100_02 opening Problem

5.22. Procedure 21: Analysis Gas Loop: Shut down

5.22.1.Scope

Stop the analysis gas loop.

Procedure
Set the control Loop Mode button "GL Analyzer" to OFF or MANUAL

Used Variables:

CL1101_ControlLoop_Mode

5.22.2.PLC Subroutine: G_Ana_Stop

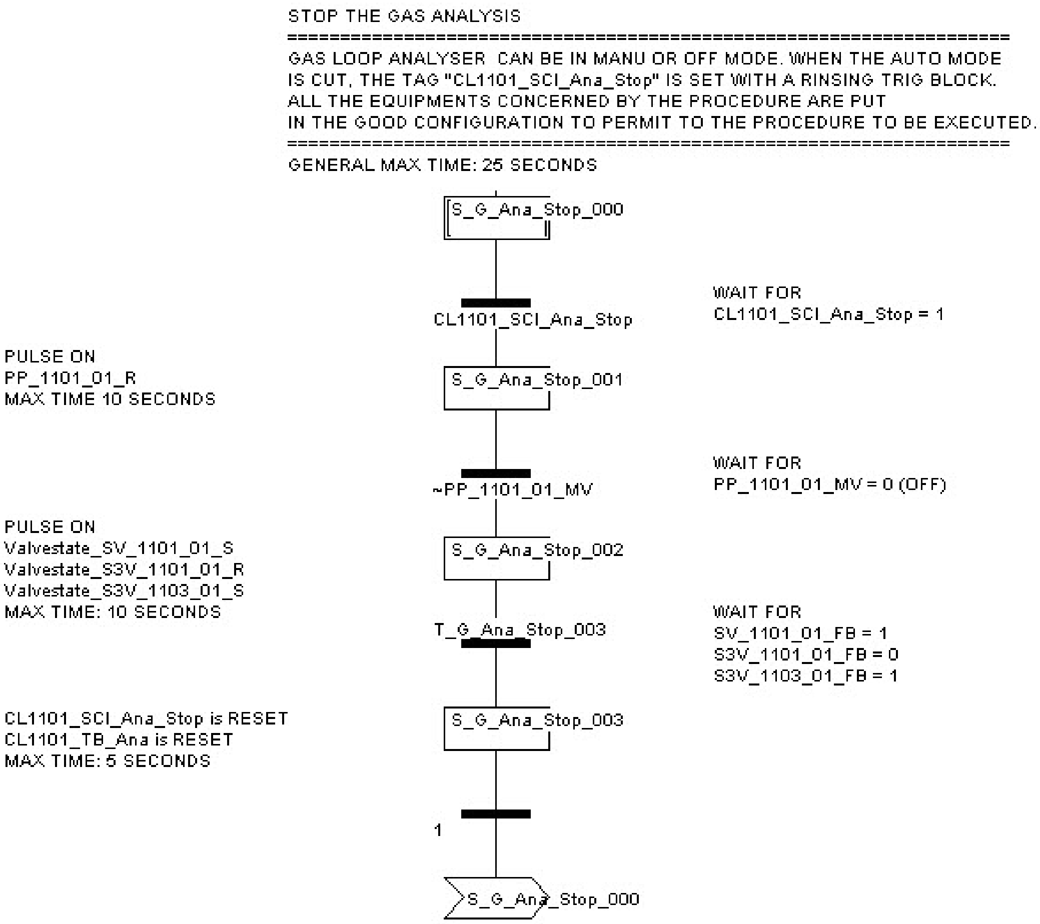
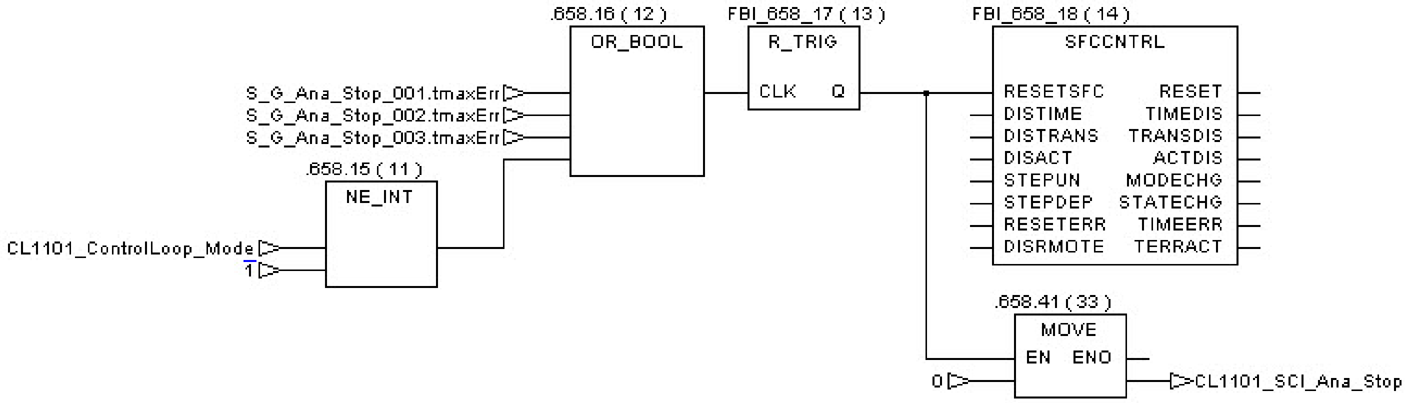


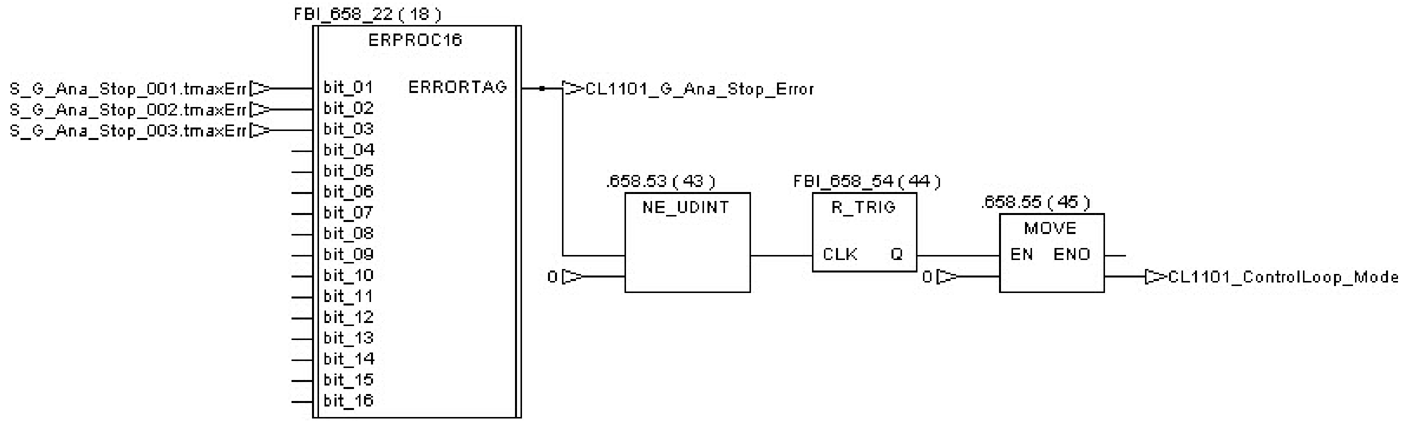
Figure 109: PLC procedure: G_Ana_Stop

5.22.3.Procedure management

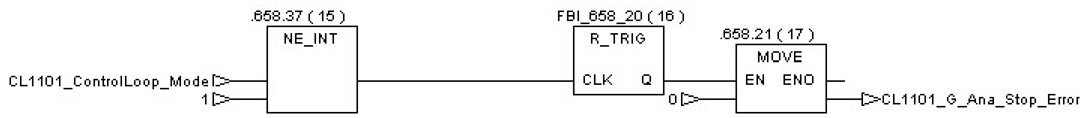
Reset of the procedure:
If a time error occurs during the execution of the procedure, the block “SFC_CNTRL” reset procedure and the associated tag which starts it.



Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.
When the error is recorded, the Control Loop mode is triggered to OFF mode.



The error number is displayed until the procedure is re-started.



5.22.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_G_Ana_Stop_001**	The pump has not stopped
2	**S_G_Ana_Stop_002**	valve(s) status Error operator has to look for valve alarm
4	**S_G_Ana_Stop_003**	tag reset problem (Tracing bit or Start button)

5.23. Procedure 22: Analysis Gas Loop: Start-up

5.23.1.Scope

Start the analysis gas loop. This part of the gas loop uses PP_1101_01 to create a circulating flow of gas from VSL2_1007_01 over the gas analyzers.

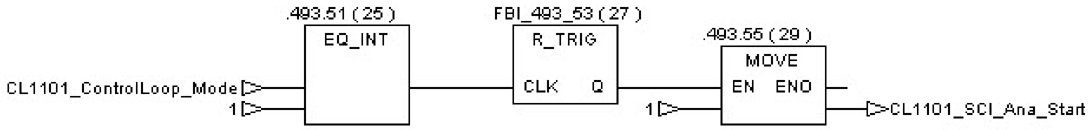
Prerequisite
Please make sure to have read the specific gas analyzer manual for a detailed description on how to use this Analyzer.

Procedure
Make sure HV_1007_12 and HV_1007_13 are open.
Put the control Loop Mode button "GL Analyzer" to AUTOMATIC mode (CL1101_SCI_Ana_Start is set (PLC Address: 000095)).
If a cold startup of the gas loop is done, close both valves HV_1100_01 and HV_1100_02 before starting the analysis loop. When PP_1101_01 is running, open them gradually to adjust the flow rates through the analyzers according to PROCEDURE 23: Analysis Gas Loop: adjust flow rates.

Used Variables:
CL1101_ControlLoop_Mode.

5.23.2.PLC Subroutine: G_Ana_Start

When the control loop mode button is triggered in automatic mode, the tag CL1101_G_ANA_Start is set (waiting condition to start the procedure).



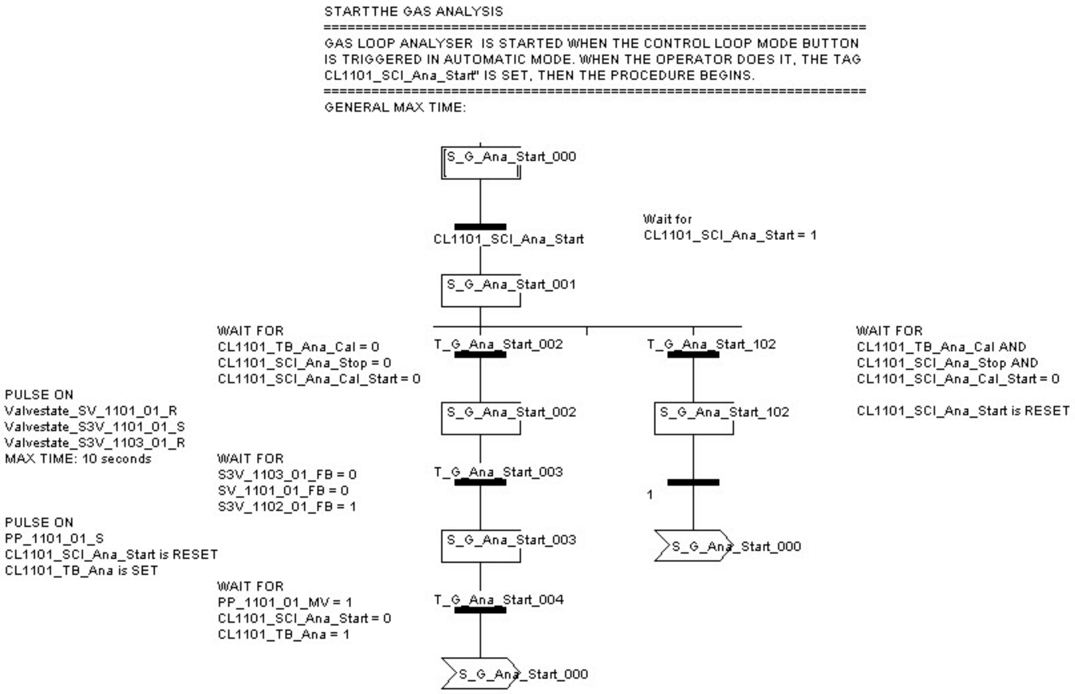
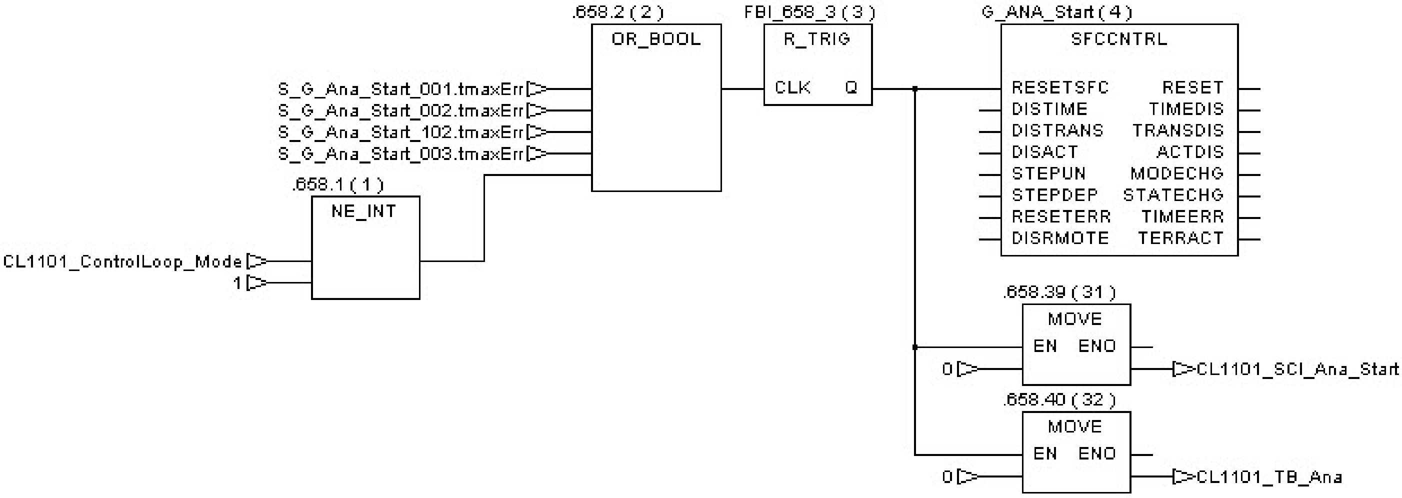


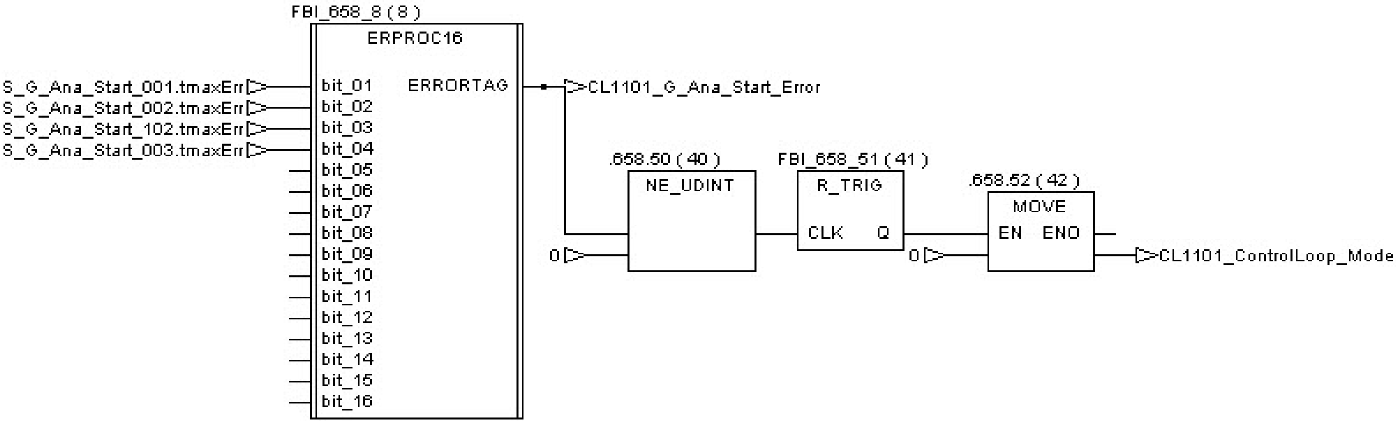
Figure 110: PLC procedure: G_Ana_Start

5.23.3.Procedure management

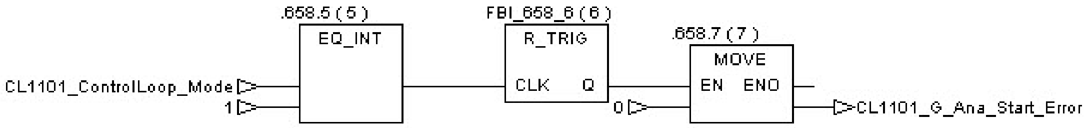
Reset of the procedure:
If a time error occurs during the execution of the procedure, the block “SFC_CNTRL” reset procedure and the associated tags (start variable and tracing bit).



Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.
When the error is recorded, the Control Loop mode is triggered to OFF mode.



The error number is displayed until the procedure is re-started.



5.23.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_G_Ana_Start_001**	No possible Error
2	**S_G_Ana_Start_002**	valve(s) status Error operator has to look for valve alarm
4	**S_G_Ana_Start_102**	Tag reset problem (Tracing bit or Start button)
8	**S_G_Ana_Start_003**	PP_1101_01 doesn't start or tag set/reset problem (Tracing bit or Start button)

5.24. Procedure 23: Analysis Gas Loop: adjust flow rates

5.24.1.Scope

Adjust the flow rate for each analyzer in the gas analysis loop. This flow rate should be big enough in order to sample gas that is representative for the rest of the gas in VSL2_1007_01 and it should not exceed the flow rate that could damage the analyzers.

Procedure

While the analysis loop is active, use HV_1101_02 and FI_1101_02 to set the flow rate for AT_1101_02 and HV_1101_01 and FI_1101_01 for AT_1101_01.

This procedure is done entirely by the OPERATOR.

5.25. Procedure 24: Analysis Gas Loop: Calibration of gas analyzer AT_1101_01

5.25.1. Scope

Calibration of the Maihak S 710 Extractive Gas Analyzer for CH4 and CO2.

Necessities

Calibration gas is done at a pressure up to 200mbarg on a 6mm tubing connection. This can be a bottle with a two stage gas pressure regulating valve.
Please carefully read the manual for a detailed description on how to use this apparatus.

Procedure

The analyzer is calibrated with two calibration gases that contain different percentages of CH4 and CO2. The nominal percentages measured may have a gap, so the analyzer can interpolate to calculate its measurement. A calibration gas that doesn't contain any CH4 or CO2 can be used, like the N2 from the gas loop. Another calibration gas has to be connected to the gas loop.
The analyzer manual describes from page 135 how to program different calibration procedures.

Calibration with N2:
Make HPCV_1103_01 sets a pressure not too high for the analyzers
Put the Passive gas loop and the analyzer gas loop in automatic mode
Click on the HMI button Start calibration (CL1101_SCI_Ana_Cal_Start is set in the PLC).
The procedure "**G_Ana_Stop**" is called and the tracing bit "CL1101_TB_Ana_Cal" is SET.
S3V_1103_01 and S3V_1101_01 switch and provide a N2 flow in the analyzer loop.
Calibrate the analyzer as described in its manual.

Calibration with calibration gas containing known concentration of CH4 and CO2:
Set the gas bottle on a pressure around 100 mbarg
Connect to the inlet of PP_1101_01
Calibrate the analyzer as described in its manual
Disconnect the gas bottle and reconnect the original tube on PP_1101_01
Click on the HMI button "Stop calibration" (CL1101_SCI_End_Calibration_Gas is set in the PLC).
The "PROCEDURE 22: Analysis Gas Loop: Start-up" is automatically started.

Used Variables:
CL1101_SCI_Ana_Cal_Start,CL1101_SCI_End_Calibration_Gas,
CL1101_TB_Ana_Cal.

5.25.2.PLC Subroutine: G_Ana_Cal_Start

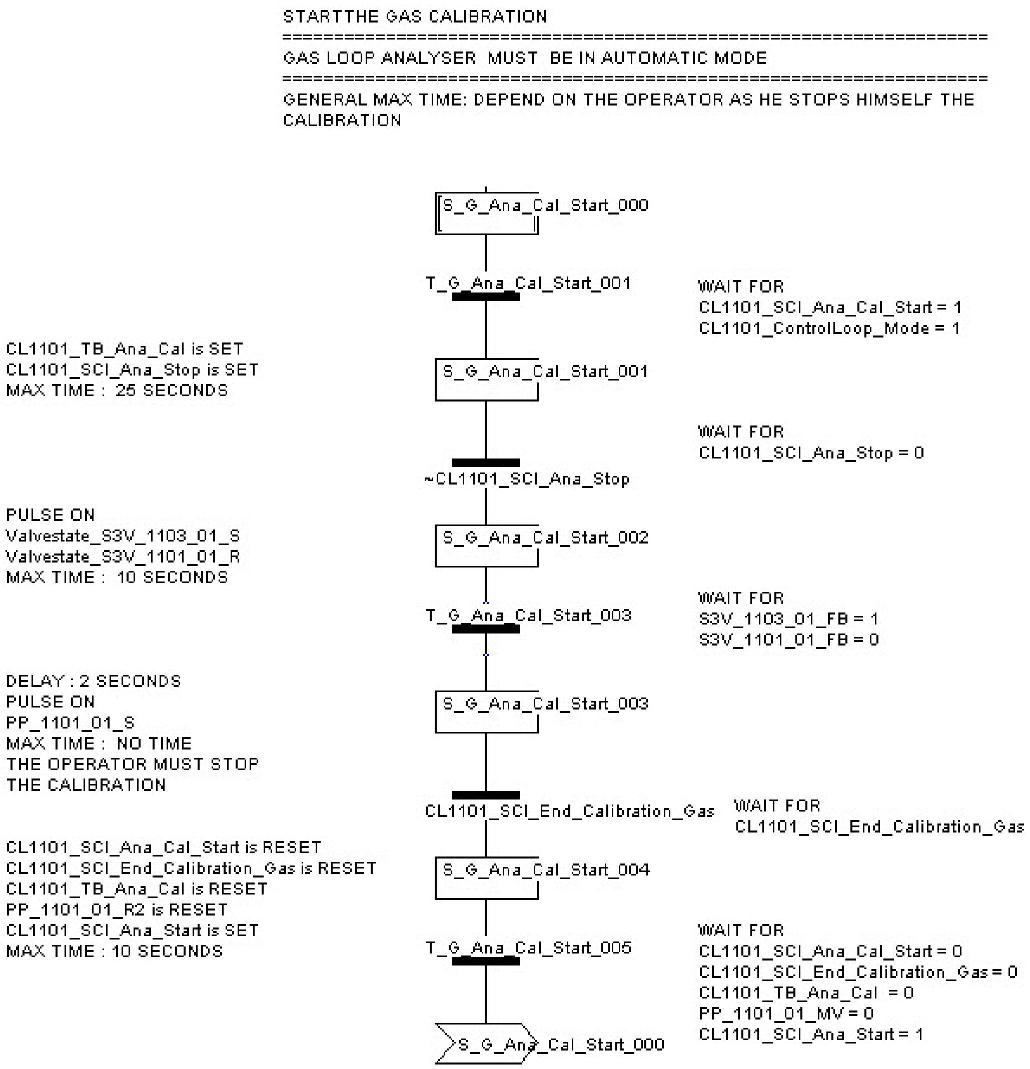
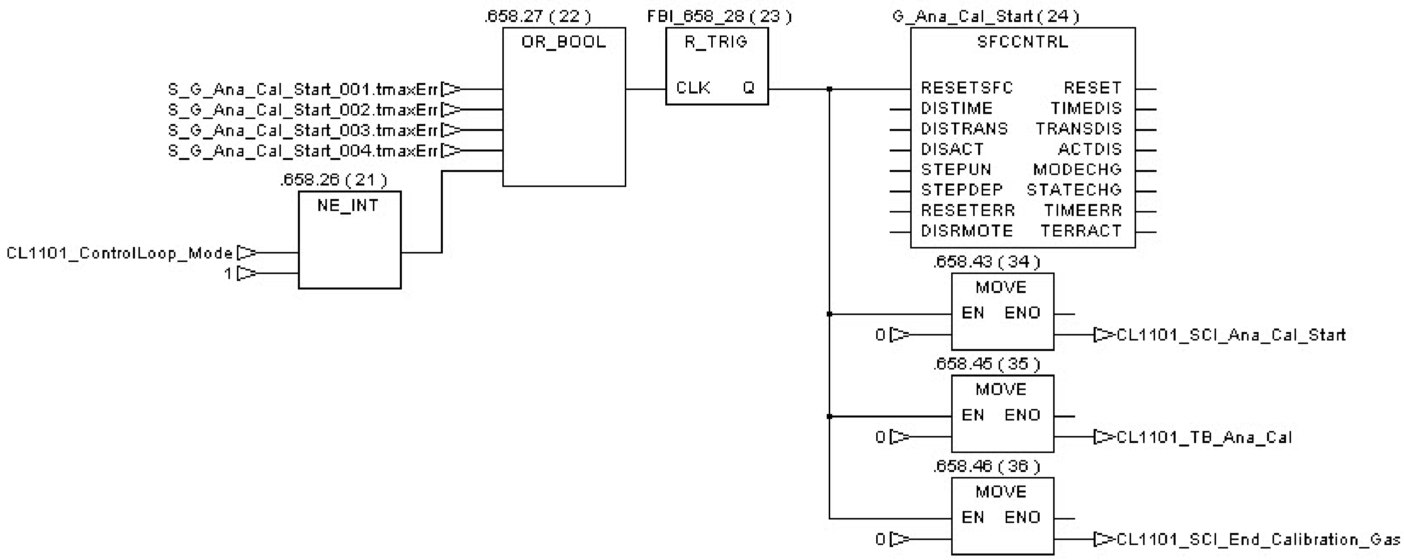


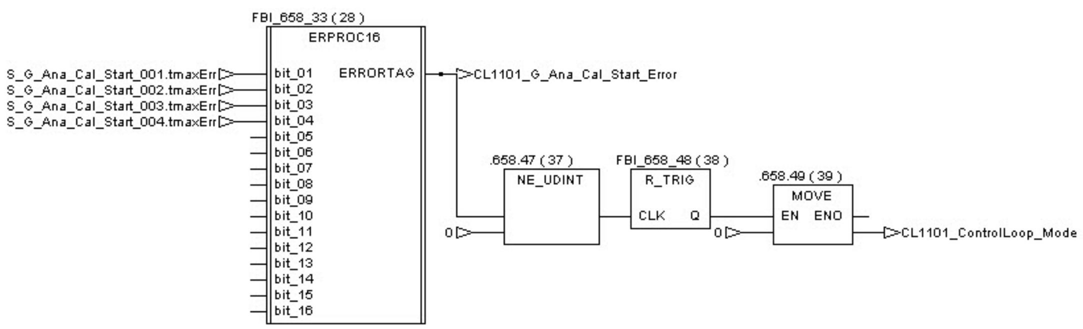
Figure 111: PLC procedure: G_Ana_Cal_Start

5.25.3. Procedure management

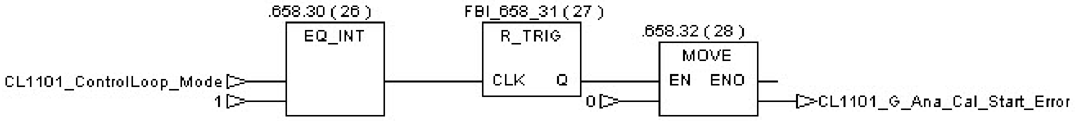
<u>Reset of the procedure:</u>
If a time error occurs during the execution of the procedure, the block "SFC_CNTRL" reset procedure and the associated tags (start variable, stop variable and tracing bit).



<u>Procedure error management:</u>
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.
When the error is recorded, the Control Loop mode is triggered to OFF mode.



The error number is displayed until the procedure is re-started.



5.25.4.Error number description

Error number	Procedure Action Step	problem description
1	S_G_Ana_Cal_Start_001	Problem during the execution of the procedure "G_ANA_Stop" The procedure "G_ANA_Stop" should also have an error code
2	S_G_Ana_Cal_Start_002	valve(s) status Error operator has to look for valve alarm
4	S_G_Ana_Cal_Start_003	PP_1101_01 has not been activated
8	S_G_Ana_Cal_Start_004	PP_1101_01 has not been stopped or Tag reset problem (Tracing bit or Start button)

5.26. Procedure 25: Active Gas Loop: Shut down

5.26.1.Scope

Stop the active gas loop.

Procedure
Put the control Loop Mode button "Active gas loop" to OFF or MANUAL

Used Variables:
CL1100_ControlLoop_Mode.

5.26.2.PLC Subroutine:

The shutdown of the active gas loop is done, as the start up, by the procedure **G_Active_Loop**. The details of this procedure is described in "**procedure 26: Active Gas Loop: Start-up**" chapter.

Description:
The tags used and the description are detailed in gas loop pressure control chapter.

Input HMI: CL1100_SCI_ACTIVE_Reset
Valves S3V_1100_01 and S3V_1100_02 are reset in default state.
The pump PP 1100_01 is stopped
Valves SV_1100_01, SV_1102_01 and SV_1100_05 are closed

5.27. Procedure 26: Active Gas Loop: Start-up

5.27.1.Scope

When the operator triggers the AUTOMATIC mode, the procedure starts the active gas loop and waits on the action step 5 (S_G_Active_Loop_005). When the operator decides to stop the active gas loop, he triggers the “Control Loop mode” to OFF or MANUAL.

Prerequisite

HV__1102_01 and HV_1100_01 must be closed.

Procedure

Make sure that HV_1007_10, HV_1007_11, HV_1007_14 and HV_1102_02 and HV_1102_03 are open.

Put the HMI control Loop Mode button “Active Gas” to AUTOMATIC MODE. This action set the variable “CL1100_SCI_ACTIVE_Start”, then the procedure “G_ACTIVE_Loop” starts.

To reset the procedure, trigger the control Loop mode to OFF or Manu. The active gas Loop is stopped and the procedure goes to its initial action step (ready to re-start).

Used Variables:

CL1100_ControlLoop_Mode.

CL1100_SCI_Start_Active_GasLoop,

CL1100_SCI_Reset_Active_GasLoop

5.27.2.PLC Subroutine: G_Active_Loop

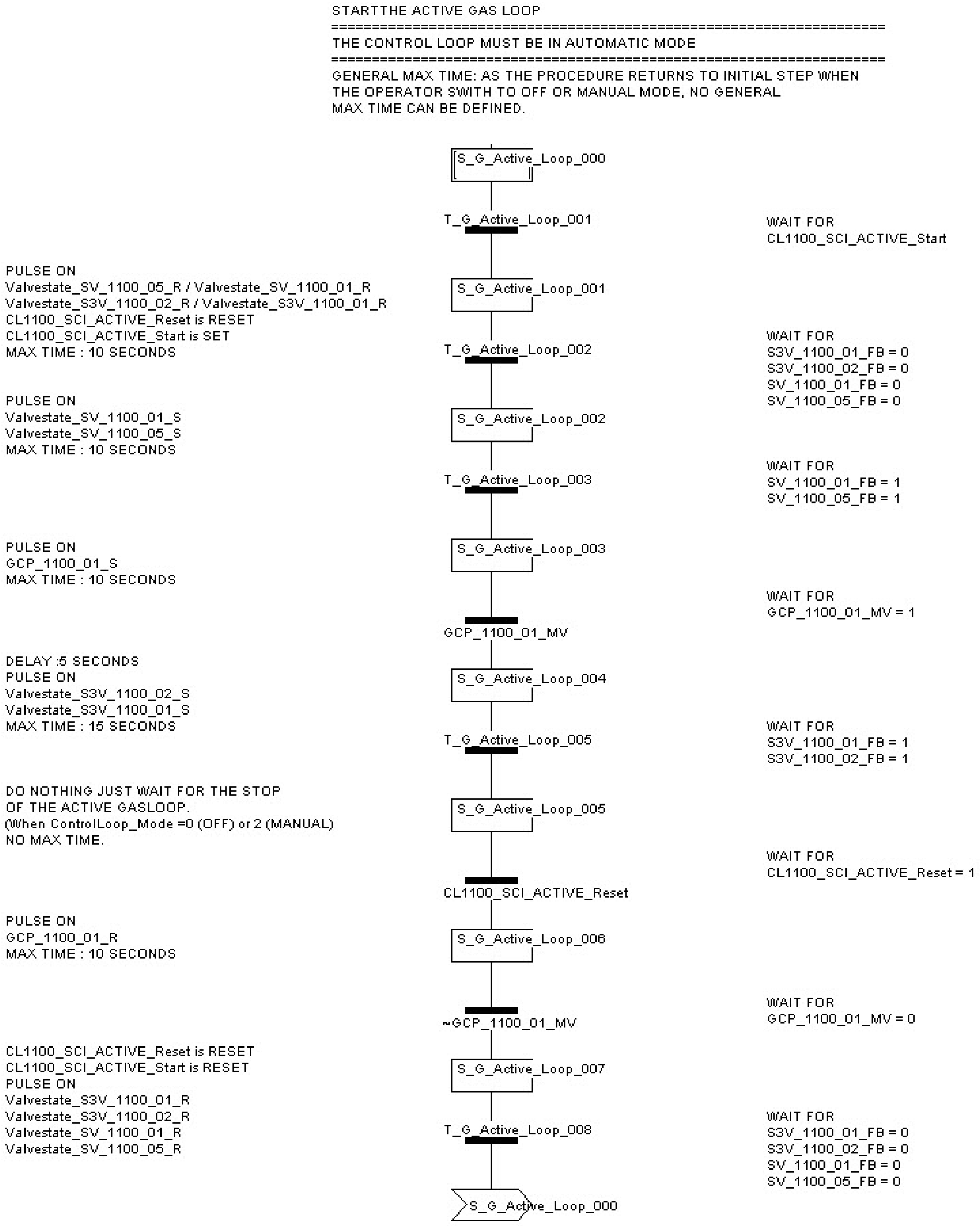
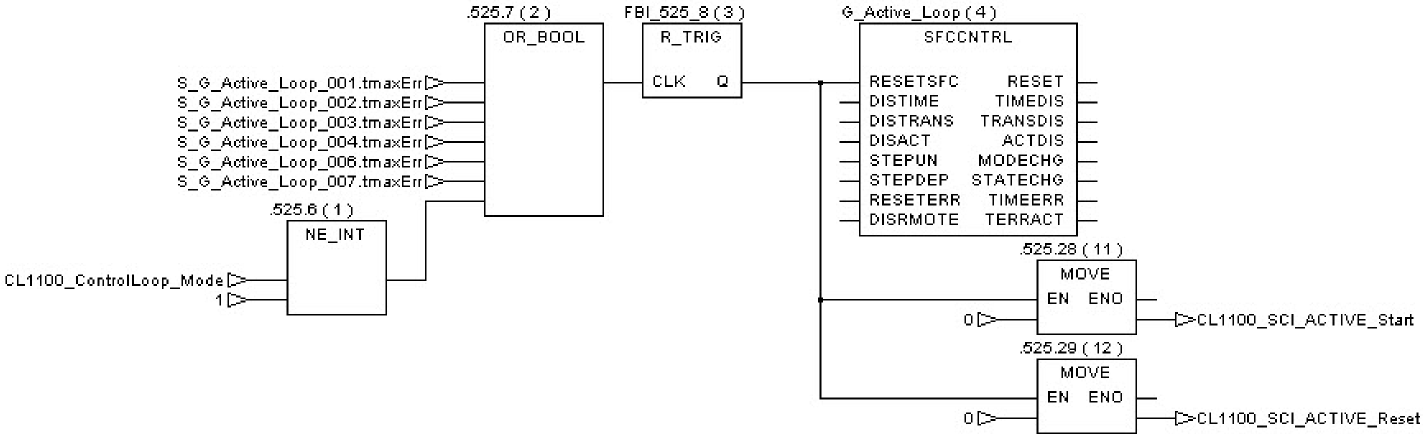


Figure 112: PLC procedure: G_Active_Loop

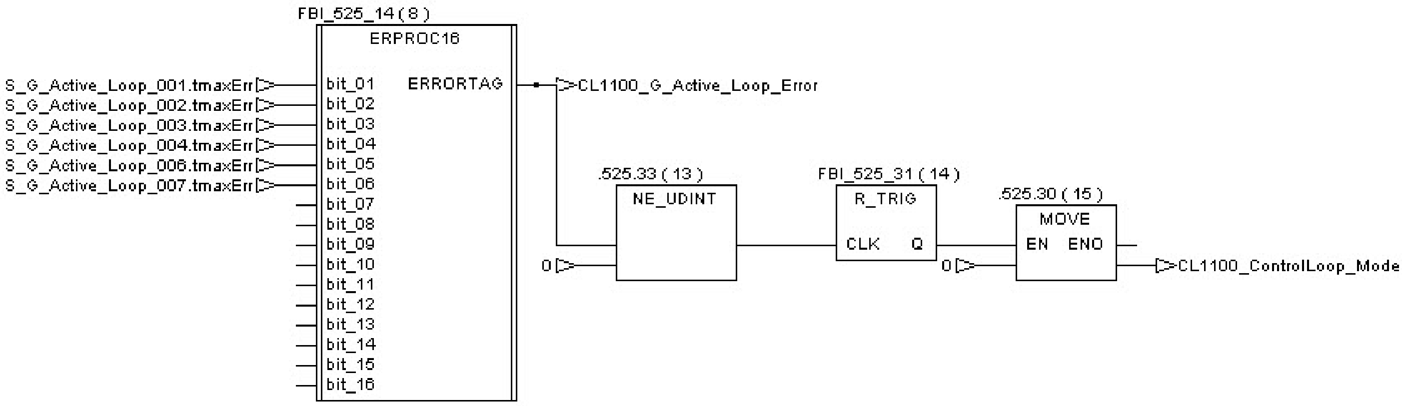
5.27.3.Procedure management

<u>Reset of the procedure:</u>

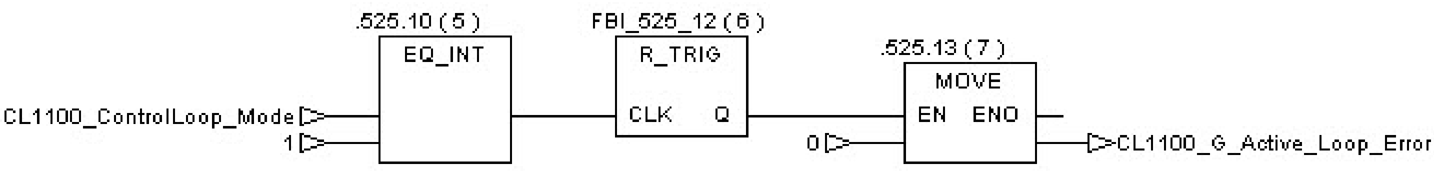
If a time error occurs during the execution of the procedure, the block “SFC_CNTRL” resets the procedure and triggers the control loop to OFF mode. The start variable, the stop variable and the tracing bit are reset.



Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, it records and displays this number on the HMI (error code procedure window). This has been created to diagnostic internal procedure problem.



The error number is displayed until the procedure is re-started.



5.27.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_G_Active_Loop_001**	valve(s) status Error operator has to look for valve alarm
2	**S_G_Active_Loop_002**	valve(s) status Error operator has to look for valve alarm
4	**S_G_Active_Loop_003**	GCP_1100_01 has not been activated
8	**S_G_Active_Loop_004**	valve(s) status Error operator has to look for valve alarm
16	**S_G_Active_Loop_006**	GCP_1100_01 has not been stopped
32	**S_G_Active_Loop_007**	valve(s) status Error operator has to look for valve alarm

5.28. Procedure 27: Filtration Unit: Replacement of tube in pump PP_1202_01

5.28.1.Scope

The aim of this procedure is to replace the tube used in pump PP_1202_01 (PP_1202_01) at regular time intervals in order to prevent the wear to cause potential tearing.

Material
Tube Watson Marlow Marprene II 902.0016.016 #14
Spanners

Precautions
Effluent vessel must be empty.
Eventual filtrate production must be recycled.
If FU is working: go to by-pass (procedure 34); FU is stopped if after CIP or SIP.

Frequency
Need to be done every 20 days minimum.
Need to be done before every SIP action.

General recommendations
After CIP and before SIP is a good moment to replace this tube because
Some cleaning procedure removes effluent from the tubing around the pump.
It is possible that wearing did not cause the tube to tear during filtration yet, while the higher pressure and temperature during SIP do.

Protocol
Make sure:
-for LF_1200_01 side that pressure PT_1203_01 is around 0 barg and SV_1205_05 is not actuated
-for LF_1200_02 side, that PT_1203_06 is around 0 barg and SV_1201_06 is not actuated.
Probably some filtrate or water is present in LF_1200_03 module. Have a tray/cloth/paper ready to catch eventual escaping fluid.
Open the pump head and move the tube from the head to the front of the pump.
Disconnect the press fitting that connects the tube to the pipe fitting. (Not the one that connects the steel pipe to the pipe fitting at the left hand side (side of SV_1205_05 / SV_1205_06). Let all the fluid get out.
Disconnect the press fitting on the tube at the other side.
Remove the pipe adapters that are at both sides of the tube (inside) and attach them to a new piece of tube of the same length after the press fittings are connected.
Connect both sides of the tube to the fittings at both sides of PP_1202_01

Close the lid of PP_1202_01 with the tube properly inside.

All this procedure is done manually by the OPERATOR.

5.29. Procedure 28: Filtration Unit: Calibration of PP_1202_01 flow rate

5.29.1.Scope

IMPORTANT POINT:
At the current time this function is desactivated. As the harvested volume calculation is not efficient, the calibration factor is frozen to the value "2". This point needs to be discussed then validated with the MPP. Different options can be considered.

Because the tube in filtration pump PP_1202_01 is subject to wear the flow rate reduces slowly in time with respect to the rotation speed. This rotation speed is linear to the output signal from the PLC. The PLC multiplies the desired daily production (in L/day) by a factor **CL1202_Filtr_flowrate_cal_factor** to obtain a percentage of the output for the rotation speed of **PP_1202_01**. This relationship between the output signal and the effective flow rate must be adapted regularly.

Procedure
This is done automatically by the PLC. After harvesting the effluent vessel **VSL2_1204_01** by PROCEDURE 39:
Filtration Unit: Harvest Effluent vessel **VSL2_1204_01**, the PLC calculates a new calibration factor using the amount of effluent produced since last harvesting and the time past since last harvesting. It does this if following conditions are fulfilled:

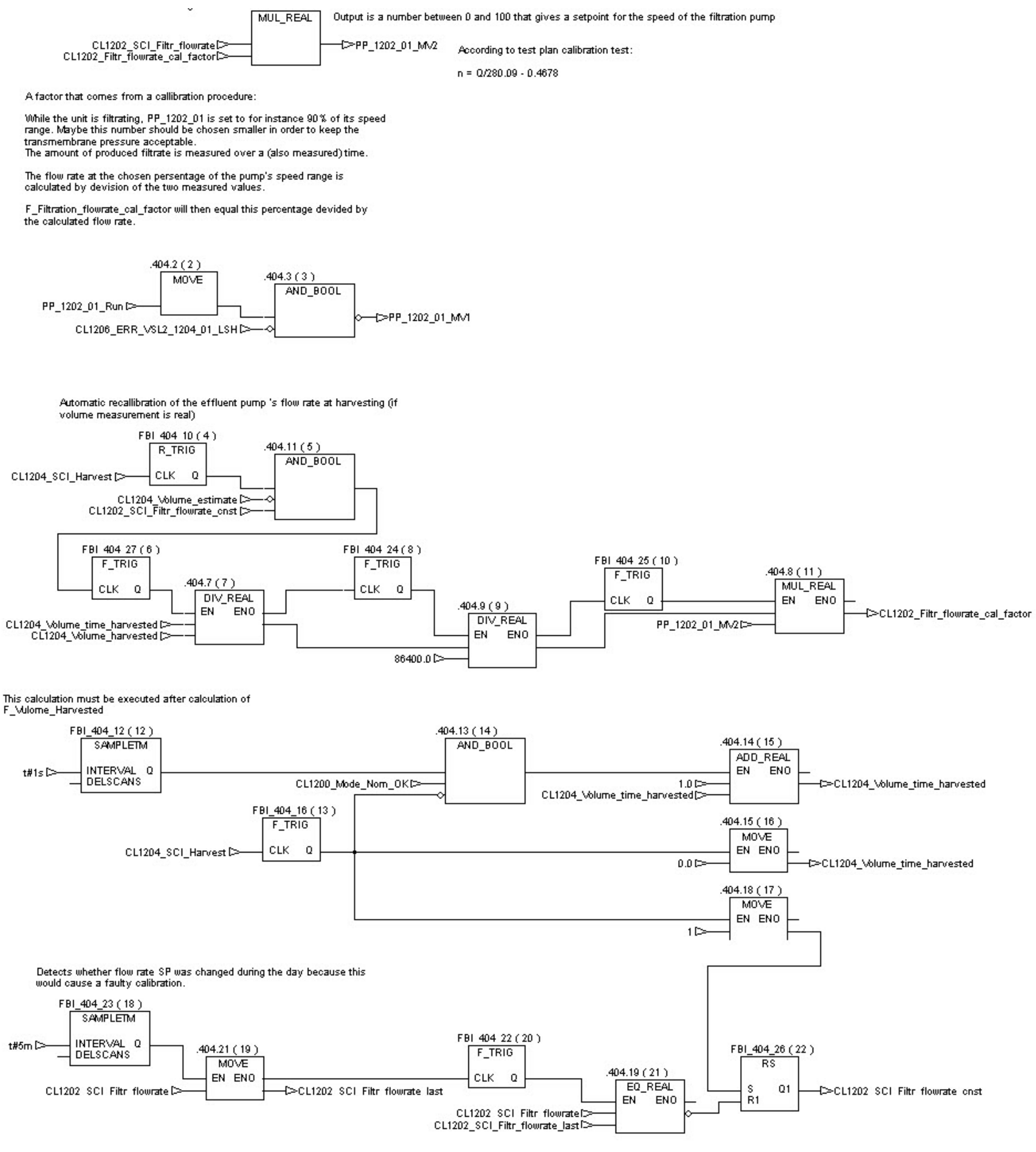
- Set point for filtrate production per day has not changed between last two harvests.

Measurement of liquid volume in the tank was measurable by LT_1206_01 at the start of the harvest procedure.

The variable **CL1202_Filtr_flowrate_cal_factor** has a certain value (initial value 2)
Measure the amount of filtrate produced during some time.
Recalculate this production to production in one day (L)
The new **CL1202_Filtr_flowrate_cal_factor** is calculated. This variable multiplied by CL1202_SCI_Filtr_flowrate gives the rotation speed of pump **PP_1202_01_MV2** (in percentage).

Used Variables:
CL1202_SCI_Filtr_flowrate (PLC @: 400408) desired daily production in L/day

5.29.2.*PLC Subroutine*: CL1202_Filtrate_management



5.30. Procedure 29: Filtration Unit: (Nominal) Shut down

5.30.1.Scope

The procedure which manages the Stop of the filtration unit can only be activated (as all the other procedures) in automatic mode. Eventual CIP or SIP actions that might active are not stopped. It can be useful when the FU is stopped for maintenance or when something unforeseeable happens.
As detailed in the “Filtration Unit General (CL1200)” chapter, it is one of different ways to stop the filtration unit.
This procedure stops the circulation pump GP_1201_01, waits for two seconds and then resets all valves related to the FU.

Consequence
The FU mustn’t remain stopped for a long time. As soon as possible restart it, if necessary in bypass or recycle mode.
All parts of the filtration unit which contain filtrate or retentate need to be cleaned if they will not be used in the near future. Membranes are best preserved in clear water. Use the cleaning procedures to wash the filtration unit.

Procedure
When FU, CIP and SIP mode are in automatic, use the HMI to start PLC procedure **CL1200_SCI_Stop**
Wait for the PLC procedure to finish.
Once the filtration unit is stopped, the Tracing bit called “CL1200_TB_Stop” (PLC Address: 000092) is SET.

Used Variables: **CL1200_SCI_Stop** (PLC @: 000285)

5.30.2.PLC Subroutine: F_Stop

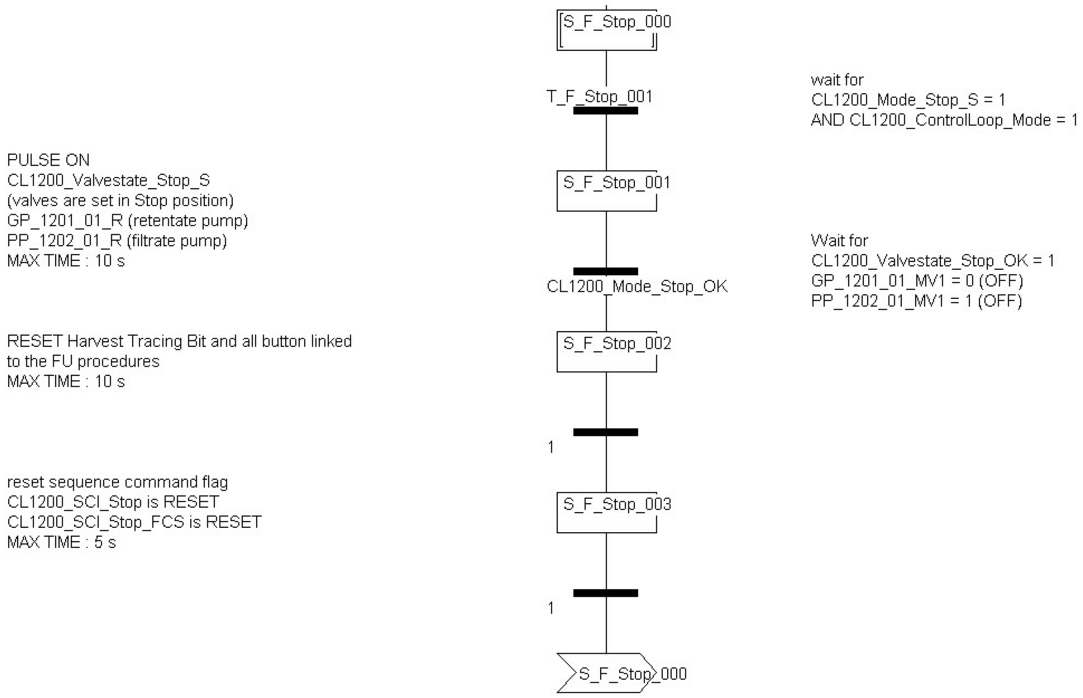
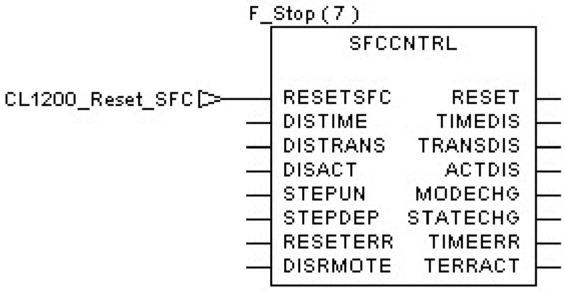


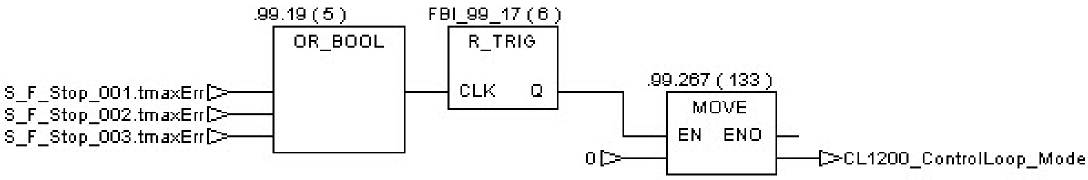
Figure 113: PLC procedure: F_Stop

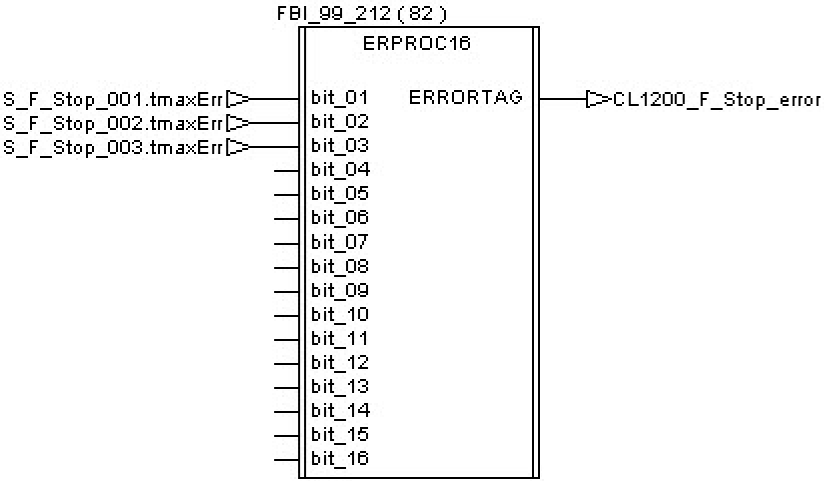
5.30.3.Procedure management

Reset of the procedure:
If a time error occurs during the execution of the procedure, the start procedure button variable and the Control Loop Mode is triggered to OFF mode. (If the stop procedure has a problem, the only way to solve it is to set all equipments in default position by the OFF mode).
In Parallel, the procedure named "CL1200_ RESET_PROC" is started. This procedure, detailed further on, triggers a general reset (FU procedures and equipments) to ensure the default status of all the filtration function when automatic mode is re-started.
The block "SFC_CNTRL" permits, thanks to the procedure "CL1200_RESET_PROC" to reset the F_Stop procedure.

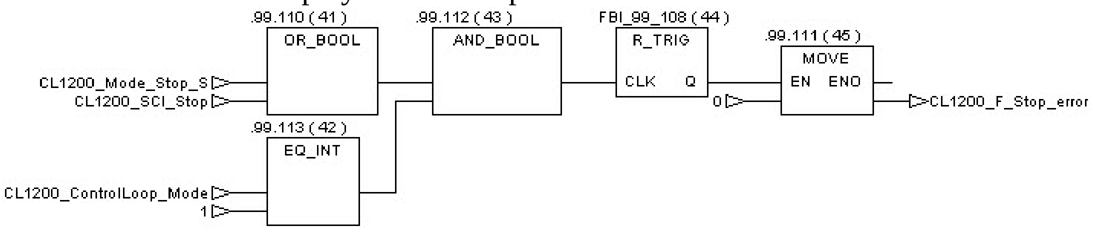


Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.
When the error is recorded, the Control Loop mode is triggered to OFF mode.





The error number is displayed until the procedure is re-started.



5.30.4.Error number description

Error number	Procedure Action Step	problem description
1	S_F_Stop_001	valve(s) status Error operator has to look for valve alarm
2	S_F_Stop_002	No possible Error
4	S_F_Stop_003	No possible Error

5.30.5.Controlled valves

CL1200_Valvestate_Stop_S

Added Valves in **CL1200_Valvestate_Stop_S (2009)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_MV	000061	RESET
	S3V_1201_04_MV	000064	RESET
	S3V_1201_07_MV	000042	RESET
	S3V_1201_08_MV	000043	RESET
	S3V_1201_09_MV	000044	RESET
	SV_1201_01_MV	000060	RESET
	SV_1201_02_MV	000049	RESET
	SV_1201_03_MV	000063	RESET
	SV_1201_04_MV	000098	RESET
	SV_1201_05_MV	000062	RESET
	SV_1201_06_MV	000097	RESET
	SV_1201_07_MV	000041	RESET
	SV_1201_08_MV	000056	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_MV	000050	RESET
	SV_1202_02_MV	000099	RESET
	SV_1202_03_MV	000051	RESET
	SV_1202_04_MV	000100	RESET
Filtration Unit Pressure control			
	SV_1203_01_MV	000055	RESET
	SV_1203_02_MV	000055	RESET
	SV_1203_03_MV	000055	RESET
	SV_1203_04_MV	000107	RESET
Effluent Tank General			
	SV_1204_01_MV	000052	RESET
	SV_1204_02_MV	000054	RESET
	SV_1204_03_MV	000101	RESET

5.30.6.Awaited Feedback

CL1200_Valvestate_Stop_OK

Added Feedback in CL1200_Valvestate_Stop_OK (2009)

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_FB	100088	RESET
	S3V_1201_04_FB	100085	RESET
	S3V_1201_07_FB	100075	RESET
	S3V_1201_08_FB	100074	RESET
	S3V_1201_09_FB	100073	RESET
	SV_1201_01_FB	100089	RESET
	SV_1201_02_FB	100084	RESET
	SV_1201_03_FB	100086	RESET
	SV_1201_04_FB	100130	RESET
	SV_1201_05_FB	100087	
	SV_1201_06_FB	100129	RESET
	SV_1201_07_FB	100076	RESET
	SV_1201_08_FB	100077	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	RESET
	SV_1202_02_FB	100131	RESET
	SV_1202_03_FB	100082	RESET
	SV_1202_04_FB	100132	RESET
Filtration Unit Pressure control			
	SV_1203_01_FB	100078	RESET
	SV_1203_02_FB	100064	RESET
	SV_1203_03_FB	100063	RESET
	SV_1203_04_FB	100137	RESET
Effluent Tank General			
	SV_1204_01_FB	100081	RESET
	SV_1204_02_FB	100079	RESET
	SV_1204_03_FB	100133	RESET

5.31. Procedure 30: Filtration Unit: Removal of dead-end filter LF_1200_03

5.31.1. Scope

Remove the filter from its housing. This is necessary when the entire filtrate line is to be cleaned as described in PROCEDURE 55: Cleaning of Filtration Unit: Filtrate tank VSL2_1204_01 and filtrate line through LF_1200_01 or LF_1200_02. It is also necessary when the filter is clogged up and therefore needs to be replaced.

Prerequisite
The FU must be working in recycle mode or stopped.
Preferably, the FU is cleaned and sterilized (sterilizing removes liquid from the filter housing).
If the state of the filter and/or the filtrate is to be checked and CIP and SIP are consequently not possible, be prepared for splashing while removing the filter housing and some filtrate being left in the housing that should be catched in a tray. Have also a cloth and / or paper ready.
Pressure PT_1203_08 < 200 mbarg.

Procedure
Open the big Tri-Clamp that connects the filter house to the bottom of the filter.
Remove the filter housing.
Turn the filter counterclockwise and pull it off.
Remove any spilled liquid on the frame and clean with water and soap.

All the procedure is done manually by the OPERATOR.

5.32. Procedure 31: Filtration Unit: Installation of dead-end filter LF_1200_03

5.32.1. Scope

Install a new dead end filter into the filter housing

Prerequisite
The FU must be working in recycle mode or stopped.
Preferably, the FU is cleaned and sterilized.
Pressures probe PT_1203_08, is < 200 mbarg.

Consequence
This procedure is to be followed by PROCEDURE 69: SIP: membrane LF_1200_01 / LF_1200_02, filtrate line and Filtrate tank VSL2_1204_01

Procedure
If the filter housing is not open yet, open big the Tri-Clamp that connects the filter house on the bottom of the filter and remove the filter housing from the bottom.
Push the filter over the ring and take care that the two notches on the bottom of the filter glide over the two pins at the housing inlet.
Turn the filter clockwise to fix it to the housing inlet.
Close the filter housing and the Tri-Clamp.

All the procedure is done manually by the OPERATOR.

5.33. Procedure 32: Filtration Unit: Removal of ceramic membranes LF_1200_01 / LF_1200_02

5.33.1. Scope

Remove a ceramic membrane from its module.

Prerequisite

The FU must not be working on the membrane module that is to be removed. So it must either be working on the other membrane or in bypass or stopped mode.
Pressures PT_1203_01, -02 and 03 for LF_1200_01 or PT_1203_04, -05 and 06 for LF_1200_02 must be around zero.
It is advised to have the membrane module cleaned by PROCEDURE 56: Cleaning of Filtration Unit: automated execution of a sequence of procedures to clean membrane LF_1200_01 / LF_1200_02

Tools

Two 8mm spanners and one 13mm spanner, pair of pincers

Procedure

On the HMI, indicate that there is no membrane present in the module where it is to be removed.
CL1200_SCI_Membr1_present (PLC Address: 000289)
CL1200_SCI_Membr2_present (PLC Address: 000290)

First the piece of piping that connects the top flange of the membrane module to the valve (V-S-04 in case of LF_1200_01 or V-S-05 in case of LF_1200_02) must be half demounted from the valve so that it can pivot around one of the bolts that connect it with the valve. This is done by removing three of the bolts and loosening the fourth.
Use the pincers to open the two hygenic DIN 11851 fittings at the side (filtrate) and the one on the top.
Now there are no more shift forces working on the connections of the membrane and it is safe to open the flanges using the 8mm spanners. Best is to start with the upper flange.
Remove the rubber rings from the membrane and put them where you will find them back later. Remove the membrane from the module. This should be done by letting it glide in a smooth movement and without using power.

All the procedure is done manually by the OPERATOR.

5.34. Procedure 33: Filtration Unit: Installation of ceramic membranes LF_1200_01 / LF_1200_02

5.34.1.Scope

Installation of a ceramic membrane into a membrane module

Prerequisite

The FU must be working on the other membrane or in bypass mode or stopped.
Pressures PT_1203_01, -02 and 03 for LF_1200_01 or PT_1203_04, -05 and 06 for LF_1200_02 must be around zero.
If the inside of the membrane module is not clean it is advised to have the membrane module cleaned by PROCEDURE 50: Cleaning of Filtration Unit: both retentate and filtrate sides of membrane LF_1200_01 / LF_1200_02

Tools

Two 8mm spanners and one 13mm spanner, pair of pincers

Procedure

If the membrane module is not opened yet from removing a previous membrane using PROCEDURE 32: Filtration Unit: Removal of ceramic membranes LF_1200_01 / LF_1200_02 then execute the first 4 steps of this procedure in order to open it.
Insert the membrane into the module. This should be done by letting it glide in a smooth movement and without using power.
Make the membrane stick out the module more or less the same amount and slide over the rubber rings.
Put the module on the lower flange, taking care of the membrane sticking out that is to be fit into the flange, and center the lower flange from the membrane module to the one on the frame.
Put the upper flange with the hygenic ISO 11851 connection on the upper membrane module flange. Hold up the loose piece of piping to the valve while you do this, and lower the loose piece afterwards, so that both hygenic ISO 11851 connections meet.
Close the flanges using the 8mm spanners. Tighten always two opposite bolts after each other, and afterwards the two other opposite bolts.
Close the hygienic DIN 11851 fittings. Do not tighten the one on top yet.
Put back the three bolts and tighten with the 13mm spanner.
Use the pincers to tighten the hygienic fittings.
On the HMI, indicate that there is a membrane present in the module.
CL1200_SCI_Membr1_present (PLC Address: 000289)
CL1200_SCI_Membr2_present (PLC Address: 000290)

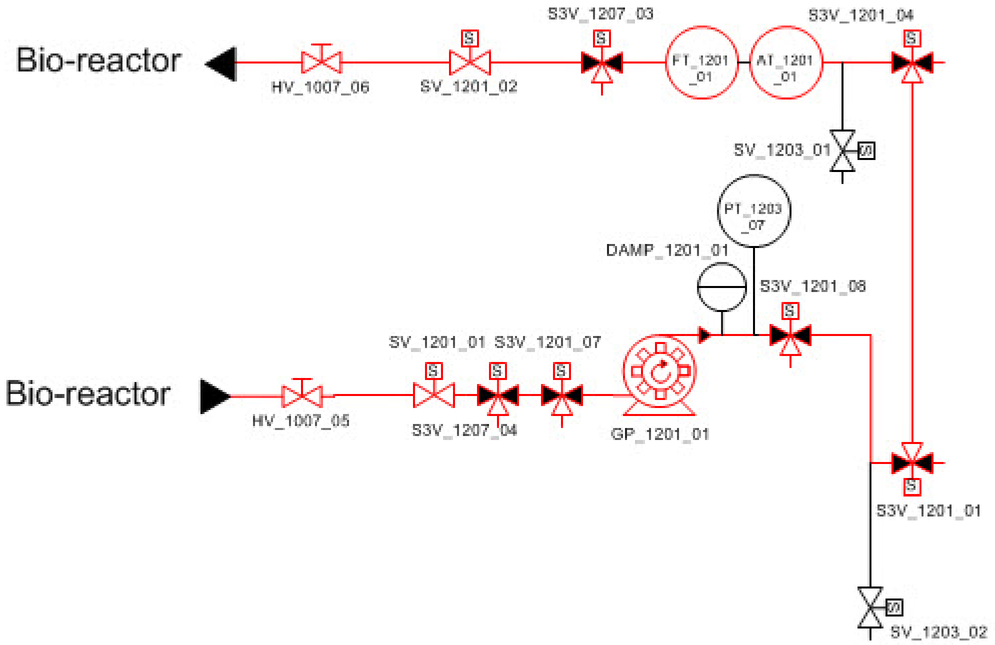
All the procedure is done manually by the OPERATOR.

5.35. Procedure 34: Filtration unit: Start up in Bypass mode

5.35.1.Scope

IMPORTANT POINT:
The Bypass Mode can be set from any state of the Filtration Unit (New function compared to the EPAS software version). THIS PROCEDURE CAN ONLY BE EXECUTED IN AUTOMATIC MODE.
Once the Bypass mode is running, the operator can switch to MANUAL MODE. The Process will be maintained in Bypass mode.
(The Bypass mode is also called automatically by the PLC when the level of Effluent Vessel reaches the Level Switch High .The procedure which manages this function is the "F_AUTO_Bypas" procedure)

Start the FU over in bypass mode. In this mode both membranes are bypassed.
Retentate is circulated over piping and flexible hose from and to VSL2_1007_01, which also includes GP_1201_01, FT_1201_01 and AT_1201_01. Membranes and entire filtrate side of the FU are now physically cut off from the rest of the system – which can be useful for maintenance reasons. Turbidity can still be monitored by AT_1201_01.



Prerequisite
The Filtration Unit must be in automatic mode. The membrane used previously must be cleaned and preserved in clear water if it remains in module.
HV_1007_06 is opened
HV_1007_05 is opened

Procedure
Use the HMI to start PLC procedure F_Bypass: CL1201_SCI_Bypass
If the FU is already in stop mode, the procedure set the status of the valves and the Pump (GP_1201_01)
If the FU is in any other filtration state, the PLC stops the Filtration Unit before setting the status of the valves and the Pump (GP_1201_01)
Wait for the PLC procedure to finish.
The FU is now in bypass mode, which can be checked on the HMI with the tracing bit "**CL1201_TB_Bypass**" (PLC Address: 000090)

Used Variables:
CL1201_SCI_Bypass (PLC Address: 000270)
CL1201_TB_Bypass (PLC Address: 000090)

5.35.2.PLC Subroutine: F_Bypass

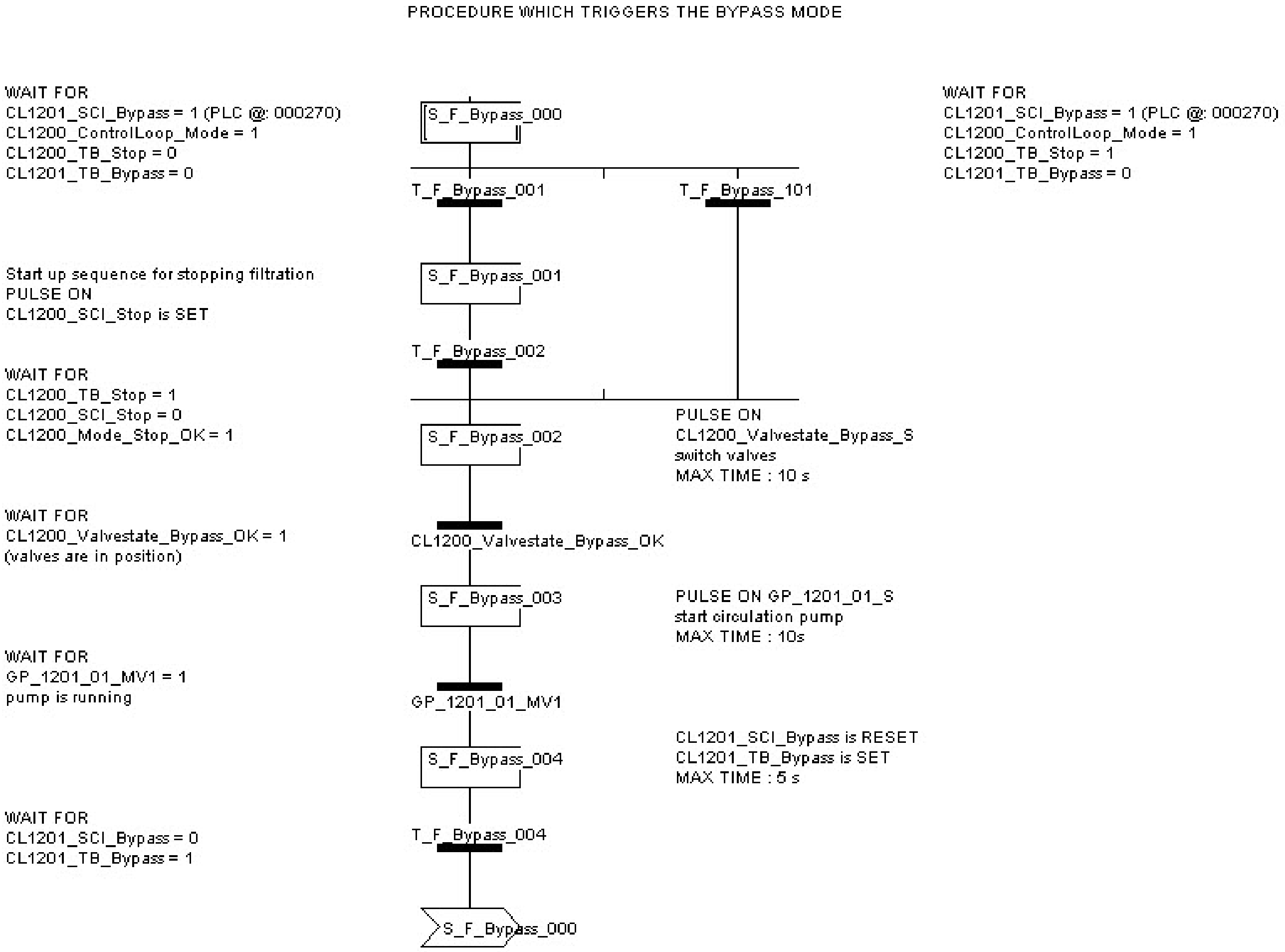
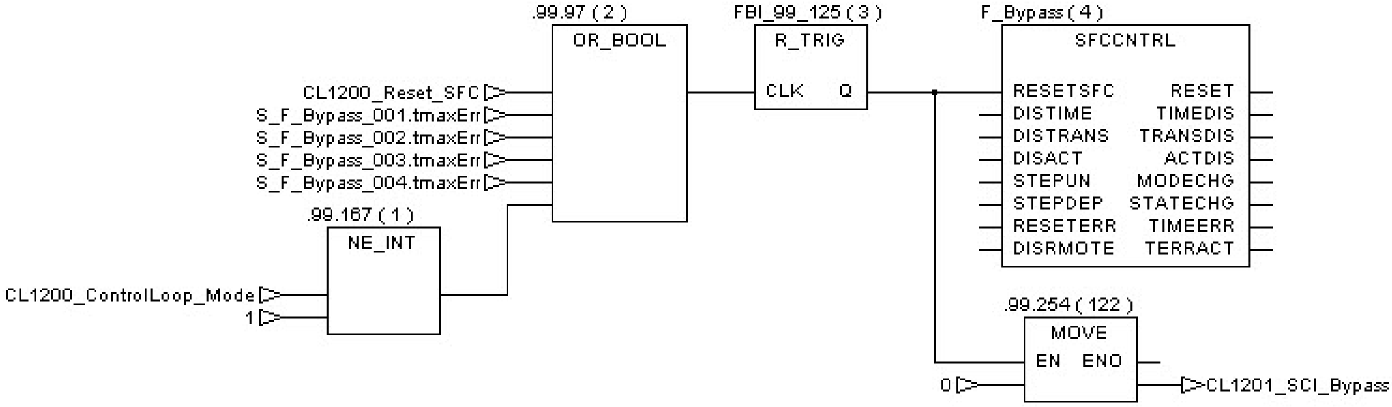


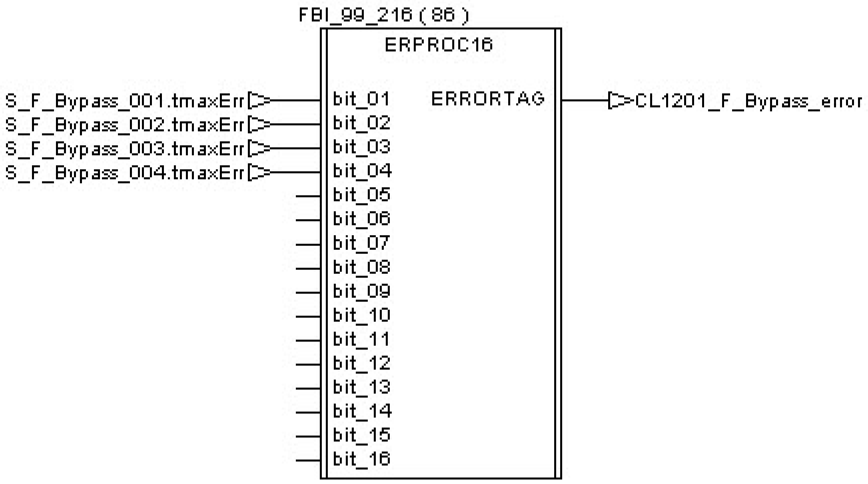
Figure 114: PLC procedure: F_Bypass

5.35.3.Procedure management

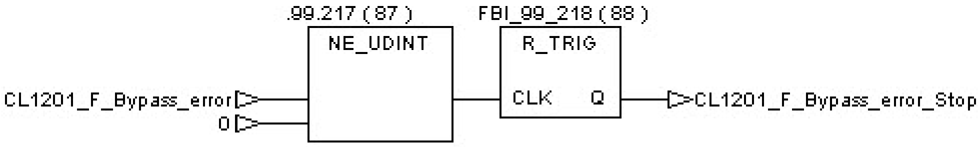
Reset of the procedure:
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure, the tag linked to the procedure.
The same reset is done when the control Loop mode button is trigger to OFF or MANUAL Mode during the procedure execution.



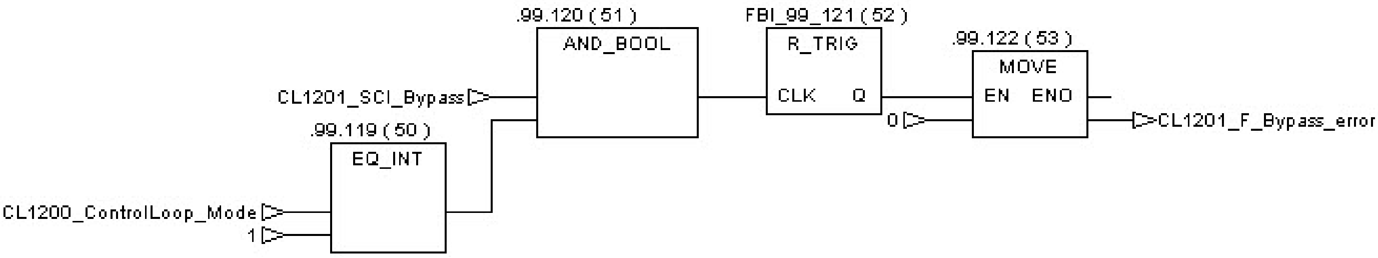
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, The tag “CL1201_F_Bypas_error_Stop” receives a pulse and then the Filtration Unit is stopped thanks to the procedure “F_Stop”.



The error number is displayed until the procedure is re-started.



5.35.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_F_Bypass_001**	Problem during the execution of the procedure "F_Stop" The procedure "F_Stop" should also have an error code
2	**S_F_Bypass_002**	valve(s) status Error operator has to look for valve alarm
4	**S_F_Bypass_003**	The pump GP_1201_01 is has not been activated
8	**S_F_Bypass_004**	Tag reset problem (Tracing bit or Start button)

5.35.5.Controlled valves

CL1200_Valvestate_Bypass_S

Added valves in CL1200_Valvestate_Bypass_S (2009)

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_MV	000061	SET
	S3V_1201_04_MV	000064	SET
	S3V_1201_07_MV	000042	RESET
	S3V_1201_08_MV	000043	RESET
	SV_1201_01_MV	000060	SET
	SV_1201_02_MV	000049	SET
Filtration Unit Pressure control			
	SV_1203_01_MV	000055	RESET
	SV_1203_02_MV	000037	RESET
CIP General			
	S3V_1207_03_MV	000069	RESET
	S3V_1207_04_MV	000070	RESET

5.35.6.Awaited Feedback

CL1200_Valvestate_Bypass_OK

Added Valve in CL1200_Valvestate_Bypass_OK (2009)

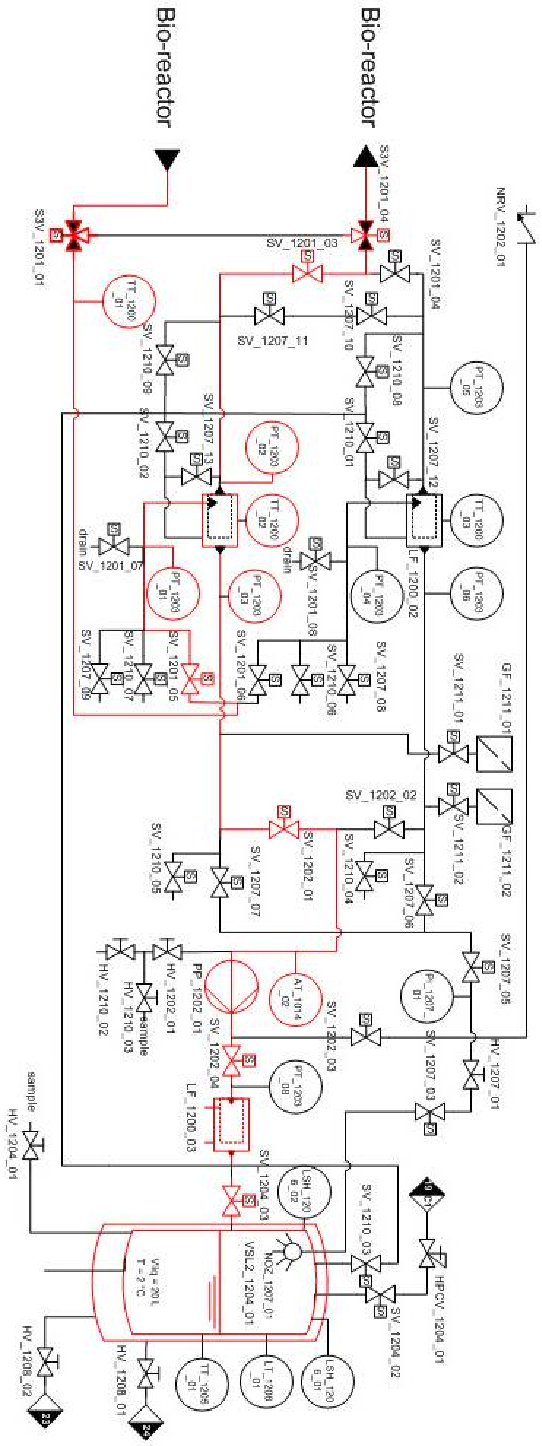
	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_FB	100088	SET
	S3V_1201_04_FB	100085	SET
	S3V_1201_07_FB	100075	RESET
	S3V_1201_08_FB	100074	RESET
	SV_1201_01_FB	100089	SET
	SV_1201_02_FB	100084	SET
Filtration Unit Pressure control			
	SV_1203_01_FB	100078	RESET
	SV_1203_02_FB	100064	RESET
CIP General			
	S3V_1207_03_FB	100096	RESET
	S3V_1207_04_FB	100095	RESET

5.36. Procedure 35: Filtration Unit: Start up of filtration through membrane LF_1200_01 / LF_1200_02

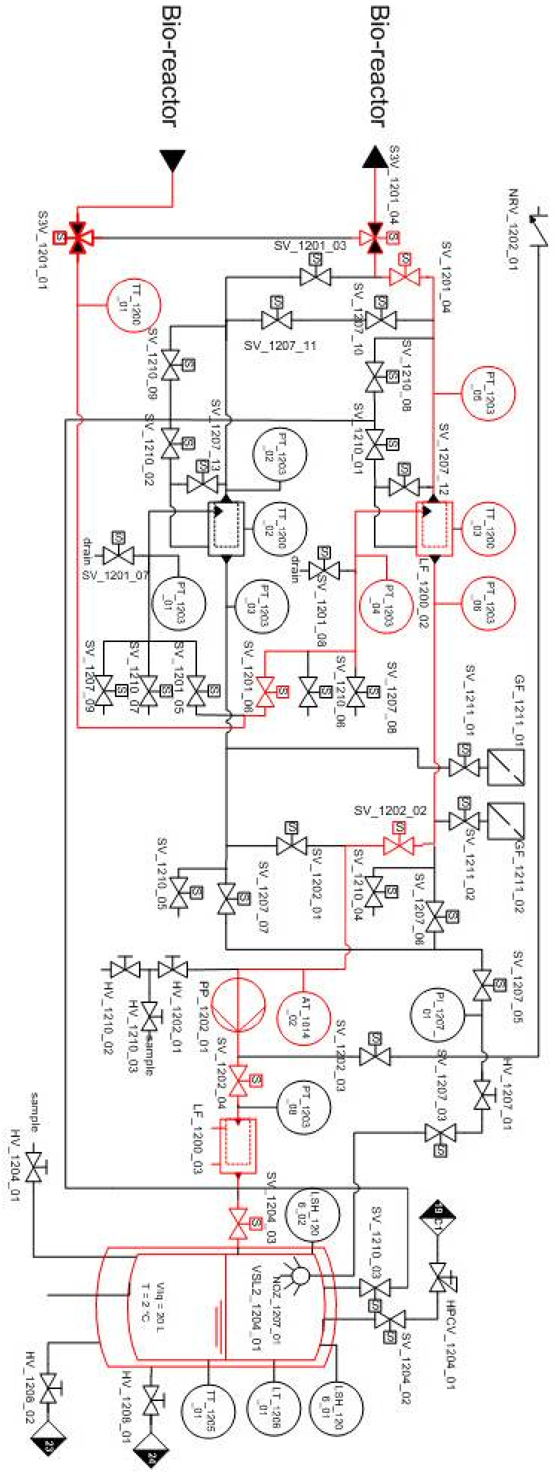
IMPORTANT POINT:
The Start of the filtration through membrane 1 or 2 can be set from the stop mode or the bypass mode (New function compared to the EPAS software version). THIS PROCEDURE CAN ONLY BE EXECUTED IN AUTOMATIC MODE.
Once the Nominal mode is running, the operator can switch to MANUAL MODE. The Process will be maintained in nominal mode 1 or 2.

THE OPERATOR MUST INFORM THE PLC THAT THE MEMBRANE CHOSEN IS PRESENT (Defined by the following variables:
CL1200_SCI_Membr1_present - plc @: 000289
CL1200_SCI_Membr2_present - plc @: 000290

Membrane 1



Membrane 2



5.36.1.Scope:

Start the FU over one of the two membranes. This function uses three different procedures: F_CIR1, F_CIR2 and F_Fil.

F_Cir1 and F_Cir2:
Triggers the valves in filtration position (Membrane 1 or 2) except the valves linked to the recycle mode, then starts the retentate pump GP_1201_01.

F_Fil:
Starts the filtrate pump then, depending of the procedure calling (F_Cir1, F_Cir2, F_S12 or F_S21) triggers the last valves (SV_1202_03_MV/ SV_1202_04_MV / SV_1204_02_MV / SV_1204_03_MV) in nominal or recycle position.

Use the HMI to start PLC procedure F_Cir1 or F_Cir2:
CL1200_SCI_Cir1 (PLC Address: 000271)
CL1200_SCI_Cir2 (PLC Address: 000272)
Wait for the PLC procedure to finish.
CL1200_TB_Cir1 (PLC Address: 000331)
CL1200_TB_Cir2 (PLC Address: 000332)
PLC starts automatically the procedure F_Fil:
CL1200_SCI_Fil (PLC Address: 000274)
Wait for the PLC procedure to finish.
CL1200_TB_Nom (PLC Address: 0000344)
The FU is now in nominal filtration mode.

5.36.2.PLC Subroutine: F_Cir1

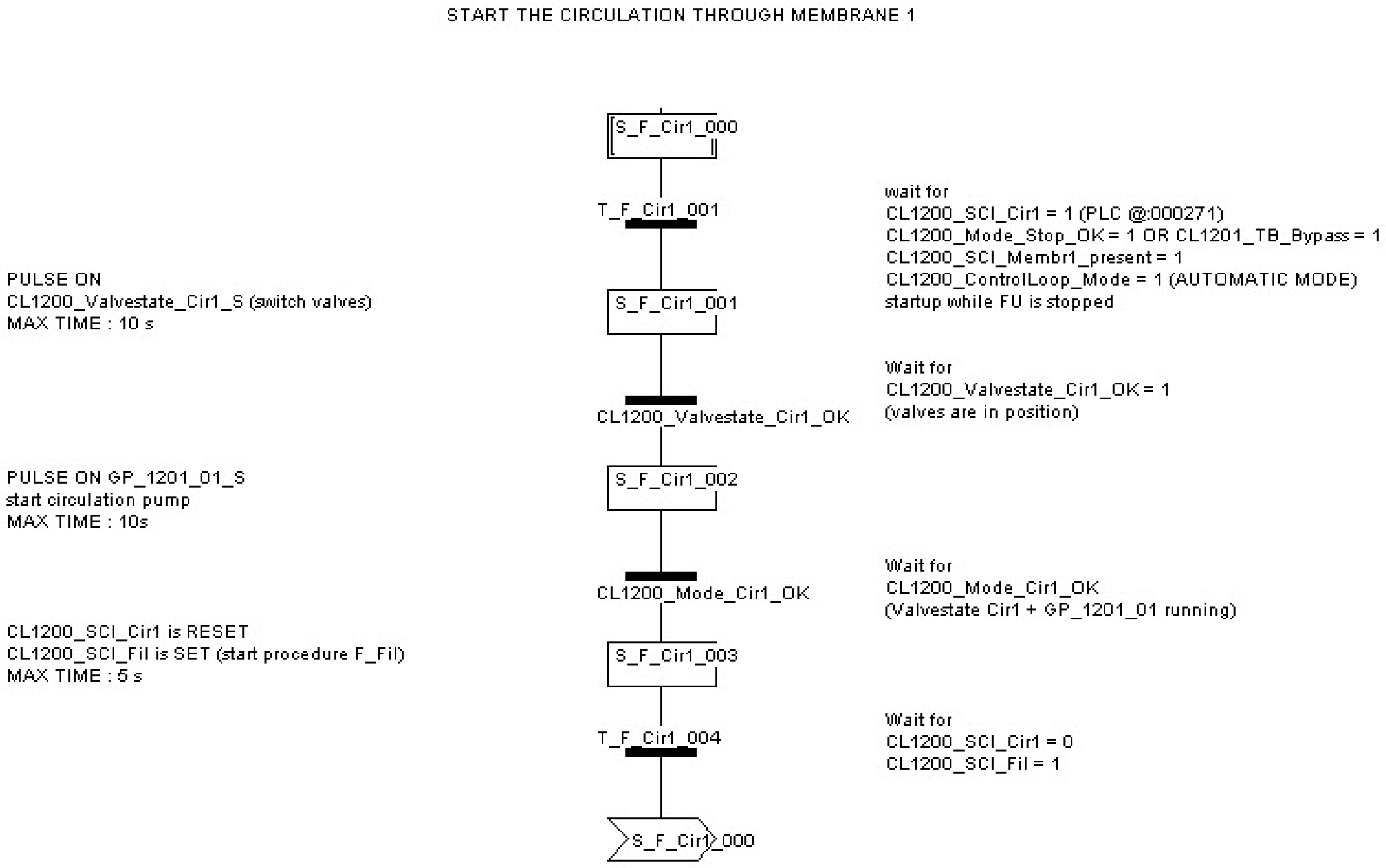
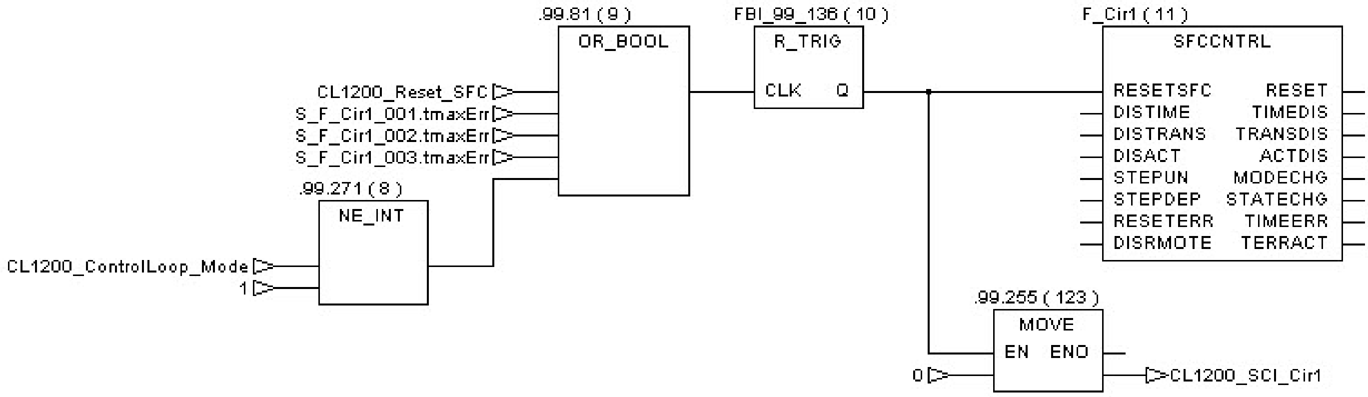


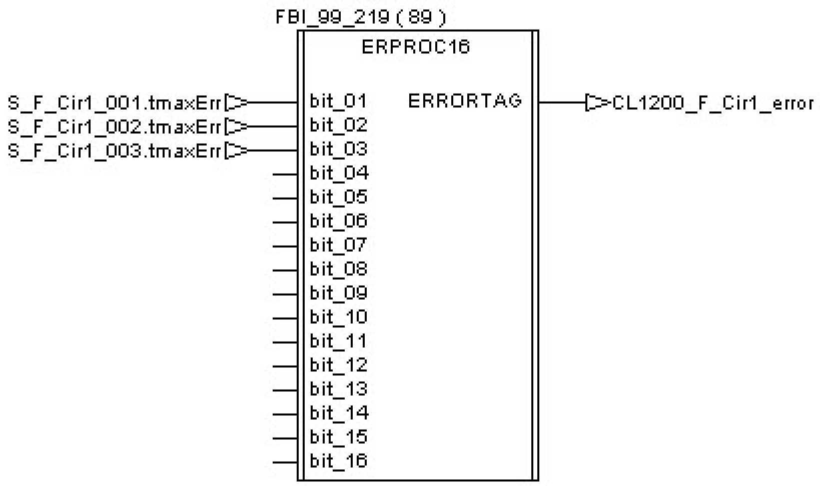
Figure 115: PLC procedure: F_Cir1

5.36.3.Procedure management

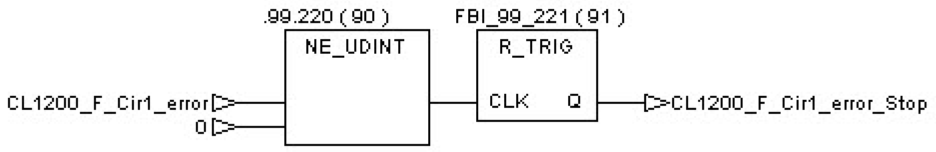
Reset of the procedure:
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure, the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



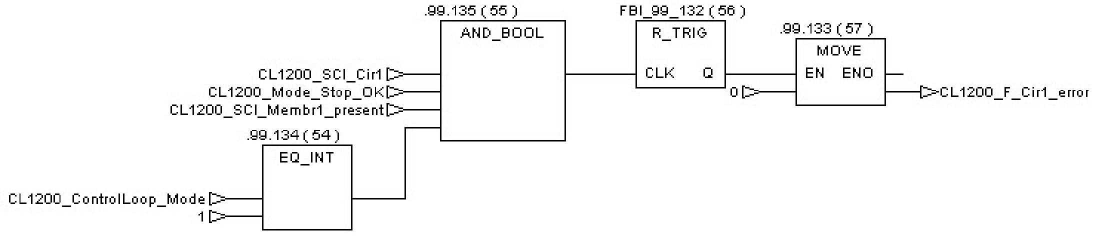
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1200_F_Cir1_error_Stop" receives a pulse then the Filtration Unit is stopped thanks to the procedure "F_Stop".



The error number is displayed until the procedure is re-started.



5.36.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_F_Cir1_001**	valve(s) status Error operator has to look for valve alarm
2	**S_F_Cir1_002**	The pump GP_1201_01 has not been activated
4	**S_F_Cir1_003**	Tag reset problem (Tracing bit or Start button)

5.36.5.Controlled Valves

CL1200_Valvestate_Cir1_S

Added Valves in **CL1200_Valvestate_Cir1_S (2009)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_MV	000061	RESET
	S3V_1201_04_MV	000064	RESET
	S3V_1201_07_MV	000042	RESET
	S3V_1201_08_MV	000043	RESET
	SV_1201_01_MV	000060	SET
	SV_1201_02_MV	000049	SET
	SV_1201_03_MV	000063	SET (changed from Reset to set)
	SV_1201_04_MV	000098	RESET
	SV_1201_05_MV	000062	SET (Changed from RESET to SET)
	SV_1201_06_MV	000097	RESET
	SV_1201_07_MV	000041	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_MV	000050	SET (Changed from RESET to SET)
	SV_1202_02_MV	000099	RESET
	SV_1202_03_MV	000051	RESET
	SV_1202_04_MV	000100	SET
Filtration Unit Pressure control			
	SV_1203_01_MV	000055	RESET
	SV_1203_02_MV	000055	RESET
	SV_1203_04_MV	000107	RESET
CIP General			
	S3V_1207_03_MV	000069	RESET
	S3V_1207_04_MV	000070	RESET
	SV_1207_03_MV	000076	RESET
	SV_1207_07_MV	000068	RESET
	SV_1207_09_MV	000071	RESET
	SV_1207_11_MV	000058	RESET
	SV_1207_13_MV	000109	RESET
SIP General			
	SV_1210_02_MV	000085	RESET
	SV_1210_03_MV	000088	RESET
	SV_1210_05_MV	000029	RESET
	SV_1210_07_MV	000025	RESET
	SV_1210_09_MV	000027	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_MV	000105	RESET

5.36.6.Awaited Feed Back

CL1200_Valvestate_Cir1_OK

Added Feedback in **CL1200_Valvestate_Cir1_OK (2009)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_FB	100088	RESET
	S3V_1201_04_FB	100085	RESET
	S3V_1201_07_FB	100075	RESET
	S3V_1201_08_FB	100074	RESET
	SV_1201_01_FB	100089	SET
	SV_1201_02_FB	100084	SET
	SV_1201_03_FB	100086	SET
	SV_1201_04_FB	100130	RESET
	SV_1201_05_FB	100087	SET(changed from RESET to SET)
	SV_1201_06_FB	100129	RESET
	SV_1201_07_FB	100076	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	SET
	SV_1202_02_FB	100131	RESET
Filtration Unit Pressure control			
	SV_1203_01_FB	100078	RESET
	SV_1203_02_FB	100064	RESET
CIP General			
	S3V_1207_03_FB	100096	RESET
	S3V_1207_04_FB	100095	RESET
	SV_1207_07_FB	100097	RESET
	SV_1207_09_FB	100094	RESET
	SV_1207_11_FB	100091	RESET
	SV_1207_13_FB	100139	RESET
SIP General			
	SV_1210_02_FB	100105	RESET
	SV_1210_05_FB	100056	RESET
	SV_1210_07_FB	100060	RESET
	SV_1210_09_FB	100058	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET

5.36.7.PLC Subroutine: F_Cir2

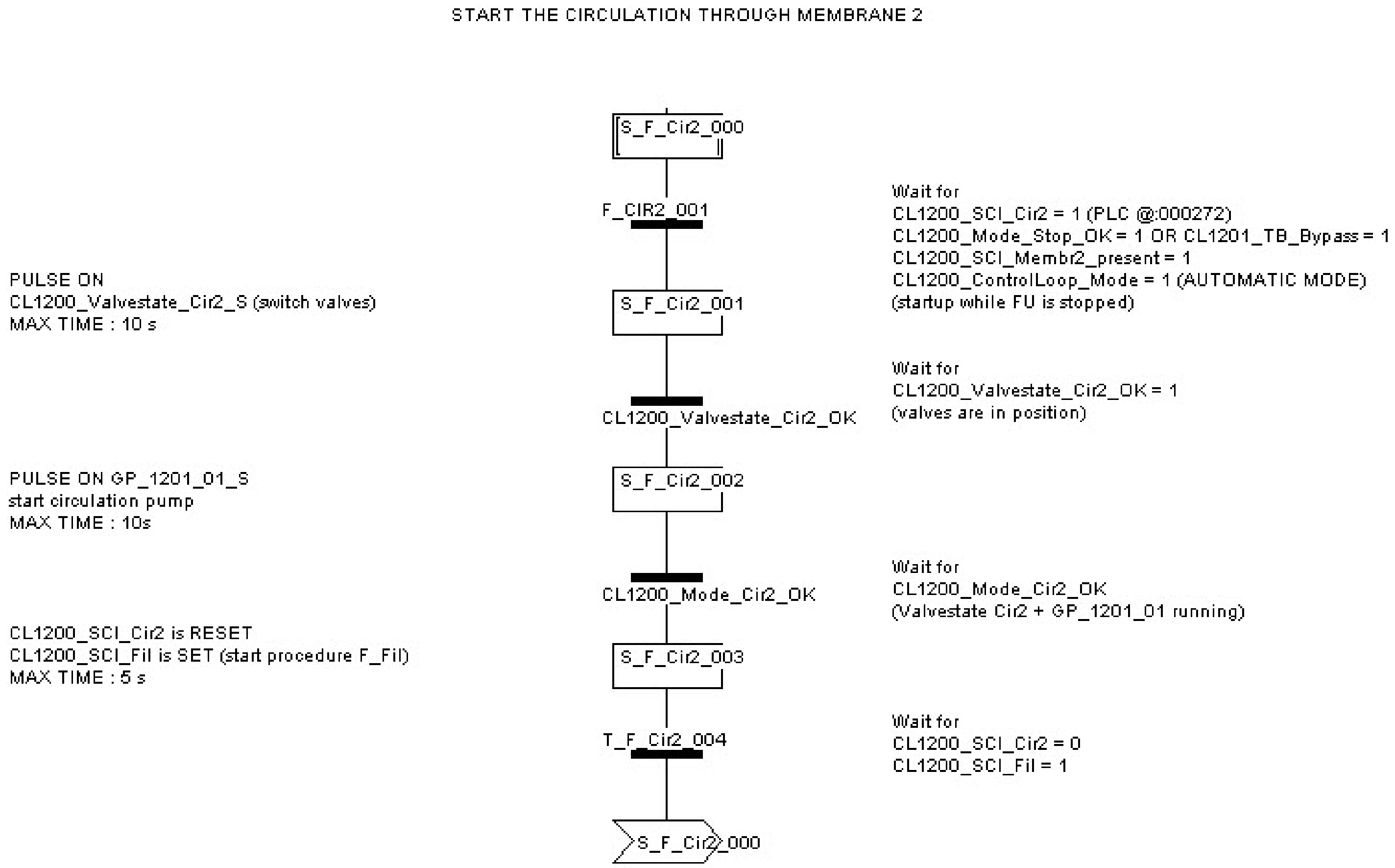
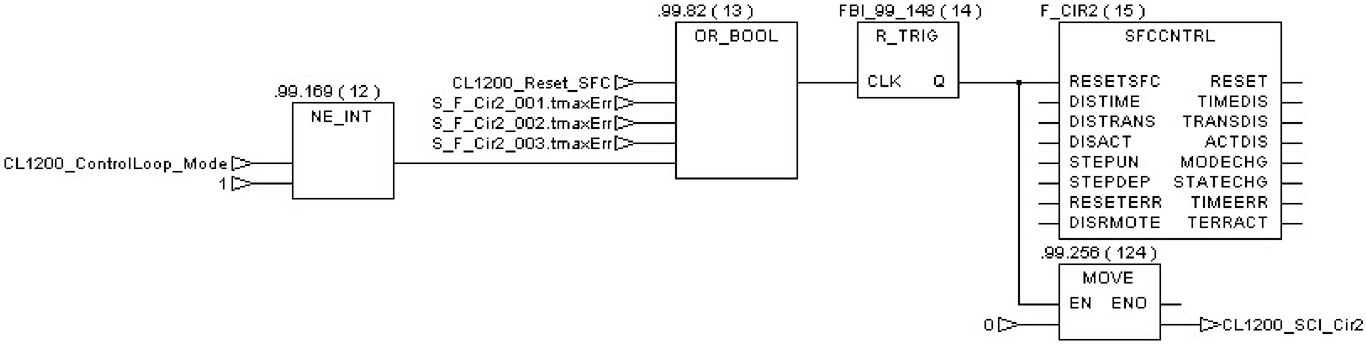


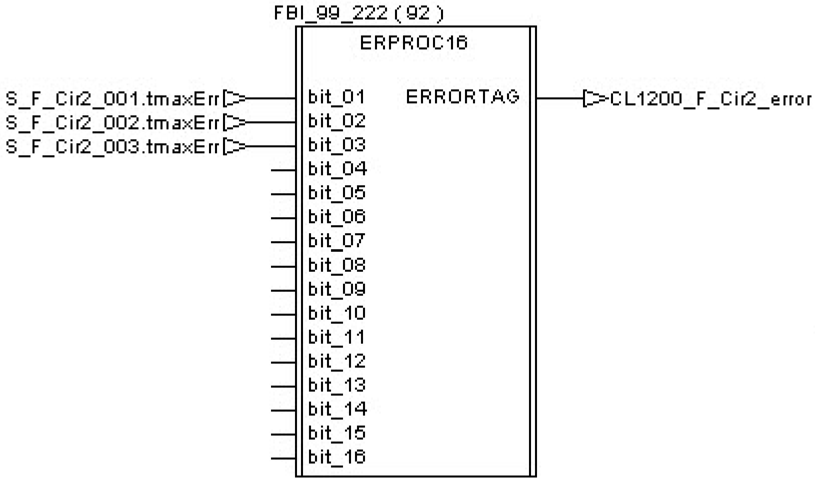
Figure 116: PLC procedure: F_Cir2

5.36.8.Procedure management

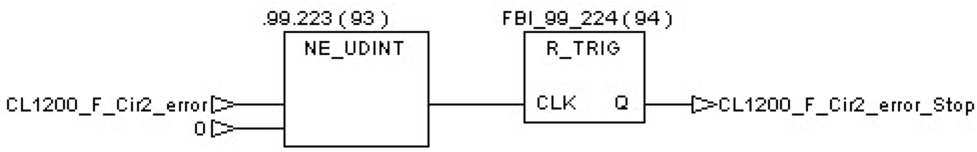
Reset of the procedure:
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure, the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



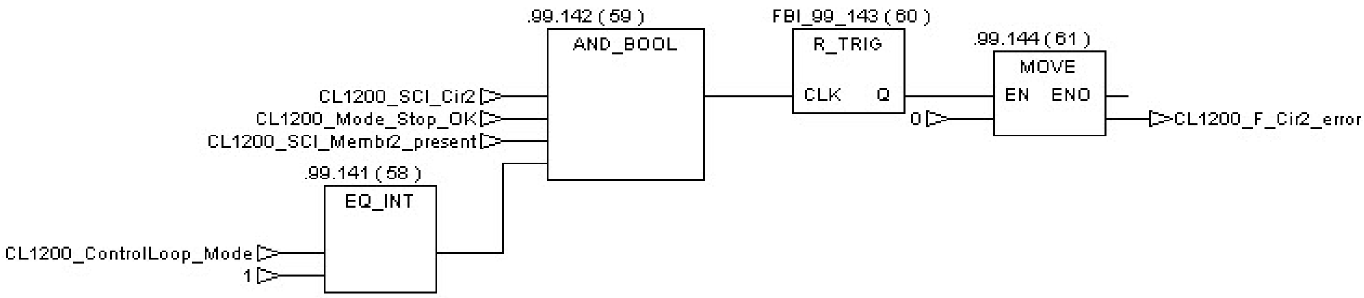
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1200_F_Cir2_error_Stop" receives a pulse then the Filtration Unit is stopped thanks to the procedure "F_Stop".



The error number is displayed until the procedure is re-started.



5.36.9.Error number description

Error number	Procedure Action Step	problem description
1	**S_F_Cir2_001**	valve(s) status Error operator has to look for valve alarm
2	**S_F_Cir2_002**	The pump GP_1201_01 has not been activated
4	**S_F_Cir2_003**	Tag reset problem (Tracing bit or Start button)

5.36.10.Controlled Valves

CL1200_Valvestate_Cir2_S

Added Valves in **CL1200_Valvestate_Cir2_S (2009)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_MV	000061	RESET
	S3V_1201_04_MV	000064	RESET
	S3V_1201_07_MV	000042	RESET
	S3V_1201_08_MV	000043	RESET
	SV_1201_01_MV	000060	SET
	SV_1201_02_MV	000049	SET
	SV_1201_03_MV	000063	RESET (changed from set to Reset)
	SV_1201_04_MV	000098	SET
	SV_1201_05_MV	000062	RESET(Changed from SET to RESET)
	SV_1201_06_MV	000097	SET
	SV_1201_08_MV	000056	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_MV	000050	RESET (Changed from SET to RESET)
	SV_1202_02_MV	000099	SET
	SV_1202_03_MV	000051	RESET
	SV_1202_04_MV	000100	SET
Filtration Unit Pressure control			
	SV_1203_01_MV	000055	RESET
	SV_1203_02_MV	000055	SET
	SV_1203_04_MV	000107	RESET
CIP General			
	S3V_1207_03_MV	000069	RESET
	S3V_1207_04_MV	000070	RESET
	SV_1207_03_MV	000076	RESET
	SV_1207_06_MV	000067	RESET
	SV_1207_08_MV	000072	RESET
	SV_1207_10_MV	000057	RESET
	SV_1207_12_MV	000110	
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_03_MV	000088	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_06_FB	100059	RESET
	SV_1210_08_FB	100057	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_MV	000106	RESET

5.36.11.Awaited Feed Back

CL1200_Valvestate_Cir2_OK

Added Feedback in **CL1200_Valvestate_Cir2_OK (2009)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_FB	100088	RESET
	S3V_1201_04_FB	100085	RESET
	S3V_1201_07_FB	100075	RESET
	S3V_1201_08_FB	100074	RESET
	SV_1201_01_FB	100089	SET
	SV_1201_02_FB	100084	SET
	SV_1201_03_FB	100086	RESET
	SV_1201_04_FB	100130	SET
	SV_1201_05_FB	100087	RESET (Changed from SET to RESET)
	SV_1201_06_FB	100129	SET
	SV_1201_08_FB	100077	RESET
Filtration Unit Filtrate Flow Control			RESET
	SV_1202_01_FB	100083	RESET
	SV_1202_02_FB	100131	SET
Filtration Unit Pressure control			
	SV_1203_01_FB	100078	RESET
	SV_1203_02_FB	100064	RESET
CIP General			
	S3V_1207_03_FB	100096	RESET
	S3V_1207_04_FB	100095	RESET
	SV_1207_06_FB	100098	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_12_FB	100140	RESET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_06_FB	100059	RESET
	SV_1210_08_FB	100057	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_FB	100136	RESET

5.36.12.PLC Subroutine: F_Fil

This procedure has a new function compared to the EPAS software.
It can be called in three different cases.

1- When operator asks for the filtration through membrane 1 or 2 from the stop mode or the bypass mode.
2- When the operator asks for the switch from nominal mode membrane 1 to membrane 2 or for the switch from nominal mode membrane 2 to membrane 1.
3- When the operator asks for the switch from recycle mode membrane 1 to membrane 2 or for the switch from recycle mode membrane 2 to membrane 1.

In the Two first cases, the PLC will execute the left branch of the procedure which will configure the nominal filtration (filtrate goes to effluent).
The third case will use the right branch of the procedure thanks to a flag called “CL1200_SWITCH_MEMBRANE_FLAG” and set by the procedure “F_S12” or “F_S21”. This action is done only when the filtration is running in recycle mode. This new added function permits to take into account the status of the Filtration (Recycle or Nominal) during the switch from one membrane to the other and then to recover it.

The other changes done on the procedure concerns the way to trigger the valve. Now all the valves concerning by the filtration membrane 1 or 2 are set in one time during the procedure F_Cir1 or F_Cir2 except the valves linked to the Recycle mode (SV_1202_03_MV/ SV_1202_04_MV / SV_1204_02_MV / SV_1204_03_MV).
Due to this change, the procedure “F_Fil” is in charge of starting the filtrate pump PP_1202_01 and, depending of the filtration status wanted, to configure the fourth valves enounced above in recycle or in nominal mode.

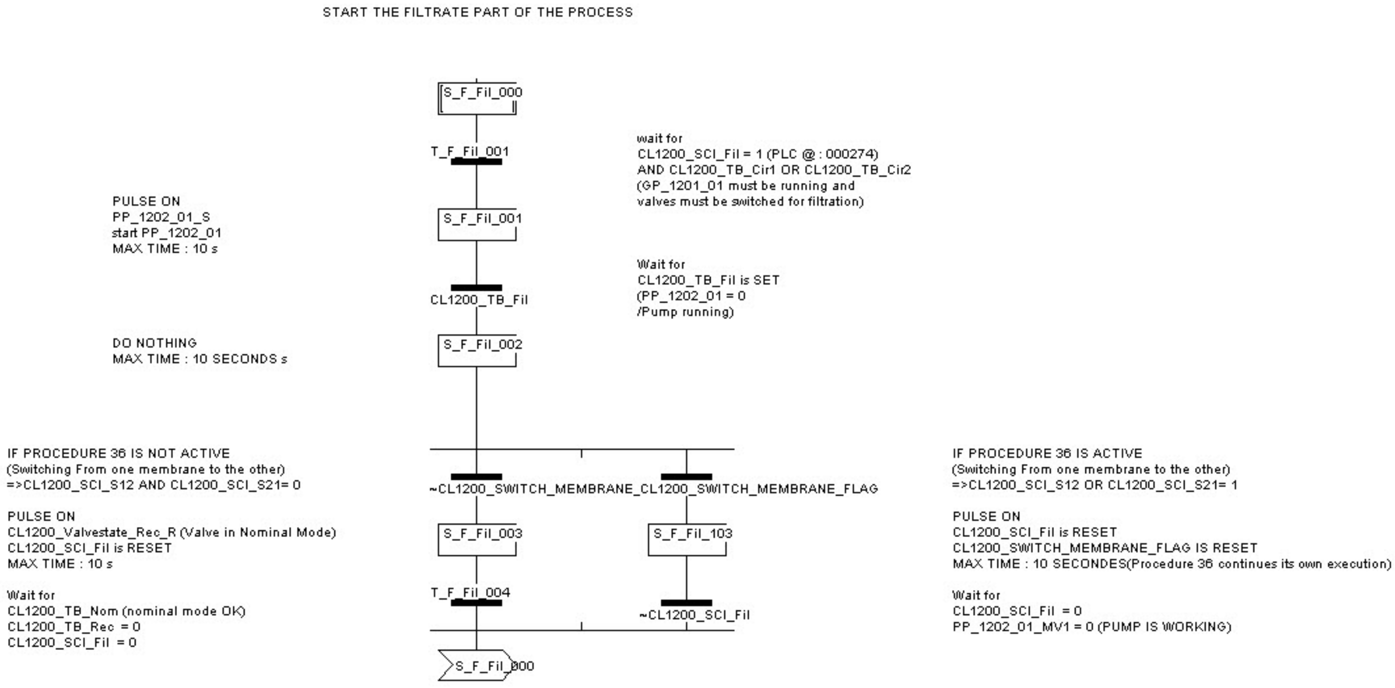
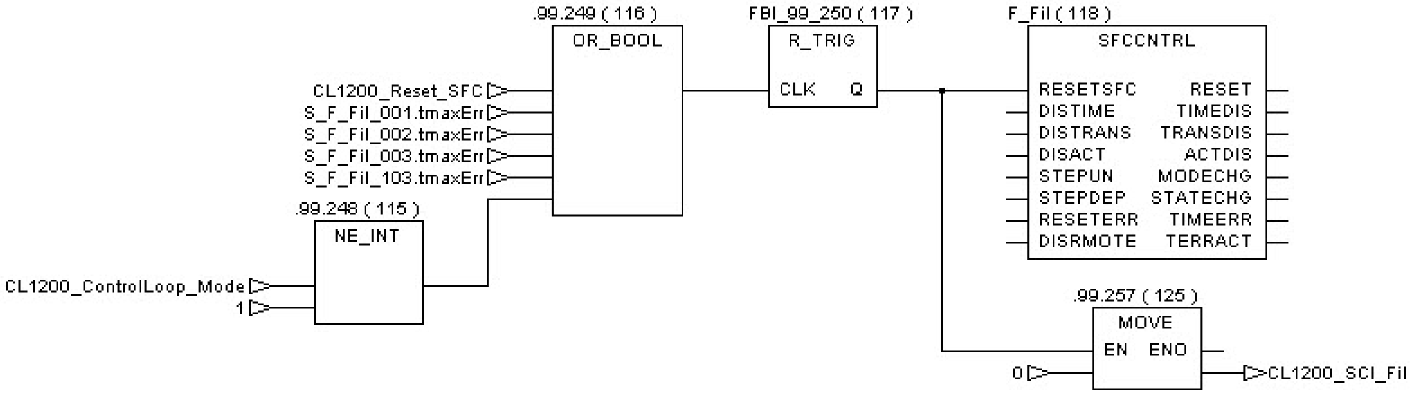


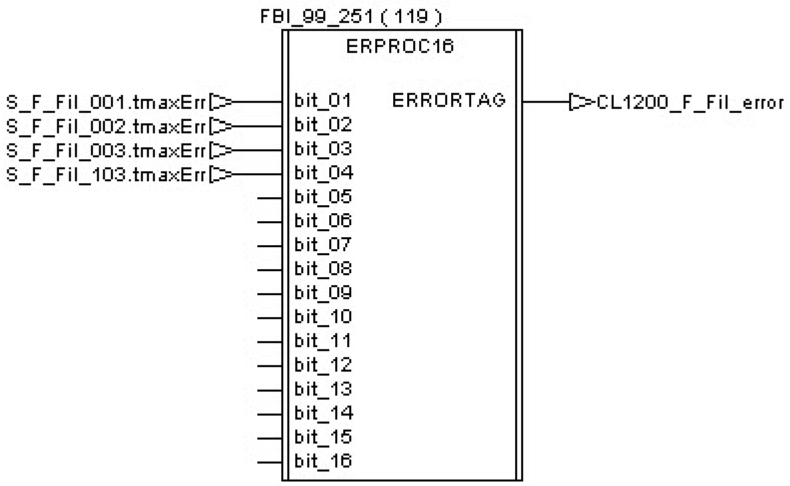
Figure 117: PLC procedure: F_Fil

5.36.13.Procedure management

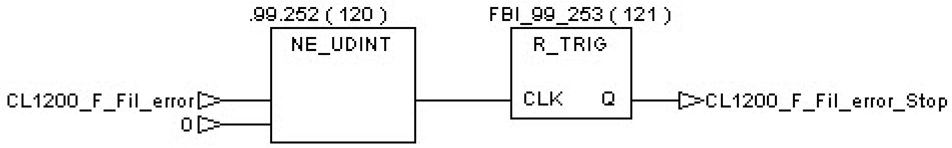
<u>Reset of the procedure:</u>
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure, the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



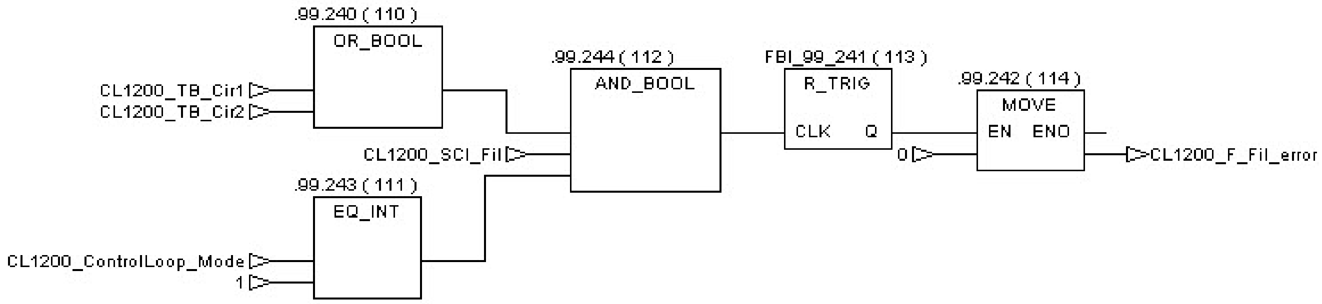
<u>Procedure error management:</u>
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag “CL1201_F_Fil_error_Stop” receives a pulse then the Filtration Unit is stopped thanks to the procedure “F_Stop”.



The error number is displayed until the procedure is re-started.



5.36.14.Error number description

Error number	Procedure Action Step	problem description
1	**S_F_Fil_001**	The pump PP_1202_01 has not been activated
2	**S_F_Fil_002**	Just a delay, no possible error
4	**S_F_Fil_003**	valve(s) status Error ("CL1200_Valvestate_Rec_R" describe in procedure "F_Rec") operator has to look for valve alarm or Tag reset problem (Tracing bit or Start button)
8	**S_F_Fil_103**	Tag reset problem (Tracing bit or Start button)

Awaited Feedback for filtration through Membrane 1

CL1200_Valvestate_Nom1_OK

Added Feedback from **CL1200_Valvestate_Cir1_OK (2009)**

Added Feedback in **CL1200_Valvestate_Nom1_OK (2009)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_FB	100088	RESET
	S3V_1201_04_FB	100085	RESET
	S3V_1201_07_FB	100075	RESET
	S3V_1201_08_FB	100074	RESET
	SV_1201_01_FB	100089	SET
	SV_1201_02_FB	100084	SET
	SV_1201_03_FB	100086	SET
	SV_1201_04_FB	100130	RESET
	SV_1201_05_FB	100087	SET (changed from RESET to SET)
	SV_1201_06_FB	100129	RESET
	SV_1201_07_FB	100076	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	SET
	SV_1202_02_FB	100131	RESET
	SV_1202_03_FB	100082	RESET
	SV_1202_04_FB	100132	SET
Filtration Unit Pressure control			
	SV_1203_01_FB	100078	RESET
	SV_1203_02_FB	100064	RESET
	SV_1203_04_FB	100137	RESET
Effluent Tank General			
	SV_1204_01_FB	100081	RESET
	SV_1204_02_FB	100079	SET
	SV_1204_03_FB	100133	SET
CIP General			
	S3V_1207_03_FB	100096	RESET
	S3V_1207_04_FB	100095	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_07_FB	100097	RESET
	SV_1207_09_FB	100094	RESET
	SV_1207_11_FB	100091	RESET
	SV_1207_13_FB	100139	RESET
SIP General			
	SV_1210_02_FB	100105	RESET
	SV_1210_03_FB	100108	RESET
	SV_1210_05_FB	100056	RESET
	SV_1210_07_FB	100060	RESET
	SV_1210_09_FB	100058	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET

Theses four valves
OR
The variable: CL1204_SCI_Harvest
(HMI button for harvesting)
permits to SET CL1200_Valvestate_Nom1_OK

Awaited Feedback for filtration through Membrane 2

CL1200_Valvestate_Nom2_OK

Added Feedback from **CL1200_Valvestate_Cir2_OK (2009)**

Added Feedback in **CL1200_Valvestate_Nom2_OK (2009)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_FB	100088	RESET
	S3V_1201_04_FB	100085	RESET
	S3V_1201_07_FB	100075	RESET
	S3V_1201_08_FB	100074	RESET
	SV_1201_01_FB	100089	SET
	SV_1201_02_FB	100084	SET
	SV_1201_03_FB	100086	RESET
	SV_1201_04_FB	100130	SET
	SV_1201_05_FB	100087	RESET (Changed from SET to RESET)
	SV_1201_06_FB	100129	SET
	SV_1201_08_FB	100077	RESET
Filtration Unit Filtrate Flow Control			RESET
	SV_1202_01_FB	100083	RESET
	SV_1202_02_FB	100131	RESET
	SV_1202_03_FB	100082	RESET
	SV_1202_04_FB	100132	SET
Filtration Unit Pressure control			
	SV_1203_01_FB	100078	RESET
	SV_1203_02_FB	100064	RESET
	SV_1203_04_FB	100137	RESET
Effluent Tank General			
	SV_1204_01_FB	100081	RESET
	SV_1204_02_FB	100079	SET
	SV_1204_03_FB	100133	SET
CIP General			
	S3V_1207_03_FB	100096	RESET
	S3V_1207_04_FB	100095	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_06_FB	100098	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_12_FB	100140	RESET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_03_FB	100108	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_06_FB	100059	RESET
	SV_1210_08_FB	100057	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_FB	100136	RESET

Theses four valves
OR
The variable: CL1204_SCI_Harvest
(HMI button for harvesting)
permits to SET CL1200_Valvestate_Nom1_OK

5.37. Procedure 36: Filtration Unit: Switch from one membrane to the other LF_1200_01 / LF_1200_02

5.37.1.Scope:

IMPORTANT POINT:
The switch of the membrane can be activated in nominal or in recycle mode (the membrane must be present).
New function: Now when the procedure takes into account the process status. Depending on the filtration state running (recycle mode or nominal mode), the procedure will switch to the other membrane then recover the same status.
THIS PROCEDURE CAN ONLY BE EXECUTED WITH FU, CIP and SIP IN AUTOMATIC MODE.

Prerequisite
FU must be filtrating over one of the two membranes in nominal or in recycle.
The PLC automatically goes in the previous process state (recycle or nominal) after having switched to the other membrane.
The membrane that is switched over from must be cleaned and preserved in clear water if it remains in the membrane module.

Procedure
Use the HMI to switch filtration unit in **automatic mode**
CL1200_SCI_S12 (PLC address: 000283): from Membrane 1 to membrane 2.
CL1200_SCI_S21 (PLC address: 000284): from Membrane 2 to membrane 1

This operation could also be done in a step by step way.
CL1200_SCI_Stop (PLC address: 000285): Stop Filtration Unit
CL1200_SCI_Cir1 or CL1200_SCI_Cir2 (PLC Address: 000271 / 000272)
(e.g.: PROCEDURE 35: Filtration Unit: Start up of filtration through membrane LF_1200_01 / LF_1200_02.)

Used Variables:
CL1200_SCI_S12 (PLC address: 000283)
CL1200_SCI_S21 (PLC address: 000284)

5.37.2.PLC Subroutine: F_S12

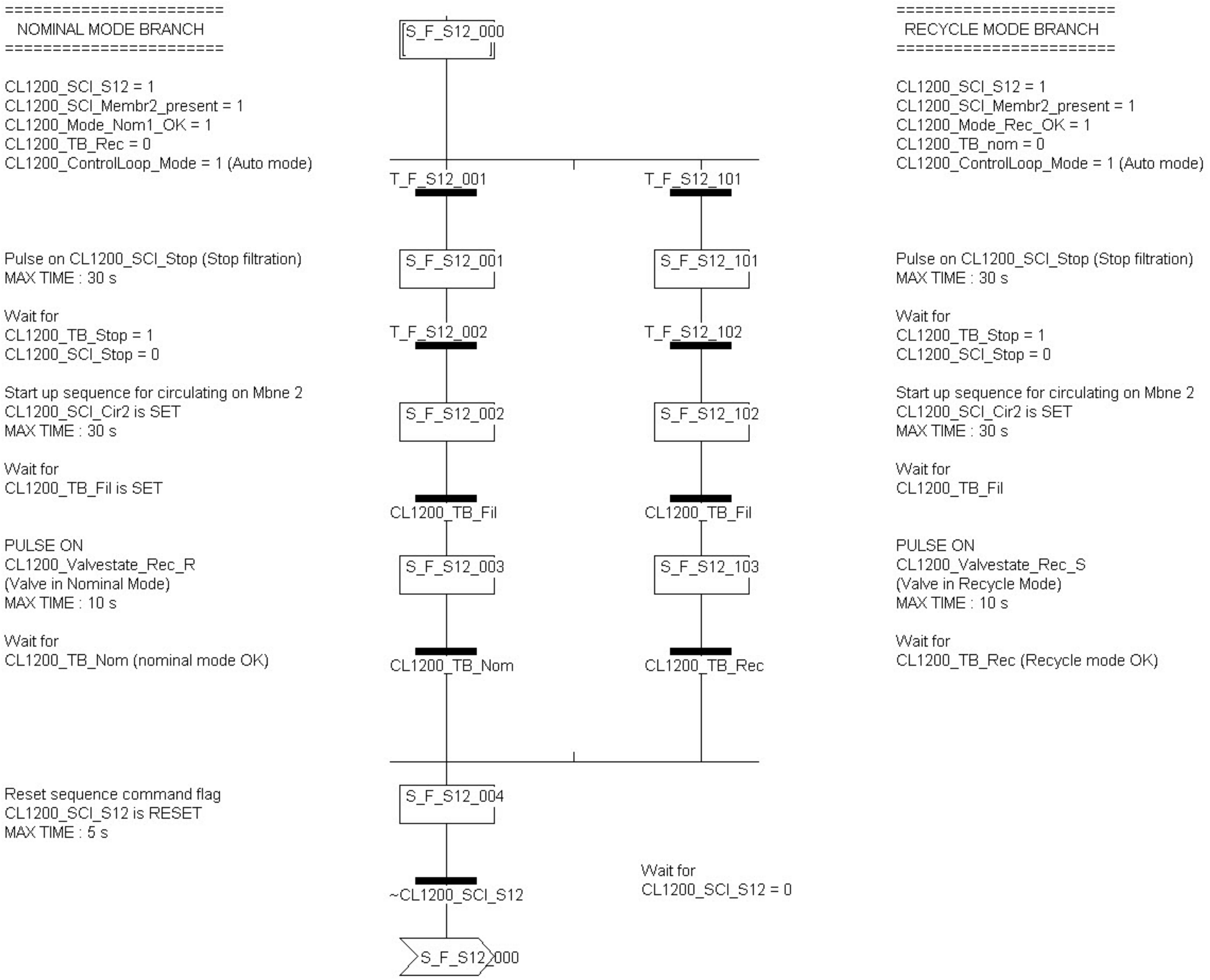
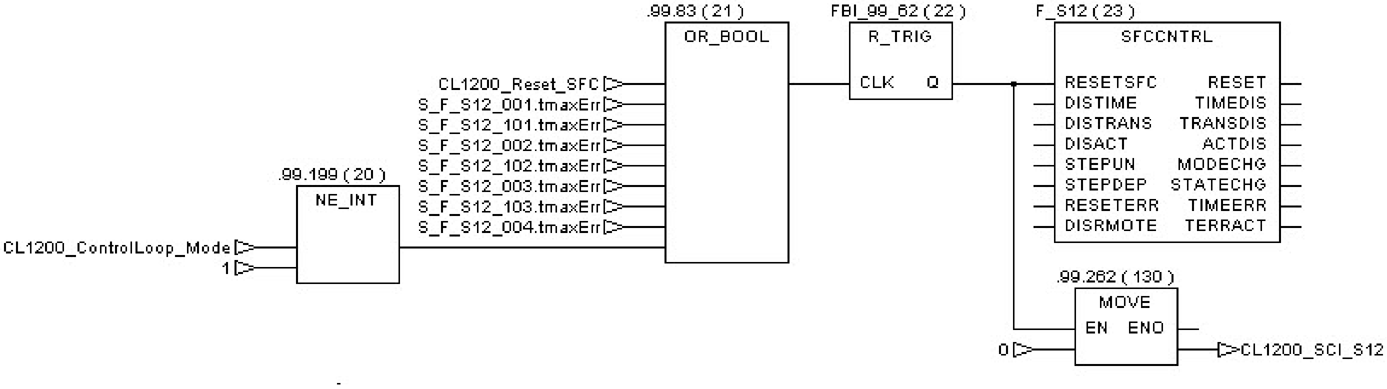


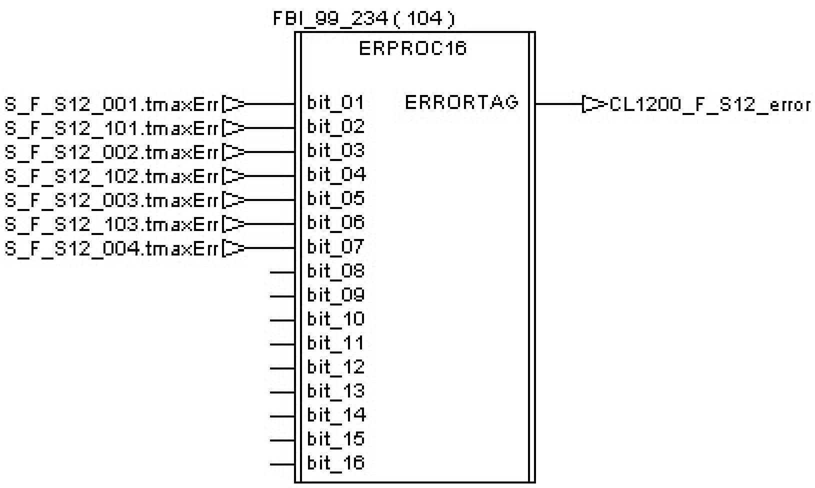
Figure 118: PLC procedure: F_S12

5.37.3.Procedure management

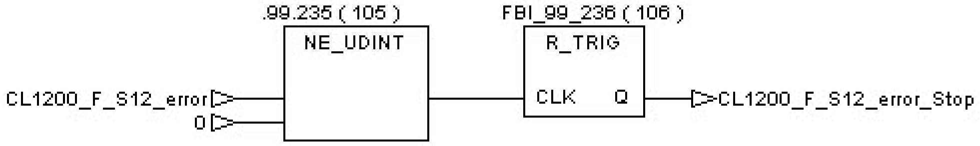
Reset of the procedure:
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure, the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



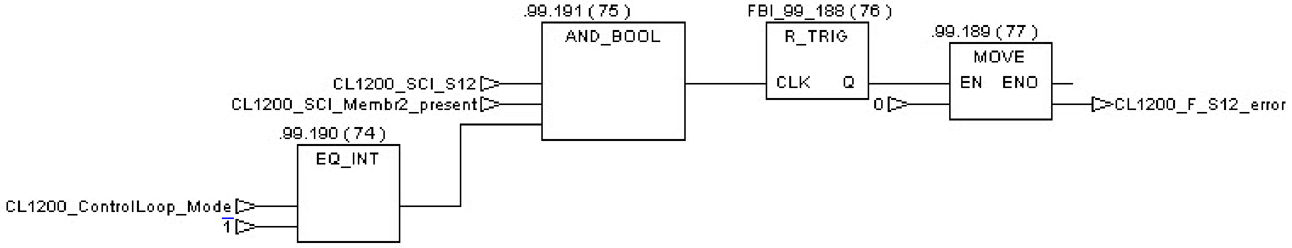
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1200_F_S12_error_Stop" receives a pulse and then the Filtration Unit is stopped thanks to the procedure "F_Stop".



The error number is displayed until the procedure is re-started.



5.37.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_F_S12_001**	Problem during the execution of the procedure "F_Stop" The procedure "F_Stop" should also have an error code
2	**S_F_S21_101**	Problem during the execution of the procedure "F_Stop" The procedure "F_Stop" should also have an error code
4	**S_F_S21_002**	Problem during the execution of the procedure "F_Cir2" The procedure "F_Cir2" should also have an error code
8	**S_F_S12_102**	Problem during the execution of the procedure "F_Cir2" The procedure "F_Cir2" should also have an error code
16	**S_F_S12_003**	No posible error
32	**S_F_S12_103**	valve(s) status Error operator has to look for valve alarm
64	**S_F_S12_004**	Tag reset problem (Tracing bit or Start button)

5.37.5.PLC Subroutine: F_S21

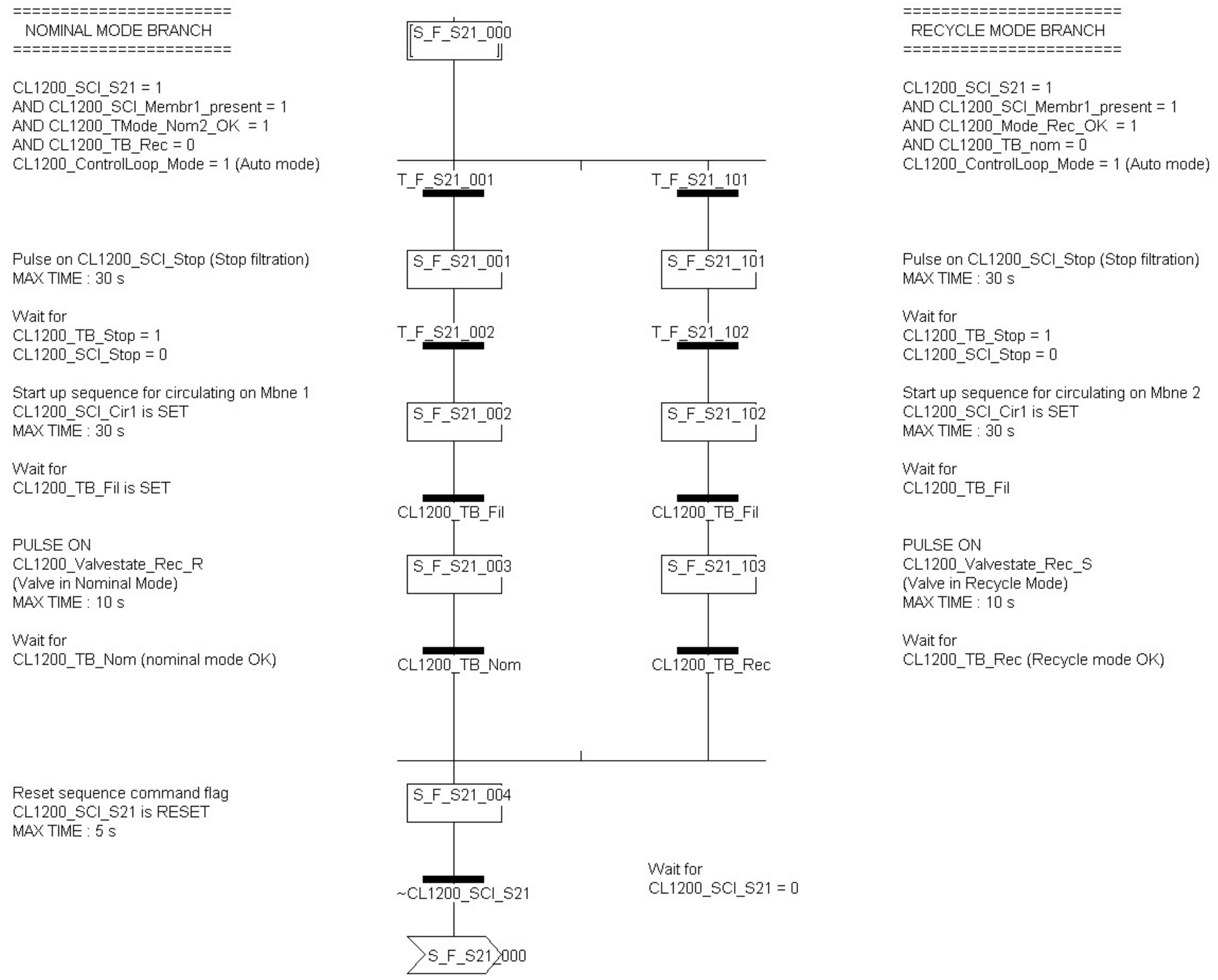
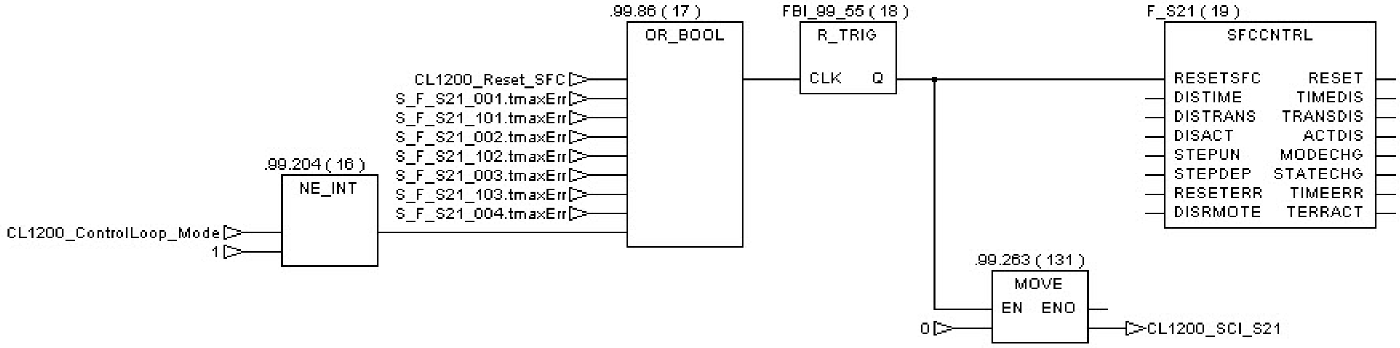


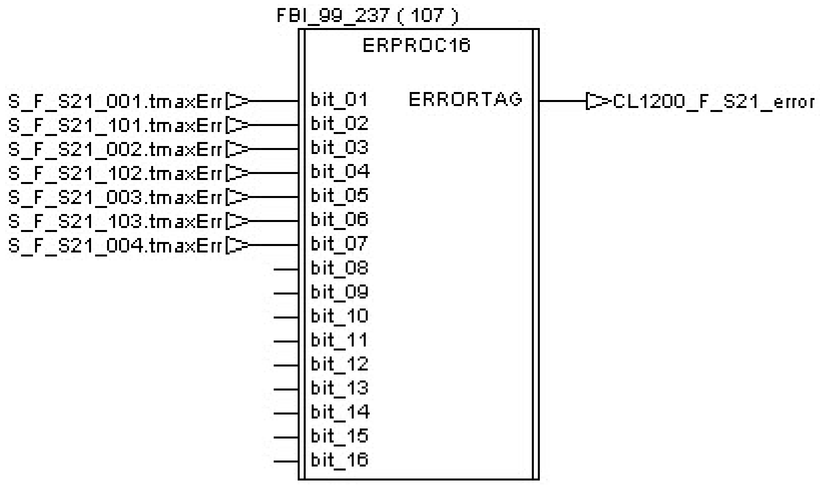
Figure 119: PLC procedure: F_S21

5.37.6.Procedure management

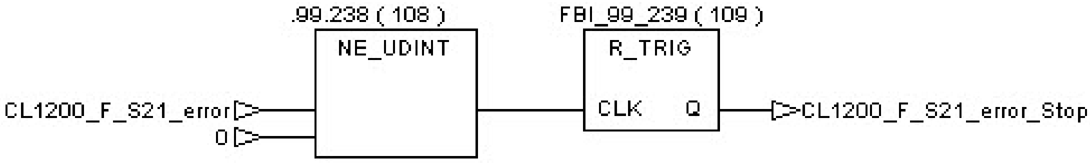
Reset of the procedure:
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure, the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



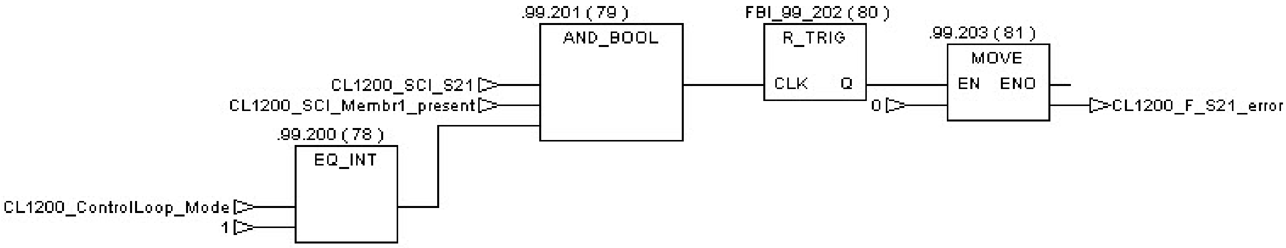
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag “CL1200_F_S12_error_Stop” receives a pulse and then the Filtration Unit is stopped thanks to the procedure “F_Stop”.



The error number is displayed until the procedure is re-started.

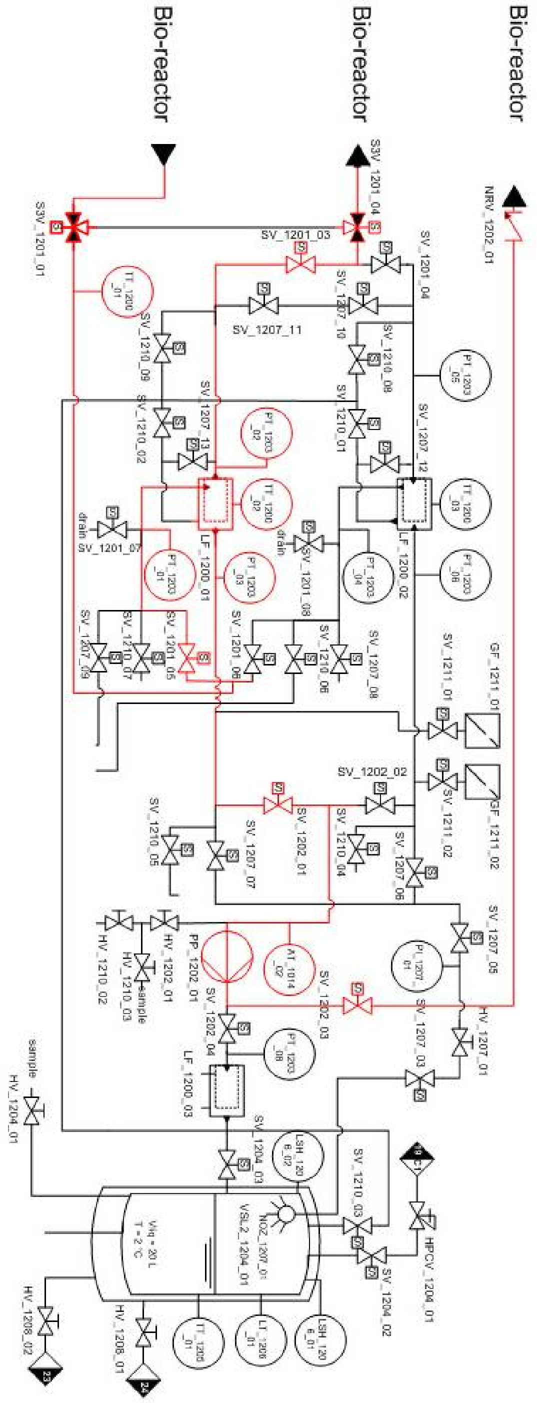


5.37.7.Error number description

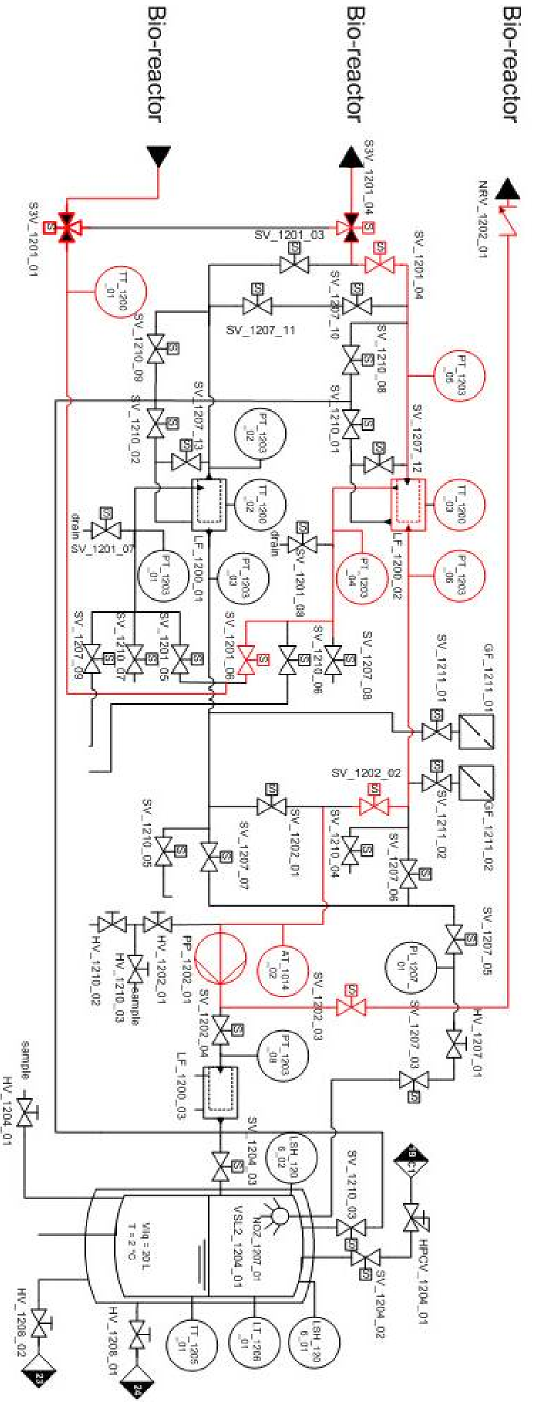
Error number	Procedure Action Step	problem description
1	**S_F_S21_001**	Problem during the execution of the procedure "F_Stop" The procedure "F_Stop" should also have an error code
2	**S_F_S21_101**	Problem during the execution of the procedure "F_Stop" The procedure "F_Stop" should also have an error code
4	**S_F_S21_002**	Problem during the execution of the procedure "F_Cir1" The procedure "F_Cir1" should also have an error code
8	**S_F_S21_102**	Problem during the execution of the procedure "F_Cir1" The procedure "F_Cir1" should also have an error code
16	**S_F_S21_003**	No posible error
32	**S_F_S21_103**	valve(s) status Error operator has to look for valve alarm
64	**S_F_S21_004**	Tag reset problem (Tracing bit or Start button)

5.38. Procedure 37: Filtration Unit: Enter Recycle mode

Membrane 1



Membrane 2



5.38.1.Scope

IMPORTANT POINT:
THE HMI RECYCLE MODE BUTTON CAN BE ACTIVATED ONLY WHEN THE PROCESS IS IN NOMINAL MODE STATE AND THE CONTROL LOOP MODE IS IN AUTOMATIC

As the recycle line should be sterilized (procedure S_REC) before entering in recycle mode, the operator can reset the F_REC procedure (if a problem occurs with the steam generator). This function is activated by the tag "CL1200_Reset _F_Rec_Proc" (PLC @: 000786) with is the cancel button of the operator panel appearing during the S_Rec procedure. For information, this operator panel asks to the operator if the steam generator is ready.

This procedure switches the Filtration Unit from Nominal mode to recycle mode.
The Nominal mode: From the bioreactor to Effluent Vessel (VSL2_1204_01) passing by Filtration Unit
The Recycle mode: From bioreactor to bioreactor passing by Filtration Unit.
The PLC closes SV_1202_04 then opens SV_1202_03 to recycle the produced filtrate back to the bioreactor.
There are two triggering ways to start the procedure:
-HMI Variable **CL1200_SCI_Recycle_mode** (000281).
This way can be monitored on HMI by the variable **CL1200_TB_Rec** (000343)
-The Level of VSL2_1204_01: If the level reaches 15 litres, an Operator Panel with three buttons appears on the HMI screen to choose the way to follow (Harvest, Recycle Mode or cancel).
The variable checked by IFIX to display the Operator Panel is **CL1204_OP_LevelHigh** (PLC @: 000362).

Recycle Mode might be used before CIP and SIP procedures applied on effluent vessel VSL2_1204_01.

Prerequisite
Before entered in recycle mode, close HV_1007_07.

Make sure that steam is available.
Open manually HV_1210_01 for steam input.
FU must be filtrating over one of the two membranes in nominal mode.
The FU must be in Automatic mode (CL1200_ControlLoop_Mode = 1).

Procedure

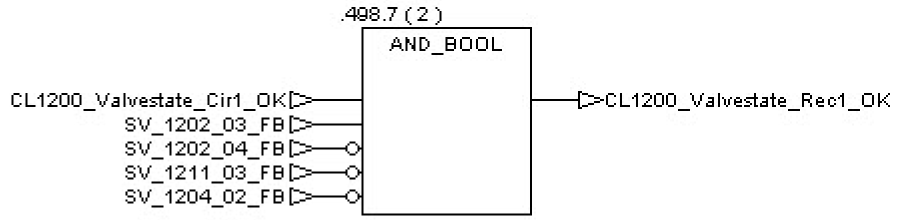
Press button 'Recycle mode' on the HMI:
CL1200_SCI_Recycle_mode
The PLC starts the Procedure by calling the **procedure 80: purges and the sterilization of the recycle line.**
Once the sterilization is done, the filtration unit starts in recycle mode.

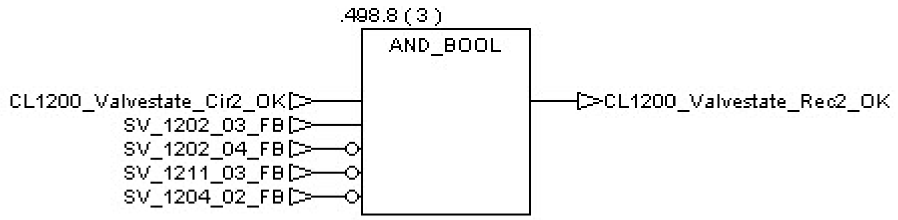
Used Variables:

CL1200_SCI_Recycle_mode (PLC Address : 000281)
CL1200_TB_Rec (000343)
CL1204_OP_LevelHigh (PLC @: 000362)

5.38.2.Recycle mode and Tracing bit

During the F_Rec procedure execution, a pulse is sent on the "CL1200_Valvestate_Rec_S" tag. It permits to close SV_1202_04 and SV_1204_02 and to open SV_1202_03. The valve SV_1211_03, used during the sterilization of the recycle line (S_Rec procedure) should also be closed.
Once these valves are configured and depending on the filtration membrane running the "CL1200_Valvestate_Rec1_OK" tag or the "CL1200_Valvestate_Rec2_OK" tag is set.





Then the mode and the tracing bit are set.

Reading variable description:

CL1200_TB_Fil = CL1200_Mode_Fil1_OK OR CL1200_Mode_Fil2_OK

CL1200_Mode_Fil1_OK = CL1200_Mode_Cir1_OK=1 AND PP_1202_01_MV1=0 (activated)
CL1200_Mode_Fil2_OK = CL1200_Mode_Cir2_OK=1 AND PP_1202_01_MV1=0 (activated)

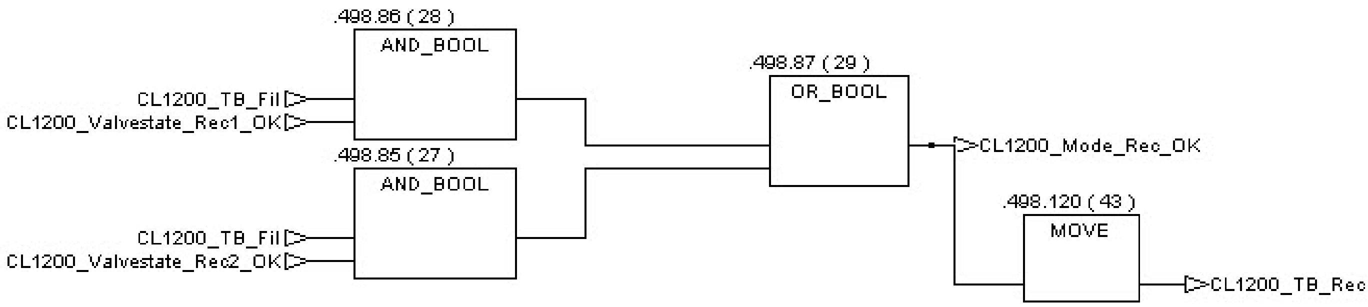


Figure 120: PLC Block: F_MODE_REC

5.38.3.PLC Subroutine: F_Rec

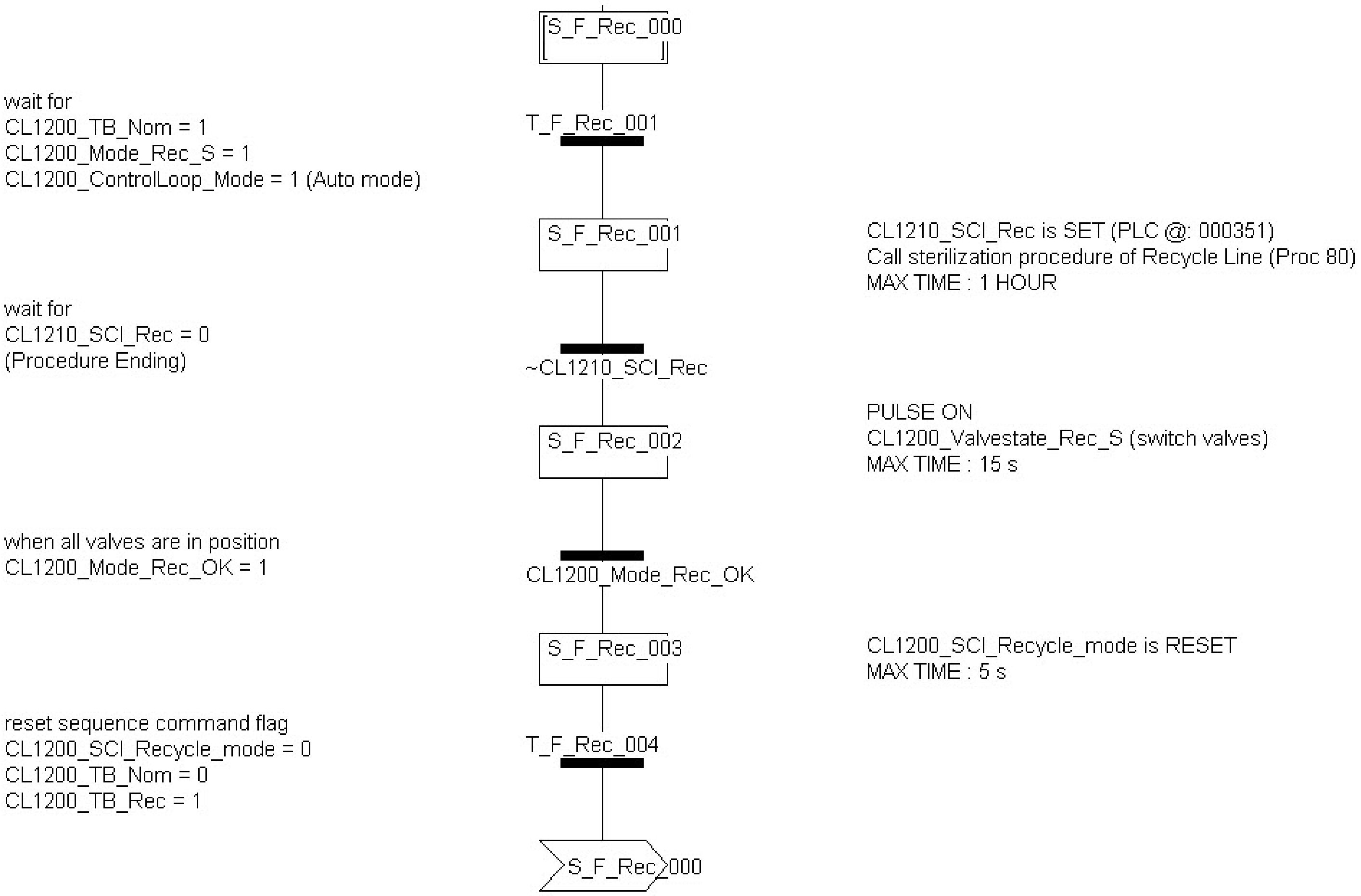
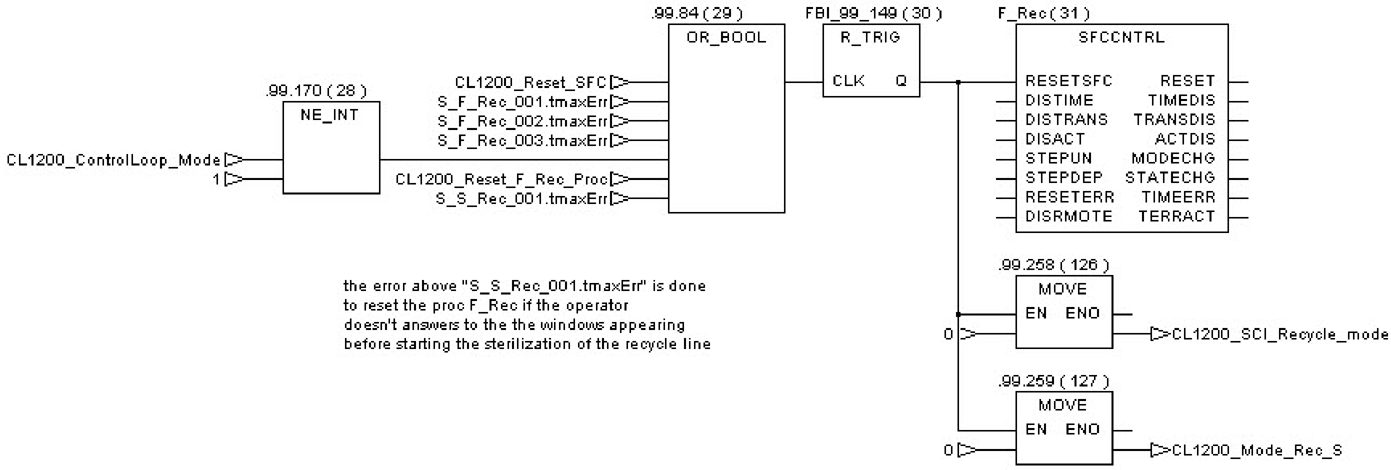


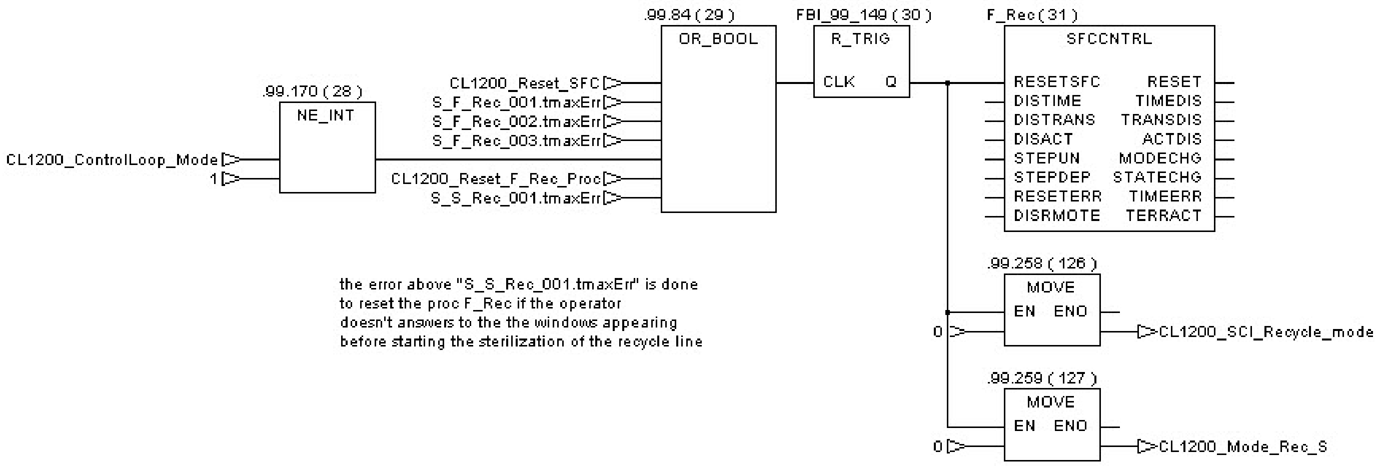
Figure 121: PLC procedure: F_Rec

5.38.4.Procedure management

Reset of the procedure:
As the recycle line should be sterilized (procedure S_REC) before entering in recycle mode, the operator can reset the F_REC procedure. This function is activated by the tag “CL1200_Reset _F_Rec_Proc” (PLC @: 000786) with is the cancel button of the operator panel appearing during the S_Rec procedure. For information, this operator panel asks to the operator if the steam generator is ready. The operator has 10 minutes to answer then the error time step is set which and reset the procedure F_REC.

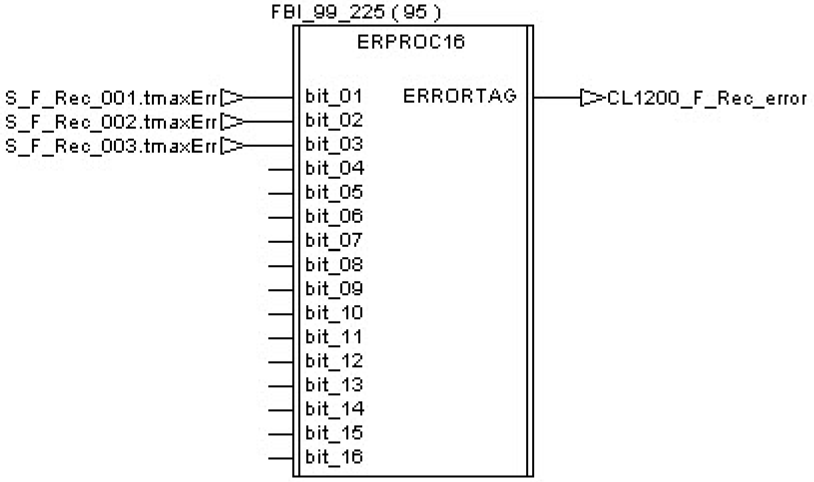


If a time error occurs during the execution of the procedure, SFC_CNTRL reset the procedure, the tag linked to the procedure.
The same reset is done when the control Loop mode button is trigger to OFF or MANUAL Mode during the procedure execution.

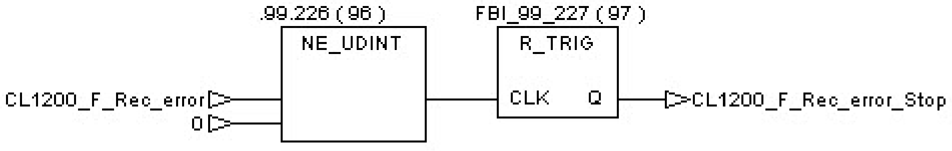


Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step.

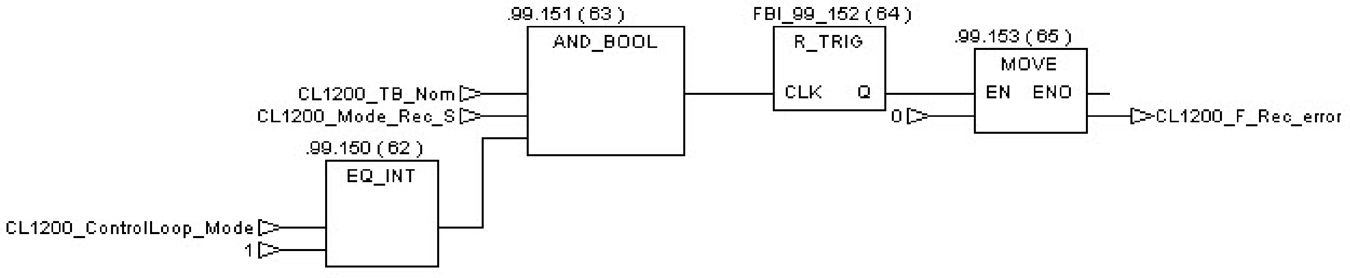
In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1200_F_Rec_error_Stop" receives a pulse and then the Filtration Unit is stopped thanks to the procedure "F_Stop".



The error number is displayed until the procedure is re-started.



5.38.5.Error number description

Error number	Procedure Action Step	problem description
1	**S_F_Rec_001**	Problem during the execution of the procedure "S_REC" (sterilization of the recycle line) The procedure "S_REC" should also have an error code
2	**S_F_Rec_002**	valve(s) status Error operator has to look for valve alarm
4	**S_F_Rec_003**	Tag reset problem (Tracing bit or Start button)

5.38.6.Controlled Valves

CL1200_Valvestate_Rec_S

	VALVES	ADDRESS	COMMENTS
Filtration Unit Filtrate Flow Control			
	SV_1202_03_MV	000051	SET
	SV_1202_04_MV	000100	RESET
Effluent Tank General			
	SV_1204_02_MV	000054	RESET

5.38.7.Awaited Feedback

For recycle mode membrane 1

CL1200_Valvestate_Rec1_OK

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_FB	100088	RESET
	S3V_1201_04_FB	100085	RESET
	S3V_1201_07_FB	100075	RESET
	S3V_1201_08_FB	100074	RESET
	SV_1201_01_FB	100089	SET
	SV_1201_02_FB	100084	SET
	SV_1201_03_FB	100086	SET
	SV_1201_04_FB	100130	RESET
	SV_1201_05_FB	100087	SET(changed from RESET to SET)
	SV_1201_06_FB	100129	RESET
	SV_1201_07_FB	100076	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	SET
	SV_1202_02_FB	100131	RESET
	SV_1202_03_FB	100082	SET
	SV_1202_04_FB	100132	RESET
Filtration Unit Pressure control			
	SV_1203_01_FB	100078	RESET
	SV_1203_02_FB	100064	RESET
Effluent Tank General			
	SV_1204_02_FB	100079	RESET
CIP General			
	S3V_1207_03_FB	100096	RESET
	S3V_1207_04_FB	100095	RESET
	SV_1207_07_FB	100097	RESET
	SV_1207_09_FB	100094	RESET
	SV_1207_11_FB	100091	RESET
	SV_1207_13_FB	100139	RESET
SIP General			
	SV_1210_02_FB	100105	RESET
	SV_1210_05_FB	100056	RESET
	SV_1210_07_FB	100060	RESET
	SV_1210_09_FB	100058	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET
	SV_1211_03_FB	100138	RESET

For recycle mode membrane 2

CL1200_Valvestate_Rec2_OK

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_FB	100088	RESET
	S3V_1201_04_FB	100085	RESET
	S3V_1201_07_FB	100075	RESET
	S3V_1201_08_FB	100074	RESET
	SV_1201_01_FB	100089	SET
	SV_1201_02_FB	100084	SET
	SV_1201_03_FB	100086	RESET
	SV_1201_04_FB	100130	SET
	SV_1201_05_FB	100087	RESET (Changed from SET to RESET)
	SV_1201_06_FB	100129	SET
	SV_1201_08_FB	100077	RESET
Filtration Unit Filtrate Flow Control			RESET
	SV_1202_01_FB	100083	RESET
	SV_1202_02_FB	100131	SET
	SV_1202_03_FB	100082	SET
	SV_1202_04_FB	100132	RESET
Filtration Unit Pressure control			
	SV_1203_01_FB	100078	RESET
	SV_1203_02_FB	100064	RESET
Effluent Tank General			
	SV_1204_02_FB	100079	RESET
CIP General			
	S3V_1207_03_FB	100096	RESET
	S3V_1207_04_FB	100095	RESET
	SV_1207_06_FB	100098	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_12_FB	100140	RESET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_06_FB	100059	RESET
	SV_1210_08_FB	100057	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_FB	100136	RESET
	SV_1211_03_FB	100138	RESET

5.39. Procedure 38: Filtration Unit: Enter Nominal mode

5.39.1.Scope

IMPORTANT POINT:
THE HMI NOMINAL MODE BUTTON CAN BE ACTIVATED ONLY WHEN THE PROCESS IS IN RECYCLE MODE STATE AND THE CONTROL LOOP MODE IS IN AUTOMATIC

Close SV_1202_03 and open SV_1202_04.
Close HV_1007_07

If the FU is working in recycle mode, this procedure opens the valve SV_1202_04 and closes the valve SV_1202_03 to re-enter in nominal filtration mode, where the produced filtrate is led to the effluent vessel.

Prerequisite
FU must be filtrating over one of the two membranes in recycle mode.

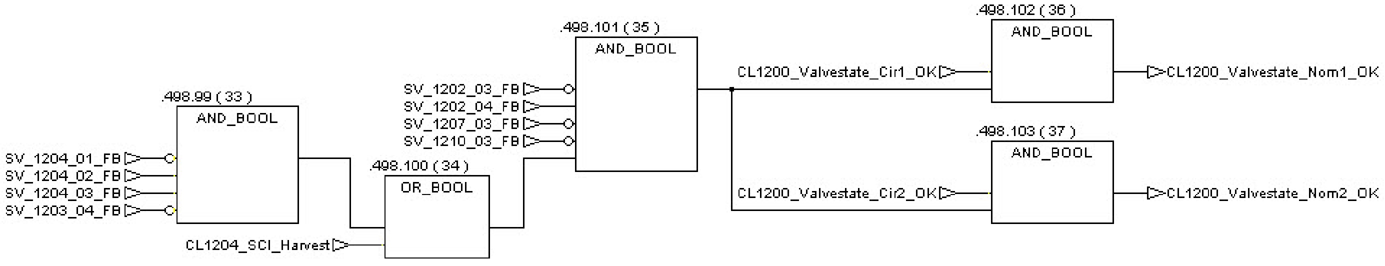
Procedure
Press button 'Nominal mode' on the HMI:
CL1200_SCI_Nom (PLC Address: 000280)
Once the line is sterilized,
Wait for the end of the procedure:
CL1200_TB_Nom = 1 (PLC Address: 000344)
At the end of procedure, the PLC set the variable
CL1210_SCI_FlushRec (PLC Address: 000364) which starts **procedure 82** (**SIP: Flush recycle line).**

Used Variables:
CL1200_SCI_Nom (PLC Address: 000280)
CL1200_TB_Nom (PLC Address: 000344)

5.39.2.Nominal Mode and Tracing Bit

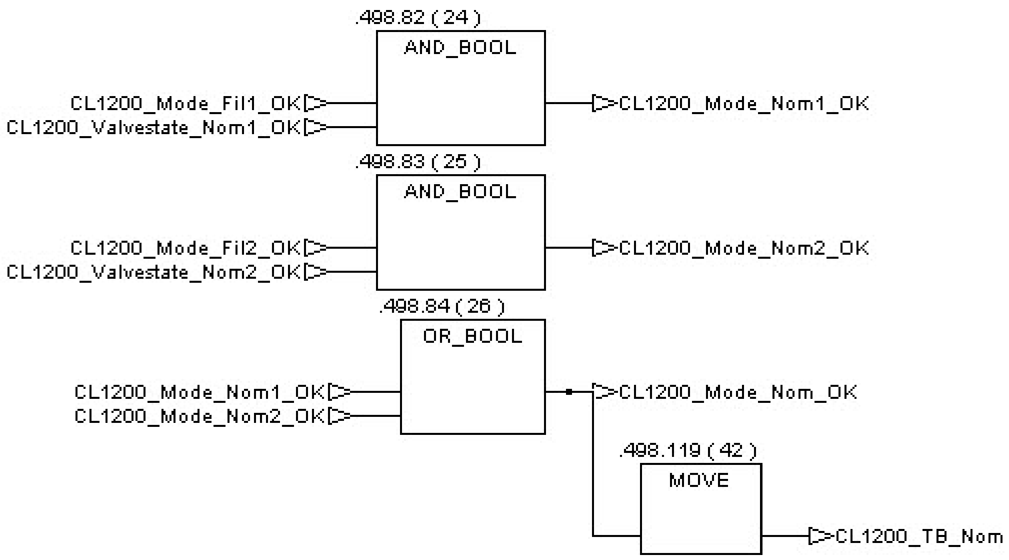
During the F_Nom procedure execution, a pulse is sent on the "CL1200_Valvestate_Rec1_R tag. It permits to open SV_1202_04, SV_1204_02 and SV_1204_03 and to Close SV_1202_03.

When these valves are configured and the circulation membrane 1 or 2 is set, the "CL1200_Valvestate_Nom1" tag or the "CL1200_Valvestate_Nom2" tag is set



Then the mode and the tracing bit are set.

CL1200_Mode_Fil1_OK = CL1200_Mode_Cir1_OK=1 AND PP_1202_01_MV1=0 (activated)
CL1200_Mode_Fil2_OK = CL1200_Mode_Cir2_OK=1 AND PP_1202_01_MV1=0 (activated)



5.39.3.PLC Subroutine: F_Nom

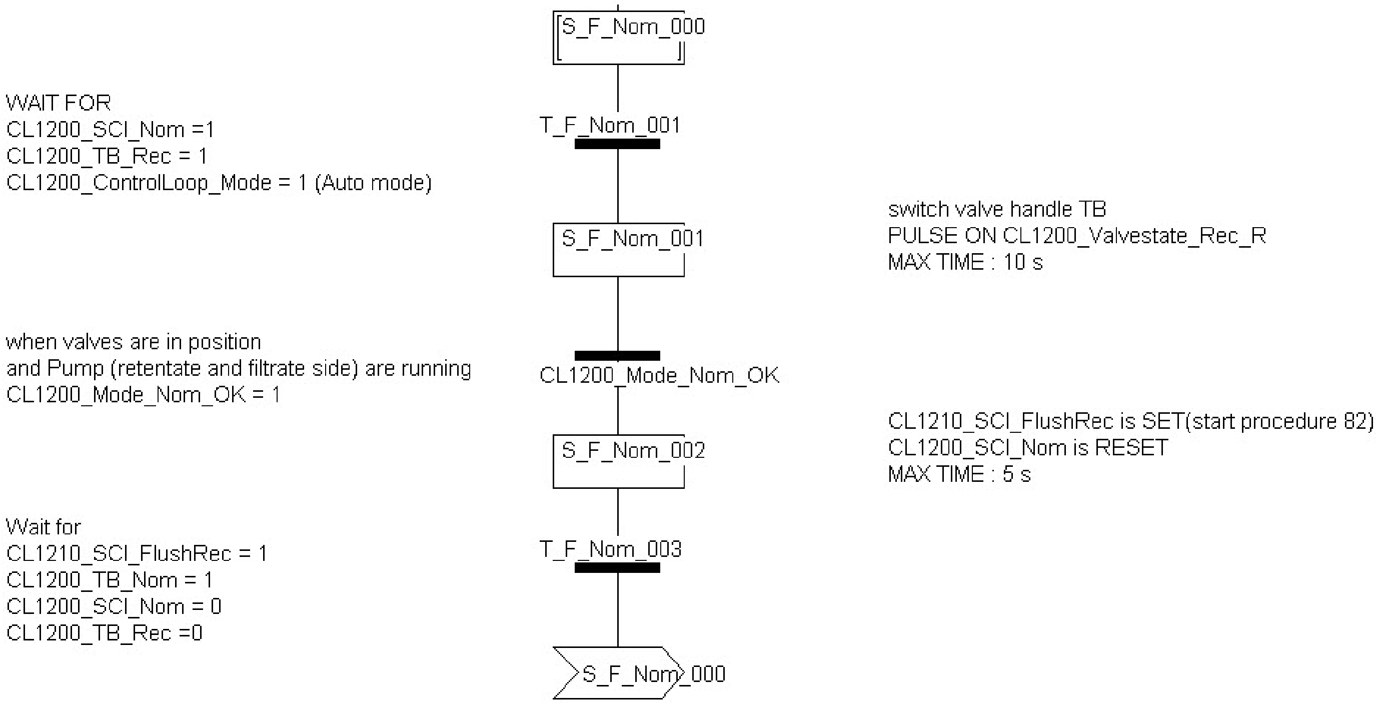
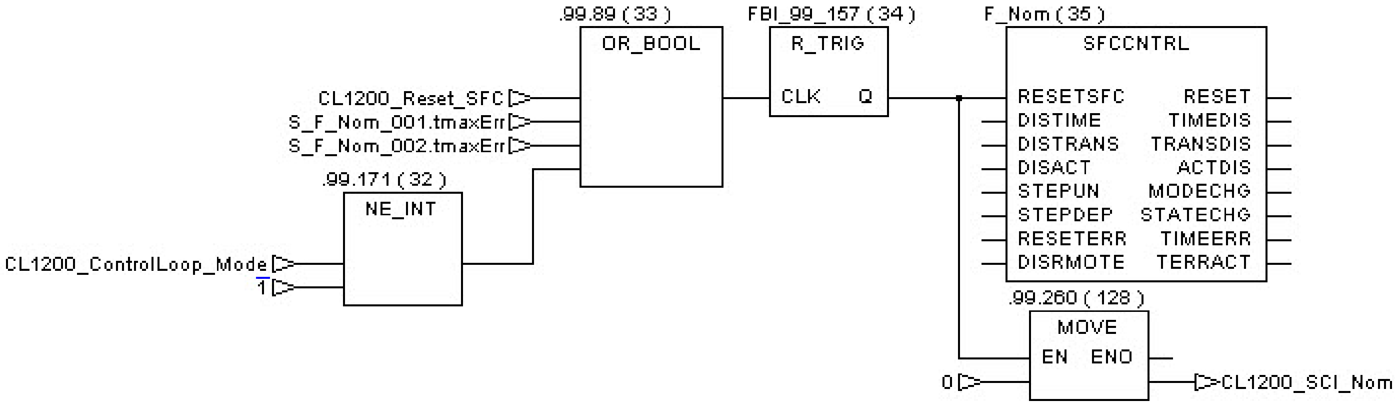


Figure 122: PLC procedure: F_Nom

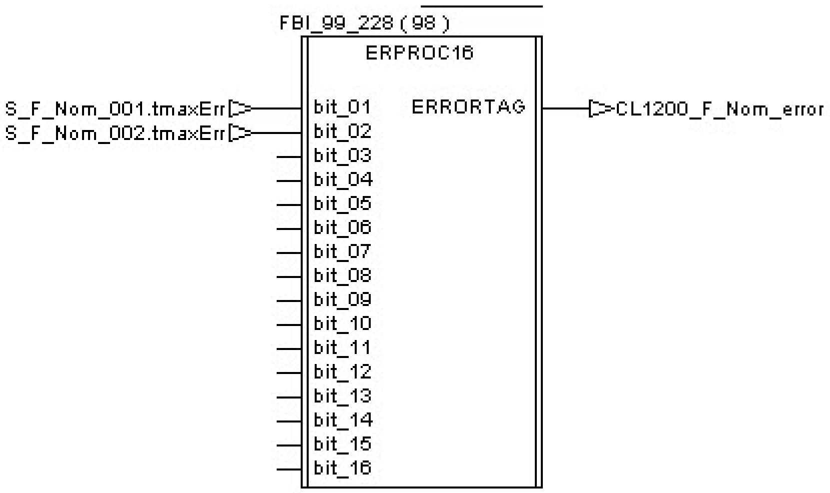
5.39.4.Procedure management

Reset of the procedure:

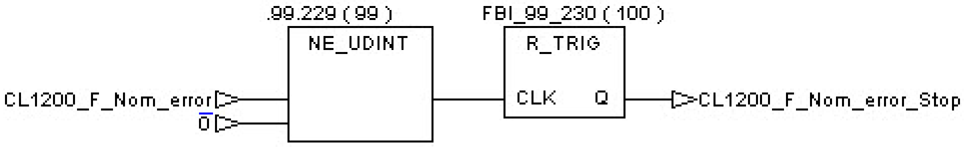
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure, the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



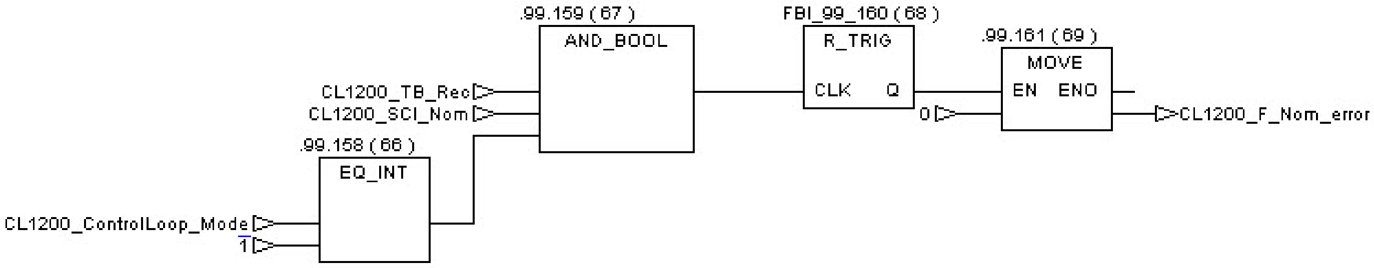
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag “CL1200_F_Nom_error_Stop” receives a pulse and then the Filtration Unit is stopped thanks to the procedure “F_Stop”.



The error number is displayed until the procedure is re-started.



5.39.5.Error number description

Error number	Procedure Action Step	problem description
1	**S_F_Nom_001**	valve(s) status Error operator has to look for valve alarm
2	**S_F_Nom_002**	Tag reset problem (Tracing bit or Start button)

5.39.6.Controlled Valves

CL1200_Valvestate_Rec_R

	VALVES	ADDRESS	COMMENTS
Filtration Unit Filtrate Flow Control			
	SV_1202_03_MV	000051	RESET
	SV_1202_04_MV	000100	SET
Effluent Tank General			
	SV_1204_02_MV	000054	SET
	SV_1204_03_MV	000101	SET

5.39.7. Awaited Feedback

For Nominal mode membrane 1

CL1200_Valvestate_Nom1_OK

Added Feedback from **CL1200_Valvestate_Cir1_OK (2009)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_FB	100088	RESET
	S3V_1201_04_FB	100085	RESET
	S3V_1201_07_FB	100075	RESET
	S3V_1201_08_FB	100074	RESET
	SV_1201_01_FB	100089	SET
	SV_1201_02_FB	100084	SET
	SV_1201_03_FB	100086	SET
	SV_1201_04_FB	100130	RESET
	SV_1201_05_FB	100087	SET (changed from RESET to SET)
	SV_1201_06_FB	100129	RESET
	SV_1201_07_FB	100076	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	SET
	SV_1202_02_FB	100131	RESET
	SV_1202_03_FB	100082	RESET
	SV_1202_04_FB	100132	SET
Filtration Unit Pressure control			
	SV_1203_01_FB	100078	RESET
	SV_1203_02_FB	100064	RESET
	SV_1203_04_FB	100137	RESET
Effluent Tank General			
	SV_1204_01_FB	100081	RESET
	SV_1204_02_FB	100079	SET
	SV_1204_03_FB	100133	SET
CIP General			
	S3V_1207_03_FB	100096	RESET
	S3V_1207_04_FB	100095	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_07_FB	100097	RESET
	SV_1207_09_FB	100094	RESET
	SV_1207_11_FB	100091	RESET
	SV_1207_13_FB	100139	RESET
SIP General			
	SV_1210_02_FB	100105	RESET
	SV_1210_03_FB	100108	RESET
	SV_1210_05_FB	100056	RESET
	SV_1210_07_FB	100060	RESET
	SV_1210_09_FB	100058	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET

Theses four valves
OR
The variable: CL1204_SCI_Harvest
(HMI button for harvesting)
permits to SET CL1200_Valvestate_Nom1_OK

For Nominal mode membrane 2

CL1200_Valvestate_Nom2_OK

Added Feedback from **CL1200_Valvestate_Cir2_OK (2009)**

	VALVES	ADDRESS	COMMENTS
	S3V_1201_07_FB	100075	RESET
	S3V_1201_08_FB	100074	RESET
	SV_1201_01_FB	100089	SET
	SV_1201_02_FB	100084	SET
	SV_1201_03_FB	100086	RESET
	SV_1201_04_FB	100130	SET
	SV_1201_05_FB	100087	RESET (Changed from SET to RESET)
	SV_1201_06_FB	100129	SET
	SV_1201_08_FB	100077	RESET
Filtration Unit Filtrate Flow Control			RESET
	SV_1202_01_FB	100083	RESET
	SV_1202_02_FB	100131	RESET
	SV_1202_03_FB	100082	RESET
	SV_1202_04_FB	100132	SET
Filtration Unit Pressure control			
	SV_1203_01_FB	100078	RESET
	SV_1203_02_FB	100064	RESET
	SV_1203_04_FB	100137	RESET
Effluent Tank General			
	SV_1204_01_FB	100081	RESET
	SV_1204_02_FB	100079	SET
	SV_1204_03_FB	100133	SET
CIP General			
	S3V_1207_03_FB	100096	RESET
	S3V_1207_04_FB	100095	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_06_FB	100098	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_12_FB	100140	RESET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_03_FB	100108	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_06_FB	100059	RESET
	SV_1210_08_FB	100057	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_FB	100136	RESET

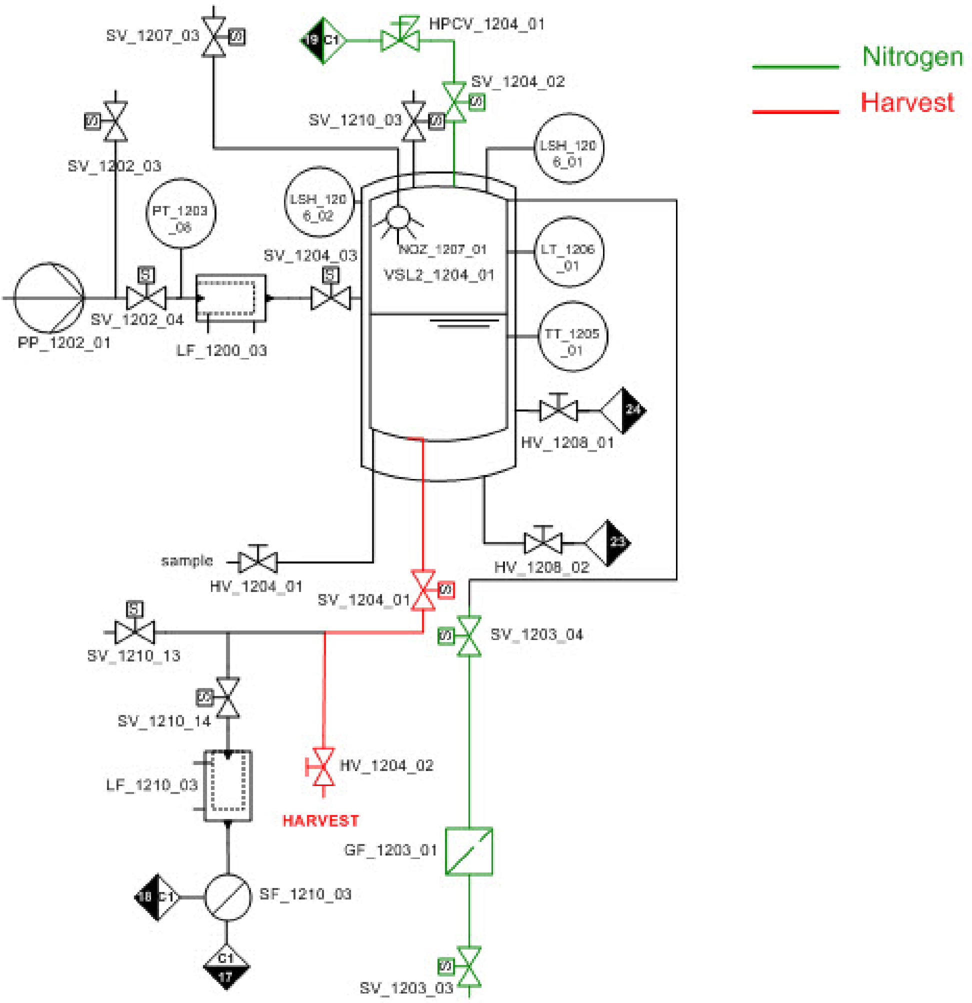
Theses four valves
OR
The variable: CL1204_SCI_Harvest
(HMI button for harvesting)
permits to SET CL1200_Valvestate_Nom1_OK

5.40. Procedure 39: Filtration Unit: Harvest Effluent vessel VSL2_1204_01

5.40.1.Scope

Harvest the effluent production contained in the effluent vessel VSL2_1204_01. To start the procedure, the filtration unit control loop mode button must be in automatic mode.
This procedure can also be used to evacuate any eventual liquid content in the effluent vessel, for instance cleaning agent left after interruption of a cleaning procedure that includes the effluent vessel. A dedicated tag named “CL1204_OP_Harvest_Flag” is set by the CIP procedure to avoid sterilization of the harvest line during cleaning phase.
The vent SV_1204_02 is opened (Change performs in 2010) and 1 barg pressurized N2 is applied by SV_1203_03 to evacuate liquid through SV_1204_01.

The Harvest can be stopped at any time by the HMI button “CL1204_StopHarvestNow” otherwise the Level switch low LSL_1206_01 finishes the procedure.


SV_1207_03
HPCV_1204_01
Nitrogen
Harvest
SV_1204_02
SV_1210_03
SV_1202_03
LSH_120
6_01
PT_1203
_08
LSH_120
6_02
SV_1204_03
NOZ_1207_01
LT_1206
_01
VSL2_1204_01
PP_1202_01
SV_1202_04
LF_1200_03
TT_1205
_01
HV_1208_01
sample
HV_1204_01
HV_1208_02
SV_1204_01
SV_1210_13
SV_1203_04
SV_1210_14
HV_1204_02
LF_1210_03
HARVEST
GF_1203_01
SF_1210_03
SV_1203_03

Prerequisite
The Filtration Unit must be in Automatic Mode.
The Manual valve HV_1204_02 must be opened.
A 20 Litres Vessel must be present to keep the harvest.

Procedure

Make sure tubing connects HV_1204_02 to a vessel with >= 20 L free space.
Press button ‘Harvest’: **CL1204_SCI_Harvest** (PLC Address: 000277)
The tracing Bit CL1204_TB_Harvest (PLC Address: 000278) is set.
The procedure set the variable CL1210_SCI_Harvest (Procedure 81: SIP: purge and sterilize harvest line). Operator has to follow HMI instruction.
Press HMI button **CL1201_SCI_Harvest_IsVsslPresent** (PLC Address: 000279)
Wait for the PLC procedure ending.

Used Variables:
CL1204_SCI_Harvest (PLC Address: 000277)
CL1204_TB_Harvest (PLC Address: 000278)
CL1201_SCI_Harvest_IsVsslPresent (PLC Address: 000279)

5.40.2.PLC Subroutine: F_Harvest

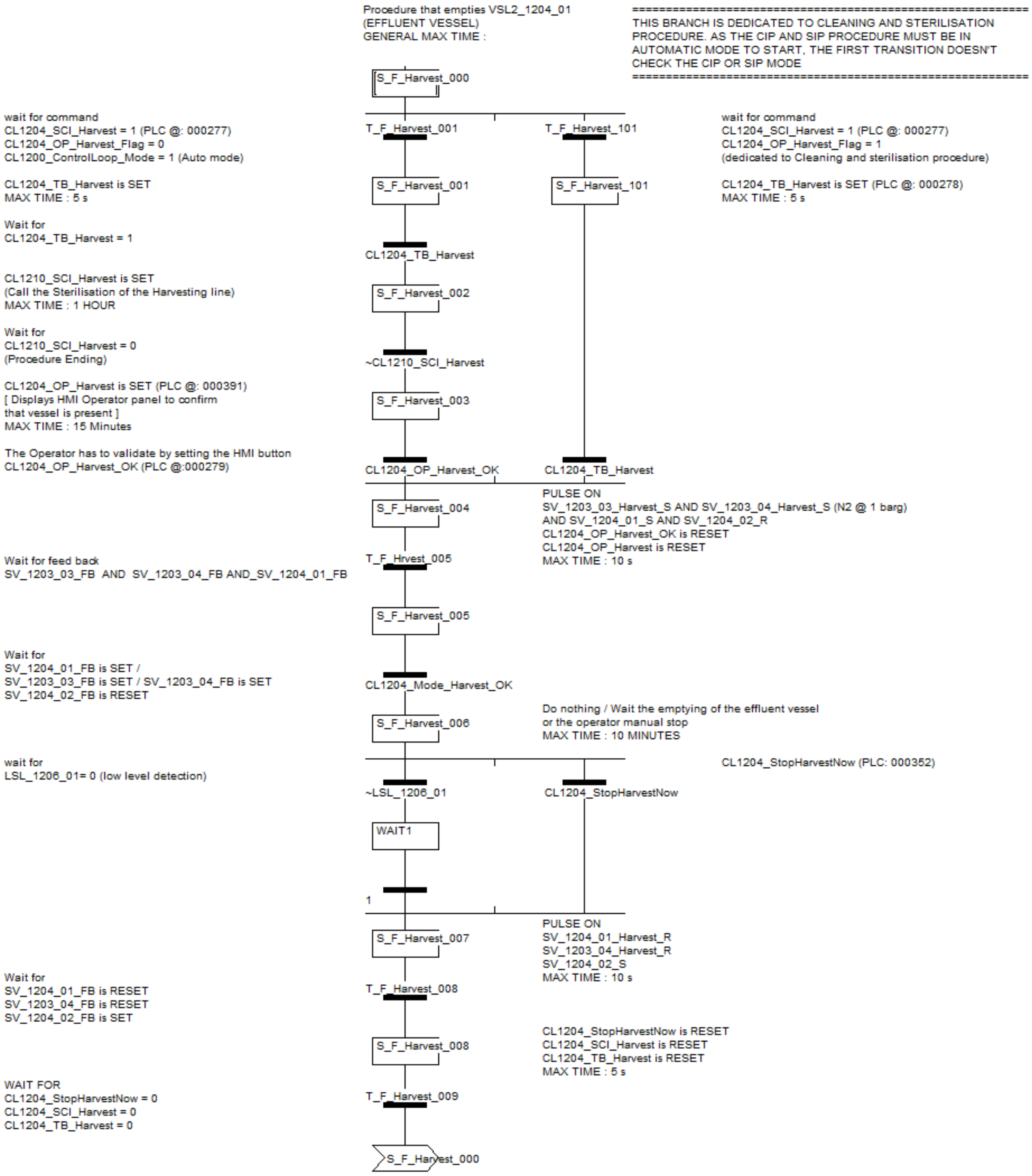
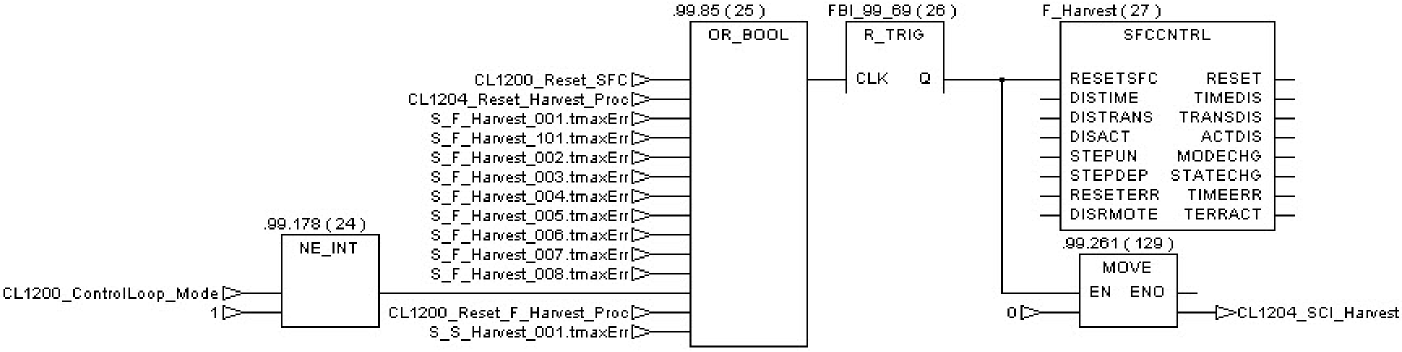


Figure 123: PLC procedure: F_Harvest

5.40.3.Procedure management

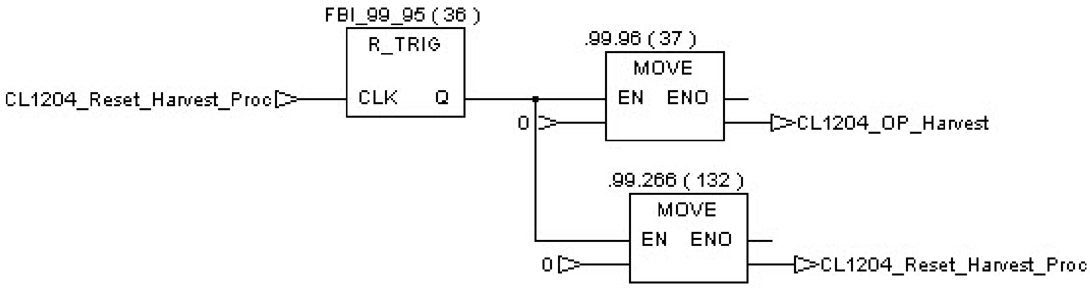
Reset of the procedure:

If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure, the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.

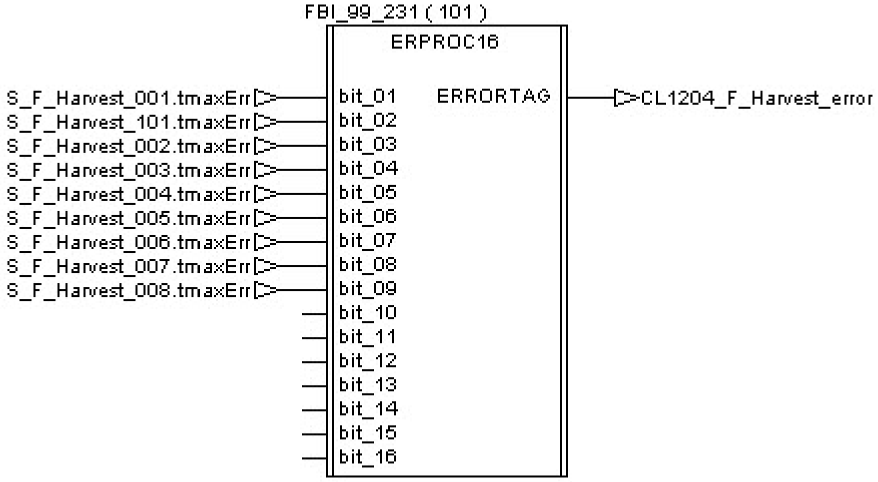


When the procedure starts, a window appears to confirm the harvest choice. The operator can start the harvest or cancel it. The cancel function is done by the following implementation.

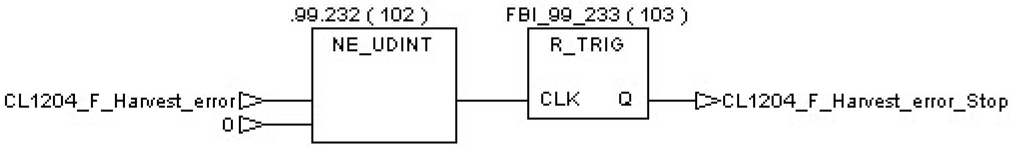
==
CL1204_Reset_Harvest_Proc is the button triggerred when the operator cancels the "operator panel" "CL1204_OP_Harvest". This tag reset the procedure and the operator panel variable.
==



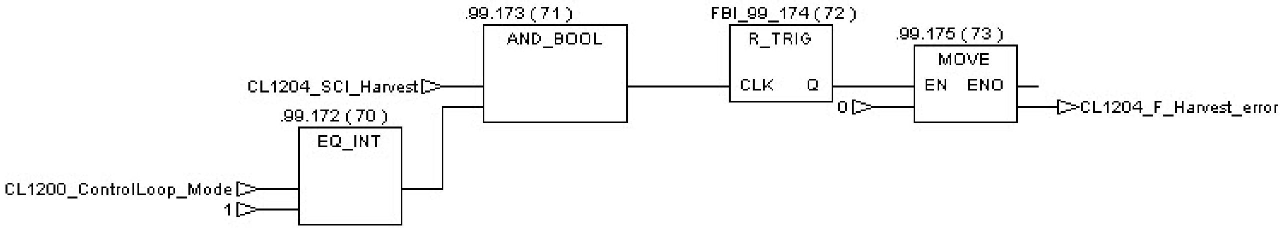
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1204_F_Harvest_error_Stop" receives a pulse and then the Filtration Unit is stopped thanks to the procedure "F_Stop".



The error number is displayed until the procedure is re-started.



5.40.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_F_Harvest_001**	Tag reset problem (Tracing bit)
2	**S_F_Harvest_101**	Tag reset problem (Tracing bit)

4	**S_F_Harvest_002**	Problem during the execution of the procedure "S_Harvest" (sterilization of the Harvest line) The procedure "S_Harvest" should also have an error code
8	**S_F_Harvest_003**	The operator didn't answer to the operator panel asking if a vessel is present (max time 15 minutes)
16	**S_F_Harvest_004**	valve(s) status Error operator has to look for valve alarm
32	**S_F_Harvest_005**	valve status Error operator has to look for valve alarm
64	**S_F_Harvest_006**	level switch low (LSL_1206_01) problem
128	**S_F_Harvest_007**	valve(s) status Error operator has to look for valve alarm
256	**S_F_Harvest_008**	Tag reset problem (Tracing bit or Start button)

Description:
Input HMI: **CL1204_SCI_Harvest** (PLC Address: 000277)
CL1204_TB_Harvest (PLC Address: 000278)
CL1201_SCI_Harvest_IsVsslPresent (PLC Address: 000279)
CL1204_OP_Harvest is SET (PLC Address: 000391)

The Vessel for harvesting must be present and valves are in position
The Harvest begins and continues until the level switch is OFF
Valves are RESET and the harvesting vessel is taken off

5.41. Procedure 40: Drain Filtration Unit: retentate line

5.41.1.Scope

Drain the retentate line of the FU. If the purpose is to shut down and clean the entire system, **use PROCEDURE 46: Shut down the System, drain, rinse and clean Bioreactor VSL2_1007_01, Feeding vessel VSL2_1000_01 and Filtration unit**.
The description below may need adaptation as it is never been executed before.

Prerequisite
FU is stopped (can be done by procedures 17 or 29)
This procedure has to be executed in Manual Mode.

Procedure
Drain the retentate in the FU at the pressure side of GP_1201_01 via VSL2_1007_01 by opening SV_1201_02 and SV_1202_03. If the hose at HV_1007_07 is connected and HV_1007_07 is open, the liquid will be pushed into the bioreactor. Switch both SV_1201_05 and -04 to empty the second membrane. Switch both S3V_1201_01 and -05 to drain the bypass piece.
Close HV_1007_06.
Stop GP_1201_01
Close SV_1201_02.
Stop PP_1202_01 and start it backwards.
Close HV_1007_05 when gas starts entering VSL2_1007_01.
Stop GP_1201_01
Close SV_1201_01 and SV_1203_02.

PLC Subroutine: No SFC procedure

5.42. Procedure 41: Drain Filtration Unit: inside membranes LF_1200_01/LF_1200_02

5.42.1.Scope

Drain and rinse the retentate inside one membrane of the FU.

Prerequisite
The filtration unit must not be running over the membrane that is to be drained.

Procedure
Dilute the retentate with water using **PROCEDURE 49: Cleaning of Filtration Unit: retentate side of membrane LF_1200_01 / LF_1200_02: CL1207_SCI_Cl1 or CL1207_SCI_Cl2**

5.43. Procedure 42: Drain Filtration Unit: filtrate line

5.43.1.Scope

Get liquid out of the part of the filtration piping starting at the effluent vessel and going via filtrate side to retentate side of the membrane LF_1200_01 of LF_1200_02.

Prerequisite
Effluent vessel VSL2_1204_01 must be empty

Procedure

**IMPORTANT POINT: The procedure C_Drain_All1, C_Drain_All2, CL1207_SCI_CB_to_drain1 and CL1207_SCI_CB_to_drain2 do not exist. Depending of the needs of the MPP, it can be created in an automatic way. However, it also can be done by the manual mode.
Need to be discussed.**

Unlock the tubing in PP_1202_01.
Make sure that the steam valve on the steam generator is entirely closed.
Use the HMI to start PLC procedure C_Drain_All1 if filtrate line including membrane1 is to drained or C_Drain_All2 if filtrate line including membrane2 needs to be drained: CL1207_SCI_CB_to_drain1, CL1207_SCI_CB_to_drain2

These procedures open the respective drain valve SV_1201_07 or SV_1201_08 at the bottom of the membrane module and valves SV_1210_09 and SV_1210_02 or respectively SV_1210_08and SV_1210_01.
Then SV_1203_03 is activated to put pressure from the N2 line on the effluent vessel and push the liquid out of the filtration line, through a piece of the SIP piping and the retentate side of the membrane. It leaves the system via the drain valve.

5.44. Procedure 43: Drain Filtration Unit: Entire Filtration Unit

5.44.1.Scope

Empty all FU piping.

Prerequisite
FU must be stopped (procedure 17 or 29).

Procedure
Harvest the effluent in VSL2_1204_01 (see PROCEDURE 39: Filtration Unit:): CL1204_SCI _Harvest
Drain the retentate piping (see PROCEDURE 40: Drain Filtration Unit: retentate line)
Drain filtrate piping (see PROCEDURE 42: Drain Filtration Unit: filtrate line)

5.45. Procedure 44: Fill Filtration Unit with water

5.45.1.Scope

Membranes mounted in a membrane module are best preserved in clear water.

Prerequisite
FU must be filtrating over one of the two membranes in nominal or in recycle mode.

Procedure
This can be done using a cleaning procedure like PROCEDURE 50: Cleaning of Filtration Unit: Retentate and filtrate side of membrane LF_1200_01 / LF_1200_02 followed by PROCEDURE 49: Cleaning of Filtration Unit: retentate side of membrane LF_1200_01 / LF_1200_02.

PLC Subroutines: **C_Cl1, C_Cl2, C_BCl1, C_BCl2**
These subroutines are described in PROCEDURE 49 and PROCEDURE 50

Variables Used (I/O):
All variables involved in PROCEDURE 49 and PROCEDURE 50

5.46. Procedure 45: CIP: (Nominal) shut down of CIP activities

5.46.1. Scope

The procedure which manages the Stop of the CIP can only be activated (as all the other procedures) in automatic mode. Its aim is to Stop any CIP action being active.
This procedure should normally not be used because any CIP procedure should terminate itself in a nominal way. This may be very useful to stop any CIP procedure that is initiated wrongly.
A section named "Stop cleaning procedure management" situated in the CIP General chapter, detailed the different ways offered by the software to stop the cleaning functions.

Procedure
The CIP control loop button must be in automatic mode.
Use the HMI to start PLC procedure C_Stop: **CL1207_SCI_Stop** (PLC Address: 000268).
The CIP pumps are stopped.
The CIP valves are closed
All the procedures, the start buttons and the tracing bits linked to the cleaning functions are reset.
CL1207_TB_Stop (PLC Address: 000339) is set.

Water or cleaning agent may be left in the cleaning agent tank VSSL_1209_01 and the cleaning buffer tank VSSL_1209_02. If this is the case or if it is not sure that they are emptied use PROCEDURE 58: Empty VSSL_1209_and PROCEDURE 59: Empty VSSL_1209_02 or PROCEDURE 60: Clean VSSL_1209_01 and VSSL_1209_02: CL1209_SCI_Empty_CA (PLC Address: 000244), CL1209_SCI_Empty_CB (PLC Address: 000245), CL1207_SCI_Clean_CAB (PLC Address: 000241)

Used Variables:
CL1207_SCI_Stop (PLC Address: 000268)
CL1207_TB_Stop (PLC Address: 000339)

5.46.2.PLC Subroutines: C_Stop

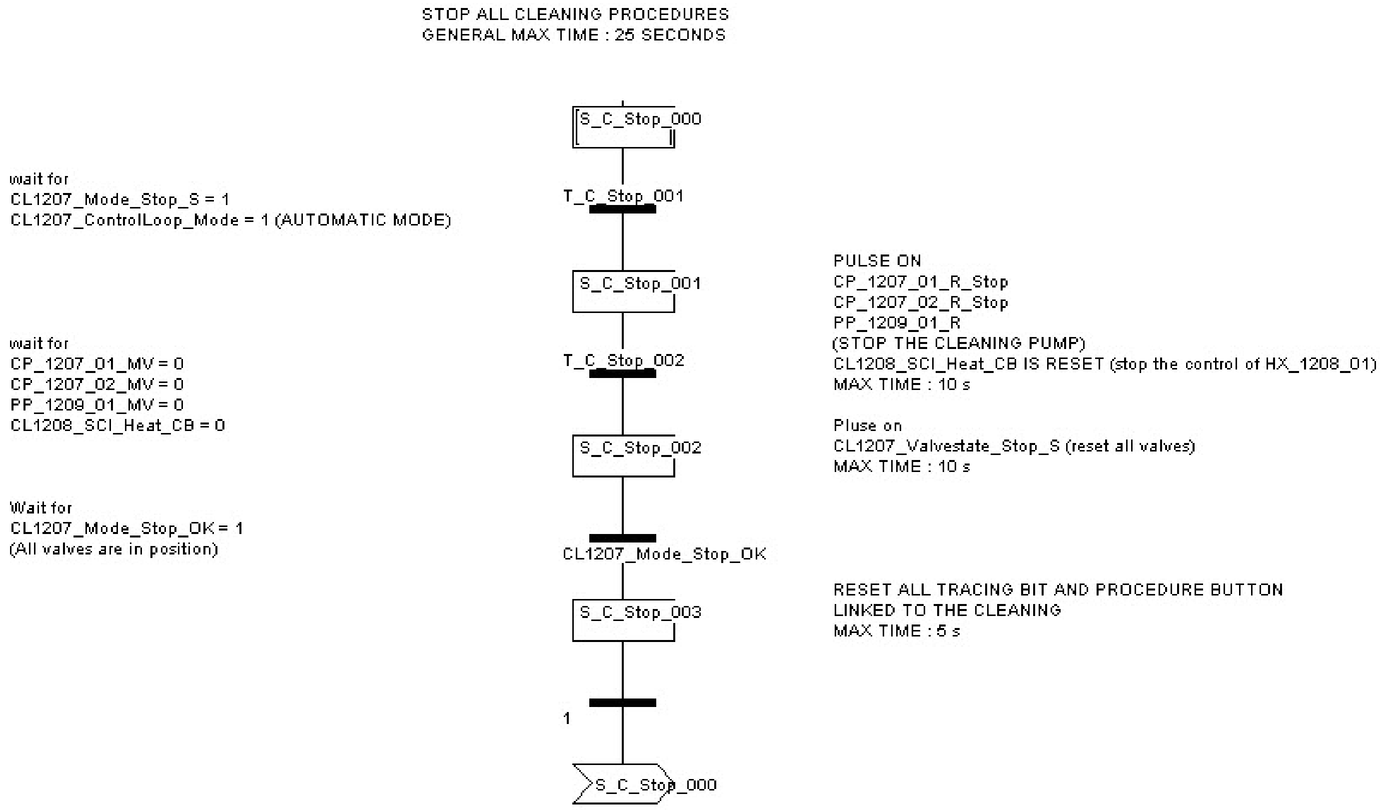
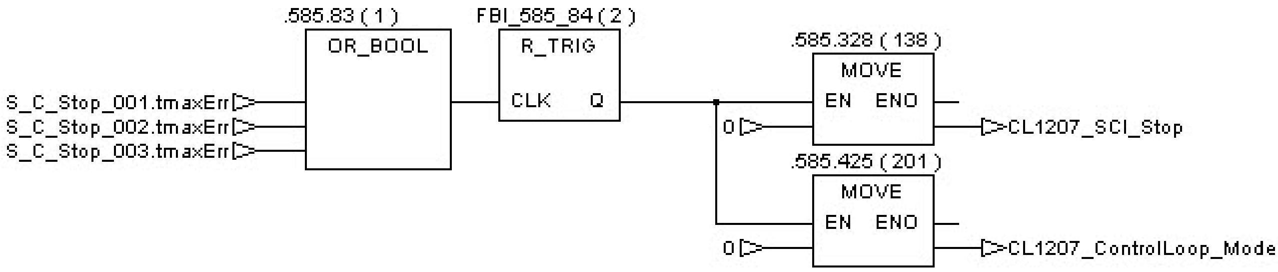


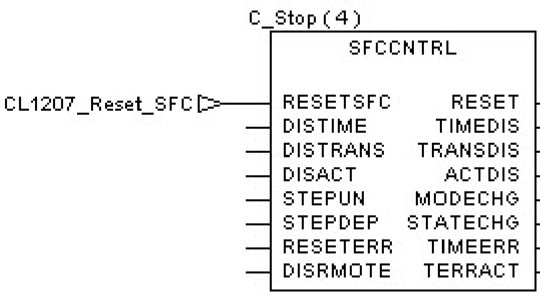
Figure 124: PLC procedure: C_Stop

5.46.3.Procedure management

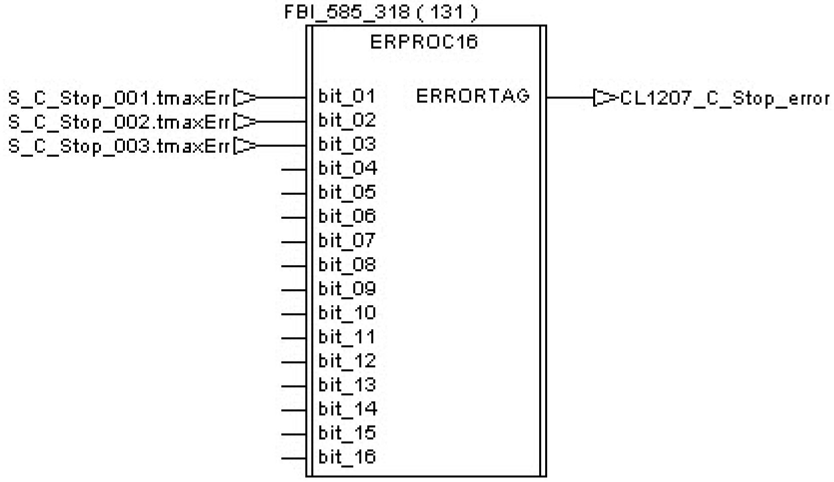
If a time error occurs during the execution of the procedure, the start procedure button variable is reset and the Control Loop Mode is triggered to OFF mode. (If the stop procedure has a problem, the only way to solve it is to set all equipments in default position by the OFF mode).



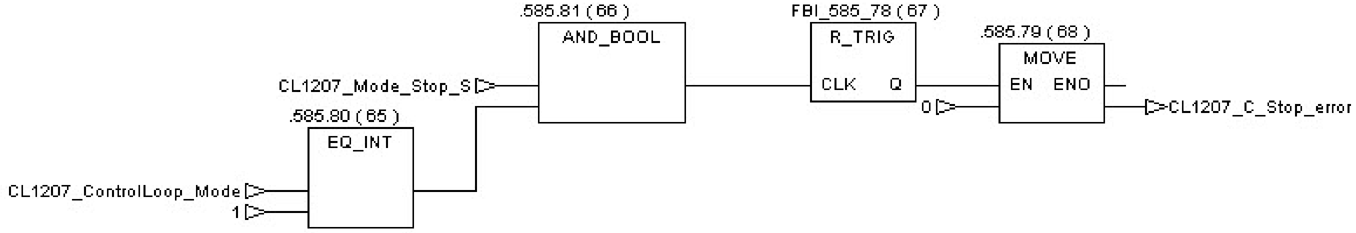
In Parallel, the procedure named "CL1207_ RESET_PROC" is started. This procedure, detailed further on, triggers a general reset (CIP procedures and equipments) to ensure the default status of all the Cleaning function when automatic mode is re-started.
The block "SFC_CNTRL" permits to reset the procedure C_Stop. It is done thanks to the variable "CL1207_Reset_SFC" (set by proc "CL1207_RESET_PROC").



<u>Procedure error management:</u>
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



The error number is displayed until the procedure is re-started.



5.46.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_C_Stop_001**	One of the two cleaning pumps have not been stopped. (CP_1207_01, CP_1207_02 or PP_1209_01)
2	**S_C_Stop_002**	valve(s) status Error operator has to look for valve alarm
4	**S_C_Stop_003**	Tag reset problem (Tracing bit or Start button)

5.46.5.Controlled valves

CL1207_Valvestate_Stop_S

Added Valves in **CL1207_Valvestate_Stop_S (2009)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_MV	000061	And (CL1207_SCI_CIPMP) =>RESET
	S3V_1201_04_MV	000064	And (CL1207_SCI_CIPMP) =>RESET
	SV_1201_07_MV	000041	And [(CL1207_SCI_BCI1) OR (CL1207_SCI_ET1)] =>RESET
	SV_1201_08_MV	000056	And [(CL1207_SCI_BCI2) OR (CL1207_SCI_ET2)]=>RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_MV	000050	And (CL1207_SCI_ET1) => RESET
	SV_1202_02_MV	000099	And (CL1207_SCI_ET2) => RESET
	SV_1202_03_MV	000051	And (CL1207_SCI_VSL2_1204_01) =>RESET
	SV_1202_04_MV	000100	And [(CL1207_SCI_ET1) OR (CL1207_SCI_ET2)]
Effluent Tank General			
	SV_1204_01_MV	000052	And (CL1207_SCI_VSL2_1204_01) =>RESET
	SV_1204_02_MV	000054	And (CL1207_SCI_VSL2_1204_01) =>RESET
	SV_1204_03_MV	000101	And [(CL1207_SCI_ET1) OR (CL1207_SCI_ET2)] =>RESET
CIP General			
	S3V_1207_03_MV	000069	RESET
	S3V_1207_04_MV	000070	RESET
	SV_1207_01_MV	000074	RESET
	SV_1207_02_MV	000075	RESET
	SV_1207_03_MV	000076	RESET
	SV_1207_04_MV	000077	RESET
	SV_1207_05_MV	000059	RESET
	SV_1207_06_MV	000067	RESET
	SV_1207_07_MV	000068	RESET
	SV_1207_08_MV	000072	RESET
	SV_1207_09_MV	000071	RESET
	SV_1207_10_MV	000057	RESET
	SV_1207_11_MV	000058	RESET
	SV_1207_12_MV	000110	RESET
	SV_1207_13_MV	000109	RESET
CIP Filling control			
	SV_1209_01_MV	000078	RESET
	SV_1209_02_MV	000079	RESET
	SV_1209_03_MV	000080	RESET
	SV_1209_04_MV	000065	RESET
	SV_1209_05_MV	000066	RESET

5.46.6.Awaited Feed back

CL1207_Valvestate_Stop_OK

Added Feedback in CL1207_Valvestate_Stop_OK (2009)

	VALVES	ADDRESS	COMMENTS
CIP General			
	S3V_1207_03_FB	100096	RESET
	S3V_1207_04_FB	100095	RESET
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_04_FB	100104	RESET
	SV_1207_05_FB	100090	RESET
	SV_1207_06_FB	100098	RESET
	SV_1207_07_FB	100097	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_09_FB	100094	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_11_FB	100091	RESET
	SV_1207_12_FB	100140	RESET
	SV_1207_13_FB	100139	RESET
CIP Filling control			
	SV_1209_01_FB	100103	RESET
	SV_1209_02_FB	100102	RESET
	SV_1209_03_FB	100101	RESET
	SV_1209_04_FB	100100	RESET
	SV_1209_05_FB	100099	RESET

Description:
Input HMI:
CL1207_SCI_Stop (PLC Address: 000268)
All pumps involved in CIP are TURNED OFF and all cleaning valves are closed.

5.47. Procedure 46: Shut down the System, drain, rinse and clean Bioreactor VSL2_1007_01, Feeding vessel VSL2_1000_01 and Filtration unit

5.47.1.Scope

This procedure is part of shutting down the installation. It suggests a series of handlings to empty all liquid from the system and to clean all the places where liquid was present. This hasn't been done before and consequently hasn't been tested. The way of working may need to be adapted during progress of execution of this procedure for the first time.
It can only be done thanks to the manual mode.

Procedure
Shut down the gas and filtration loops.
Stop the filtration loop: CL1200_SCI_Stop, CL1200_SCI_Stop_FCS_S
Stop the entire gas loop.
Shut down pH and temperature control
Use the HMI to disable pH control. Close HV_1011_01 and HV_1011_02.
Close valves that connect VSL2_1007_01 to the gas loop, except for N2 addition. (HV_1007_08, -13, -14, -15, -16, -17)
Disable temperature control in both VSL2_1007_01 and VSL2_1000_01 on the HMI. This will disable the heater HX_1008_01 and the cooler HX_1002_01.
Deactivate CP_1008_01. To do this, switch off F14 in the electrical cabinet from the bioreactor frame.
Deactivate CP_1002_01. To do this, switch off F16 in the electrical cabinet from the bioreactor frame.
Empty both double jackets, heating vessel and cooler.
Drain bioreactor
Connect a hose to HV_1007_03 and to a recipient.
Open HV_1007_03 to drain the reactor. N2 will be added.
Close HV_1009_01 the moment gas starts leaving via HV_1007_03.
Drain influent vessel
Connect a hose to HV_1000_01 and to a recipient.
Stop GP_1001_01 and disable feeding.
Open HV_1000_01 to drain the reactor. N2 will be added.
Close HV_1003_01 the moment gas starts leaving via HV_1000_01.
Rinse influent vessel
Fill VSSL_1209_01with water (cfr. PROCEDURE 62: Fill water into VSSL_1209_01): CL1209_SCI_Fill_WA
Make sure HV_1000_01 is open and open HV_100_02, HV_1000_03 and SV_1207_01: SCI_SV_1207_01_S
Start CP_1207_01 to rinse the influent vessel: SCI_CP_1207_01_P
Repeat previous three last steps until the water coming out of HV_1000_01 is clear.

Drain FU: pressure side of retentate line
Drain the retentate in the FU at the pressure side of GP_1201_01 via VSL2_1007_01 by opening SV_1201_02 and SV_1203_02: PROCEDURE 40
Switch SV_1201_05, SV_1201_04 and SV_1201_03 to empty the second membrane.
Switch both S3V_1201_01 and -04 to drain the bypass piece.
Close SV_1201_02 and SV_1203_02.
Drain FU: suction side of retentate line
The suction side of the filtration unit retentate line cannot be emptied by pressurized N2. Its contents can however be replaced by water coming from the bioreactor.
Disconnect the return hose from the FU connected to HV_1007_06 and put it into a recipient.
Fill VSSL_1209_01with water (cfr. PROCEDURE 62: Fill water into VSSL_1209_01): CL1209_SCI_Fill_WA (PLC Address: 000253)
Close HV_1007_06 and HV_1007_03 and open SV_1207_02: SCI_SV_1207_02_S (TBD). Then Start CP_1207_01 to start filling water in the bioreactor: SCI_CP_1207_01_P (PLC Address: 000338). Repeat these two last steps until HV_1007_05 is below water level.
Start the FU in bypass mode: CL1201_SCI_Bypass (PROCEDURE 34). If necessary fill more water. Stop the FU when the water coming out of the return hose is clear: CL1200_SCI_Stop
Do the same circulating over membrane 1 and 2: CL1200_SCI_Cir1, CL1200_SCI_Cir2, CL1200_SCI_Fil (PROCEDURE 36)
Reconnect the return hose to HV_1007_06. Close SV_1207_02 and open HV_1007_03 to drain the remaining water from the bioreactor.
Rinse piping between bioreactor VSL2_1007_01 and influent vessel VSL2_1000_01
Close HV_1000_01 and make sure HV_1007_03 is open.
Fill water in VSSL_1209_01(cfr. PROCEDURE 62: Fill water into VSSL_1209_01) and repeat this until the connection to the pump is under water: CL1209_SCI_Fill_WA Switch S3V_1001_01 and start GP_1001_01. Control the volume present in VSL2_1000_01 and fill more water if necessary: SCI_GP_1001_01_Right
When the water coming from HV_1007_03 is clear GP_1001_01 can be stopped and valves can be switched back.
Open HV_1000_01 to empty VSL2_1000_01.
Rinse piping from recirculation loop over GP_1001_01.
Fill VSSL_1209_01with water (cfr. PROCEDURE 62: Fill water into VSSL_1209_01): CL1209_SCI_Fill_WA
Make sure HV_1000_01 is closed and open HV_1000_02, HV_1000_03 (V-V-06) and SV_1207_01
Start CP_1207_01 to fill the influent vessel: SCI_CP_1207_01_P
Repeat previous three last steps until the connection to GP_1001_01 is below water level.
Start GP_1001_01. Let it run for some time to have the volume of liquid in VSL2_1000_01
Circulated a few times: SCI_GP_1001_01_Right)
Open HV_1000_01 to empty VSL2_1000_01.
Clean VSL2_1000_01 and piping between VSL2_1007_01 and VSL2_1000_01

Use PROCEDURE 47: Cleaning Influent tank VSL2_1000_01 to clean VSL2_1000_01.
Close HV_1000_01 and make sure HV_1007_03 is closed.
Fill cleaning agent into VSSL_1209_01 (cfr.PROCEDURE 61: Fill cleaning agent into VSSL_1209_01), open HV_1000_02, HV_1000_03 (V-V-06) and SV_1207_01.
Start CP_1207_01 to fill the influent vessel. Repeat this until the connection to the pump is under water: CL1209_SCI_Fill_CA (PLC Address: 000248)
Switch S3V_1001_01 and start GP_1001_01. GP_1001_01 will stop automatically to protect GP_1001_01 from running dry. Repeat from previous step constantly for about half an hour. This maintains presence of cleaning agent where otherwise influent remains in the piping.
This way influent caked onto the piping is soaked off.
Switch S3V_1001_01 back
Clean piping from recirculation loop over GP_1001_01
Make sure HV_1000_01 is closed and open HV_1000_02, HV_1000_03 (V-V-06) and SV_1207_01
Fill VSSL_1209_01 with cleaning agent (cfr. PROCEDURE 61: Fill cleaning agent into VSSL_1209_01): CL1209_SCI_Fill_CA (PLC Address: 000248)
Start CP_1207_01 to fill the influent vessel. Repeat this until the connection to the pump is under water: SCI_CP_1207_01_P
Start GP_1001_01. Let it run for 30 minutes: SCI_GP_1001_01_Right
Open HV_1000_01 to empty VSL2_1000_01.
Rinse influent vessel VSL2_1000_01
Fill VSSL_1209_01with water (cfr. PROCEDURE 62: Fill water into VSSL_1209_01): CL1209_SCI_Fill_WA
Make sure HV_1000_01 is open and open HV_1000_02, HV_1000_03 and SV_1207_01: SCI_SV_1207_01_S
Start CP_1207_01 to rinse the influent vessel:
Repeat previous three last steps until the water coming out of HV_1000_01 is clear.
Rinse piping between bioreactor VSL2_1007_01 and influent vessel VSL2_1000_01
Close HV_1000_01 and make sure HV_1007_03 is open.
Fill VSSL_1209_01with water (cfr. PROCEDURE 62: Fill water into VSSL_1209_01) and repeat this until: CL1209_SCI_Fill_WA
The connection to the pump is under water.
Switch S3V_1001_01 and start GP_1001_01. Control the volume present in VSL2_1000_01 and fill more water if necessary: : SCI_GP_1001_01_Right
When the water coming from HV_1007_03 is clear GP_1001_01 can be stopped and valves can be switched back.
Open HV_1000_01 to empty VSL2_1000_01.
Rinse piping from recirculation loop over GP_1001_01.
Fill VSSL_1209_01with water (cfr. PROCEDURE 62: Fill water into VSSL_1209_01): CL1209_SCI_Fill_WA
Make sure HV_1000_01 is closed and open HV_1000_02, HV_1000_03 (V-V-06) and SV_1207_01: SCI_SV_1207_01_S
Start CP_1207_01 to fill the influent vessel: SCI_CP_1207_01_P
Repeat previous three last steps until the connection to GP_1001_01 is below water level.

Start GP_1001_01. Let it run for some time to have the volume of liquid in VSL2_1000_01
Open HV_1000_01 to empty VSL2_1000_01.
Rinse influent vessel VSL2_1000_01
Fill water into VSSL_1209_01(cfr. PROCEDURE 62: Fill water into VSSL_1209_01): CL1209_SCI_Fill_WA
Make sure HV_1000_01 is open and open HV_1000_02, HV_1000_03 (V-V-06) and SV_1207_01: SCI_SV_1207_01_S
Start CP_1207_01 to rinse the influent vessel: SCI_CP_1207_01_P
Repeat previous three last steps until the water coming out of HV_1000_01 is clear.
Stop BLE_1005_01 by means of the HMI: SCI_BLE_1005_01 (PLC ADDRESS: 000201)
Clean FU using a series a pre programmed actions (cfr. PROCEDURE 56: Cleaning of Filtration Unit: automated execution of a sequence of procedures to clean membrane LF_1200_01 / LF_1200_02
Clean VSL2_1007_01 and FU retentate side by filling cleaning agent into VSL2_1007_01 and running FU in bypass mode.
Some (used cleaning agent may be present in VSL2_1007_01 from previous actions. Fill more cleaning agent in VSL2_1007_01 by repeatedly filling VSSL_1209_01 by PROCEDURE 61: Fill cleaning agent into VSSL_1209_01, and pumping it into VSL2_1007_01 (SV_1207_02 open, activate CP_1207_01) until connection HV_1007_05 is under liquid level. Then add some more to compensate for the volume in the FU in bypass mode.
Start the FU in bypass mode PROCEDURE 34: Filtration unit: Start up in Bypass mode: CL1201_SCI_Bypass
Let this run for about half an hour.
Stop the FU and empty VSL2_1007_01 by HV_1007_03: CL1200_SCI_Stop
Rinse VSL2_1007_01
Fill VSSL_1209_01 with water (cfr. PROCEDURE 62: Fill water into VSSL_1209_01): CL1209_SCI_Fill_WA
Make sure HV_1007_03 is open and open HV_1007_04 and SV_1207_07: SCI_SV_1207_02_S
Start CP_1207_01 to rinse the VSL2_1007_01: SCI_CP_1207_01_P
Repeat previous three last steps until the water coming out of VSL2_1007_01 is clear.
Rinse the FU bypass loop by filling water into VSL2_1007_01 and running FU in bypass mode. Return connection from FU to VSL2_1007_01 must be detached first.
Detach the flexible hose from HV_1007_06 and put it in a recipient, a sink or connect it to a drain.
Fill water in VSL2_1007_01 by repeatedly filling VSSL_1209_01 by PROCEDURE 62: Fill water into VSSL_1209_01, and pumping it into VSL2_1007_01 (SV_1207_02open, activate CP_1207_01) until connection HV_1007_05 is under liquid level. Then add some more to compensate for the volume in the FU in bypass mode.
Start the FU in bypass mode PROCEDURE 34: Filtration unit: Start up in Bypass mode: CL1201_SCI_Bypass
For about half an hour keep on filling water into VSL2_1007_01 and have it pumped through the FU bypass loop

Stop the FU and empty VSL2_1007_01 by HV_1007_03.
Stop BLE_1012_01: CL1012_ControlLoop_mode button to OFF mode

Used Variables: CL1200_SCI_Stop, CL1100_SCI_Stop, CL1209_SCI_Fill_WA, SCI_SV_1207_01_S, SCI_CP_1207_01_P, SCI_SV_1207_02_S, CL1201_SCI_Bypass, CL1200_SCI_Cir1, CL1200_SCI_Cir2, CL1200_SCI_Fil, SCI_GP_1001_01_Right, CL1209_SCI_Fill_CA, SCI_V_S3V_1001_01_R, SCI_BLE_1005_01 (PLC ADDRESS: 000201), SCI_BLE_1012_01

PLC Subroutine: **F_Stop, G_Stop, C_Fill_WA, F_Bypass, F_Cir1, F_Cir2, F_Fil, C_Fill_CA**

Variables Used (I/O):
All variables involved in PROCEDURE 18/29, PROCEDURE 62 and PROCEDURE 34, PROCEDURE 35/36, PROCEDURE 61

5.48. Procedure 47: Cleaning Influent tank VSL2_1000_01

5.48.1.Scope

IMPORTANT POINT: This procedure does not exist. Depending of the needs of the MPP, it can be created in an automatic way.
However, it also can be done by the manual mode.
Need to be discussed.

Clean the influent tank VSL2_1000_01.

Procedure:
Fill VSSL_1209_03 with cleaning agent prepared following PROCEDURE 4: Preparation of cleaning agent for Filtration Unit Cleaning.
Open HV_1000_01.
VSSL_1209_01 is filled with water: CL1209_SCI_Fill_WA (PROCEDURE 62)
SV_1207_01 is opened and CP_1207_01 started to empty VSSL_1209_01 in the influent vessel and rinse off all particles that can be rinsed off by water: Now cleaning agent can reach the particles that are so well attached that they couldn't be rinsed off with water. VSSL_1209_01 is filled with cleaning agent, which is then squirted into VSL2_1007_01: CL1209_SCI_Fill_CA (PROCEDURE 61)
When the particles are in contact with the cleaning agent for some time they soak off and can be removed with water. VSSL_1209_01is filled with water again and the influent vessel is rinsed: CL1209_SCI_Fill_WA (PROCEDURE 62)

Repeat this procedure until all particles are removed.
Close HV_1000_01.

Used Variables: CL1209_SCI_Fill_WA, SCI_SV_1207_01_S, SCI_CP_1207_01_P, CL1209_SCI_Fill_CA

PLC Subroutine: **C_Fill_WA, C_Fill_CA**
These subroutines are described in PROCEDURE 61 and PROCEDURE 62

Variables Used (I/O):
All variables involved in PROCEDURE 61 and PROCEDURE 62, CP_1207_01 and SV_1207_01_MV

5.49. Procedure 48: Cleaning Bioreactor VSL2_1007_01

5.49.1.Scope

IMPORTANT POINT: This procedure has never existed. Depending of the needs of the MPP, it can be created in an automatic way.
However, it also can be done by the manual mode.
Need to be discussed.

Clean the bioreactor VSL2_1007_01.

Procedure:
Fill VSSL_1209_03 with cleaning agent prepared following PROCEDURE 4: Preparation of cleaning agent for Filtration Unit Cleaning.
Open HV_1007_03.
VSSL_1209_01is filled with water: CL1209_SCI_Fill_WA
SV_1207_02opened and CP_1207_01 started to empty VSSL_1209_01 in the bioreactor and rinse off all particles that can be rinsed off by water: SCI_SV_1207_02_S, SCI_CP_1207_01_P
Now cleaning agent can reach particles that could not be rinsed with water. VSSL_1209_01is filled with cleaning agent, which is then squirted into VSL2_1007_01: CL1209_SCI_Fill_CA
When the particles are in contact with the cleaning agent for some time they soak off and can be removed with water. VSSL_1209_01 is filled with water again and the bioreactor is rinsed: CL1209_SCI_Fill_WA
Repeat this procedure until all particles are removed.
Close HV_1007_03.

Used Variables: CL1209_SCI_Fill_WA, SCI_SV_1207_02_S, SCI_CP_1207_01_P, CL1209_SCI_Fill_CA

PLC Subroutine: **C_Fill_WA, C_Fill_CA**
These subroutines are described in PROCEDURE 61 and PROCEDURE 62

Variables Used (I/O):
All variables involved in PROCEDURE 61 and PROCEDURE 62, V_C_02 and CP_1207_01

Description: See PROCEDURE 61 and PROCEDURE 62

5.50. Procedure 49: Cleaning of Filtration Unit: retentate side of membrane LF_1200_01 / LF_1200_02

5.50.1.Scope

This Procedure can only be activated when the FU, the CIP and the SIP control Loop mode button are in Automatic mode.

The aim of this procedure is to clean the inside of a membrane. It may be useful to do on a regular time basis to slow down fouling of the membrane. This procedure must be used to remove retentate before use of:
PROCEDURE 50: Cleaning of Filtration Unit: retentate and filtrate side of membrane LF_1200_01 / LF_1200_02.
Automated cleaning of the membranes (PROTOCOLS OF CLEANING) as described in **PROCEDURE 56: Cleaning of *Filtration Unit: automated execution of a sequence of procedures to clean membrane LF_1200_01 / LF_1200_02*** will call this procedure a defined number of times.

Prerequisite
Define parameters before (see procedure 61 / 62 / 63)
Set the temperature CL1208_SCI_CB_Temp_SP (PLC Address: 400400)

Procedure
Take the precautions and advises linked to the membranes
Use the HMI to start the procedure C_Cl1 for membrane LF_1200_01 or C_Cl2 for membrane LF_1200_02:
CL1207_SCI_Cl1 (PLC Address: 000239)
CL1207_SCI_Cl2 (PLC Address: 000240)

This initiates automatically the actions below:
VSSL_1209_01 is filled with water and - if wanted - cleaning agent: **CL1209_SCI_Fill_WA** (PLC Address: 000253)
CL1209_SCI_Fill_CA (PLC Address: 000249)
Content of VSSL_1209_01 is pumped into the cleaning buffer VSSL_1209_02.
CP_1207_02 circulates the contents of the VSSL_1209_02 and the piping from SV_1207_09 (LF_1200_01) or SV_1207_08 (LF_1200_02) to SV_1207_11 (LF_1200_01) or SV_1207_10 (LF_1200_02), including the retentate side of the membrane:
Normal pressures are:
PT_1203_01 / PT_1203_04 ~= 1.15 barg to 1.32 barg (increases gradually in time)
PT_1203_02/ PT_1203_05~= 0.14 barg
PT_1203_03/ PT_1203_06~= 0.49 barg
The liquid go back to VSSL_1209_02
Both Cleaning Vessel (VSSL_1209_01 and VSSL_1209_02) are emptied
The procedure stops.
Repeat the procedure until all the particles are removed then finish with clear water.

Used Variables:
CL1207_SCI_Cl1 (PLC Address: 000239)
CL1207_TB_Cl1 (PLC Address: 000225)
CL1207_SCI_Cl2 (PLC Address: 000240)
CL1207_TB_Cl2 (PLC Address: 000226)

5.50.2.PLC Subroutine: C_Cl1

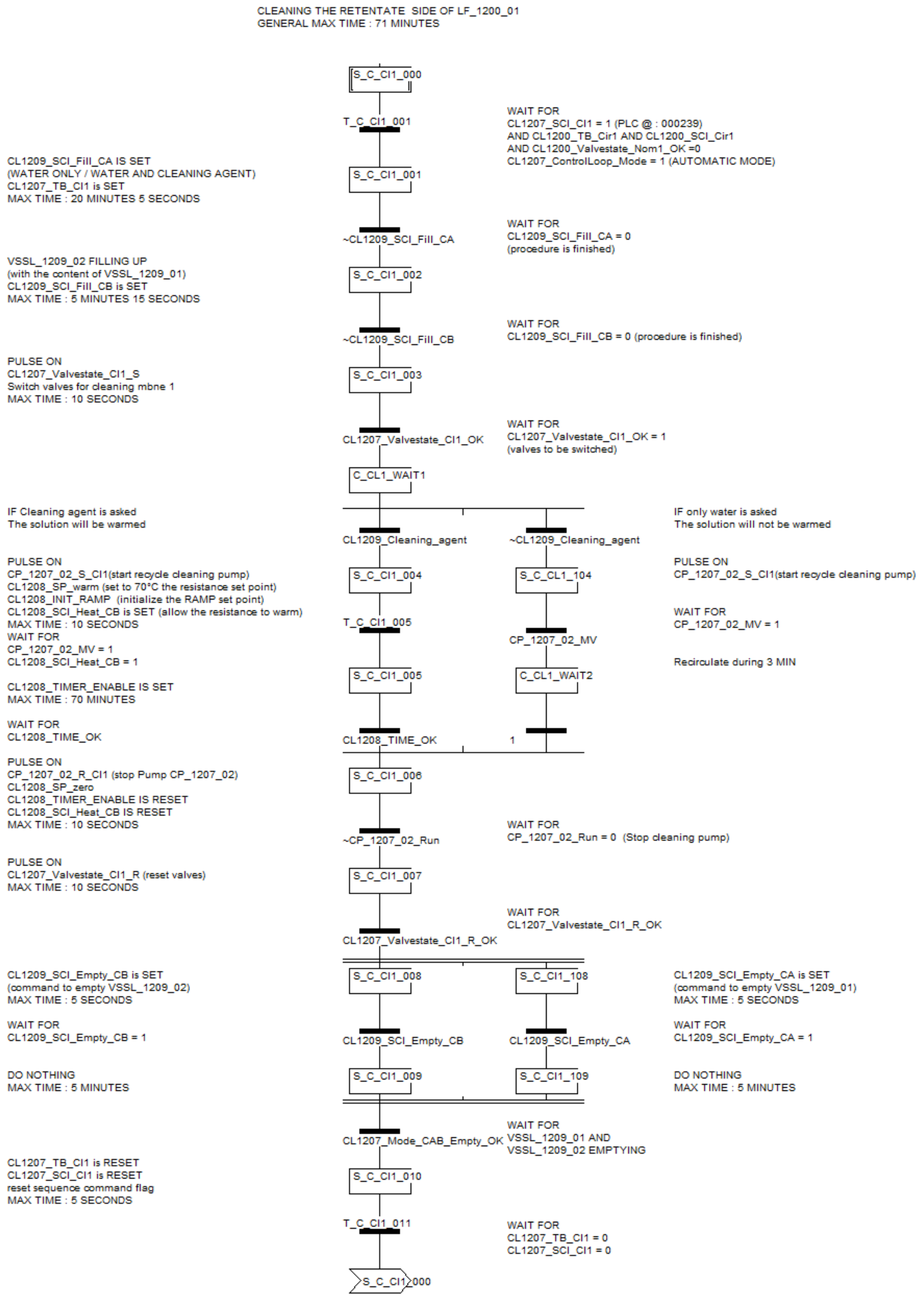
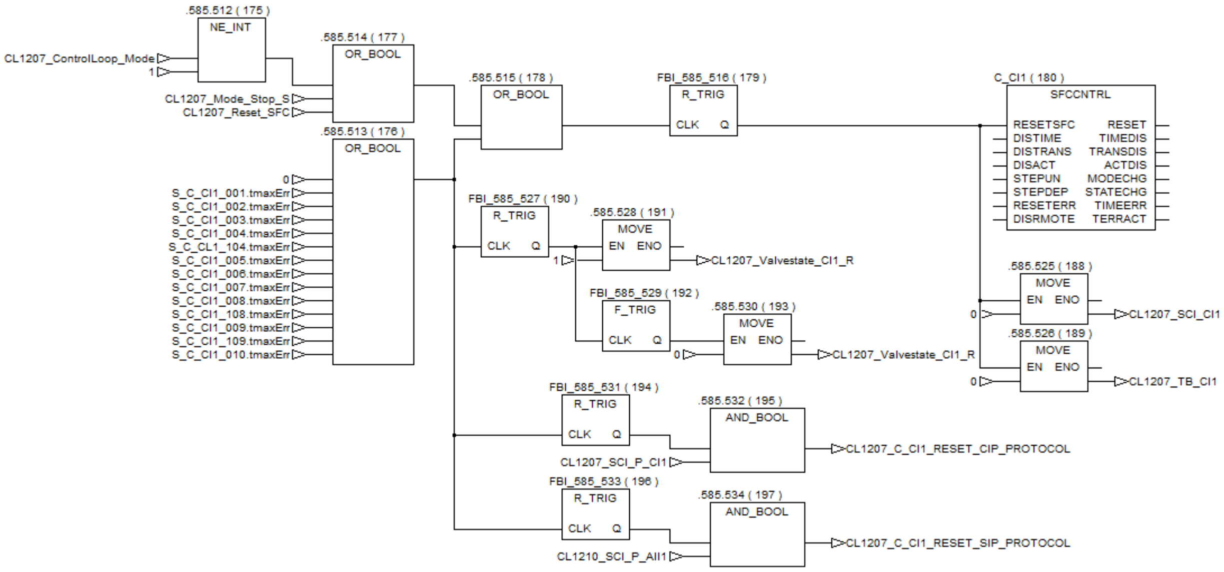


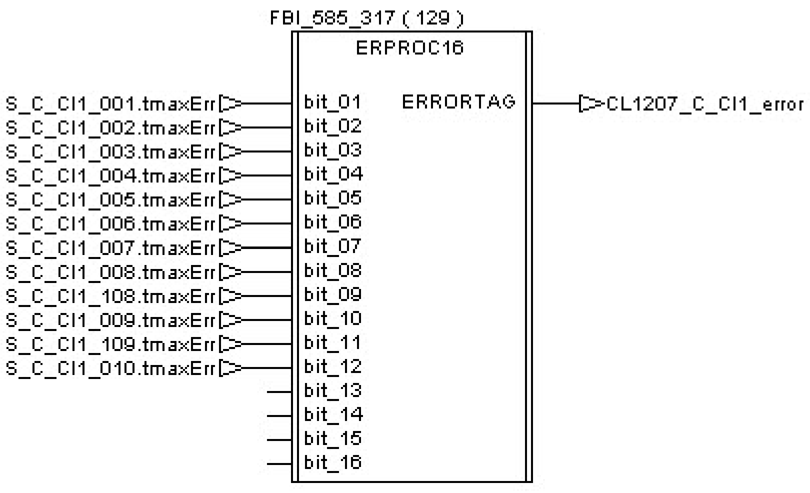
Figure 125: PLC procedure: C_Cl1

5.50.3.Procedure management

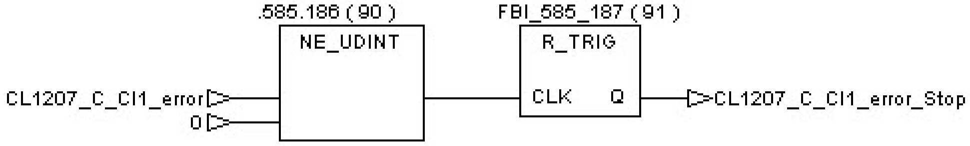
Reset of the procedure:
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



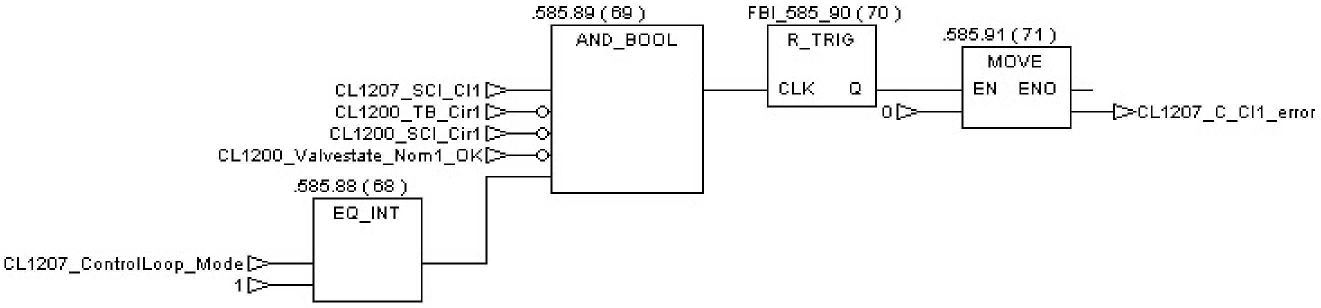
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag “CL1207_C_Cl1_error_Stop” receives a pulse and then the Cleaning Unit is stopped thanks to the procedure “C_Stop”.



The error number is displayed until the procedure is re-started.



5.50.4.Error number description

Error number	Procedure Action Step	problem description
1	S_C_Cl1_001	Problem during the execution of the procedure "C_Fill_CA" (filling of the cleaning buffer VSSL_1209_01) The procedure "C_Fill_CA" should also have an error code
2	S_C_Cl1_002	Problem during the execution of the procedure "C_Fill_CB" (filling of the cleaning buffer VSSL_1209_02) The procedure "C_Fill_CB" should also have an error code
4	S_C_Cl1_003	valve(s) status Error operator has to look for valve alarm
8	S_C_Cl1_004	The cleaning pump CP_1207_02 didn't start
16	S_C_Cl1_005	The cleaning solution didn't reach the good temperature during the defined time. Temperature problem
32	S_C_Cl1_006	The cleaning pump CP_1207_02 didn't stop
64	S_C_Cl1_007	valve(s) status Error operator has to look for valve alarm
128	S_C_Cl1_008	Tag reset problem (Start button)
256	S_C_Cl1_108	Tag reset problem (Start button)
512	S_C_Cl1_009	One of the two cleaning vessel didn't finish its emptying. One of the two procedures "C_Empty_CA" or "C_Empty_CB" should have an error code.
1024	S_C_Cl1_109	One of the two cleaning vessel didn't finish its emptying. One of the two procedures "C_Empty_CA" or "C_Empty_CB" should have an error code.
2048	S_C_Cl1_010	Tag reset problem (Tracing bit or Start button)

5.50.5.Controlled valves

CL1207_Valvestate_Cl1_S

Added Valves in CL1207_Valvestate_Cl1_S (2009/03)

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_MV	000063	RESET
	SV_1201_05_MV	000062	RESET
	SV_1201_07_MV	000041	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_MV	000050	RESET
CIP General			
	SV_1207_07_MV	000068	RESET
	SV_1207_08_MV	000072	RESET
	SV_1207_09_MV	000071	SET
	SV_1207_10_MV	000057	RESET
	SV_1207_11_MV	000058	SET
	SV_1207_13_MV	000109	RESET
SIP General			
	SV_1210_02_MV	000085	RESET
	SV_1210_05_MV	000029	RESET
	SV_1210_07_MV	000025	RESET
	SV_1210_09_MV	000027	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_MV	000105	RESET

CL1207_Valvestate_Cl1_R

Added Valves in CL1207_Valvestate_Cl1_R (2009/03)

	VALVES	ADDRESS	COMMENTS
CIP General			
	SV_1207_09_MV	000071	RESET
	SV_1207_11_MV	000058	RESET

5.50.6. Awaited Feedback

CL1207_Valvestate_CI1_OK

Added Feedback in **CL1207_Valvestate_CI1_OK (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_FB	100086	RESET
	SV_1201_05_FB	100087	RESET
	SV_1201_07_FB	100076	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	RESET
CIP General			
	SV_1207_07_FB	100097	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_09_FB	100094	SET
	SV_1207_10_FB	100092	RESET
	SV_1207_11_FB	100091	SET
	SV_1207_13_FB	100139	RESET
SIP General			
	SV_1210_02_FB	100105	RESET
	SV_1210_05_FB	100056	RESET
	SV_1210_07_FB	100060	RESET
	SV_1210_09_FB	100058	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET

CL1207_Valvestate_CI1_R_OK

Added Feedback in **CL1207_Valvestate_CI1_R_OK (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_FB	100086	RESET
	SV_1201_05_FB	100087	RESET
	SV_1201_07_FB	100076	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	RESET
CIP General			
	SV_1207_07_FB	100097	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_09_FB	100094	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_11_FB	100091	RESET
	SV_1207_13_FB	100139	RESET
SIP General			
	SV_1210_02_FB	100105	RESET
	SV_1210_05_FB	100056	RESET
	SV_1210_07_FB	100060	RESET
	SV_1210_09_FB	100058	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET

5.50.7.PLC Subroutine: C_Cl2

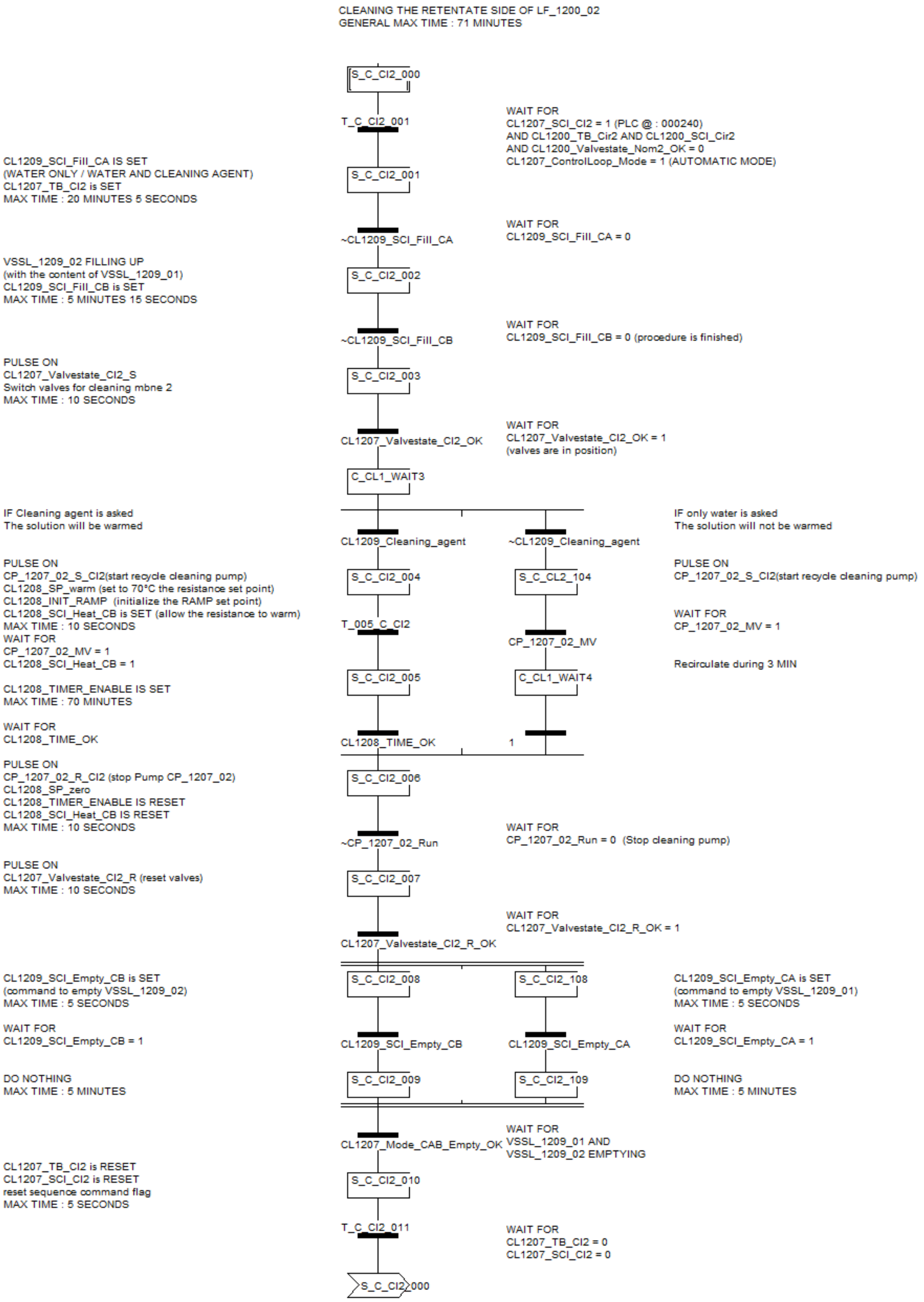
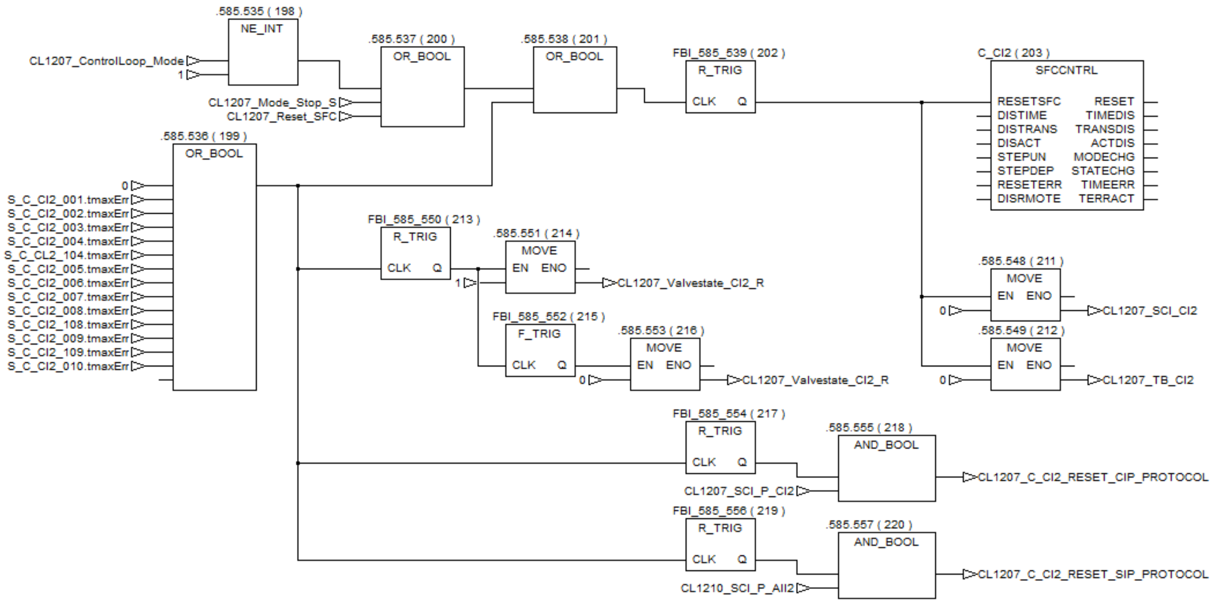


Figure 126: PLC procedure: C_Cl2

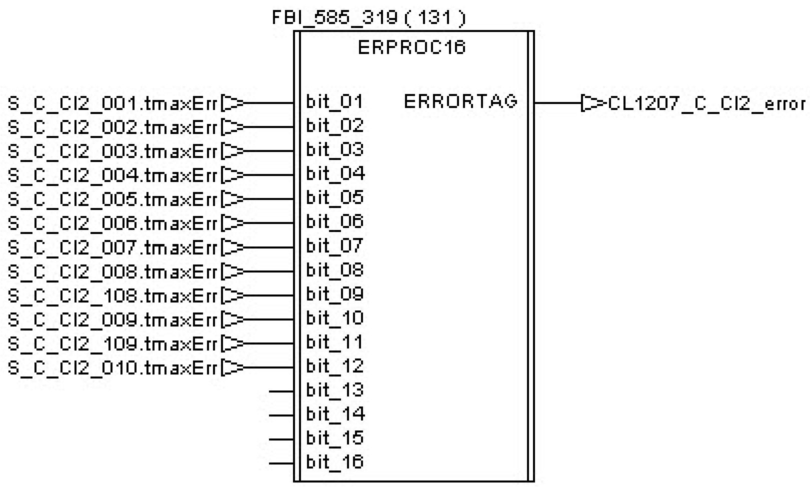
5.50.8.Procedure management

<u>Reset of the procedure:</u>

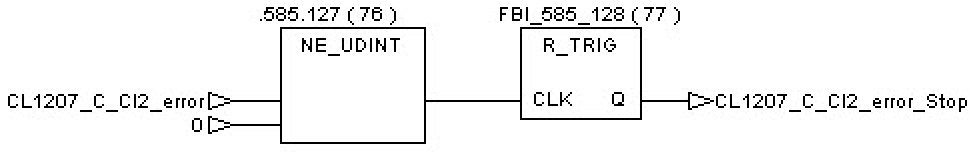
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



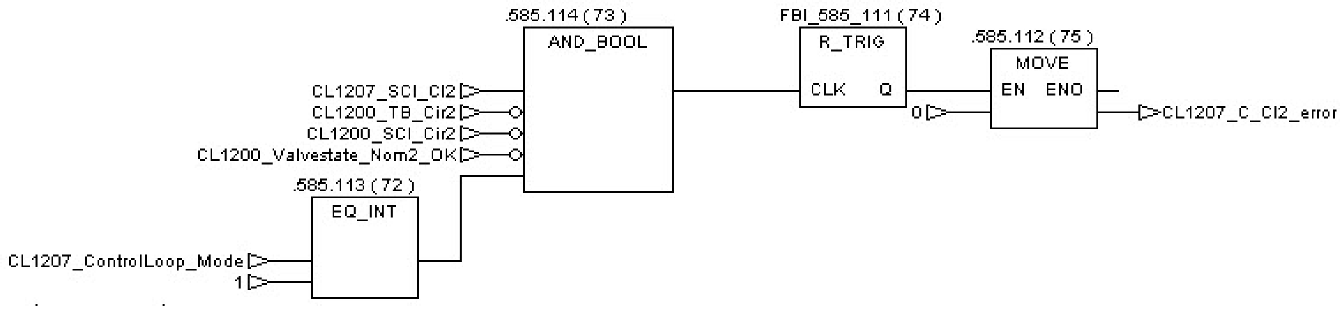
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1207_C_Cl2_error_Stop" receives a pulse and then the Cleaning Unit is stopped thanks to the procedure "C_Stop".



The error number is displayed until the procedure is re-started.



5.50.9.Error number description

Error number	Procedure Action Step	problem description
1	**S_C_Cl2_001**	Problem during the execution of the procedure "C_Fill_CA" (filling of the cleaning buffer VSSL_1209_01) The procedure "C_Fill_CA" should also have an error code
2	**S_C_Cl2_002**	Problem during the execution of the procedure "C_Fill_CB" (filling of the cleaning buffer VSSL_1209_02) The procedure "C_Fill_CB" should also have an error code
4	**S_C_Cl2_003**	valve(s) status Error operator has to look for valve alarm
8	**S_C_Cl2_004**	The cleaning pump CP_1207_02 didn't start
16	**S_C_Cl2_005**	The cleaning solution didn't reach the good temperature during the defined time. Temperature problem
32	**S_C_Cl2_006**	The cleaning pump CP_1207_02 didn't stop
64	**S_C_Cl2_007**	valve(s) status Error operator has to look for valve alarm
128	**S_C_Cl2_008**	Tag reset problem (Start button)
256	**S_C_Cl2_108**	Tag reset problem (Start button)
512	**S_C_Cl2_009**	One of the two cleaning vessel didn't finish its emptyng. One of the two procedures "C_Empty_CA" or "C_Empty_CB" should have an error code.
1024	**S_C_Cl2_109**	One of the two cleaning vessel didn't finish its emptying. One of the two procedures "C_Empty_CA" or "C_Empty_CB" should have an error code.
2048	**S_C_Cl2_010**	Tag reset problem (Tracing bit or Start button)

5.50.10.Controlled valves

CL1207_Valvestate_CI2_S

Added Valves in CL1207_Valvestate_CI2_S (2009/03)

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_04_MV	000098	RESET
	SV_1201_06_MV	000097	RESET
	SV_1201_08_MV	000056	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_02_MV	000099	RESET
CIP General			
	SV_1207_06_MV	000067	RESET
	SV_1207_08_MV	000072	SET
	SV_1207_10_MV	000057	SET
	SV_1207_11_MV	000058	RESET
	SV_1207_12_MV	000110	RESET
SIP General			
	SV_1210_01_MV	000086	RESET
	SV_1210_04_MV	000030	RESET
	SV_1210_06_MV	000026	RESET
	SV_1210_08_MV	000028	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_MV	000106	RESET

CL1207_Valvestate_CI2_R

Added Valves in CL1207_Valvestate_CI2_R (2009/03)

	VALVES	ADDRESS	COMMENTS
CIP General			
	SV_1207_08_MV	000072	RESET
	SV_1207_10_MV	000057	RESET

5.50.11.Awaited feed back

CL1207_Valvestate_CI2_OK

Added Feedback in **CL1207_Valvestate_CI2_OK (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_04_FB	100130	RESET
	SV_1201_06_FB	100129	RESET
	SV_1201_08_FB	100077	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_02_FB	100131	RESET
CIP General			
	SV_1207_06_FB	100098	RESET
	SV_1207_08_FB	100093	SET
	SV_1207_10_FB	100092	SET
	SV_1207_11_FB	100091	RESET
	SV_1207_12_FB	100140	RESET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_06_FB	100059	RESET
	SV_1210_08_FB	100057	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_FB	100136	RESET

CL1207_Valvestate_CI2_R_OK

Added Feedback in **CL1207_Valvestate_CI2_R_OK (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_04_FB	100130	RESET
	SV_1201_06_FB	100129	RESET
	SV_1201_08_FB	100077	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_02_FB	100131	RESET
CIP General			
	SV_1207_06_FB	100098	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_11_FB	100091	RESET
	SV_1207_12_FB	100140	RESET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_06_FB	100059	RESET
	SV_1210_08_FB	100057	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_FB	100136	RESET

5.51. Procedure 50: Cleaning of Filtration Unit: both retentate and filtrate side of membrane LF_1200_01/ LF_1200_02

5.51.1.Scope

This Procedure can only be activated when the FU, the CIP and the SIP control Loop mode button are in Automatic mode.

The aim of this procedure is to clean the entire membrane and its module. It is not sufficient enough for a thorough cleaning of the inside membranes because the flow rate is not as important as in PROCEDURE 49, which results non efficient cleaning for the piping with bigger sections.
PROCEDURE 56: Cleaning of Filtration Unit: automated execution of a sequence of procedures to clean membrane LF_1200_01/ LF_1200_02 will call this procedure in the PLC a number of times.

Prerequisite
Retentate side should be at least rinsed before execution of this procedure. The drain on SV_1201_08 or SV_1201_07 may get clogged if this is not done.
Define parameters before (see procedure 61 / 62 / 63)

Procedure:
Take in account the precautions and advise on the membranes.
When FU/CIP and SIP are in automatic mode, use the HMI to start the procedure:
C_BCl1 for membrane LF_1200_01: CL1207_SCI_BCl1 (PLC Address: 000229)
C_BCl2 for membrane LF_1200_02: CL1207_SCI_BCl2 (PLC Address: 000230)
This initiates the actions below:
VSSL_1209_01 is filled with water and - if desired - cleaning agent: CL1209_SCI_Fill_CA
The content of VSSL_1209_01 is pumped via SV_1207_05 and SV_1207_07 (LF_1200_01) or SV_1207_06 (LF_1200_02) through some filtrate piping into the filtrate side of the membrane. It leaves the membrane module via SV_1207_13 (LF_1200_01) or SV_1207_12 (LF_1200_02) then leaves to the drain connected to SV_1201_07 (LF_1200_01) or SV_1201_08 (LF_1200_02).
Normal pressures are:
PT_1203_01 / PT_1203_04 ~= 0 barg
PT_1203_02 / PT_1203_05 ~= 0 barg
PT_1203_03 / PT_1203_06 ~= 1 barg
Remove cleaning agent by execution of this procedure with clear water

Used Variables:
CL1207_SCI_BCl1 (PLC Address: 000229)
CL1207_TB_BCl1 (PLC Address: 000227)
CL1207_SCI_BCl2 (PLC Address: 000230)
CL1207_TB_BCl2 (PLC Address: 000228)

5.51.2.PLC Subroutine: C_BCl1

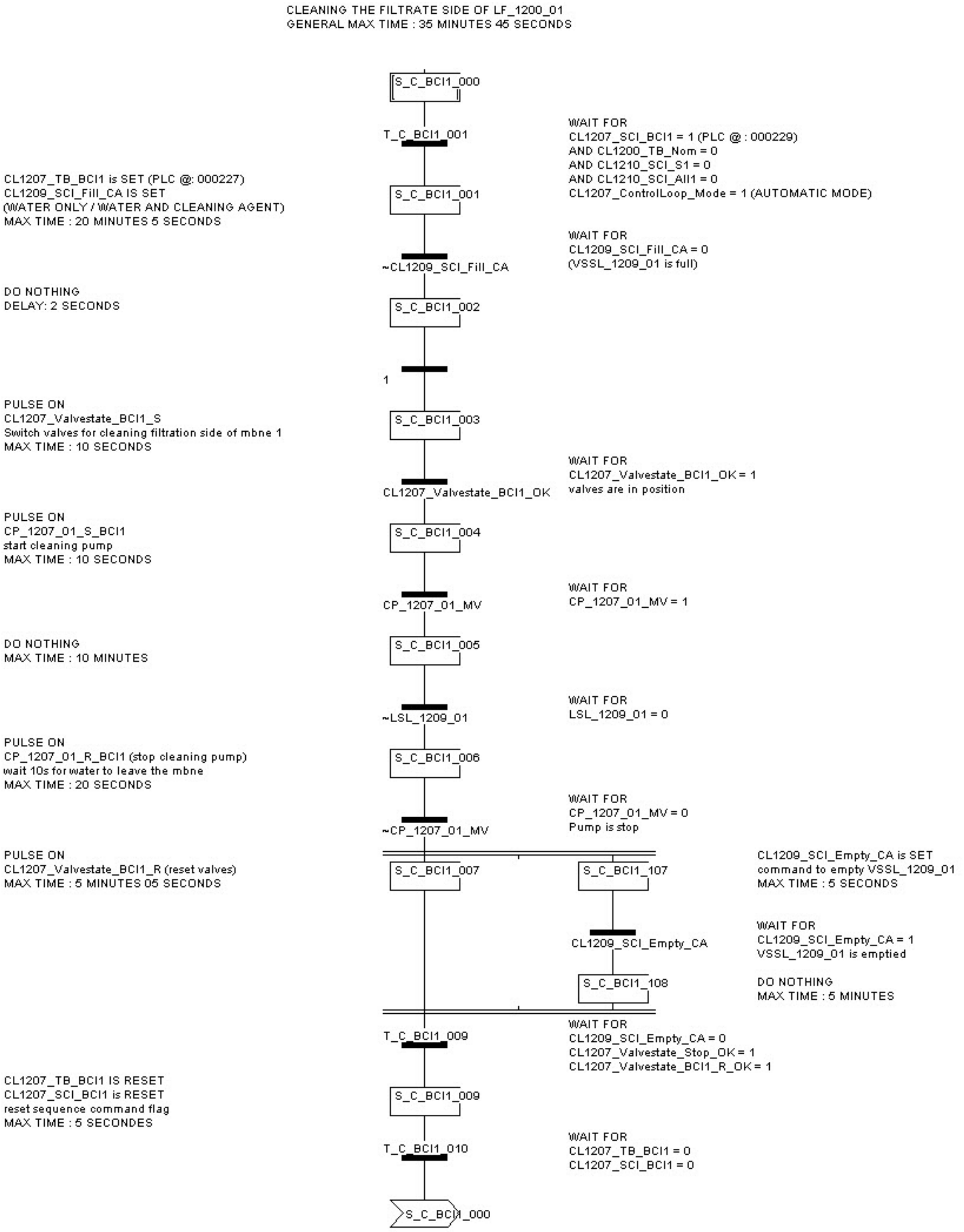
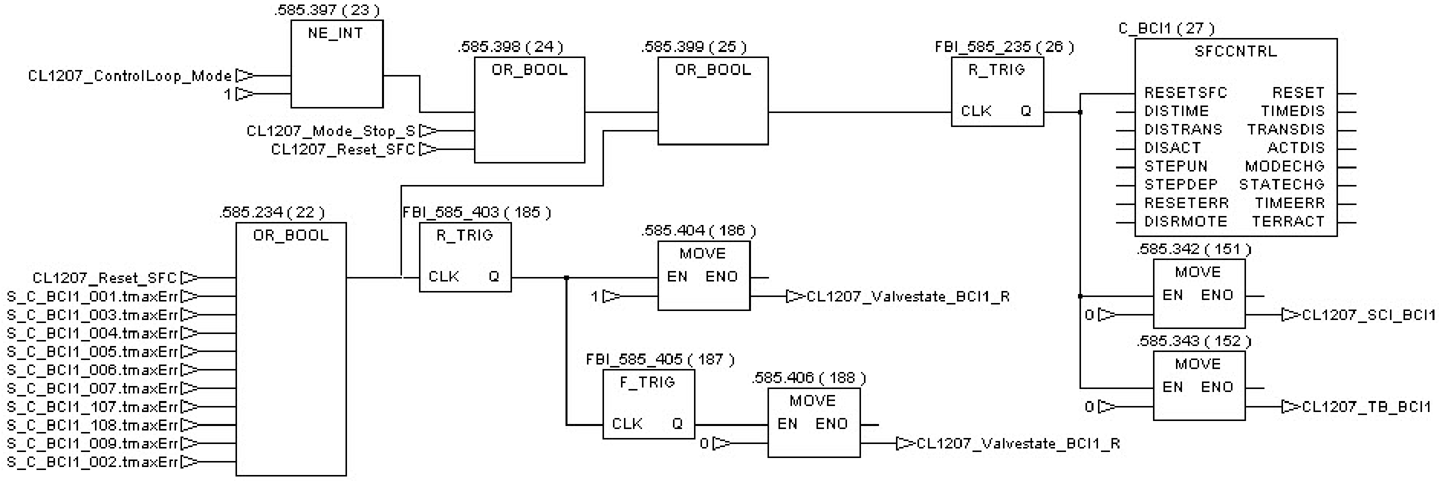


Figure 127: PLC procedure: C_BCl1

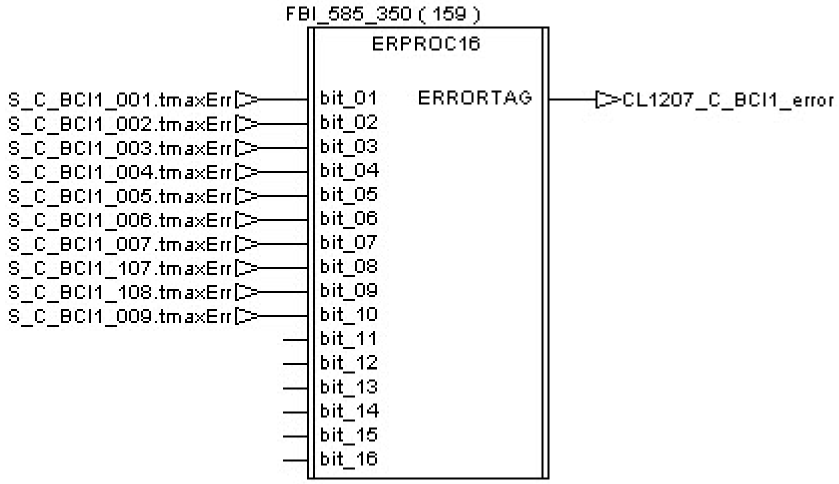
5.51.3.Procedure management

<u>Reset of the procedure:</u>

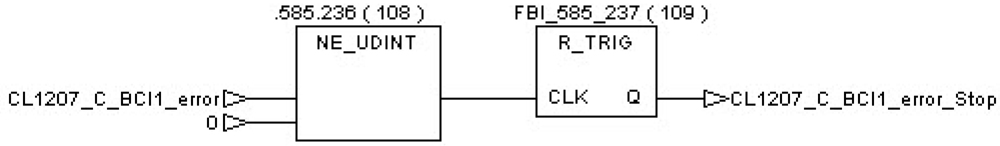
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



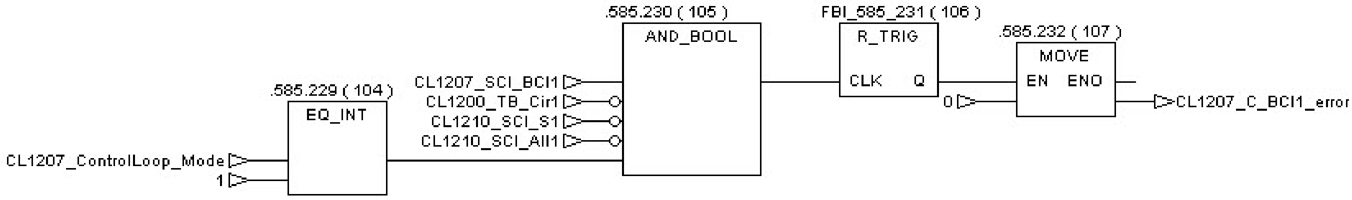
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag “CL1207_C_BCl1_error_Stop” receives a pulse and then the Cleaning Unit is stopped thanks to the procedure “C_Stop”.



The error number is displayed until the procedure is re-started.



5.51.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_C_BCl1_001**	Problem during the execution of the procedure "C_Fill_CA" (filling of the cleaning buffer VSSL_1209_01) The procedure "C_Fill_CA" should also have an error code
2	**S_C_BCl1_002**	Just a delay, no possible error
4	**S_C_BCl1_003**	valve(s) status Error operator has to look for valve alarm
8	**S_C_BCl1_004**	The cleaning pump CP_1207_01 didn't start
16	**S_C_BCl1_005**	The ten minutes are elapsed and the level switch low LSL_1209_01 has not been reset. Problem with LSL_1209_01
32	**S_C_BCl1_006**	The cleaning pump CP_1207_01 didn't stop
64	**S_C_BCl1_007**	valve(s) status Error operator has to look for valve alarm
128	**S_C_BCl1_107**	The procedure "CL1209_SCI_Empty_CA" didn't start. Possible internal memory problem of the PLC
256	**S_C_BCl1_108**	procedure "CL1209_SCI_Empty_CA" problem The procedure "C_Empty_CA" should also have an error code or valve(s) status Error operator has to look for valve alarm
512	**S_C_BCl1_009**	Tag reset problem (Tracing bit or Start button)

5.51.5.Controlled valves

CL1207_Valvestate_BCI1_S

Added Valves in **CL1207_Valvestate_BCI1_S (2009)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_MV	000063	RESET
	SV_1201_05_MV	000062	RESET
	SV_1201_07_MV	000041	SET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_MV	000050	RESET
CIP General			
	SV_1207_01_MV	000074	RESET
	SV_1207_02_MV	000075	RESET
	SV_1207_03_MV	000076	RESET
	SV_1207_04_MV	000077	RESET
	SV_1207_05_MV	000059	SET
	SV_1207_06_MV	000067	RESET
	SV_1207_07_MV	000068	SET
	SV_1207_09_MV	000071	RESET
	SV_1207_11_MV	000058	RESET
	SV_1207_13_MV	000109	SET
CIP Filling control			
	SV_1209_05_MV	000066	SET
SIP General			
	SV_1210_02_MV	000085	RESET
	SV_1210_05_MV	000029	RESET
	SV_1210_07_MV	000025	RESET
	SV_1210_09_MV	000027	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_MV	000105	RESET

CL1207_Valvestate_BCI1_R

Added Valves in **CL1207_Valvestate_BCI1_R (2009)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_07_MV	000041	RESET
CIP General			
	SV_1207_05_MV	000059	RESET
	SV_1207_07_MV	000068	RESET
	SV_1207_13_MV	000109	RESET
CIP Filling control			
	SV_1209_05_MV	000066	RESET

5.51.6.Awaited Feedback

CL1207_Valvestate_BCl1_OK

Added Feedback in **CL1207_Valvestate_BCl1_OK (2009)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_FB	100086	RESET
	SV_1201_05_FB	100087	RESET
	SV_1201_07_FB	100076	SET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	RESET
CIP General			
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_04_FB	100104	RESET
	SV_1207_05_FB	100090	SET
	SV_1207_06_FB	100098	RESET
	SV_1207_07_FB	100097	SET
	SV_1207_09_FB	100094	RESET
	SV_1207_11_FB	100091	RESET
	SV_1207_13_FB	100139	SET
CIP Filling controll			
	SV_1209_05_FB	100099	SET
SIP General			
	SV_1210_02_FB	100105	RESET
	SV_1210_05_FB	100056	RESET
	SV_1210_07_FB	100060	RESET
	SV_1210_09_FB	100058	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET

CL1207_Valvestate_BCl1_R_OK

Added Feedback in **CL1207_Valvestate_BCl1_R_OK (2009)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_FB	100086	RESET
	SV_1201_05_FB	100087	RESET
	SV_1201_07_FB	100076	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	RESET
CIP General			
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_04_FB	100104	RESET
	SV_1207_05_FB	100090	RESET
	SV_1207_06_FB	100098	RESET
	SV_1207_07_FB	100097	RESET
	SV_1207_09_FB	100094	RESET
	SV_1207_11_FB	100091	RESET
	SV_1207_13_FB	100139	RESET
CIP Filling controll			
	SV_1209_05_FB	100099	RESET
SIP General			
	SV_1210_02_FB	100105	RESET
	SV_1210_05_FB	100056	RESET
	SV_1210_07_FB	100060	RESET
	SV_1210_09_FB	100058	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET

5.51.7.PLC Subroutine: C_BCl2

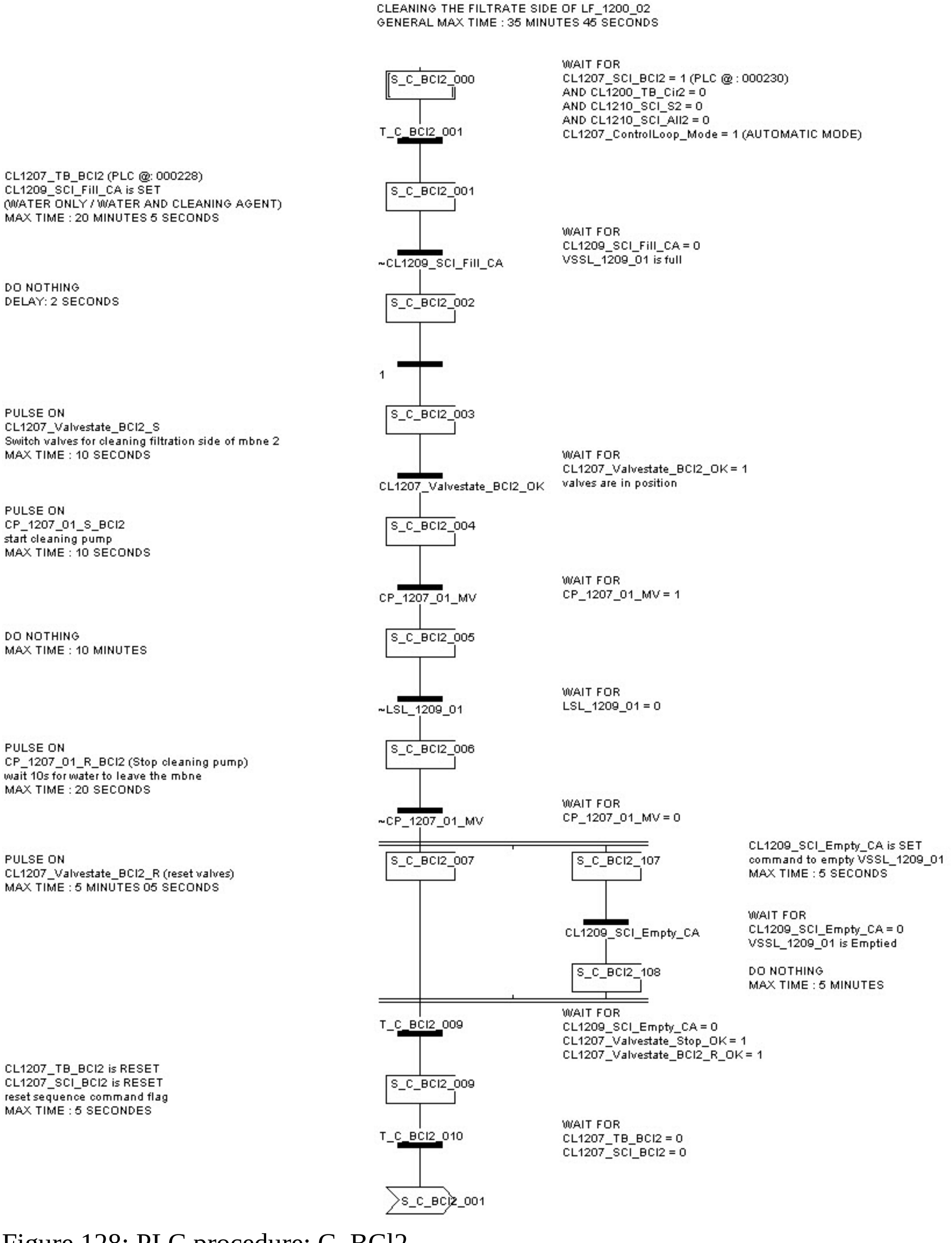
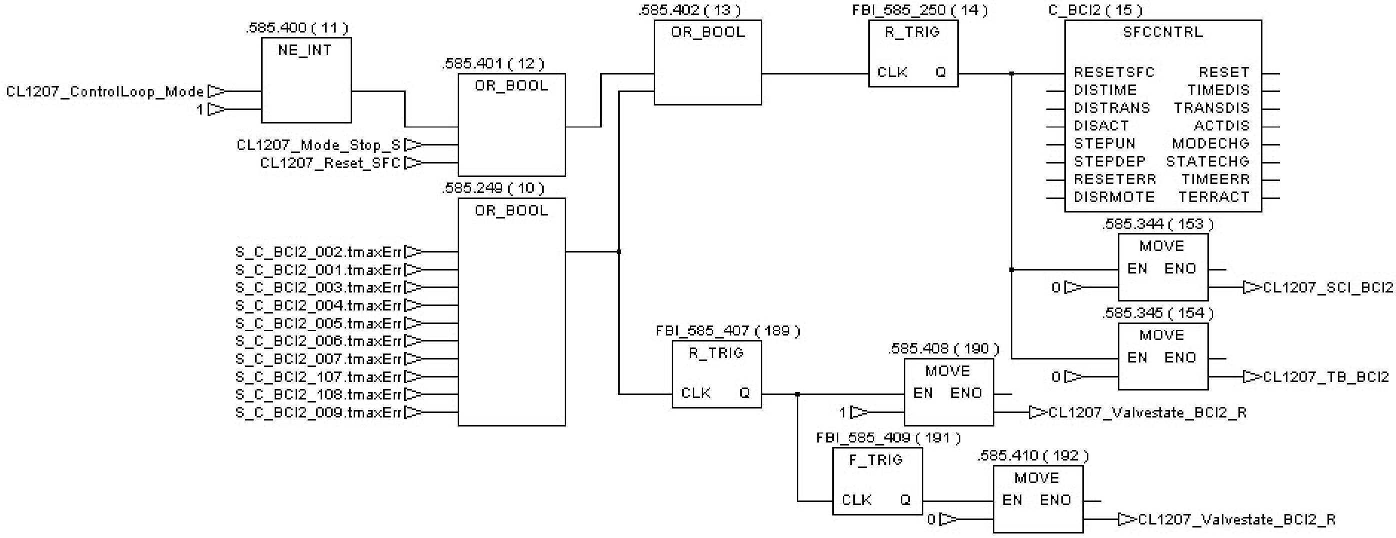


Figure 128: PLC procedure: C_BCl2

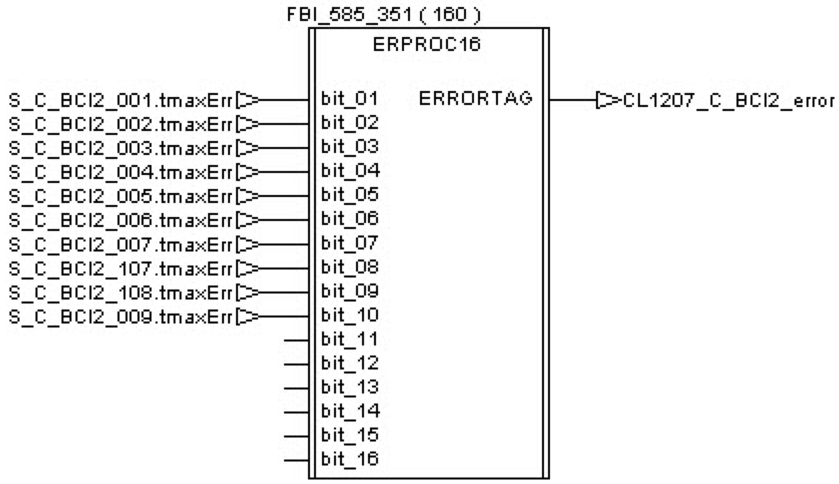
5.51.8.Procedure management

<u>Reset of the procedure:</u>
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.

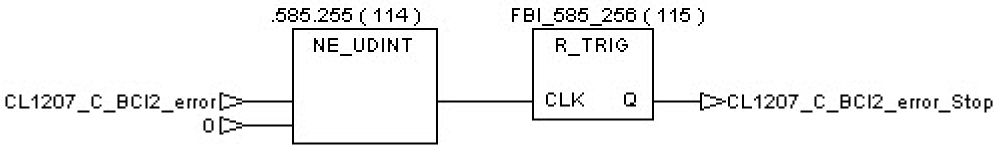
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



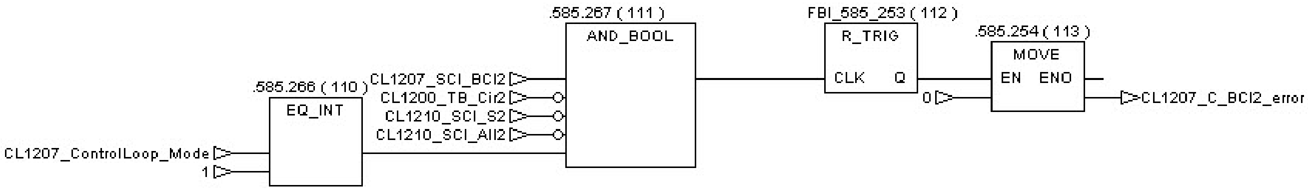
<u>Procedure error management:</u>
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1207_C_BCl2_error_Stop" receives a pulse and then the Cleaning Unit is stopped thanks to the procedure "C_Stop".



The error number is displayed until the procedure is re-started.



5.51.9.Error number description

Error number	Procedure Action Step	problem description
1	**S_C_BCl2_002**	Problem during the execution of the procedure "C_Fill_CA" (filling of the cleaning buffer VSSL_1209_01) The procedure "C_Fill_CA" should also have an error code
2	**S_C_BCl2_002**	Just a delay, no possible error
4	**S_C_BCl2_003**	valve(s) status Error operator has to look for valve alarm
8	**S_C_BCl2_004**	The cleaning pump CP_1207_01 didn't start
16	**S_C_BCl2_005**	The ten minutes are elapsed and the level switch low LSL_1209_01 has not been reset. Problem with LSL_1209_01
32	**S_C_BCl2_006**	The cleaning pump CP_1207_01 didn't stop
64	**S_C_BCl2_007**	valve(s) status Error operator has to look for valve alarm
128	**S_C_BCl2_107**	The procedure "CL1209_SCI_Empty_CA" didn't start. Possible internal memory problem of the PLC
256	**S_C_BCl2_108**	procedure "CL1209_SCI_Empty_CA" problem The procedure "C_Empty_CA" should also have an error code or valve(s) status Error operator has to look for valve alarm
512	**S_C_BCl2_009**	Tag reset problem (Tracing bit or Start button)

5.51.10.Controlled valves

CL1207_Valvestate_BCI2_S

Added Valves in **CL1207_Valvestate_BCI2_S (2009)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_04_MV	000098	RESET
	SV_1201_06_MV	000097	RESET
	SV_1201_08_MV	000056	SET
Filtration Unit Filtrate Flow Control			
	SV_1202_02_MV	000099	RESET
CIP General			
	SV_1207_01_MV	000074	RESET
	SV_1207_02_MV	000075	RESET
	SV_1207_03_MV	000076	RESET
	SV_1207_04_MV	000077	RESET
	SV_1207_05_MV	000059	SET
	SV_1207_06_MV	000067	SET
	SV_1207_07_MV	000068	RESET
	SV_1207_08_MV	000072	RESET
	SV_1207_10_MV	000057	RESET
	SV_1207_12_MV	000110	SET
CIP Filling control			
	SV_1209_05_MV	000066	SET
SIP General			
	SV_1210_01_MV	000086	RESET
	SV_1210_04_MV	000030	RESET
	SV_1210_06_MV	000026	RESET
	SV_1210_08_MV	000028	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_MV	000106	RESET

CL1207_Valvestate_BCI2_R

Added Valves in **CL1207_Valvestate_BCI2_R (2009)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_08_MV	000056	RESET
CIP General			
	SV_1207_05_MV	000059	RESET
	SV_1207_06_MV	000067	RESET
	SV_1207_12_MV	000110	RESET
CIP Filling control			
	SV_1209_05_MV	000066	RESET

5.51.11.Awaited Feedback

CL1207_Valvestate_BCI2_OK

Added Feedback in **CL1207_Valvestate_BCI2_OK (2009)**

	VALVES	ADDRESS	COMMENTS
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_04_FB	100104	RESET
	SV_1207_05_FB	100090	SET
	SV_1207_06_FB	100098	SET
	SV_1207_07_FB	100097	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_12_FB	100140	SET
CIP Filling controll			
	SV_1209_05_FB	100099	SET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_06_FB	100059	RESET
	SV_1210_08_FB	100057	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_FB	100136	RESET

CL1207_Valvestate_BCI2_R_OK

Added Feedback in **CL1207_Valvestate_BCI2_R_OK (2009)**

	VALVES	ADDRESS	COMMENTS
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_04_FB	100104	RESET
	SV_1207_05_FB	100090	RESET
	SV_1207_06_FB	100098	RESET
	SV_1207_07_FB	100097	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_12_FB	100140	RESET
CIP Filling controll			
	SV_1209_05_FB	100099	RESET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_06_FB	100059	RESET
	SV_1210_08_FB	100057	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_FB	100136	RESET

5.52. Procedure 51: Cleaning of Filtration Unit: backwash membrane LF_1200_01 / LF_1200_02

5.52.1.Scope

Backwashing is a way of prolonging the moment where a membrane is so fouled that it must be replaced and/or cleaned thoroughly, and to prolong a membrane's life. It consists of pushing back filtrate through the membrane into the retentate line. This is done by inversion of filtrate pump direction.
Consider **using PROCEDURE 52: Cleaning of Filtration Unit: backwashing membrane LF_1200_01 /LF_1200_02 using water or cleaning agent** instead. It has some advantages.

Prerequisite
Filter LF_1200_03 can be used in only one direction and thus must be removed prior to inverting the direction of PP_1202_01. This imposes CIP and SIP of filtrate line and VSL2_1204_01.

Procedure
Use the knob on PP_1202_01 to inverse its pumping direction

This procedure is done manually by the OPERATOR.

5.53. Procedure 52: Cleaning of Filtration Unit: backwashing membrane LF_1200_01 / LF_1200_02 using water or cleaning agent

5.53.1.Scope

This Procedure can only be activated when the FU, the CIP and the SIP control Loop mode button are in Automatic mode.

Important for the effectiveness of backwashing to achieve a quick rise in flow rate (and therefore pressure difference). This cannot be achieved with PROCEDURE 51: Cleaning of Filtration Unit: backwash membrane LF_1200_01 / LF_1200_02. Furthermore, PROCEDURE 51 implies removal of LF_1200_03. This procedure uses water or cleaning agent in VSSL_1209_01 and the power of CP_1207_01 to achieve a better flow shock.

Prerequisite:
FU must be stopped or be working over the other membrane. Retentate side of the membrane to be backwashed must be rinsed before (use **PROCEDURE 49: Cleaning of Filtration Unit: retentate side of membrane LF_1200_01 / LF_1200_02**).

Define parameters before (see procedure 61 / 62 / 63)

Procedure:
Use the HMI to start the procedure:
C_BW1 (LF_1200_01): CL1207_SCI_BW1 (PLC Address: 000233)
C_BW2 (LF_1200_02): CL1207_SCI_BW2 (PLC Address: 000234)
This initiates the actions below:
VSSL_1209_01 is filled with water and - if desired - cleaning agent: CL1209_SCI_Fill_CA
The liquid goes through the filtrate line, re enter to the retentate line thanks to the by pass SV_1207_13 (LF_1200_01), SV_1207_12 (LF_1200_02), then finishes inside VSSL_1209_02.
CP_1207_01 is activated
If this procedure is used with cleaning agent, use ***PROCEDURE 64: Rinse VSSL_1209_01*** and then this procedure again without cleaning agent in order to remove any cleaning agent from the FU piping and the membrane.

Used Variables:
CL1207_SCI_BW1 (PLC Address: 000233)
CL1207_TB_BW1 (PLC Address: 000368)
CL1207_SCI_BW2 (PLC Address: 000234)
CL1207_TB_BW2 (PLC Address: 000369)

5.53.2.PLC Subroutine: C_BW1

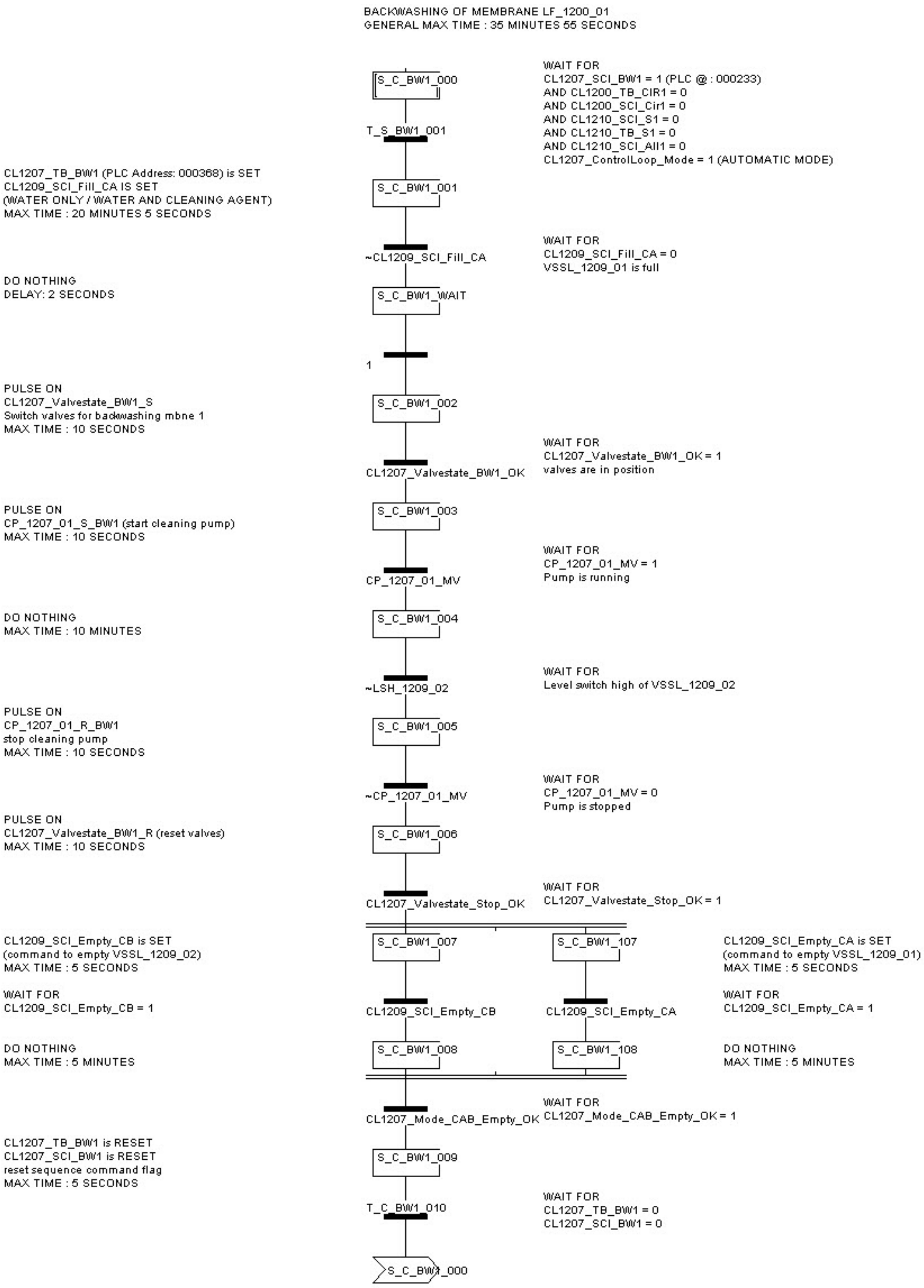


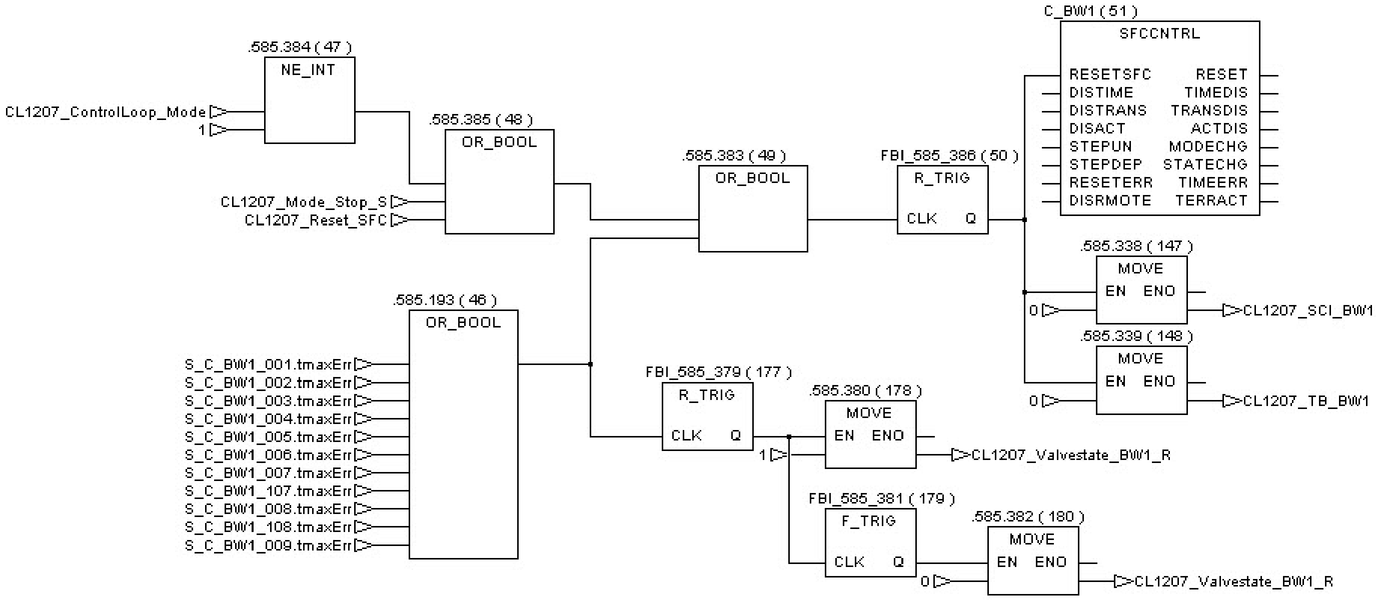
Figure 129: PLC procedure: C_BW1

5.53.3.Procedure management

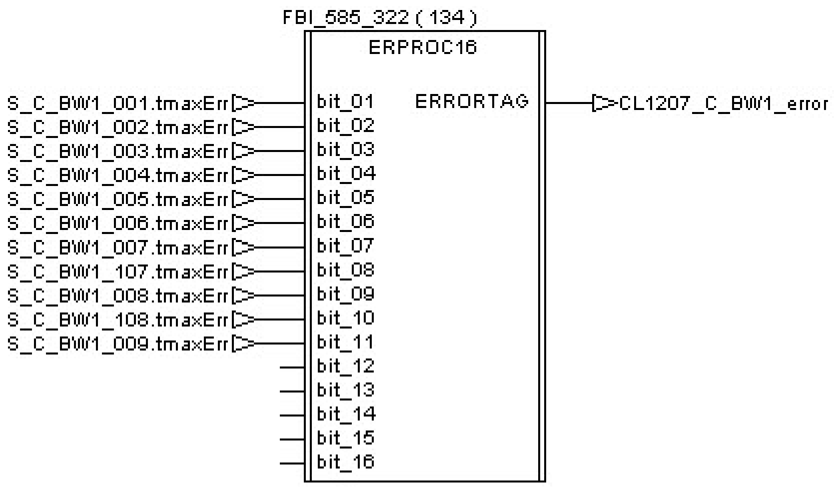
<u>Reset of the procedure:</u>

If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.

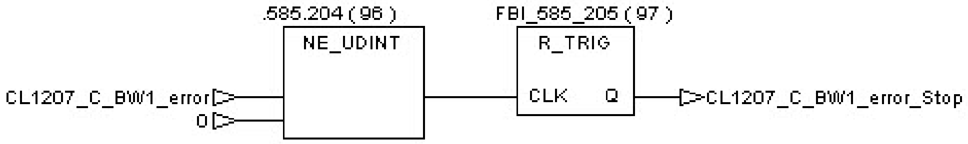
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



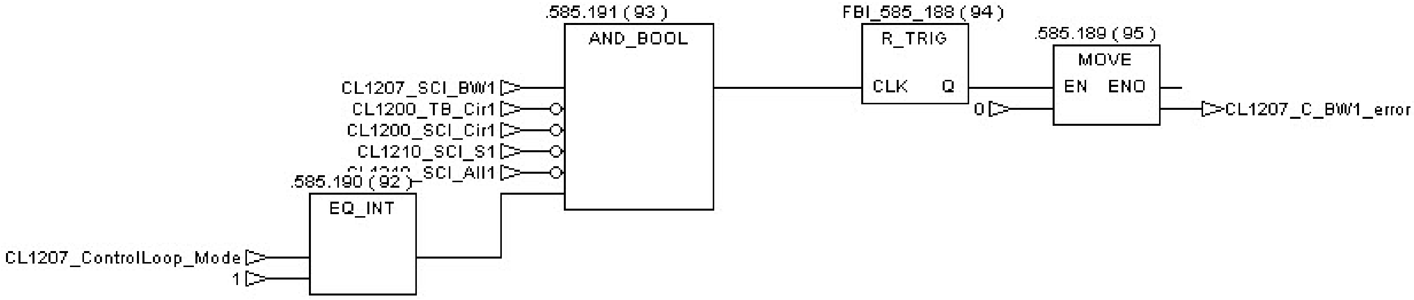
<u>Procedure error management:</u>
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag “CL1207_C_BW1_error_Stop” receives a pulse and then the Cleaning Unit is stopped thanks to the procedure “C_Stop”.



The error number is displayed until the procedure is re-started.



5.53.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_C_BW1_001**	Problem during the execution of the procedure "C_Fill_CA" (filling of the cleaning buffer VSSL_1209_01) The procedure "C_Fill_CA" should also have an error code
2	**S_C_BW1_002**	valve(s) status Error operator has to look for valve alarm
4	**S_C_BW1_003**	The cleaning pump CP_1207_01 didn't start
8	**S_C_BW1_004**	The ten minutes are elapsed and the level switch low LSL_1209_01 has not been reset. Problem with LSL_1209_01
16	**S_C_BW1_005**	The cleaning pump CP_1207_01 didn't stop
32	**S_C_BW1_006**	valve(s) status Error operator has to look for valve alarm
64	**S_C_BW1_007**	Tag set problem (Start button)
128	**S_C_BW1_008**	Tag set problem (Start button)
256	**S_C_BW1_009**	One of the two cleaning vessels didn't finish its empting. One of the two procedures "C_Empty_CA" or "C_Empty_CB" should have an error code.
512	**S_C_BW1_010**	One of the two cleaning vessels didn't finish its empting. One of the two procedures "C_Empty_CA" or "C_Empty_CB" should have an error code.
1024	**S_C_BW1_011**	Tag reset problem (Tracing bit or Start button)

5.53.5.Controlled valves

CL1207_Valvestate_BW1_S

Added Valves in **CL1207_Valvestate_BW1_S (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_MV	000063	RESET
	SV_1201_05_MV	000062	RESET
	SV_1201_07_MV	000041	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_MV	000050	RESET
CIP General			
	SV_1207_01_MV	000074	RESET
	SV_1207_02_MV	000075	RESET
	SV_1207_03_MV	000076	RESET
	SV_1207_04_MV	000077	RESET
	SV_1207_05_MV	000059	SET
	SV_1207_06_MV	000067	RESET
	SV_1207_07_MV	000068	SET
	SV_1207_09_MV	000071	RESET
	SV_1207_10_MV	000057	RESET
	SV_1207_11_MV	000058	SET
	SV_1207_13_MV	000109	SET
CIP Filling control			
	SV_1209_02_MV	000079	SET
SIP General			
	SV_1210_02_MV	000085	RESET
	SV_1210_05_MV	000029	RESET
	SV_1210_07_MV	000025	RESET
	SV_1210_09_MV	000027	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_MV	000105	RESET

CL1207_Valvestate_BW1_R

Added Valves in **CL1207_Valvestate_BW1_R (2009/03)**

	VALVES	ADDRESS	COMMENTS
CIP General			
	SV_1207_05_MV	000059	RESET
	SV_1207_07_MV	000068	RESET
	SV_1207_11_MV	000058	RESET
	SV_1207_13_MV	000109	RESET
CIP Filling control			
	SV_1209_02_MV	000079	RESET

5.53.6.Awaited Feedback

CL1207_Valvestate_BW1_OK

Added Feedback in **CL1207_Valvestate_BW1_OK (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_FB	100086	RESET
	SV_1201_05_FB	100087	RESET
	SV_1201_07_FB	100076	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	RESET
CIP General			
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_04_FB	100104	RESET
	SV_1207_05_FB	100090	SET
	SV_1207_06_FB	100098	RESET
	SV_1207_07_FB	100097	SET
	SV_1207_09_FB	100094	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_11_FB	100091	SET
	SV_1207_13_FB	100139	SET
CIP Filling control			
	SV_1209_02_FB	100102	SET
SIP General			
	SV_1210_02_FB	100105	RESET
	SV_1210_05_FB	100056	RESET
	SV_1210_07_FB	100060	RESET
	SV_1210_09_FB	100058	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET

CL1207_Valvestate_BW1_R_OK

Added Feedback in **CL1207_Valvestate_BW1_R_OK (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_FB	100086	RESET
	SV_1201_05_FB	100087	RESET
	SV_1201_07_FB	100076	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	RESET
CIP General			
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_04_FB	100104	RESET
	SV_1207_05_FB	100090	RESET
	SV_1207_06_FB	100098	RESET
	SV_1207_07_FB	100097	RESET
	SV_1207_09_FB	100094	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_11_FB	100091	RESET
	SV_1207_13_FB	100139	RESET
CIP Filling control			
	SV_1209_02_FB	100102	RESET
SIP General			
	SV_1210_02_FB	100105	RESET
	SV_1210_05_FB	100056	RESET
	SV_1210_07_FB	100060	RESET
	SV_1210_09_FB	100058	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET

5.53.7.PLC Subroutine: C_BW2

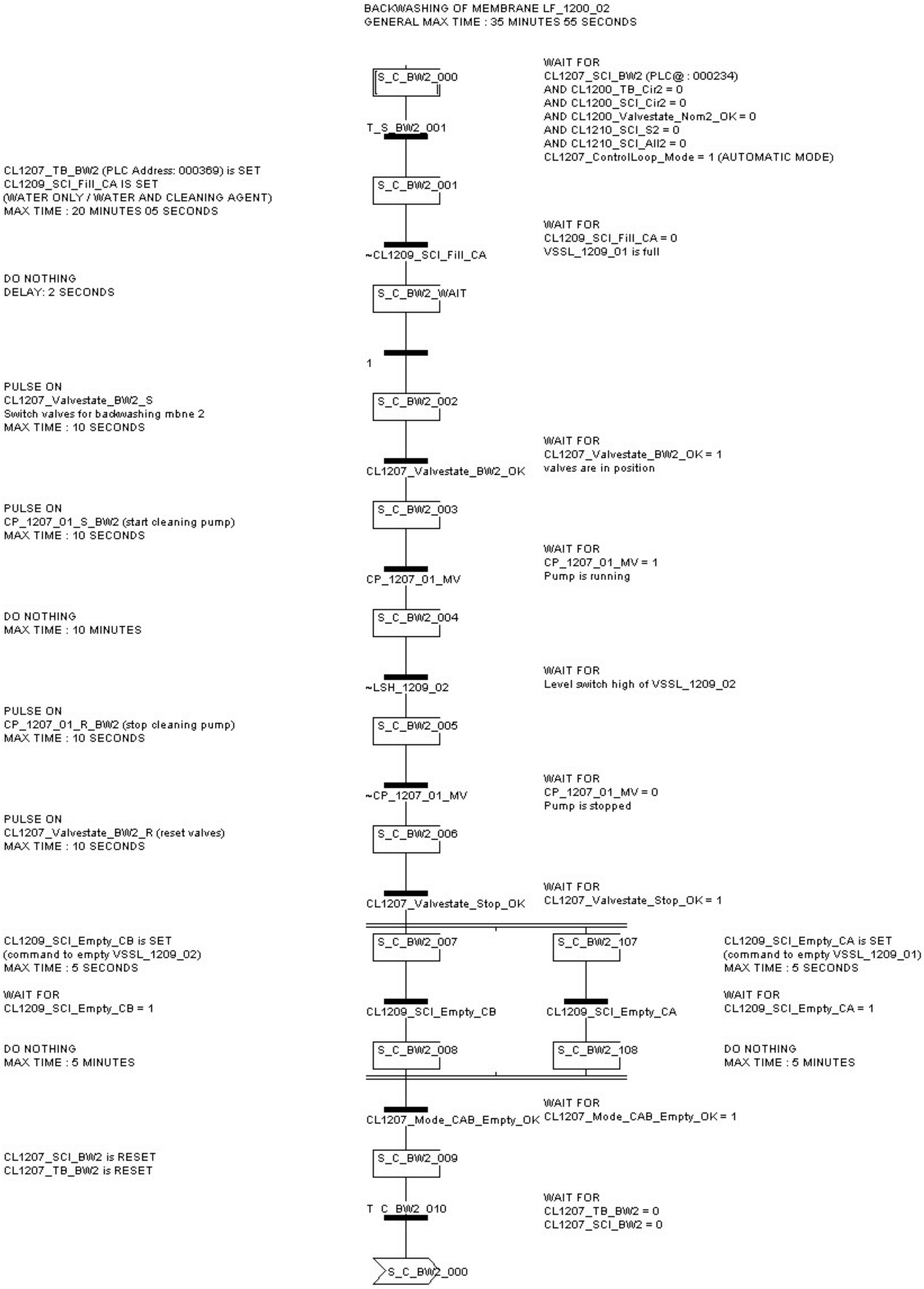
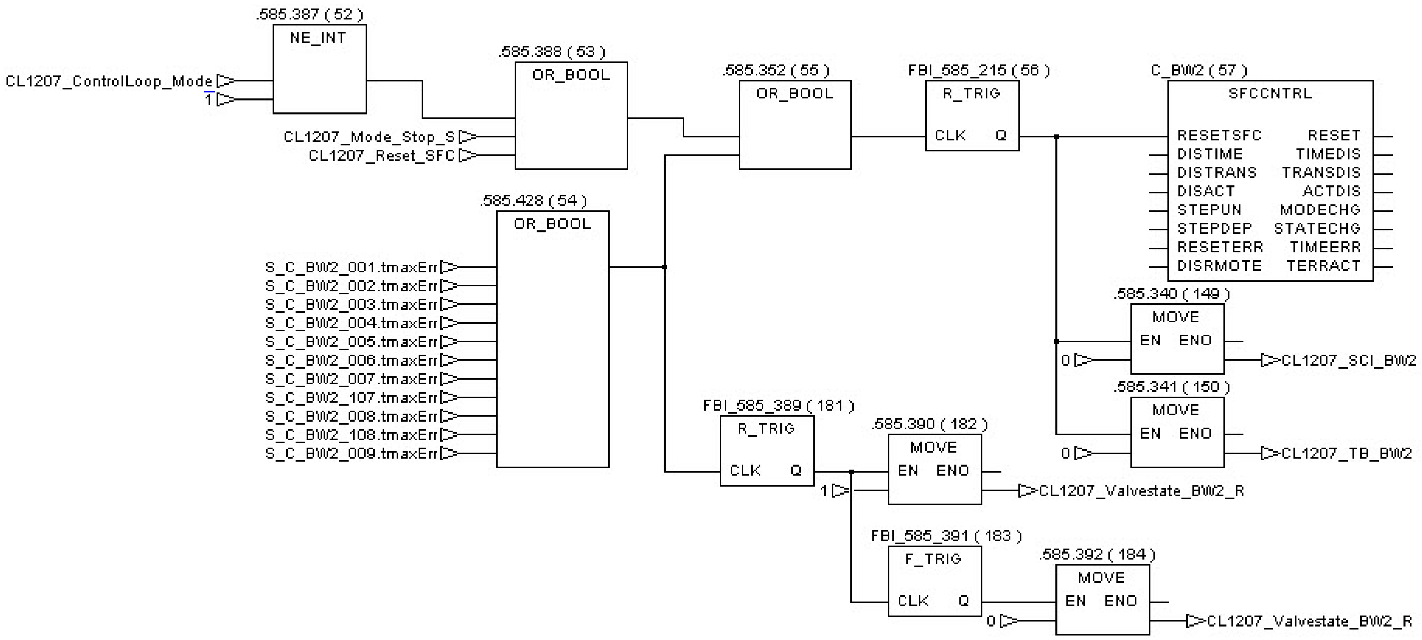


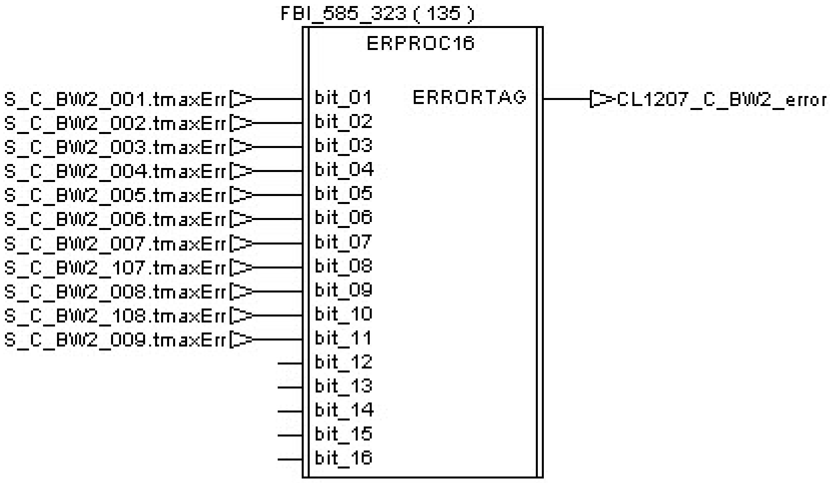
Figure 130: PLC procedure: C_BW2

5.53.8.Procedure management

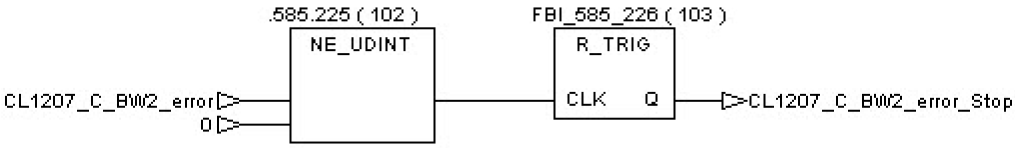
<u>Reset of the procedure:</u>
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



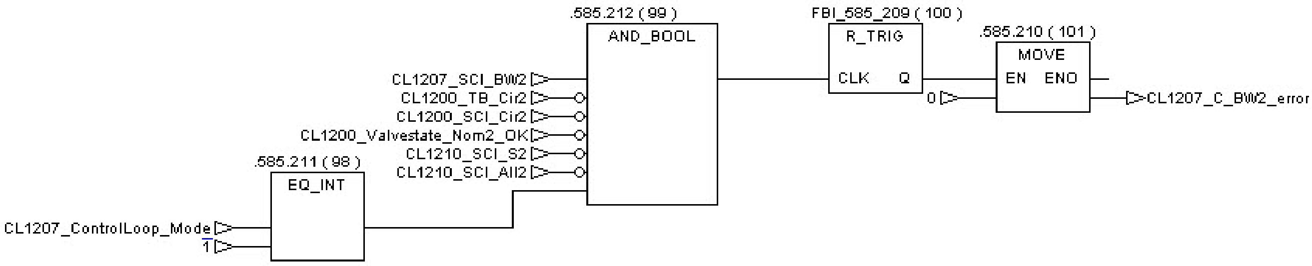
<u>Procedure error management:</u>
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1207_C_BW2_error_Stop" receives a pulse and then the Cleaning Unit is stopped thanks to the procedure "C_Stop".



The error number is displayed until the procedure is re-started.



5.53.9.Error number description

Error number	Procedure Action Step	problem description
1	**S_C_BW2_001**	Problem during the execution of the procedure "C_Fill_CA" (filling of the cleaning buffer VSSL_1209_01) The procedure "C_Fill_CA" should also have an error code
2	**S_C_BW2_002**	valve(s) status Error operator has to look for valve alarm
4	**S_C_BW2_003**	The cleaning pump CP_1207_01 didn't start
8	**S_C_BW2_004**	The ten minutes are elapsed and the level switch low LSL_1209_01 has not been reset. Problem with LSL_1209_01
16	**S_C_BW2_005**	The cleaning pump CP_1207_01 didn't stop
32	**S_C_BW2_006**	valve(s) status Error operator has to look for valve alarm
64	**S_C_BW2_007**	Tag set problem (Start button)
128	**S_C_BW2_008**	Tag set problem (Start button)
256	**S_C_BW2_009**	One of the two cleaning vessels didn't finish its emptying. One of the two procedures "C_Empty_CA" or "C_Empty_CB" should have an error code.
512	**S_C_BW2_010**	One of the two cleaning vessels didn't finish its emptying. One of the two procedures "C_Empty_CA" or "C_Empty_CB" should have an error code.
1024	**S_C_BW2_011**	Tag reset problem (Tracing bit or Start button)

5.53.10.Controlled valves

CL1207_Valvestate_BW2_S

Added Valves in **CL1207_Valvestate_BW2_S (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_04_MV	000098	RESET
	SV_1201_06_MV	000097	RESET
	SV_1201_08_MV	000056	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_02_MV	000099	RESET
CIP General			
	SV_1207_01_MV	000074	RESET
	SV_1207_02_MV	000075	RESET
	SV_1207_03_MV	000076	RESET
	SV_1207_04_MV	000077	RESET
	SV_1207_05_MV	000059	SET
	SV_1207_06_MV	000067	SET
	SV_1207_07_MV	000068	RESET
	SV_1207_08_MV	000072	RESET
	SV_1207_10_MV	000057	SET
	SV_1207_11_MV	000058	RESET
	SV_1207_12_MV	000110	SET
CIP Filling control			
	SV_1209_02_MV	000079	SET
	SV_1210_04_MV	000030	RESET
	SV_1210_06_MV	000026	RESET
	SV_1210_08_MV	000028	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_MV	000106	RESET

CL1207_Valvestate_BW2_R

Added Valves in **CL1207_Valvestate_BW2_R (2009/03)**

	VALVES	ADDRESS	COMMENTS
CIP General			
	SV_1207_05_MV	000059	RESET
	SV_1207_06_MV	000067	RESET
	SV_1207_10_MV	000057	RESET
	SV_1207_12_MV	000110	RESET
CIP Filling control			
	SV_1209_02_MV	000079	RESET

5.53.11.Awaited Feedback

CL1207_Valvestate_BW2_OK

Added Feedback in **CL1207_Valvestate_BW2_OK (2009/03)**

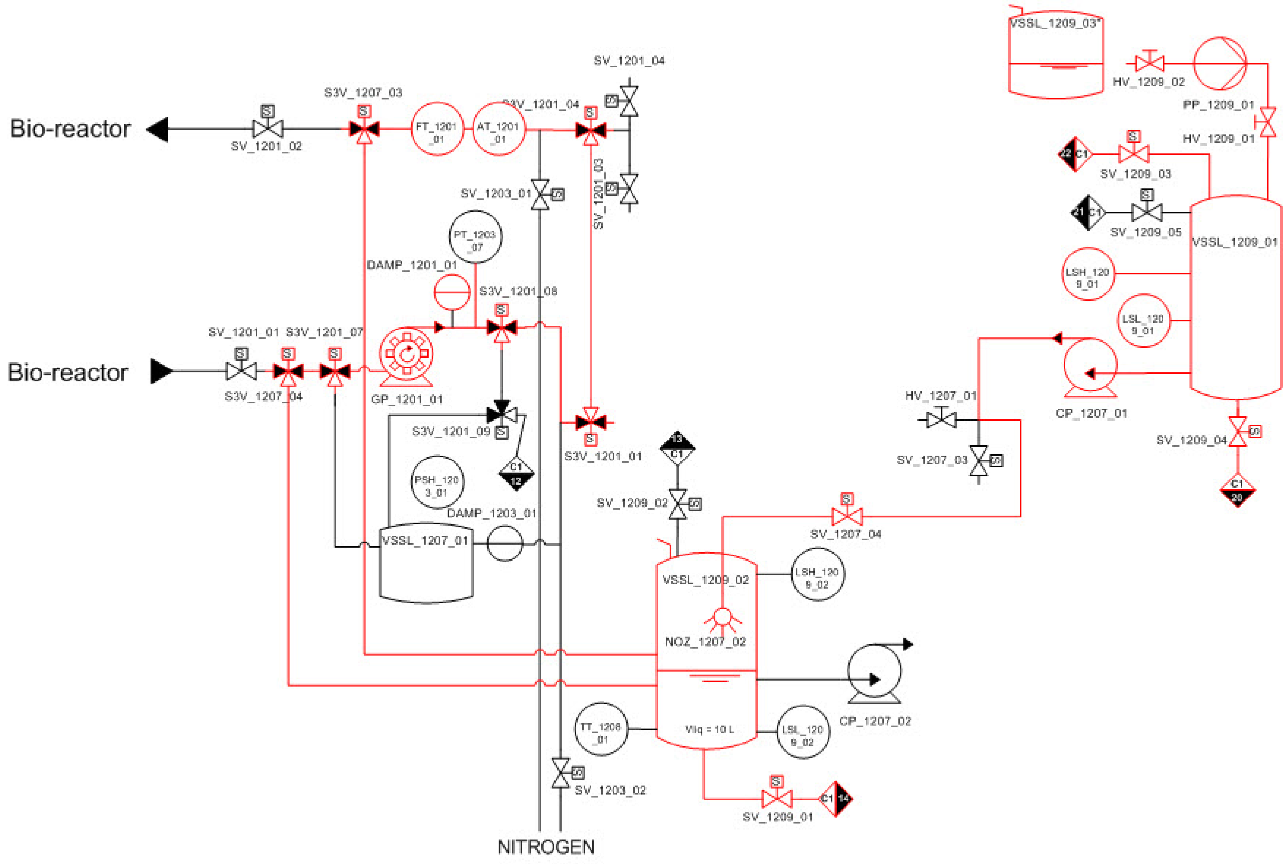
	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_04_FB	100130	RESET
	SV_1201_06_FB	100129	RESET
	SV_1201_08_FB	100077	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_02_FB	100131	RESET
CIP General			
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_04_FB	100104	RESET
	SV_1207_05_FB	100090	SET
	SV_1207_06_FB	100098	SET
	SV_1207_07_FB	100097	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_10_FB	100092	SET
	SV_1207_11_FB	100091	RESET
	SV_1207_12_FB	100140	SET
CIP Filling control			
	SV_1209_02_FB	100102	SET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_06_FB	100059	RESET
	SV_1210_08_FB	100057	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_FB	100136	RESET

CL1207_Valvestate_BW2_R_OK

Added Feedback in **CL1207_Valvestate_BW2_R_OK (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_04_FB	100130	RESET
	SV_1201_06_FB	100129	RESET
	SV_1201_08_FB	100077	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_02_FB	100131	RESET
CIP General			
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_04_FB	100104	RESET
	SV_1207_05_FB	100090	RESET
	SV_1207_06_FB	100098	RESET
	SV_1207_07_FB	100097	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_11_FB	100091	RESET
	SV_1207_12_FB	100140	RESET
CIP Filling control			
	SV_1209_02_FB	100102	RESET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_06_FB	100059	RESET
	SV_1210_08_FB	100057	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_FB	100136	RESET

5.54. Procedure 53: Cleaning of Filtration Unit: Circulation pump GP_1201_01



5.54.1.Scope

This Procedure can only be activated when the FU, the CIP and the SIP control Loop mode button are in Automatic mode.

This procedure may be used to dilute the retentate in GP_1201_01 and some of the retentate piping with water, and then again to clean GP_1201_01 and some of the retentate piping. This is done by filling VSSL_1209_02 with water or cleaning agent and then circulating over it. It might be useful before disassembling GP_1201_01, AT_1201_01 or FT_1201_01 for maintenance.

Prerequisite
FU must be stopped prior to execution of this procedure.
Define parameters before (see procedure 61 / 62 / 63)

Procedure

Use the HMI to start the procedure C_CLPMP: CL1207_SCI_CLPMP (PLC Address: 000242). This initiates the actions below:
VSSL_1209_01 is filled with water and - if desired - cleaning agent: CL1209_SCI_Fill_CA (PLC Address: 000248)
Content of VSSL_1209_01 is pumped into the cleaning buffer VSSL_1209_02 (Procedure 63).
Valves are in position:
GP_1201_01 circulates the contents of the VSSL_1209_02
The liquid comes from VSSL_1209_02, enters in the retentate line via S3V_1207_04, then go through the pump.
S3V_1201_01 and S3V_1201_04 are in By pass position and S3V_1207_03 sends the liquid back to VSSL_1209_02
VSSL_1209_01 and VSSL_1209_02 is to be emptied afterwards(procedure 58 and 59).
If cleaning agent was used, the operator should use PROCEDURE 64 and 65 for rinsed VSSL_1209_01 VSSL_1209_02
CL1207_SCI_Rinse_CA (PLC Address: 000264).
CL1207_SCI_Rinse_CB (PLC Address: 000265).

Used Variables:
CL1207_SCI_CLPMP (PLC Address: 000242)
CL1207_TB_CLPMP (PLC Address: 000370)

PLC Subroutine: **C_Fill_CA, C_Fill_CB, C_Empty_CA, C_Empty,**
These PLC subroutines are described in PROCEDURE 58, 59, 61/62 and 63.

5.54.2.PLC Subroutine: C_CLPMP

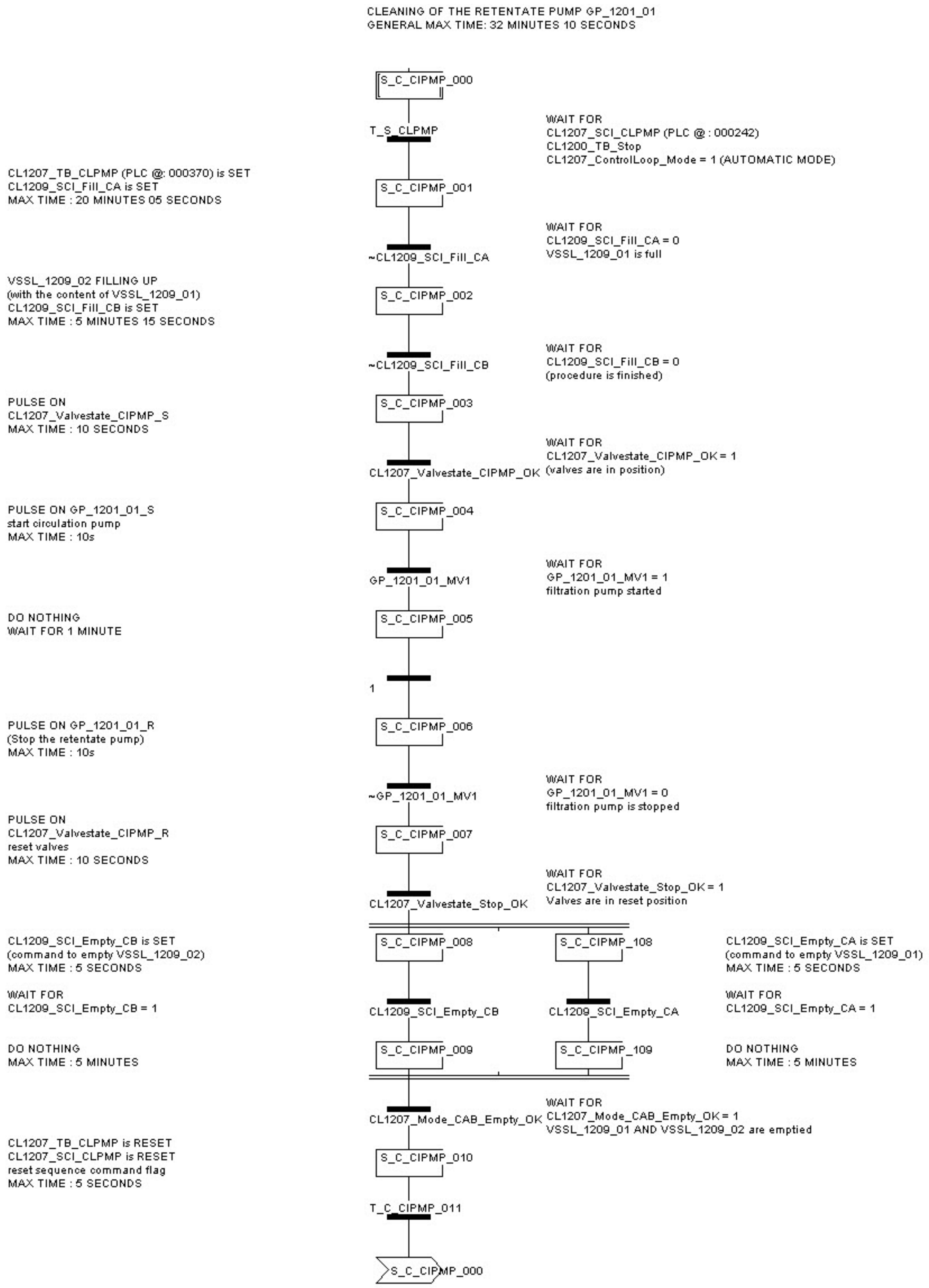
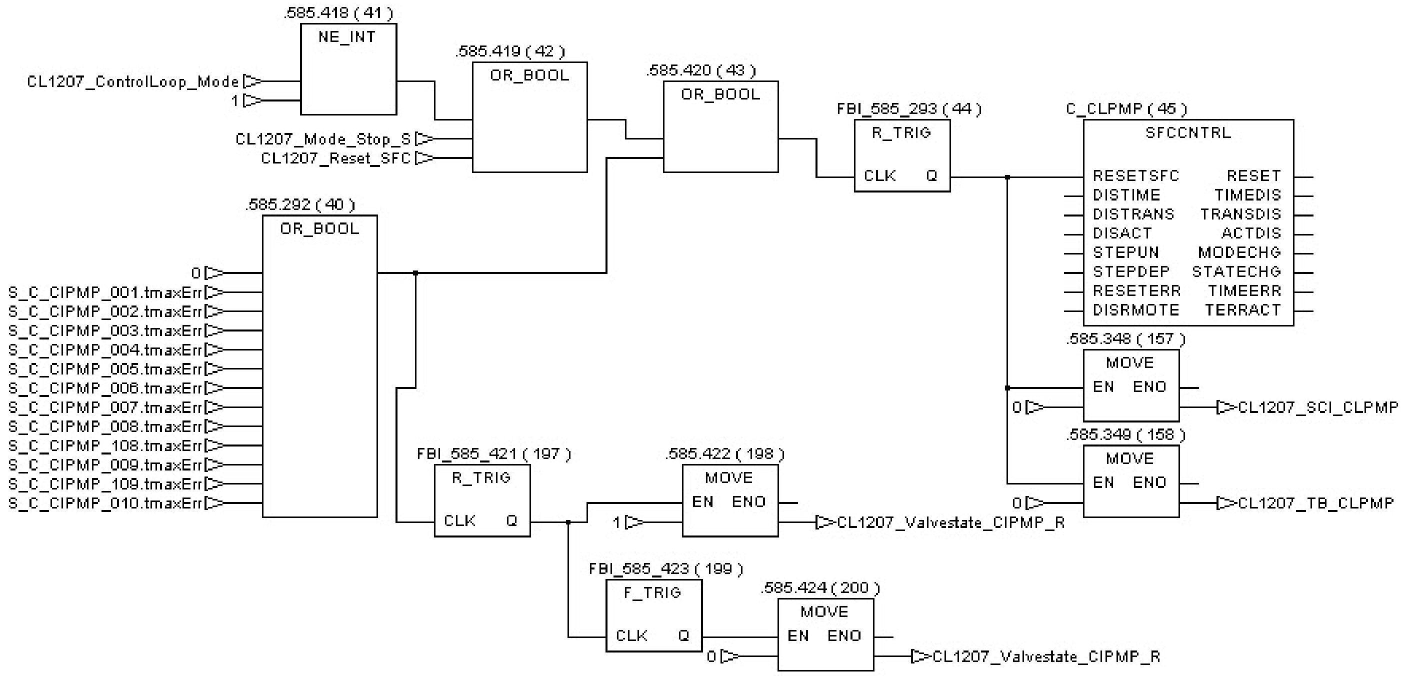


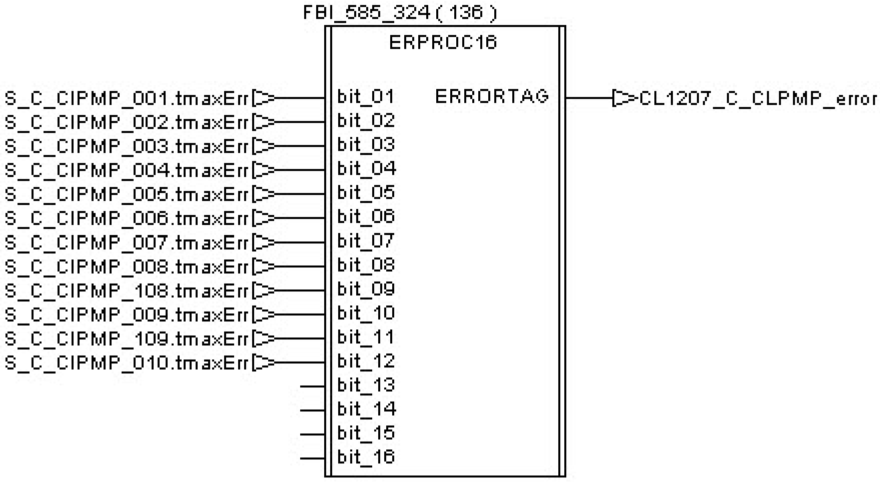
Figure 131: PLC procedure: C_CLPMP

5.54.3.Procedure management

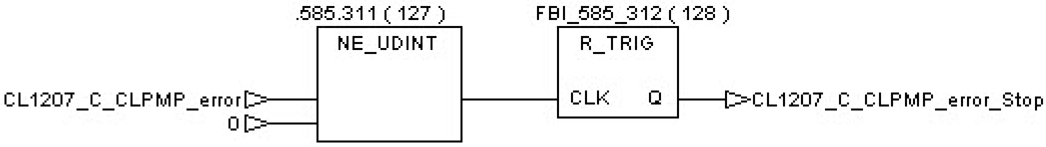
Reset of the procedure:
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



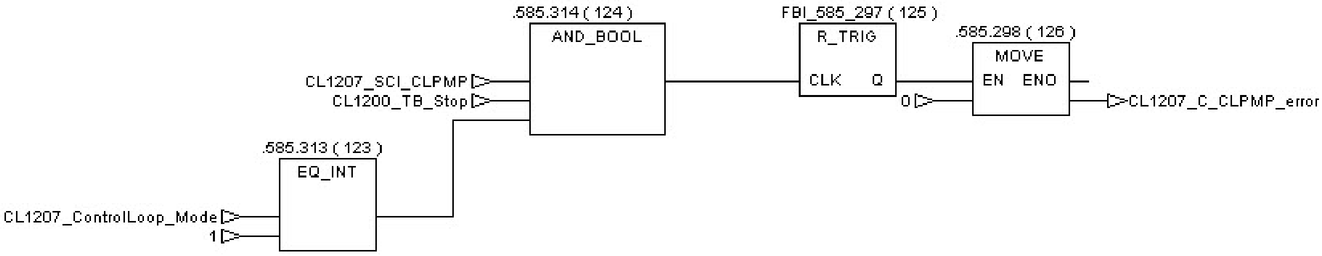
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1207_C_ClPMP_error_Stop" receives a pulse and then the Cleaning Unit is stopped thanks to the procedure "C_Stop".



The error number is displayed until the procedure is re-started.



5.54.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_C_ClPMP_001**	Problem during the execution of the procedure "C_Fill_CA" (filling of the cleaning buffer VSSL_1209_01) The procedure "C_Fill_CA" should also have an error code
2	**S_C_ClPMP_002**	Problem during the execution of the procedure "C_Fill_CB" (filling of the cleaning buffer VSSL_1209_02) The procedure "C_Fill_CB" should also have an error code
4	**S_C_ClPMP_003**	valve(s) status Error operator has to look for valve alarm
8	**S_C_ClPMP_004**	The retentate pump GP_1201_01 didn't start
16	**S_C_ClPMP_005**	Just a delay, no possible error
32	**S_C_ClPMP_006**	The retentate pump GP_1201_01 didn't stop
64	**S_C_ClPMP_007**	valve(s) status Error operator has to look for valve alarm
128	**S_C_ClPMP_008**	Tag set problem (Start button)
256	**S_C_ClPMP_108**	Tag set problem (Start button)
512	**S_C_ClPMP_009**	One of the two cleaning vessels didn't finish its emptying. One of the two procedures "C_Empty_CA" or "C_Empty_CB" should have an error code.
1024	**S_C_ClPMP_109**	One of the two cleaning vessels didn't finish its emptying. One of the two procedures "C_Empty_CA" or "C_Empty_CB" should have an error code.
2048	**S_C_ClPMP_010**	Tag reset problem (Tracing bit or Start button)

5.54.5.Controlled valves

CL1207_Valvestate_CIPMP_S

Added Valves in **CL1207_Valvestate_CIPMP_S (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_MV	000061	SET
	S3V_1201_04_MV	000064	SET
	S3V_1201_07_MV	000042	RESET
	S3V_1201_08_MV	000043	RESET
	SV_1201_01_MV	000060	RESET
	SV_1201_02_MV	000049	RESET
Filtration Unit Pressure control			
	SV_1203_01_MV	000055	RESET
	SV_1203_02_MV	000037	RESET
CIP General			
	S3V_1207_03_MV	000069	SET
	S3V_1207_04_MV	000070	SET
CIP Filling control			
	SV_1209_02_MV	000079	SET

CL1207_Valvestate_CIPMP_R

Added Valves in **CL1207_Valvestate_CIPMP_R (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_MV	000061	RESET
	S3V_1201_04_MV	000064	RESET
CIP General			
	S3V_1207_03_MV	000069	RESET
	S3V_1207_04_MV	000070	RESET
CIP Filling control			
	SV_1209_02_MV	000079	RESET

5.54.6.Awaited Feedback

CL1207_Valvestate_CIPMP_OK

Added Feedback in **CL1207_Valvestate_CIPMP_OK (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_FB	100088	SET
	S3V_1201_04_FB	100085	SET
	S3V_1201_07_FB	100075	RESET
	S3V_1201_08_FB	100074	RESET
	SV_1201_01_FB	100089	RESET
	SV_1201_02_FB	100084	RESET
Filtration Unit Pressure control			
	SV_1203_01_FB	100078	RESET
	SV_1203_02_FB	100064	RESET
CIP General			
	S3V_1207_03_FB	100096	SET
	S3V_1207_04_FB	100095	SET
CIP Filling control			
	SV_1209_02_FB	100102	SET

CL1207_Valvestate_CIPMP_R_OK

Added Feedback in **CL1207_Valvestate_CIPMP_R_OK (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	S3V_1201_01_FB	100088	RESET
	S3V_1201_04_FB	100085	RESET
	S3V_1201_07_FB	100075	RESET
	S3V_1201_08_FB	100074	RESET
	SV_1201_01_FB	100089	RESET
	SV_1201_02_FB	100084	RESET
Filtration Unit Pressure control			
	SV_1203_01_FB	100078	RESET
	SV_1203_02_FB	100064	RESET
CIP General			
	S3V_1207_03_FB	100096	RESET
	S3V_1207_04_FB	100095	RESET
CIP Filling control			
	SV_1209_02_FB	100102	RESET

5.55. Procedure 54: Cleaning of Filtration Unit: Filtrate tank VSL2_1204_01

5.55.1. Scope

This procedure cleans rinses and empties the effluent vessel VSL2_1204_01.

Prerequisite
FU must be stopped or be put into recycle or bypass mode prior to execution of this procedure.
HV_1204_01 must be closed.
VSL2_1204_01 must be harvested.
Define parameters before (see procedure 61 / 62)

Procedure
Connect the drain outlet of VSL2_1204_01 to a vessel that can hold the contents of VSSL_1209_01 (15 L) before using the HMI to start the procedure C_R_F_01 (PLC Address: 000266). This initiates the actions below:
VSSL_1209_01 is filled with water and - if desired - cleaning agent: (procedure 62 or 63)
Involved valves are set in position.
CP_1207_01 pushes the contents of the VSSL_1209_01 through the nozzle Noz-1207_01 into VSL2_1204_01.
Valves involved are reset.
VSL2_1204_01 is harvested (Procedure 39: Harvest Effluent VESSEL VSSL_1204_01).
Procedure 64 is called (Rinse VSSL_1209_01). This procedure also calls the procedure 58 (Empty VSSL_1209_01)

If this procedure is used with cleaning agent, use PROCEDURE 64: Rinse VSSL_1209_01 and then this procedure several times without cleaning agent in order to remove any cleaning agent from VSL2_1204_01.

Used Variables:
CL1207_SCI_VSL2_1204_01 (PLC Address: 000266).
CL1207_TB_VSL2_1204_01 (PLC Address: 000371).

5.55.2.PLC Subroutine: C_R_F_01

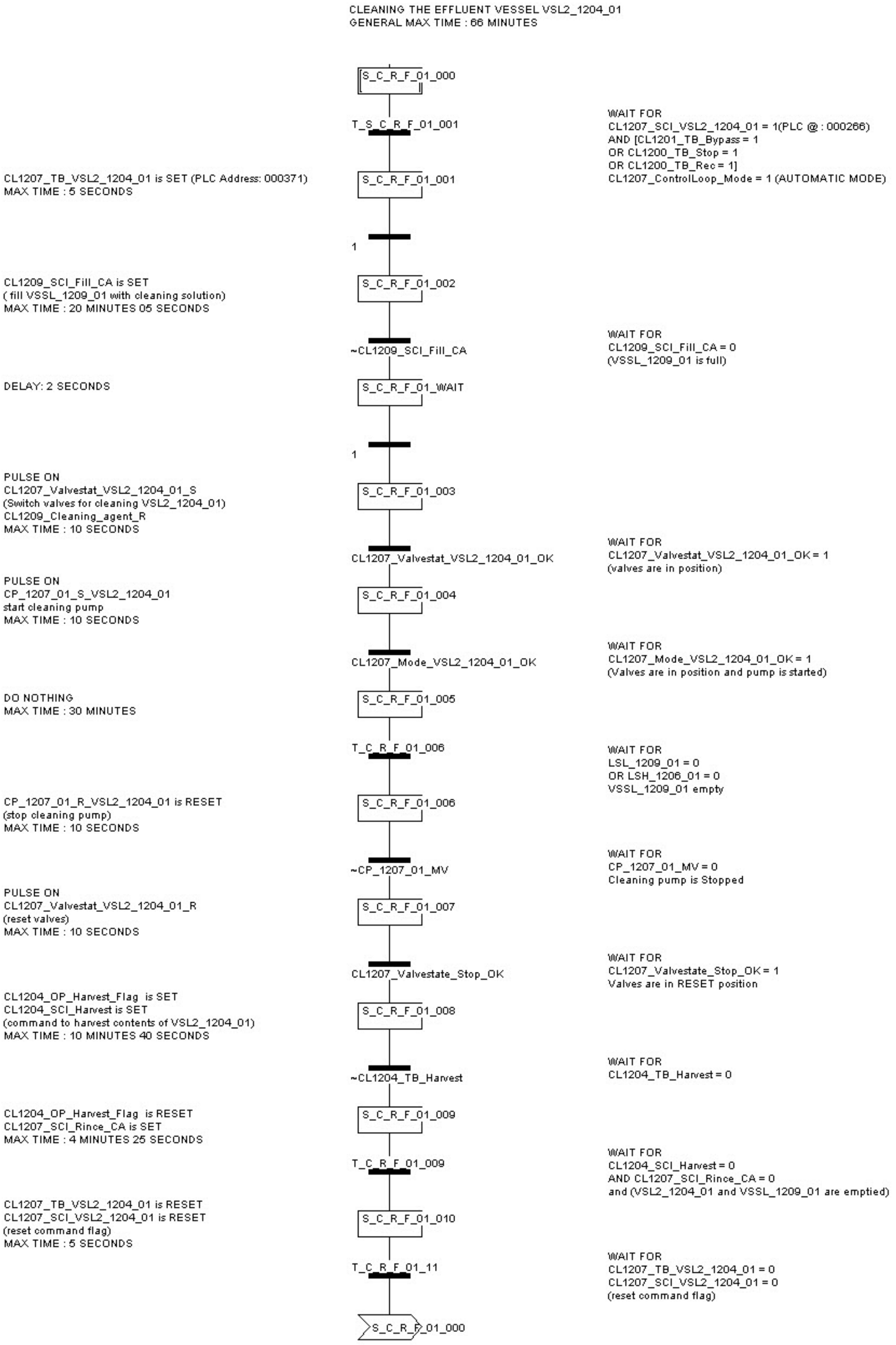
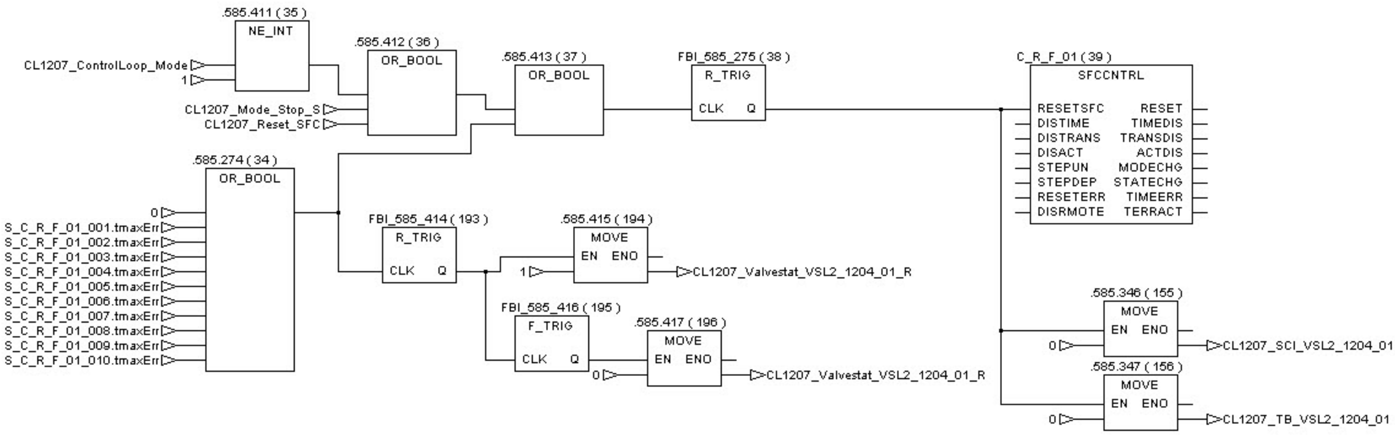


Figure 132: PLC procedure: C_R_F_01

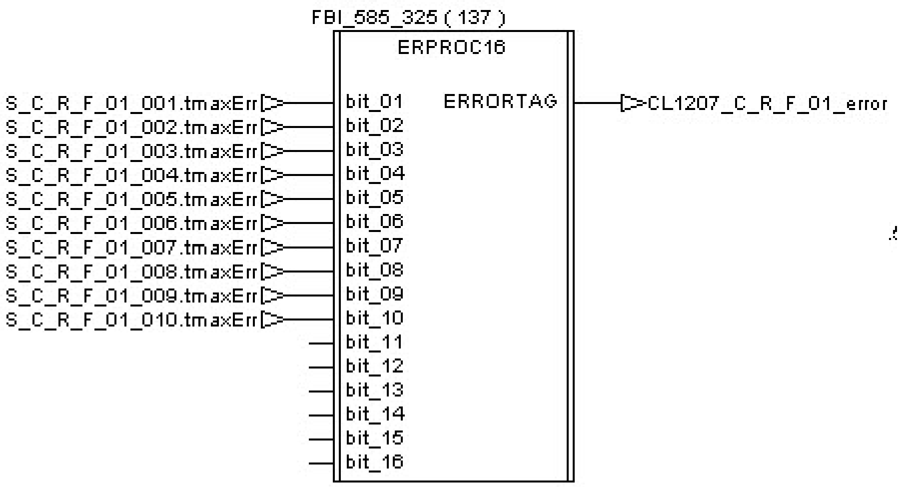
5.55.3.Procedure management

<u>Reset of the procedure:</u>

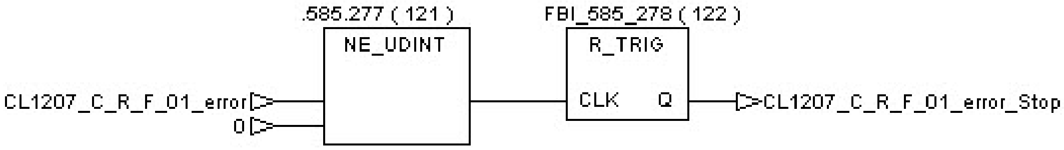
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



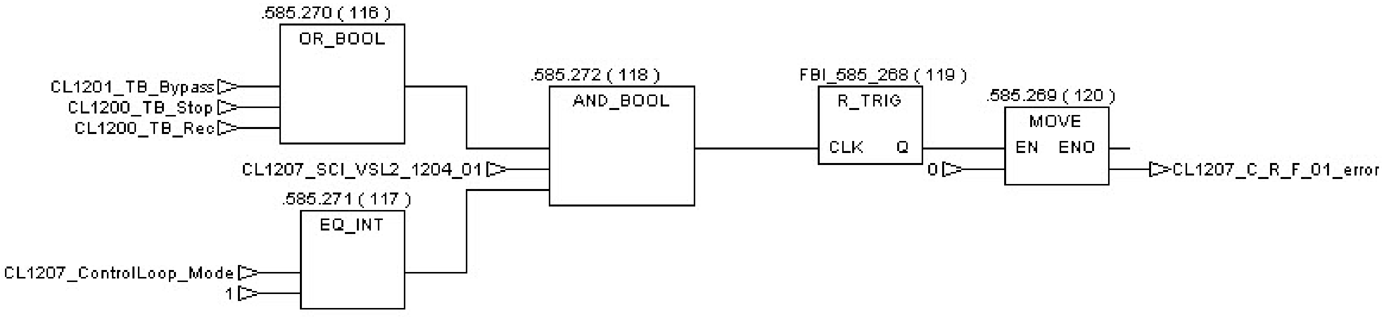
<u>Procedure error management:</u>
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1207_C_R_F01_error_Stop" receives a pulse and then the Cleaning Unit is stopped thanks to the procedure "C_Stop".



The error number is displayed until the procedure is re-started.



5.55.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_C_R_F_01_001**	No transition, no possible error
2	**S_C_R_F_01_002**	Problem during the execution of the procedure "C_Fill_CA" (filling of the cleaning buffer VSSL_1209_01) The procedure "C_Fill_CA" should also have an error code
4	**S_C_R_F_01_003**	valve(s) status Error operator has to look for valve alarm
8	**S_C_R_F_01_004**	The cleaning pump CP_1207_01 didn't start
16	**S_C_R_F_01_005**	Level switch low LSL_1209_01 or Level switch high LSH_1206_01 have a problem
32	**S_C_R_F_01_006**	The cleaning pump CP_1207_01 didn't stop
64	**S_C_R_F_01_007**	valve(s) status Error operator has to look for valve alarm
128	**S_C_R_F_01_008**	Problem during the execution of the procedure "F_Harvest" (harvest of the effluent tank) The procedure "F_Harvest" should also have an error code
256	**S_C_R_F_01_009**	Problem during the execution of the procedure "C_Rinse_CA" (filling of the cleaning buffer VSSL_1209_01) The procedure "C_Rinse_CA" should also have an error code
512	**S_C_R_F_01_010**	Tag reset problem (Tracing bit or Start button)

5.55.5.Controlled Valves

CL1207_Valvestat_VSL2_1204_01_S

Added Valves in CL1207_Valvestat_VSL2_1204_01_S (2009/03)

	VALVES	ADDRESS	COMMENTS
Filtration Unit Filtrate Flow Control			
	SV_1202_03_MV	000051	SET
	SV_1202_04_MV	000100	RESET
Filtration Unit Pressure control			
	SV_1203_04_MV	000107	RESET
Effluent Tank General			
	SV_1204_01_MV	000052	SET
	SV_1204_02_MV	000054	SET
	SV_1204_03_MV	000101	RESET
CIP General			
	SV_1207_01_MV	000074	RESET
	SV_1207_02_MV	000075	RESET
	SV_1207_03_MV	000076	SET
	SV_1207_04_MV	000077	RESET
	SV_1207_05_MV	000059	RESET
CIP Filling control			
	SV_1209_04_MV	000065	RESET
	SV_1209_05_MV	000066	SET
SIP General			
	SV_1210_03_MV	000088	RESET
	SV_1210_13_MV	000112	RESET
	SV_1210_14_MV	000113	RESET

CL1207_Valvestat_VSL2_1204_01_R

Added Valves in CL1207_Valvestat_VSL2_1204_01_R (2009/03)

	VALVES	ADDRESS	COMMENTS
Filtration Unit Filtrate Flow Control			
	SV_1202_03_MV	000051	RESET
Effluent Tank General			
	SV_1204_01_MV	000052	RESET
	SV_1204_02_MV	000054	RESET
CIP General			
	SV_1207_03_MV	000076	RESET
CIP Filling control			
	SV_1209_05_MV	000066	RESET

5.55.6.Awaited Feedback

CL1207_Valvestat_VSL2_1204_01_OK

Added Feedback in **CL1207_Valvestat_VSL2_1204_01_OK (2009_03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Filtrate Flow Control			
	SV_1202_03_FB	100082	SET
	SV_1202_04_FB	100132	RESET
Filtration Unit Pressure control			
	SV_1203_04_FB	100137	RESET
Effluent Tank General			
	SV_1204_01_FB	100081	SET
	SV_1204_02_FB	100079	SET
	SV_1204_03_FB	100133	RESET
CIP General			
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	SET
	SV_1207_04_FB	100104	RESET
	SV_1207_05_FB	100090	RESET
CIP Filling controll			
	SV_1209_04_FB	100100	RESET
	SV_1209_05_FB	100099	SET
SIP General			
	SV_1210_03_FB	100108	RESET
	SV_1210_13_FB	100142	RESET
	SV_1210_14_FB	100143	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET
	SV_1211_02_FB	100136	RESET
	SV_1211_03_FB	100138	RESET

CL1207_Valvestate_Stop_OK

Added Feedback in **CL1207_Valvestate_Stop_OK (2009)**

	VALVES	ADDRESS	COMMENTS
CIP General			
	S3V_1207_03_FB	100096	RESET
	S3V_1207_04_FB	100095	RESET
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_04_FB	100104	RESET
	SV_1207_05_FB	100090	RESET
	SV_1207_06_FB	100098	RESET
	SV_1207_07_FB	100097	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_09_FB	100094	[AND (CL1210_SCI_P_All1 = 0)] OR [AND (CL1210_SCI_P_All1 =1) AND (CL1207_SCI_Cl1 = 1)] RESET
	SV_1207_10_FB	100092	[AND (CL1210_SCI_P_All1 = 0)] RESET
	SV_1207_11_FB	100091	[AND (CL1210_SCI_P_All2 = 0)] RESET
	SV_1207_12_FB	100140	RESET
	SV_1207_13_FB	100139	RESET
CIP Filling controll			
	SV_1209_01_FB	100103	RESET
	SV_1209_02_FB	100102	RESET
	SV_1209_03_FB	100101	RESET
	SV_1209_04_FB	100100	RESET
	SV_1209_05_FB	100099	RESET

5.56. Procedure 55: Cleaning of Filtration Unit: Filtrate tank VSL2_1204_01 and filtrate line through LF_1200_01 or LF_1200_02

5.56.1. Scope

IMPORTANT POINT:
THIS PROCEDURE IS STILL IN EFFICIENCY TEST. AT THE CURRENT DATE THE PROCEDURE C_ET1 IS NOT THE SAME THAN DESCRIBED IN THE REPORT. THE DIFFERENCE IS LINKED TO THE FILLING OF THE EFFLUENT TANK. THE CLEANING VESSEL VSSL_1209_01 IS FILLED TWICE IN ORDER TO FILL COMPLETELY THE EFFLUENT TANK. SOME CHANGES CAN STILL BE DONE CONCERNING THE ADDITION OF THE N2 TO PUSH CLEANING SOLUTION THROUGH THE FILTRATE LINE.
AS THE PROCEDURE IS NOT VALIDATED, THE ERROR CODE FUNCTION IS NOT PROVIDED

This Procedure can only be activated when the FU, the CIP and the SIP control Loop mode button are in Automatic mode.

This procedure cleans or rinses the effluent vessel VSL2_1204_01 and the Filtrate piping going from VSL2_1204_01 through PP_1202_01 to the filtrate side of the membrane. It uses a piece of SIP piping to evacuate the liquid via the drain at valve SV_1201_07 (LF_1200_01) or SV_1201_08 (LF_1200_02).
Consider PROCEDURE 27: Filtration Unit: Replacement of tube in pump PP_1202_01 afterwards, depending on how long the tube was used.

Prerequisite:
FU must be stopped or be working over the bypass mode. Retentate side of the membrane to be backwashed must be rinsed before (use PROCEDURE 49: Cleaning of Filtration Unit: retentate side of membrane LF_1200_01 / LF_1200_02. If not, drain to SV_1201_07 or 08 may get clogged.
The dead end filter LF_1200_03 must be removed from its housing.
Open the lid of PP_1202_01
HV_1204_02 has to be opened.

Define parameters before (see procedure 61 / 62)

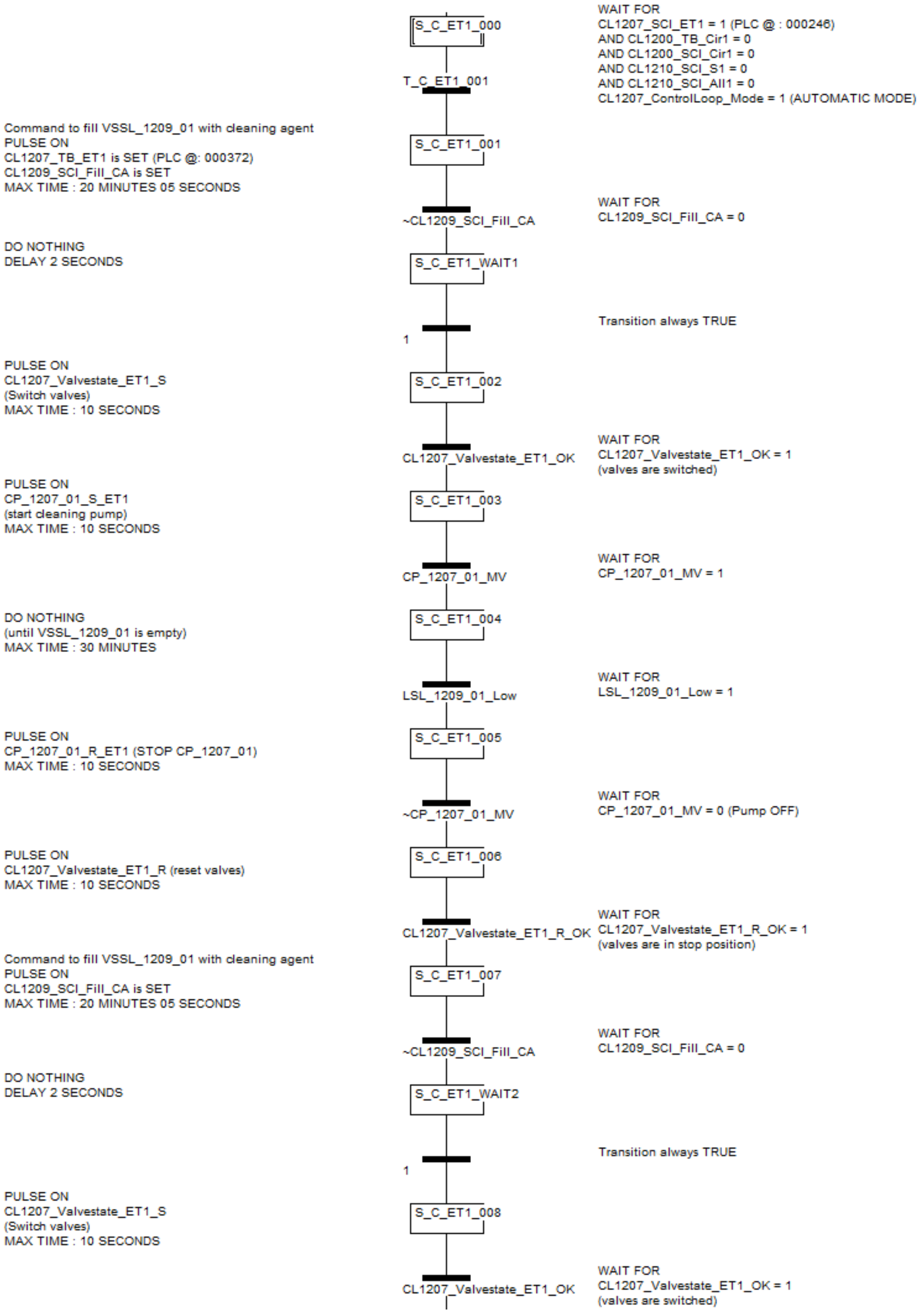
Procedure:
Use the HMI to start the procedure:
C_ET1 (LF_1200_01): CL1207_SCI_ET1(PLC Address : 000246)
C_ET2 (LF_1200_02): CL1207_SCI_ET2 (PLC Address : 000247).
This initiates the actions below:
VSSL_1209_01 is filled with cleaning agent or water only

Valves are set in position.
CP_1207_01 starts to push the contents of the VSSL_1209_01 through the nozzle Noz_1207_01 into VSL2_1204_01 (approximately 15 L into VSL2_1204_01).
Once the level of VSSL_1209_01 is low (LSL_1209_01_Low = 1), the pump is stopped and the valves are reset.
VSSL_1209_01 is filled again with cleaning agent or water only.
Valves are set in position then CP_1207_01 starts again to push the contents of the VSSL_1209_01 through the nozzle Noz_1207_01 until the Level switch High of the effluent tank (LSH_1206_01) or the Level Switch Low of the cleaning buffer VSSL_1209_01 is set or the .
The PLC waits for 1 minute the cleaning agent to take effect.
The valves SV_1207_03 and SV_1209_05 are closed and N2 injection starts by opening the valve SV_1203_04 during 5 minutes. It pushes the cleaning solution through the filtrate line, then to the retentate line via the bypass valve SV_1207_13 (membrane 1) or SV_1207_12 (membrane 2). It leaves the piping by the drain valve SV_1201_07 (membrane 1) or SV_1201_08 (membrane 2).
Valves are reset.
The effluent tank and the cleaning buffer VSSL_1209_01 are emptying simultaneously.
All the actions enounced above are repeated with only water to remove cleaning solution from effluent tank and filtrate line
Once the procedure is finished, the valves are set in default position
VSSL_1209_01 is rinsed.
CL1207_SCI_ETx and CL1207_TB_ETx are reset.

Put back the dead end filter LF_1200_03 into its housing or use a new filter instead (PROCEDURE 31: Filtration Unit: Installation of dead-end filter LF_1200_03).

5.56.2.PLC Subroutine: C_ET1

For cleaning of the effluent tubing through mbne 1.
Cleaning agent goes into effluent vessel and from there backwards into the effluent tubing. Once in the membrane module it escapes via SV_1207_13 and to the retentate side of the membrane and leaves the unit through the drain valve (SV_1201_07).
This procedure is a way to get rid of particles at the effluent side of the mbnes.



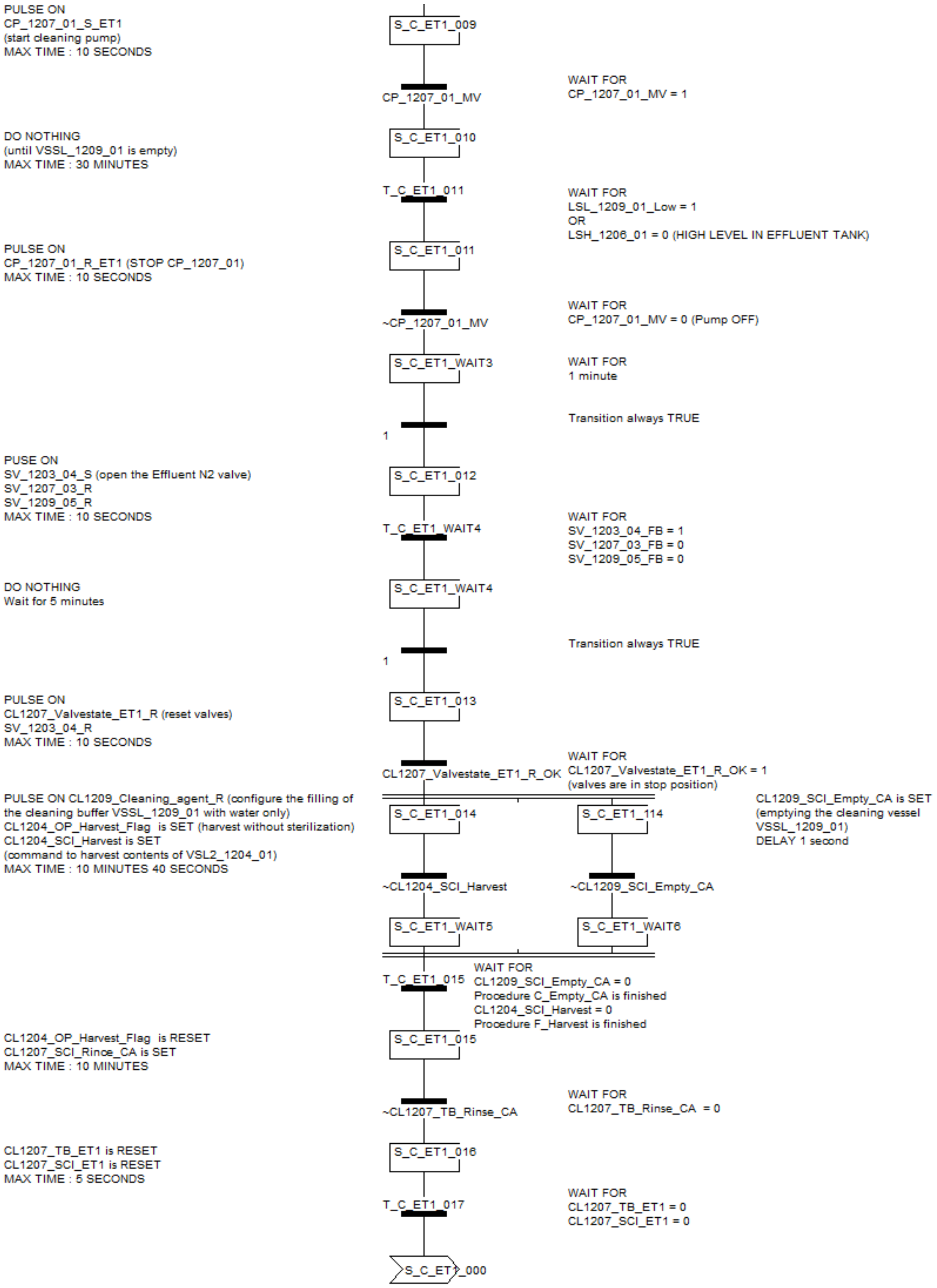
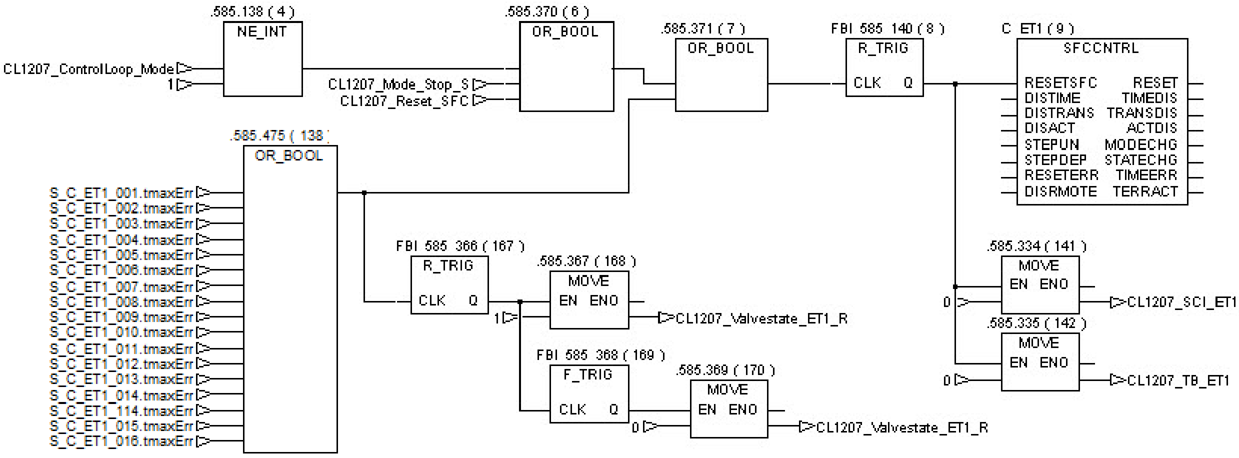


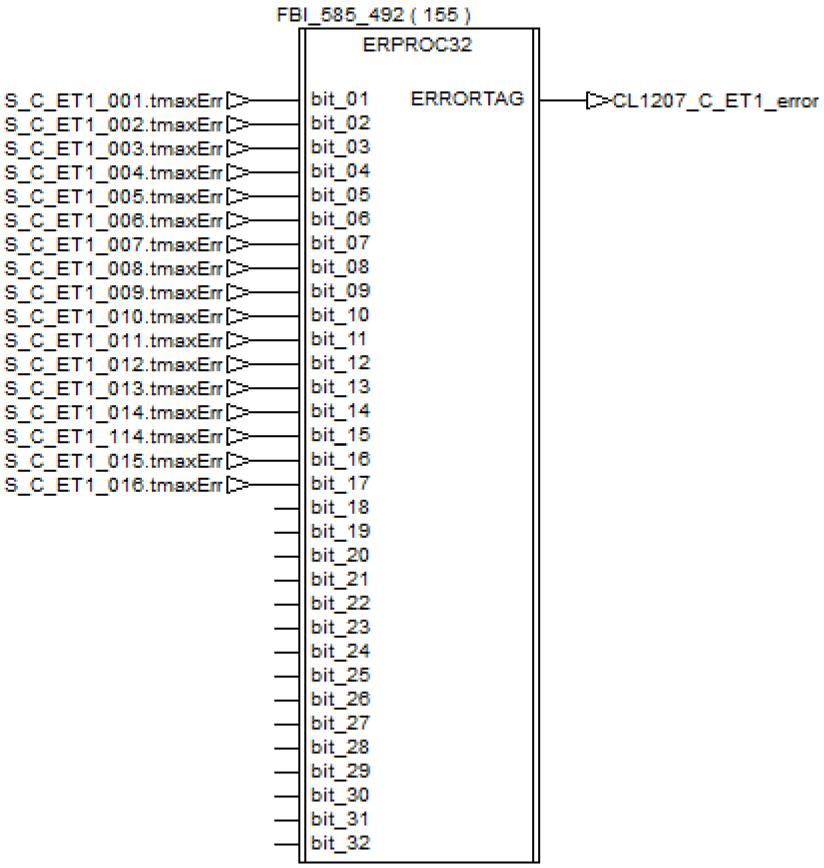
Figure 133: PLC procedure: C_ET1

5.56.3.Procedure management

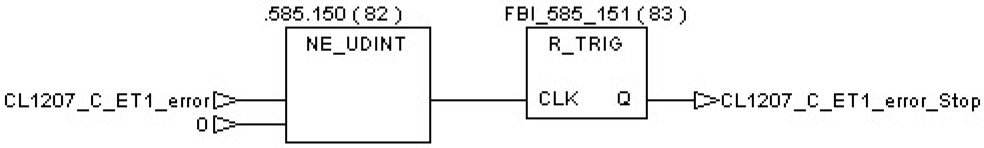
Reset of the procedure:
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



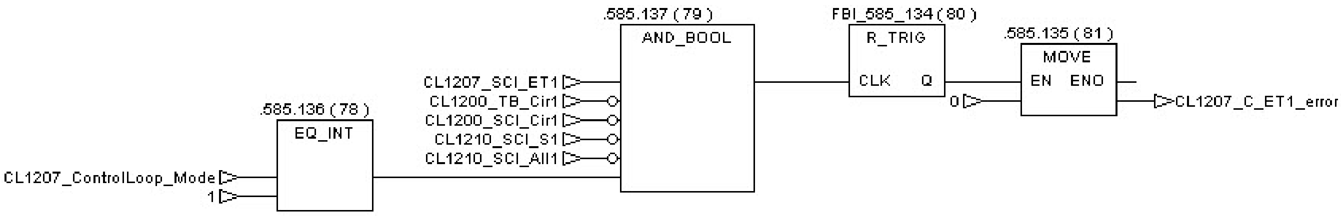
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1207_C_ET1_error_Stop" receives a pulse and then the Cleaning Unit is stopped thanks to the procedure "C_Stop".



The error number is displayed until the procedure is re-started.



5.56.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_C_ET1_001**	Tag set problem
2	**S_C_ET1_002**	valve(s) status Error operator has to look for valve alarm
4	**S_C_ET1_003**	The cleaning pump CP_1207_01 didn't start
8	**S_C_ET1_004**	LSL_1209_01 faillure, or pipe (from cleaning buffer VSSL_1209_01 to Effluent tank) blocked or closed.
16	**S_C_ET1_005**	The cleaning pump CP_1207_01 didn't stop
32	**S_C_ET1_006**	valve(s) status Error operator has to look for valve alarm
64	**S_C_ET1_007**	Problem during the execution of the procedure "C_Fill_CA" (filling of the cleaning buffer VSSL_1209_01) The procedure "C_Fill_CA" should also have an error code
128	**S_C_ET1_008**	valve(s) status Error operator has to look for valve alarm
512	**S_C_ET1_009**	The cleaning pump CP_1207_01 didn't start
1024	**S_C_ET1_010**	LSL_1209_01 faillure, or LSH_1206_01 faillure, or pipe (from cleaning buffer VSSL_1209_01 to Effluent tank) blocked or closed.
2048	**S_C_ET1_011**	The cleaning pump CP_1207_01 didn't stop
4096	**S_C_ET1_012**	valve(s) status Error operator has to look for valve alarm
8192	**S_C_ET1_013**	valve(s) status Error operator has to look for valve alarm
16384	**S_C_ET1_014**	Problem during the execution of the procedure "F_Harvest" (Harvest of the Effluent tank) The procedure "F_Harvest" should also have an error code
32768	**S_C_ET1_114**	Problem during the execution of the procedure "C_Empty_CA" (Emptying of the cleaning buffer VSSL_1209_01) The procedure "C_Empty_CA" should also have an error code
65536	**S_C_ET1_015**	Problem during the execution of the procedure "C_Rinse_CA" (Rinsing of the cleaning buffer VSSL_1209_01) The procedure "C_Rinse_CA" should also have an error code
131072	**S_C_ET1_016**	Tag reset problem

5.56.5.Controlled Valves

CL1207_Valvestate_ET1_S

Added Valves in **CL1207_Valvestate_ET1_S (2009_03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_MV	000063	RESET
	SV_1201_05_MV	000062	RESET
	SV_1201_07_MV	000041	SET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_MV	000050	SET
	SV_1202_02_MV	000099	RESET
	SV_1202_03_MV	000051	RESET
	SV_1202_04_MV	000100	SET
Filtration Unit Pressure control			
	SV_1203_04_MV	000107	RESET
Effluent Tank General			
	SV_1204_01_MV	000052	RESET
	SV_1204_02_MV	000054	SET
	SV_1204_03_MV	000101	SET
CIP General			
	SV_1207_01_MV	000074	RESET
	SV_1207_02_MV	000075	RESET
	SV_1207_03_MV	000076	SET
	SV_1207_04_MV	000077	RESET
	SV_1207_05_MV	000059	RESET
	SV_1207_07_MV	000068	RESET
	SV_1207_09_MV	000071	RESET
	SV_1207_11_MV	000058	RESET
	SV_1207_13_MV	000109	SET
CIP Filling control			
	SV_1209_05_MV	000066	SET
SIP General			
	SV_1210_02_MV	000085	RESET
	SV_1210_03_MV	000088	RESET
	SV_1210_05_MV	000029	RESET
	SV_1210_07_MV	000025	RESET
	SV_1210_09_MV	000027	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_MV	000105	RESET

CL1207_Valvestate_ET1_R

Added Valves in **CL1207_Valvestate_ET1_R (2009_03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_07_MV	000041	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_MV	000050	RESET
	SV_1202_04_MV	000100	RESET
Effluent Tank General			
	SV_1204_02_MV	000054	RESET
	SV_1204_03_MV	000101	RESET
CIP General			
	SV_1207_03_MV	000076	RESET
	SV_1207_13_MV	000109	RESET
CIP Filling control			
	SV_1209_05_MV	000066	RESET

5.56.6.Awaited Feedback

CL1207_Valvestate_ET1_OK

Added Feedback in **CL1207_Valvestate_ET1_OK (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_FB	100086	RESET
	SV_1201_05_FB	100087	RESET
	SV_1201_07_FB	100076	SET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	SET
	SV_1202_02_FB	100131	RESET
	SV_1202_03_FB	100082	RESET
	SV_1202_04_FB	100132	SET
Filtration Unit Pressure control			
	SV_1203_04_FB	100137	RESET
Effluent Tank General			
	SV_1204_01_FB	100081	RESET
	SV_1204_02_FB	100079	SET
	SV_1204_03_FB	100133	SET
CIP General			
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	SET
	SV_1207_04_FB	100104	RESET
	SV_1207_05_FB	100090	RESET
	SV_1207_07_FB	100097	RESET
	SV_1207_09_FB	100094	RESET
	SV_1207_11_FB	100091	RESET
	SV_1207_13_FB	100139	SET
CIP Filling controll			
	SV_1209_05_FB	100099	SET
SIP General			
	SV_1210_02_FB	100105	RESET
		100108	RESET
	SV_1210_05_FB	100056	RESET
	SV_1210_07_FB	100060	RESET
	SV_1210_09_FB	100058	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET

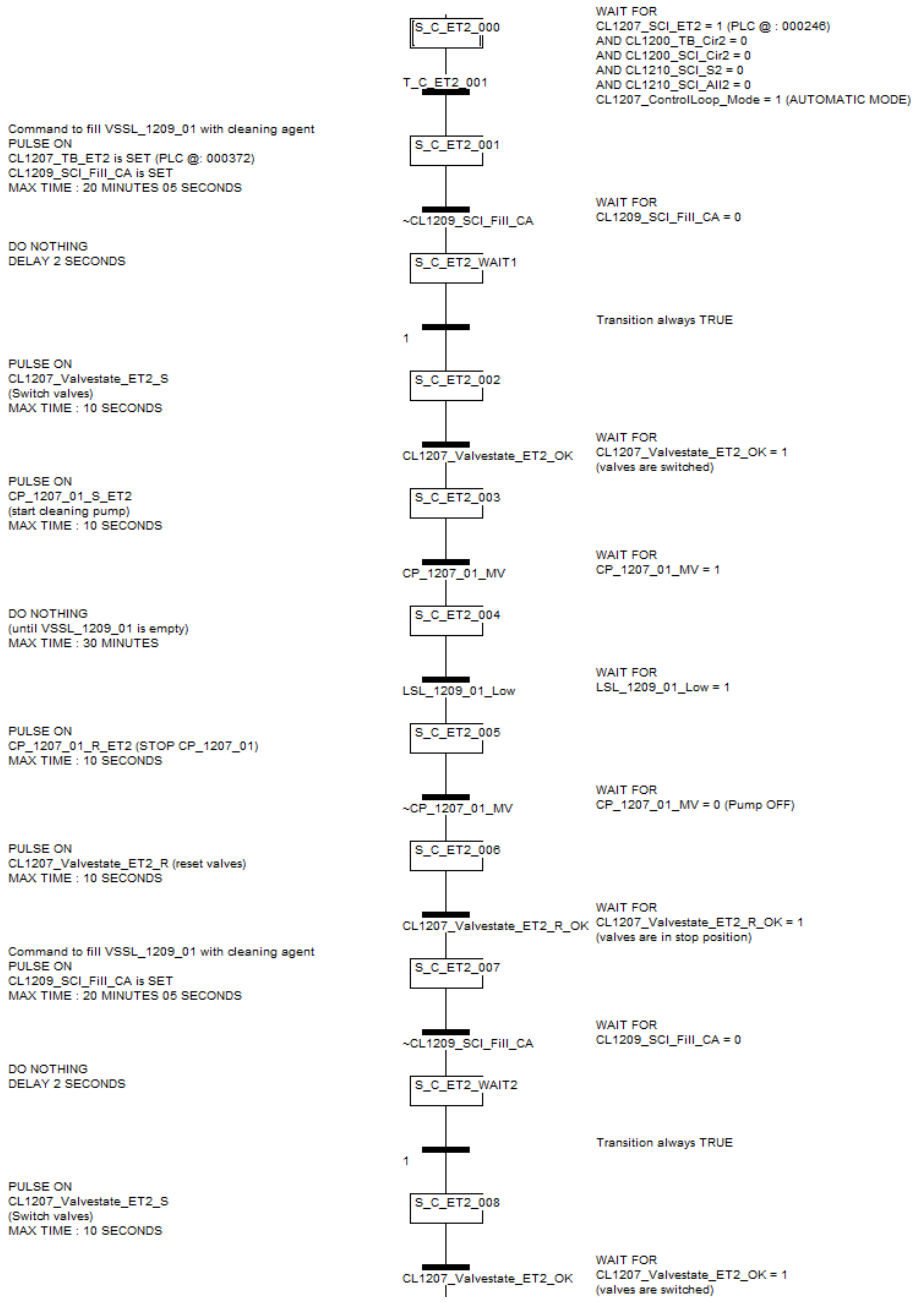
CL1207_Valvestate_ET1_R_OK

Added Feedback in **CL1207_Valvestate_ET1_R_OK (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_FB	100086	RESET
	SV_1201_05_FB	100087	RESET
	SV_1201_07_FB	100076	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	RESET
	SV_1202_02_FB	100131	RESET
	SV_1202_03_FB	100082	RESET
	SV_1202_04_FB	100132	RESET
Filtration Unit Pressure control			
	SV_1203_04_FB	100137	RESET
Effluent Tank General			
	SV_1204_01_FB	100081	RESET
	SV_1204_02_FB	100079	RESET
	SV_1204_03_FB	100133	RESET
CIP General			
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_04_FB	100104	RESET
	SV_1207_05_FB	100090	RESET
	SV_1207_07_FB	100097	RESET
	SV_1207_09_FB	100094	RESET
	SV_1207_11_FB	100091	RESET
	SV_1207_13_FB	100139	SET
CIP Filling controll			
	SV_1209_05_FB	100099	RESET
SIP General			
	SV_1210_02_FB	100105	RESET
		100108	RESET
	SV_1210_05_FB	100056	RESET
	SV_1210_07_FB	100060	RESET
	SV_1210_09_FB	100058	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET

5.56.7.PLC Subroutine: C_ET2

For cleaning of the effluent tubing through mbne 2.
Cleaning agent goes into effluent vessel and from there backwards into the effluent tubing. Once in the membrane module it escapes via SV_1207_12 and to the retentate side of the membrane and leaves the unit through the drain valve (SV_1201_08).
This procedure is a way to get rid of particles at the effluent side of the mbnes.



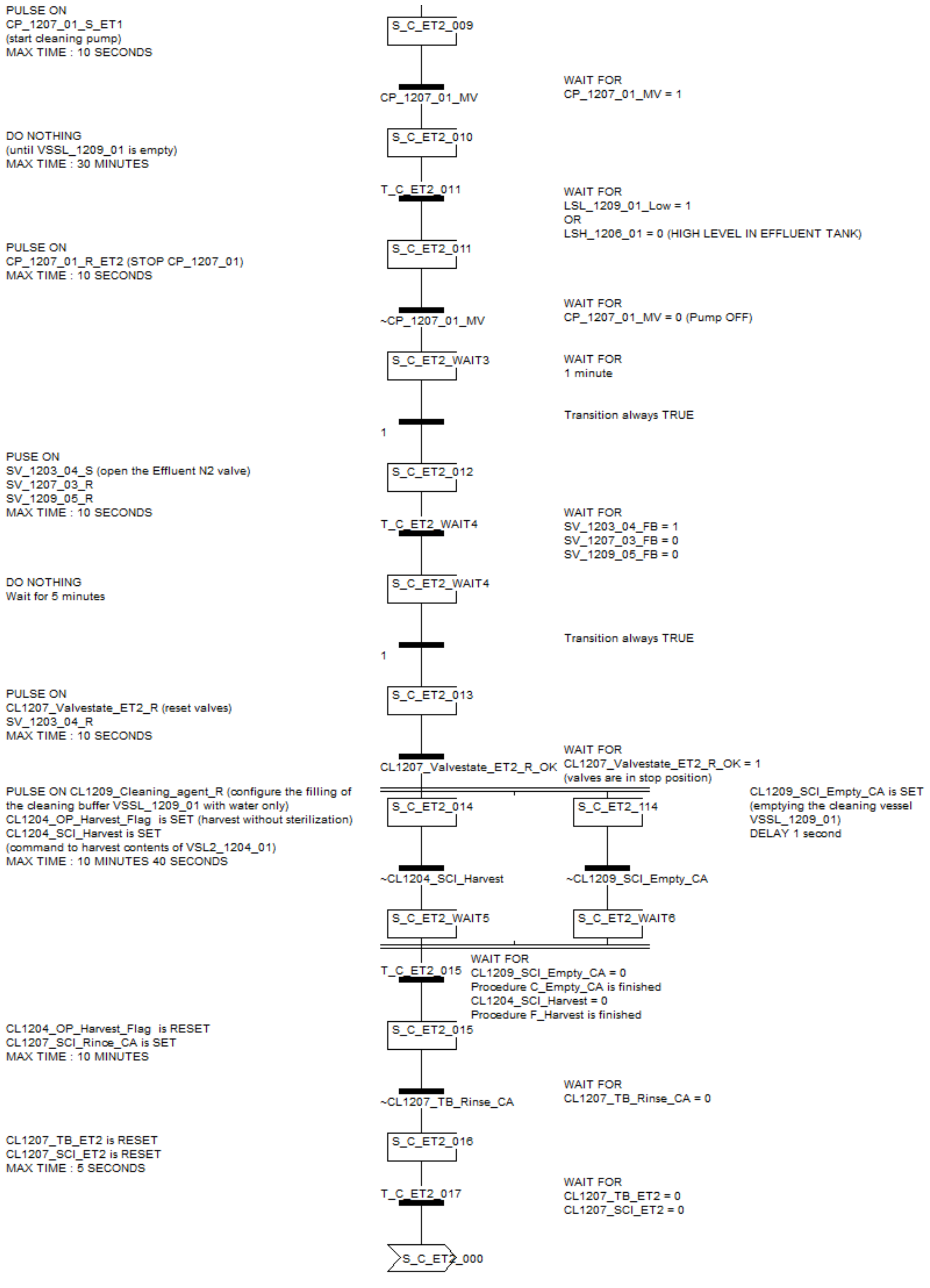
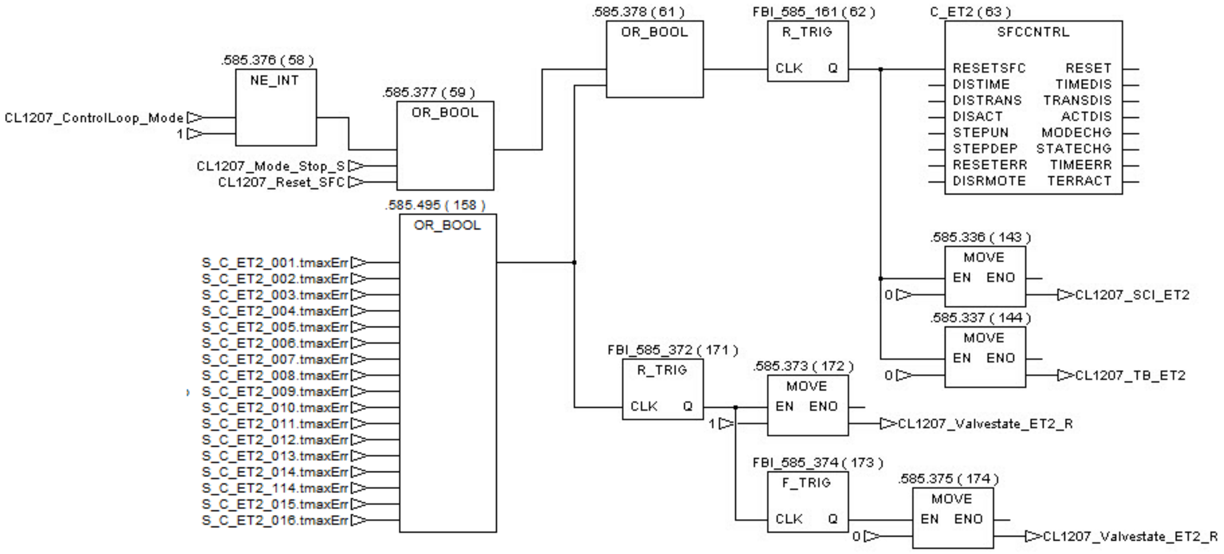


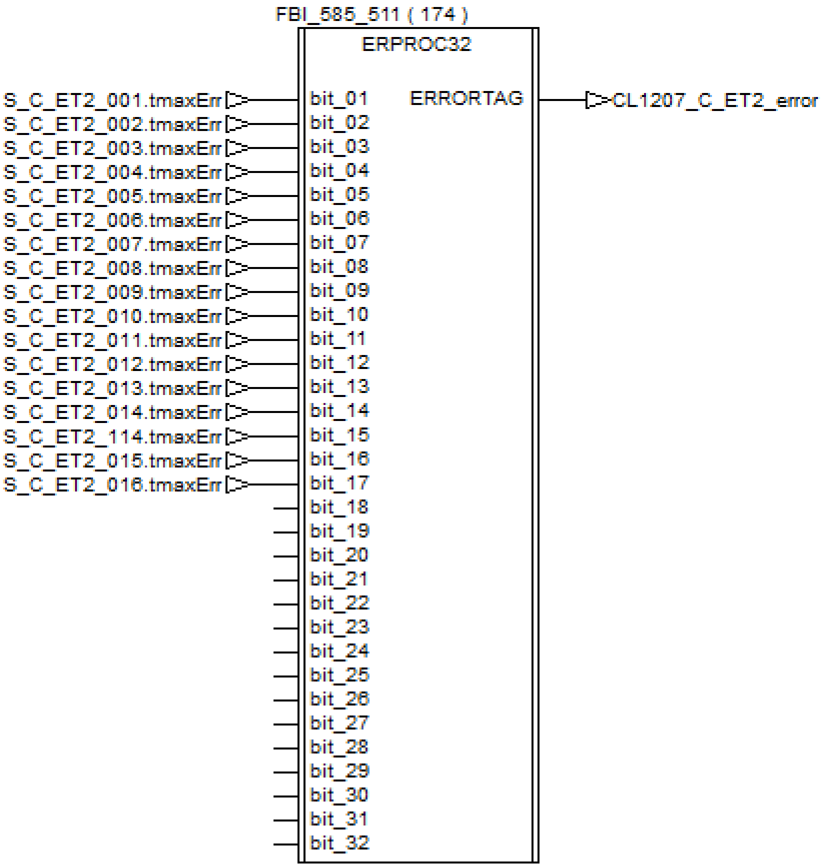
Figure 134: PLC procedure: C_ET2

5.56.8.Procedure management

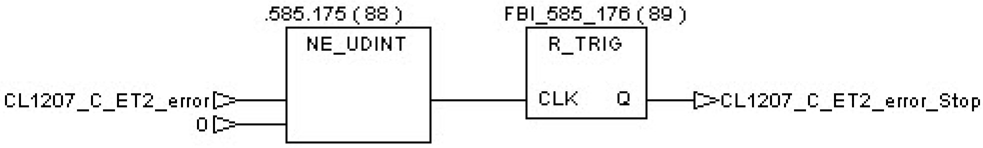
<u>Reset of the procedure:</u>
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



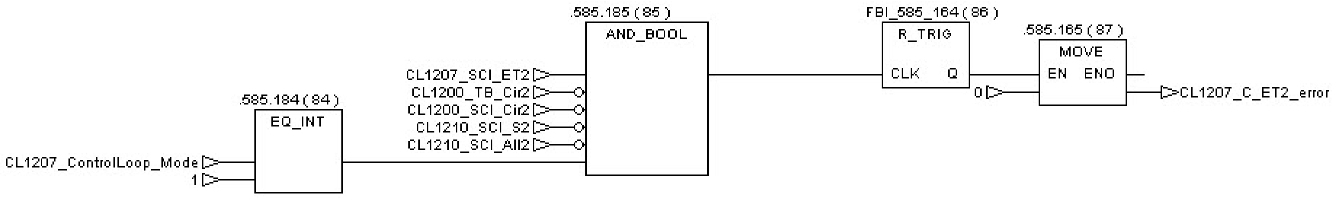
<u>Procedure error management:</u>
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1207_C_ET2_error_Stop" receives a pulse and then the Cleaning Unit is stopped thanks to the procedure "C_Stop".



The error number is displayed until the procedure is re-started.



5.56.9.Error number description

1	**S_C_ET2_001**	Tag set problem

2	**S_C_ET2_002**	valve(s) status Error operator has to look for valve alarm
4	**S_C_ET2_003**	The cleaning pump CP_1207_01 didn't start
8	**S_C_ET2_004**	LSL_1209_01 failure or pipe (from cleaning buffer VSSL_1209_01 to Effluent tank) blocked or closed.
16	**S_C_ET2_005**	The cleaning pump CP_1207_01 didn't stop
32	**S_C_ET2_006**	valve(s) status Error operator has to look for valve alarm
64	**S_C_ET2_007**	Problem during the execution of the procedure "C_Fill_CA" (filling of the cleaning buffer VSSL_1209_01) The procedure "C_Fill_CA" should also have an error code
128	**S_C_ET2_008**	valve(s) status Error operator has to look for valve alarm
512	**S_C_ET2_009**	The cleaning pump CP_1207_01 didn't start
1024	**S_C_ET2_010**	LSL_1209_01 faillure, or LSH_1206_01 faillure, or pipe (from cleaning buffer VSSL_1209_01 to Effluent tank) blocked or closed.
2048	**S_C_ET2_011**	The cleaning pump CP_1207_01 didn't stop
4096	**S_C_ET2_012**	valve(s) status Error operator has to look for valve alarm
8192	**S_C_ET2_013**	valve(s) status Error operator has to look for valve alarm
16384	**S_C_ET2_014**	Problem during the execution of the procedure "F_Harvest" (Harvest of the Effluent tank) The procedure "F_Harvest" should also have an error code
32768	**S_C_ET2_114**	Problem during the execution of the procedure "C_Empty_CA" (Emptying of the cleaning buffer VSSL_1209_01) The procedure "C_Empty_CA" should also have an error code
65536	**S_C_ET2_015**	Problem during the execution of the procedure "C_Rinse_CA" (Rinsing of the cleaning buffer VSSL_1209_01) The procedure "C_Rinse_CA" should also have an error code
131072	**S_C_ET2_016**	Tag reset problem

5.56.10.Controlled Valves

CL1207_Valvestate_ET2_S

The procedure was created on 04_2009

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_04_MV	000098	RESET
	SV_1201_06_MV	000097	RESET
	SV_1201_08_MV	000056	SET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_MV	000050	RESET
	SV_1202_02_MV	000099	SET
	SV_1202_03_MV	000051	RESET
	SV_1202_04_MV	000100	SET
Filtration Unit Pressure control			
	SV_1203_04_MV	000107	RESET
Effluent Tank General			
	SV_1204_01_MV	000052	RESET
	SV_1204_02_MV	000054	SET
	SV_1204_03_MV	000101	SET
CIP General			
	SV_1207_01_MV	000074	RESET
	SV_1207_02_MV	000075	RESET
	SV_1207_03_MV	000076	SET
	SV_1207_04_MV	000077	RESET
	SV_1207_05_MV	000059	RESET
	SV_1207_06_MV	000067	SET
	SV_1207_08_MV	000072	RESET
	SV_1207_10_MV	000057	RESET
	SV_1207_12_MV	000110	SET
CIP Filling control			
	SV_1209_05_MV	000066	SET
SIP General			
	SV_1210_01_MV	000086	RESET
	SV_1210_03_MV	000088	RESET
	SV_1210_04_MV	000030	RESET
	SV_1210_06_MV	000026	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_MV	000106	RESET

CL1207_Valvestate_ET2_R

The procedure was created on 04_2009

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_08_MV	000056	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_02_MV	000099	RESET
	SV_1202_04_MV	000100	RESET
Effluent Tank General			
	SV_1204_02_MV	000054	RESET
	SV_1204_03_MV	000101	RESET
CIP General			
	SV_1207_03_MV	000076	RESET
	SV_1207_06_MV	000067	RESET
	SV_1207_12_MV	000110	RESET
CIP Filling control			
	SV_1209_05_MV	000066	RESET

5.56.11.Awaited Feedback

CL1207_Valvestate_ET2_OK

The procedure was created on 04_2009

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_04_FB	100130	RESET
	SV_1201_06_FB	100129	RESET
	SV_1201_08_FB	100077	SET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	RESET
	SV_1202_02_FB	100131	SET
	SV_1202_03_FB	100082	RESET
	SV_1202_04_FB	100132	SET
Filtration Unit Pressure control			
	SV_1203_04_FB	100137	RESET
Effluent Tank General			
	SV_1204_01_FB	100081	RESET
	SV_1204_02_FB	100079	SET
	SV_1204_03_FB	100133	SET
CIP General			
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	SET
	SV_1207_04_FB	100104	RESET
	SV_1207_05_FB	100090	RESET
	SV_1207_06_FB	100098	SET
	SV_1207_08_FB	100093	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_12_FB	100140	SET
CIP Filling controll			
	SV_1209_05_FB	100099	SET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_03_FB	100108	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_06_FB	100059	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_FB	100136	RESET

CL1207_Valvestate_ET2_R_OK

The procedure was created on 04_2009

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_04_FB	100130	RESET
	SV_1201_06_FB	100129	RESET
	SV_1201_08_FB	100077	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	RESET
	SV_1202_02_FB	100131	RESET
	SV_1202_03_FB	100082	RESET
	SV_1202_04_FB	100132	RESET
Filtration Unit Pressure control			
	SV_1203_04_FB	100137	RESET
Effluent Tank General			
	SV_1204_01_FB	100081	RESET
	SV_1204_02_FB	100079	RESET
	SV_1204_03_FB	100133	RESET
CIP General			
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_04_FB	100104	RESET
	SV_1207_05_FB	100090	RESET
	SV_1207_06_FB	100098	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_12_FB	100140	RESET
CIP Filling controll			
	SV_1209_05_FB	100099	RESET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_03_FB	100108	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_06_FB	100059	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_FB	100136	RESET

5.57. Procedure 56: Cleaning of Filtration Unit: automated execution of a sequence of procedures to clean membrane LF_1200_01 / LF_1200_02

5.57.1. Scope

This Procedure can only be activated when the FU, the CIP and the SIP control Loop mode button are in Automatic mode.

This procedure prepares the FU for SIP of a membrane. It calls different PLC procedures in a pre programmed order. Each of them can be executed several times. This number can be set on the HMI. At the end, the cleaning vessels are also cleaned and rinsed.
This procedure can be called automatically using PROCEDURE 57:

Procedure
Use the HMI to set up how and which procedures / Membrane are to be executed:
CL1207_SCI_P_Cl1 = 1 (PLC Address: 000258)
CL1207_TB_P_Cl1 = 1 (PLC Address: 000374)
CL1207_SCI_P_Cl2 = 1 (PLC Address: 000259)
CL1207_TB_P_Cl2 = 1 (PLC Address: 000372)

and how many times:
CL1207_P_Cl_cntr_Times_1 (PLC Address: 400463) **Retentate side of FU with clear water (Procedure 49)**
CL1207_P_Cl_cntr_Times_2 (PLC Address: 400465) **Retentate side of FU with cleaning agent (Procedure 49)**
CL1207_P_Cl_cntr_Times_3 (PLC Address: 400467) **Filtrate side of FU with cleaning agent (Procedure 50)**
CL1207_P_Cl_cntr_Times_4 (PLC Address: 400469) **Retentate side of FU with clear water (Procedure 49)**
CL1207_P_Cl_cntr_Times_5 (PLC Address: 400471) **Filtrate side of FU with clear water (Procedure 50)**

Procedures hereunder will be called in sequence.
PROCEDURE 49: Cleaning of Filtration Unit: retentate side of membrane LF_1200_01 / LF_1200_02 using water to rinse the retentate side of the membrane. Amount of times and duration of circulation must be set.
PROCEDURE 49: Cleaning of Filtration Unit: retentate side of membrane LF_1200_01 / LF_1200_02 using cleaning agent to clean the retentate side of the

membrane. Amount of times and duration of circulation must be set: CL1207_SCI_Cl1 or CL1207_SCI_Cl2

PROCEDURE 50: Cleaning of Filtration Unit: both retentate and filtrate side of membrane LF_1200_01 / LF_1200_02 with cleaning agent. Amount of times must be set: CL1207_SCI_BCl1

CL1207_SCI_BCl2

PROCEDURE 49: Cleaning of Filtration Unit: retentate side of membrane LF_1200_01 / LF_1200_02 with water to remove remaining cleaning agent. Amount of times must be set: CL1207_SCI_Cl1 or CL1207_SCI_Cl2

PROCEDURE 50: Cleaning of Filtration Unit: both retentate and filtrate side of membrane LF_1200_01 / LF_1200_02 with water to remove remaining cleaning agent. Amount of times and duration of circulation must be set: SCI_C_BCl1 or SCI_C_BCl2

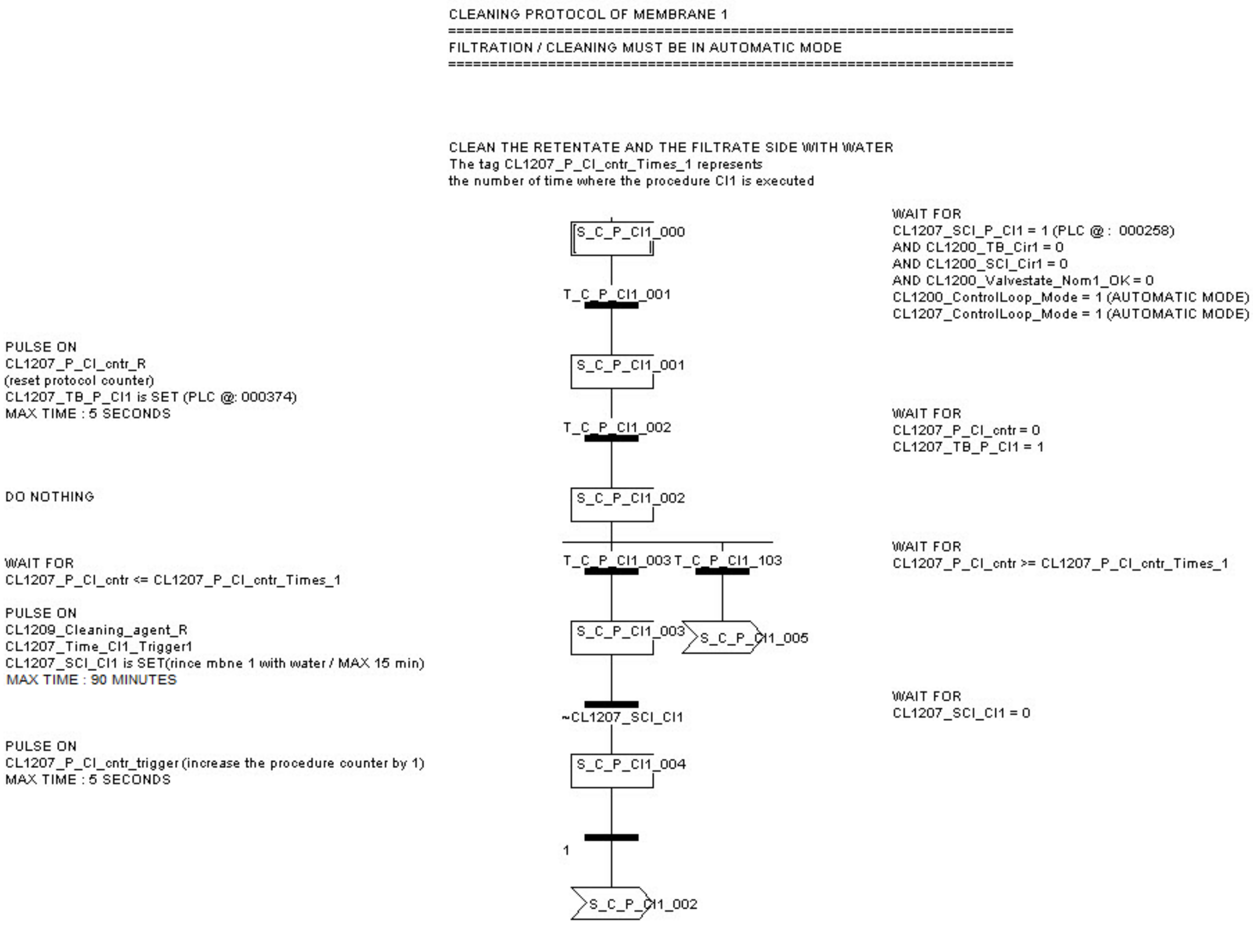
PROCEDURE 60: Clean VSSL_1209_01and VSSL_1209_02 to rinse VSSL_1209_01and -02: SCI_C_Clean_CAB

The HMI will ask to fill cleaning agent into VSSL_1209_03 when necessary.

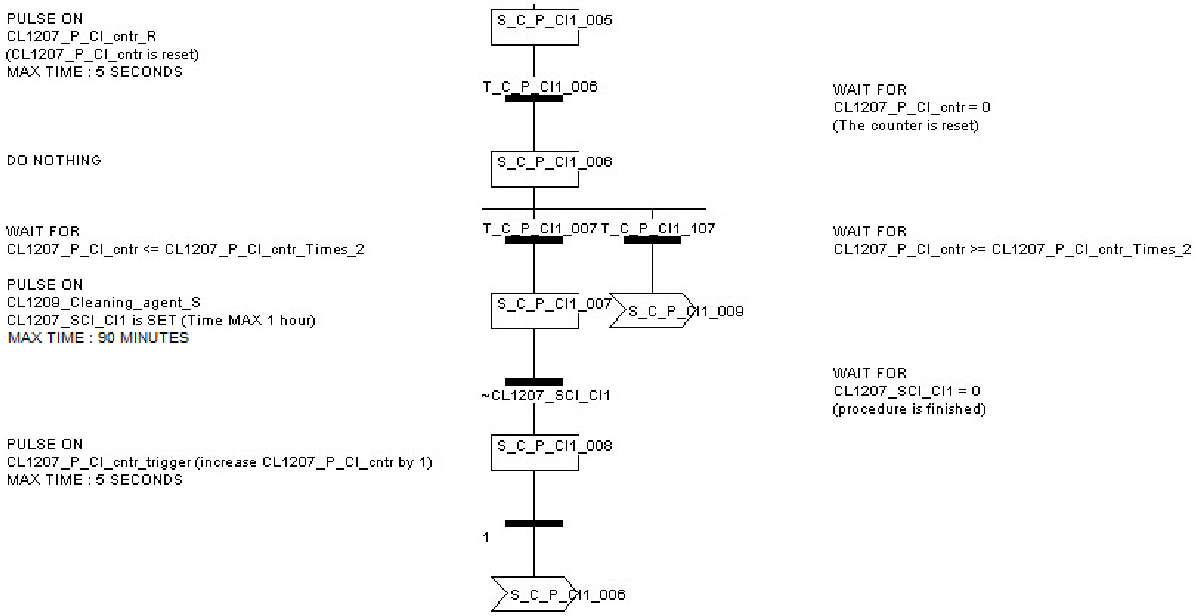
Used Variables:

CL1207_SCI_P_Cl1 = 1 (PLC Address: 000258)
CL1207_SCI_P_Cl2 = 1 (PLC Address: 000259)
CL1207_P_Cl_cntr_Times_1 (PLC Address: 400463)
CL1207_P_Cl_cntr_Times_2 (PLC Address: 400465)
CL1207_P_Cl_cntr_Times_3 (PLC Address: 400467)
CL1207_P_Cl_cntr_Times_4 (PLC Address: 400469)
CL1207_P_Cl_cntr_Times_5 (PLC Address: 400471)

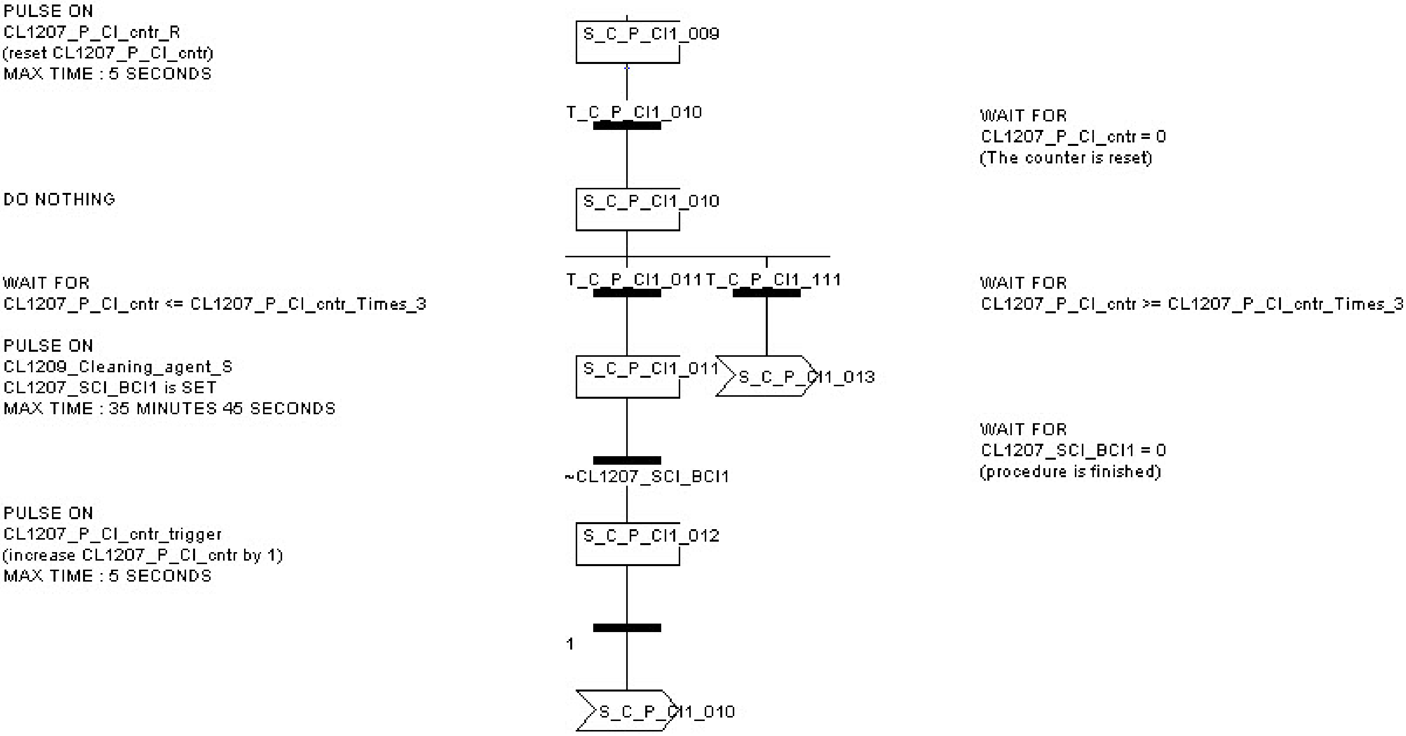
5.57.2.PLC Subroutine: C_P_Cl1



CLEAN THE RETENTATE AND THE FILTRATE SIDE WITH CLEANING AGENT.
The tag CL1207_P_CI_cntr_Times_2 represents
the number of time where the procedure CI1 is executed



CLEAN THE FILTRATE SIDE WITH CLEANING AGENT
The tag CL1207_P_CI_cntr_Times_3 represents
the number of time where the procedure BCI1 is executed



CLEAN THE RETENTATE AND THE FILTRATE SIDE WITH WATER
The tag CL1207_P_Cl_cntr_Times_4 represents
the number of time where the procedure Cl1 is executed

PULSE ON
CL1207_P_Cl_cntr_R
(reset CL1207_P_Cl_cntr)
MAX TIME 5 SECONDS

WAIT FOR
CL1207_P_Cl_cntr_R
(reset CL1207_P_Cl_cntr)

DO NOTHING

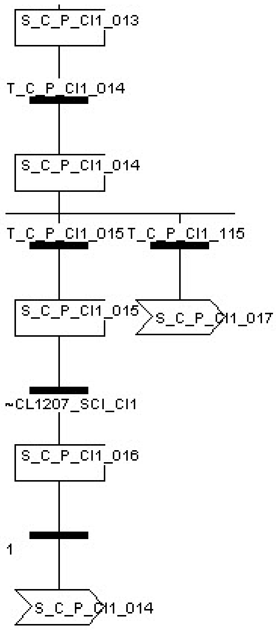
WAIT FOR
CL1207_P_Cl_cntr <= CL1207_P_Cl_cntr_Times_4

WAIT FOR
CL1207_P_Cl_cntr >= CL1207_P_Cl_cntr_Times_4

PULSE ON
CL1209_Cleaning_agent_R AND CL1207_Time_Cl1_Trigger4
Command to clean mbne 1 with water (max 30min)
CL1207_SCI_Cl1 is SET
MAX TIME : 90 MINUTES

WAIT FOR
CL1207_SCI_Cl1 = 0 (procedure is finished)

PULSE ON CL1207_P_Cl_cntr_trigger
(increase CL1207_P_Cl_cntr by 1)
MAX TIME : 5 SECONDS



CLEAN THE FILTRATE SIDE WITH WATER
The tag CL1207_P_Cl_cntr_Times_5 represents
the number of time where the procedure BCl1 is executed

PULSE ON
CL1207_P_Cl_cntr_R
(reset CL1207_P_Cl_cntr)
MAX TIME: 5 SECONDS

WAIT FOR
CL1207_P_Cl_cntr = 0
(The counter is reset)

DO NOTHING

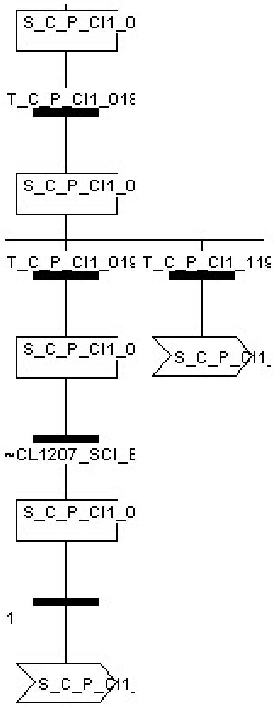
WAIT FOR
CL1207_P_Cl_cntr <= CL1207_P_Cl_cntr_Times_5

WAIT FOR
CL1207_P_Cl_cntr >= CL1207_P_Cl_cntr_Times_5

PULSE ON
CL1209_Cleaning_agent_R
Command to clean filtrate side of mbne 1 with water
CL1207_SCI_BCl1 is SET
MAX TIME 35 MINUTES 45 SECONDS

WAIT FOR
CL1207_SCI_BCl1 = 0
(procedure is finished)

PULSE ON
CL1207_P_Cl_cntr_trigger
(increase CL1207_P_Cl_cntr by 1)
MAX TIME : 5 SECONDS



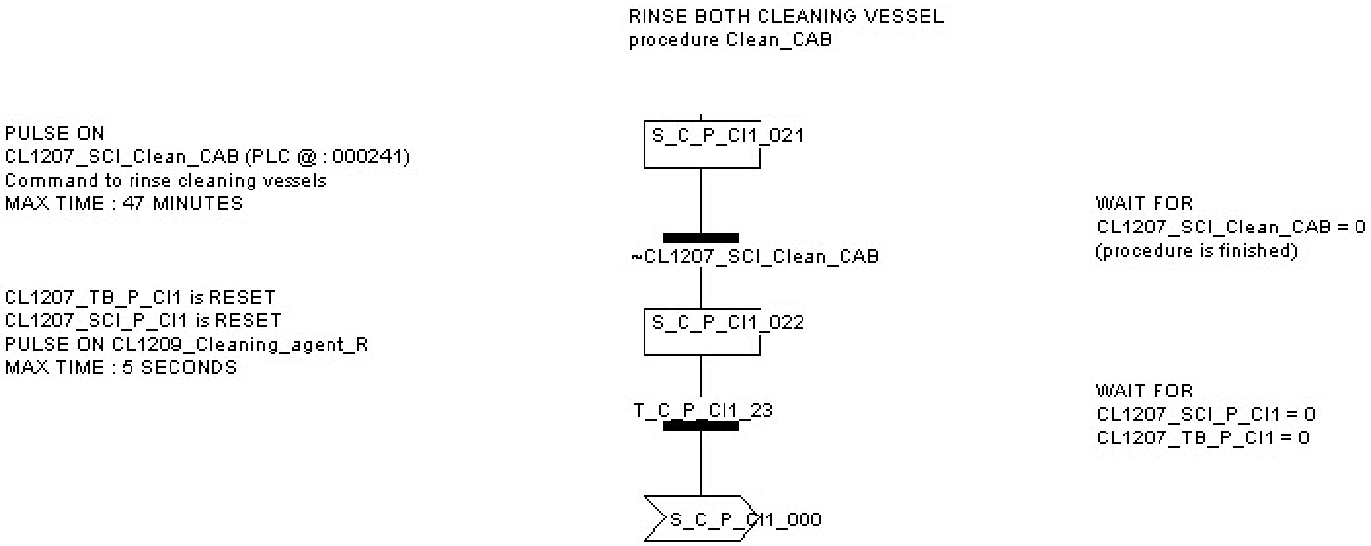


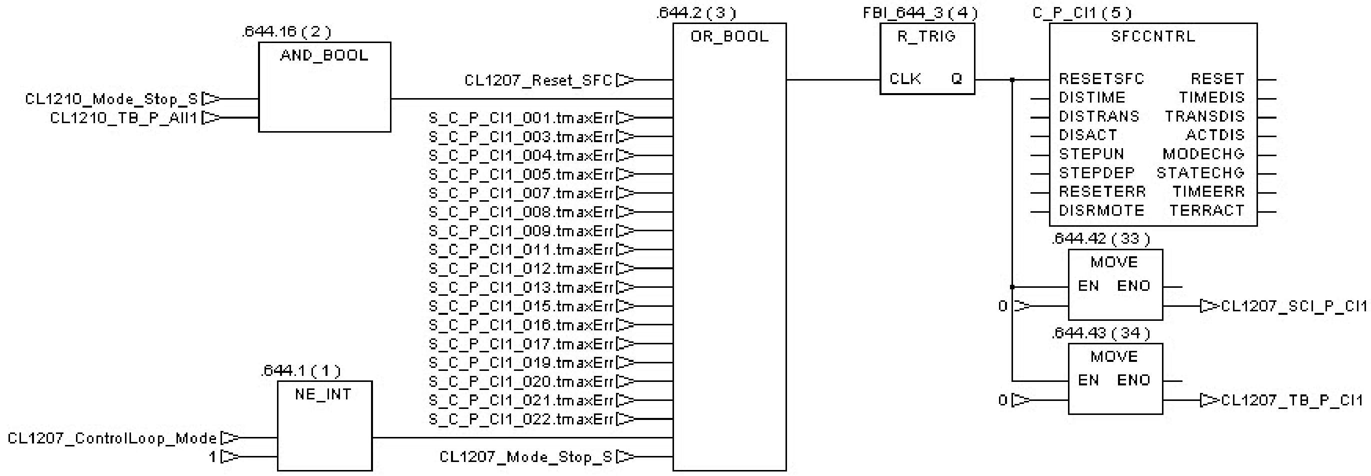
Figure 135: PLC protocol: C_P_Cl1

5.57.3.Protocol management

Reset of the protocol:

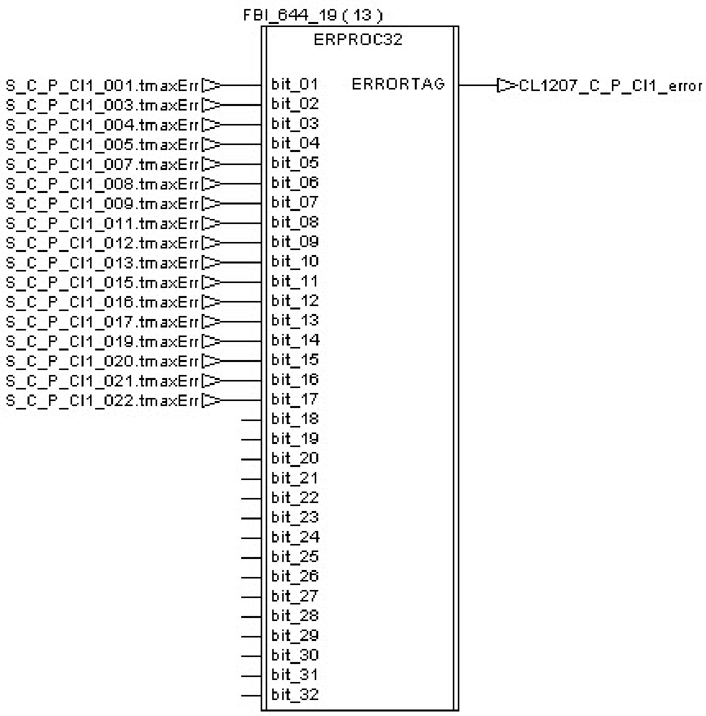
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the protocol and the tag linked to the protocol.

The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.

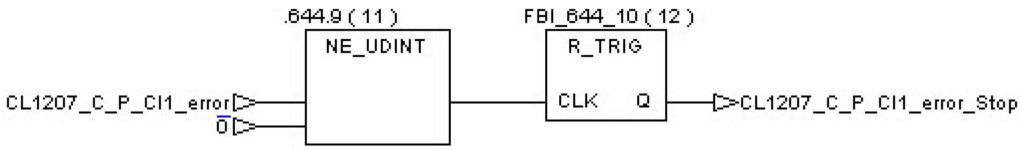


Protocol error management:

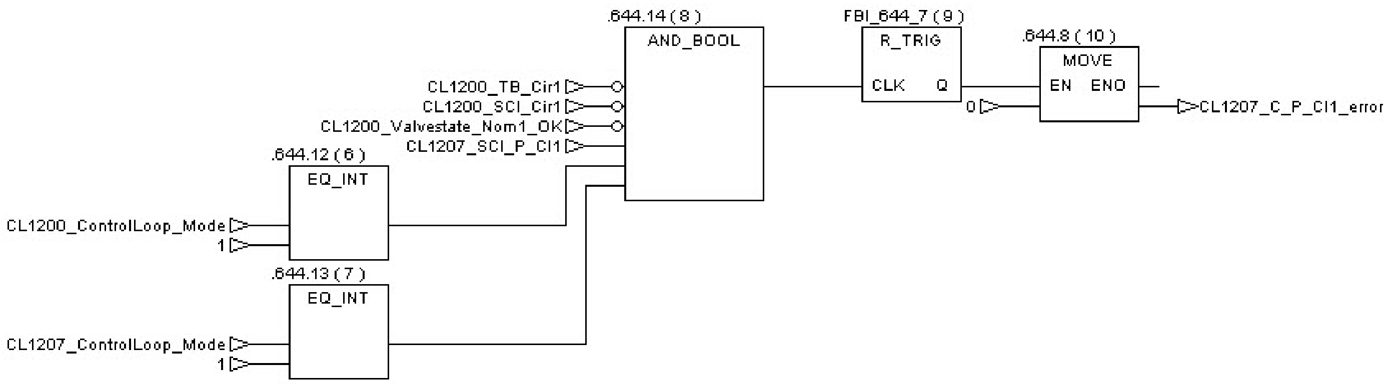
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC32 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1207_C_P_Cl1_error_Stop" receives a pulse and then the Cleaning Unit is stopped thanks to the procedure "C_Stop".



The error number is displayed until the protocol is re-started.

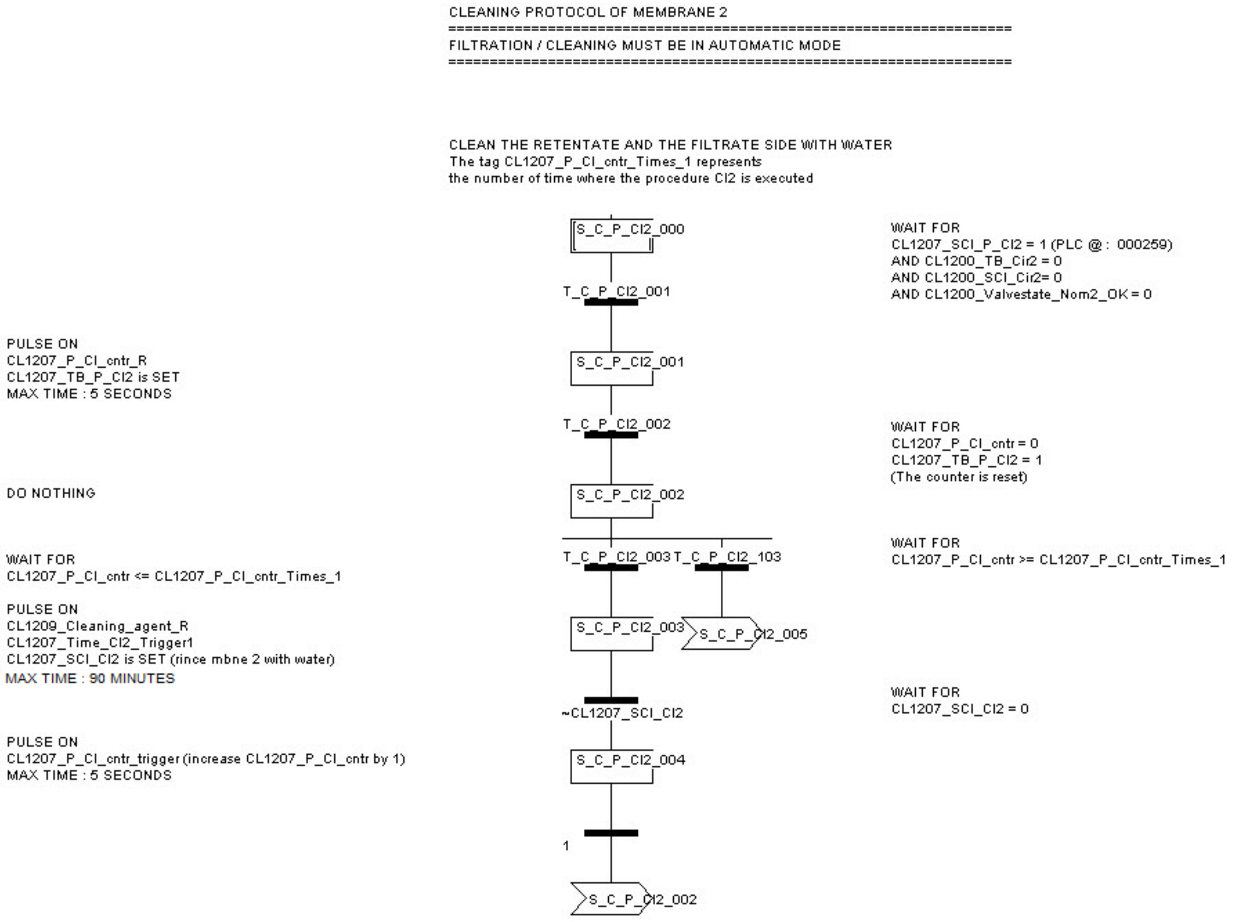


5.57.4.Error number description

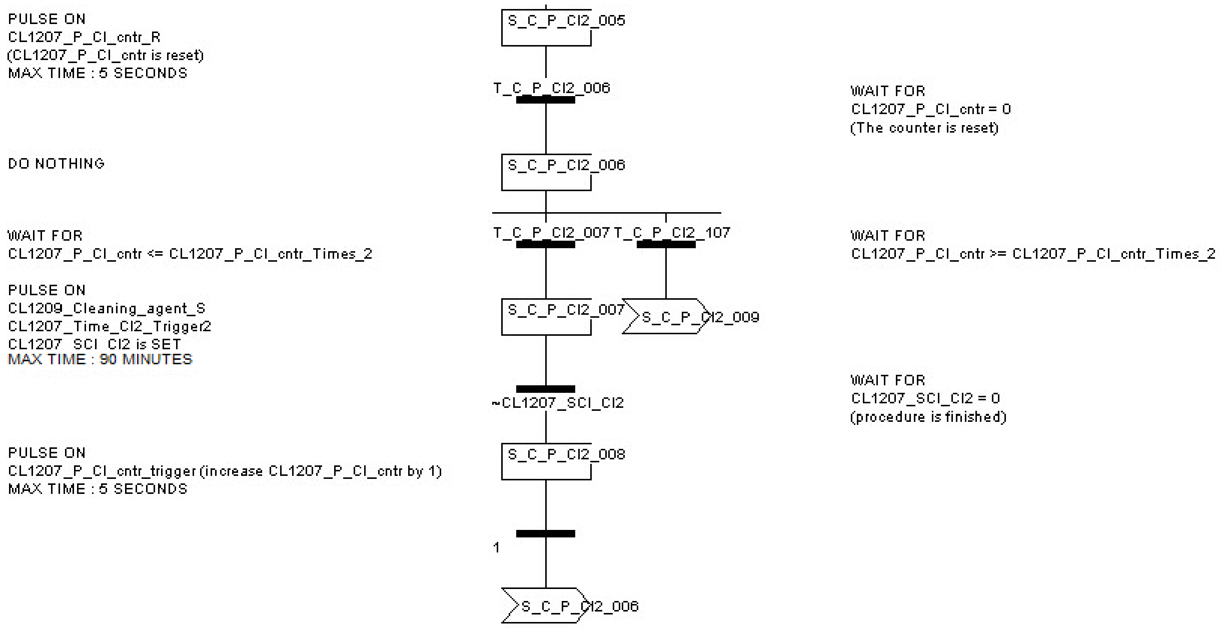
Error number	Procedure Action Step	problem description
1	**S_C_P_Cl1_001**	The Protocol counter is not reset to 0
2	**S_C_P_Cl1_003**	Problem during the execution of the procedure "C_CL1" (CLEANING THE RETENTATE SIDE OF LF_1200_01 WITH WATER ONLY) The procedure "C_CL1" should also have an error code
4	**S_C_P_Cl1_004**	No transition, no possible error
8	**S_C_P_Cl1_005**	The Protocol counter is not reset to 0
16	**S_C_P_Cl1_007**	Problem during the execution of the procedure "C_CL1" (CLEANING THE RETENTATE SIDE OF LF_1200_01 WITH CLEANING AGENT) The procedure "C_CL1" should also have an error code
32	**S_C_P_Cl1_008**	No transition, no possible error
64	**S_C_P_Cl1_009**	The Protocol counter is not reset to 0
128	**S_C_P_Cl1_011**	Problem during the execution of the procedure "C_BCL1" (CLEANING THE FILTRATE SIDE OF LF_1200_01 WITH CLEANING AGENT) The procedure "C_BCL1" should also have an error code
256	**S_C_P_Cl1_012**	No transition, no possible error
512	**S_C_P_Cl1_013**	The Protocol counter is not reset to 0
1024	**S_C_P_Cl1_015**	Problem during the execution of the procedure "C_CL1" (CLEANING THE RETENTATE SIDE OF LF_1200_01 WITH WATER ONLY) The procedure "C_CL1" should also have an error code
2048	**S_C_P_Cl1_016**	No transition, no possible error
4096	**S_C_P_Cl1_017**	The Protocol counter is not reset to 0
8192	**S_C_P_Cl1_019**	Problem during the execution of the procedure "C_BCL1" (CLEANING THE FILTRATE SIDE OF LF_1200_01 WITH WATER) The procedure "C_BCL1" should also have an error code
16384	**S_C_P_Cl1_020**	No transition, no possible error

Error number	Procedure Action Step	problem description
32768	**S_C_P_Cl1_021**	Problem during the execution of the procedure "C_CLEAN_CAB" (CLEAN THEN RINSE VSSL_1209_01 AND VSSL_1209_02) The procedure "C_CLEAN_CAB" should also have an error code
65536	**S_C_P_Cl1_022**	Tag reset problem (Tracing bit or Start button)

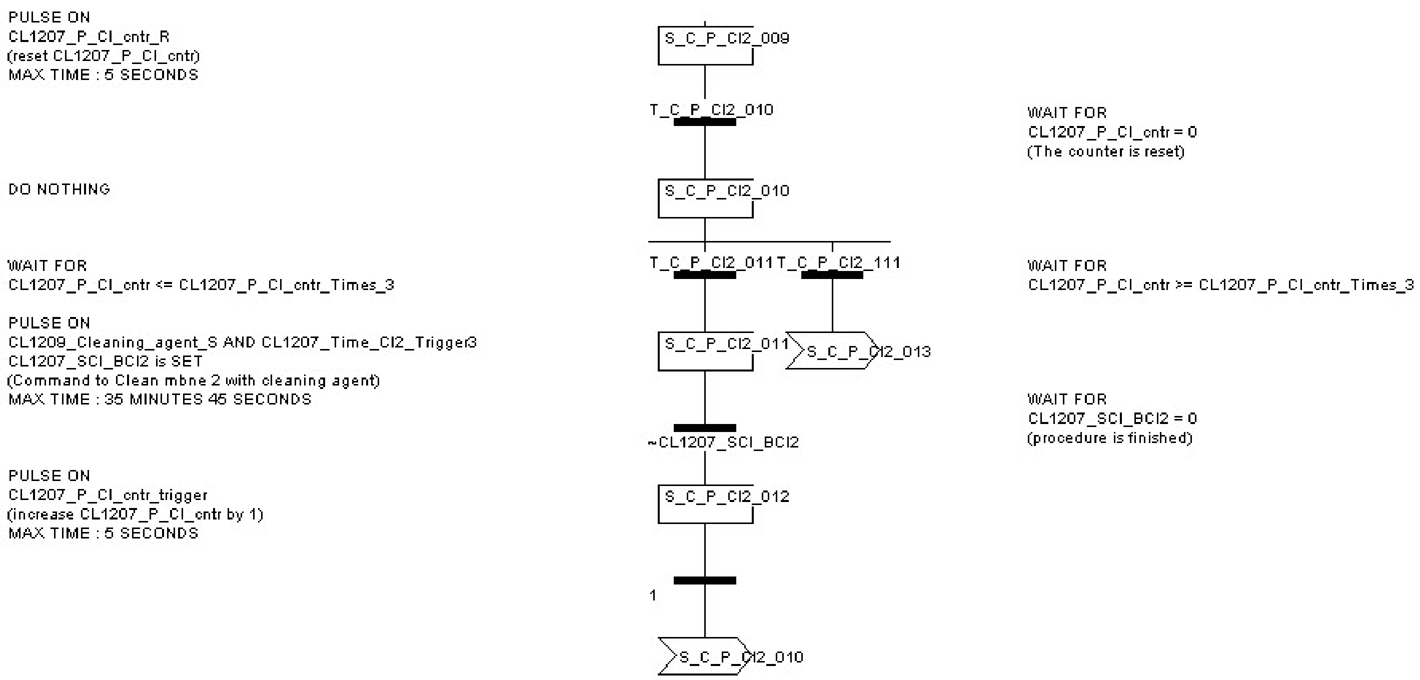
5.57.5.PLC subroutine: C_P_Cl2



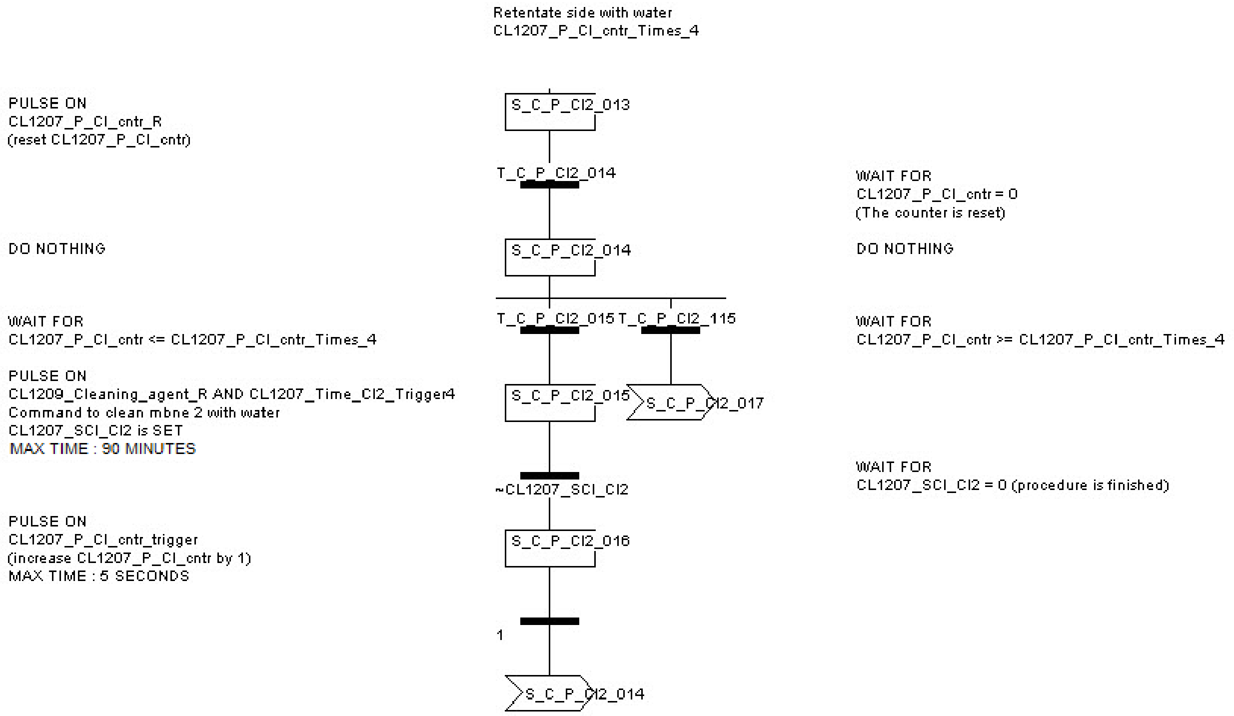
CLEAN THE RETENTATE AND THE FILTRATE SIDE WITH CLEANING AGENT.
The tag CL1207_P_CI_cntr_Times_2 represents
the number of time where the procedure CI2 is executed



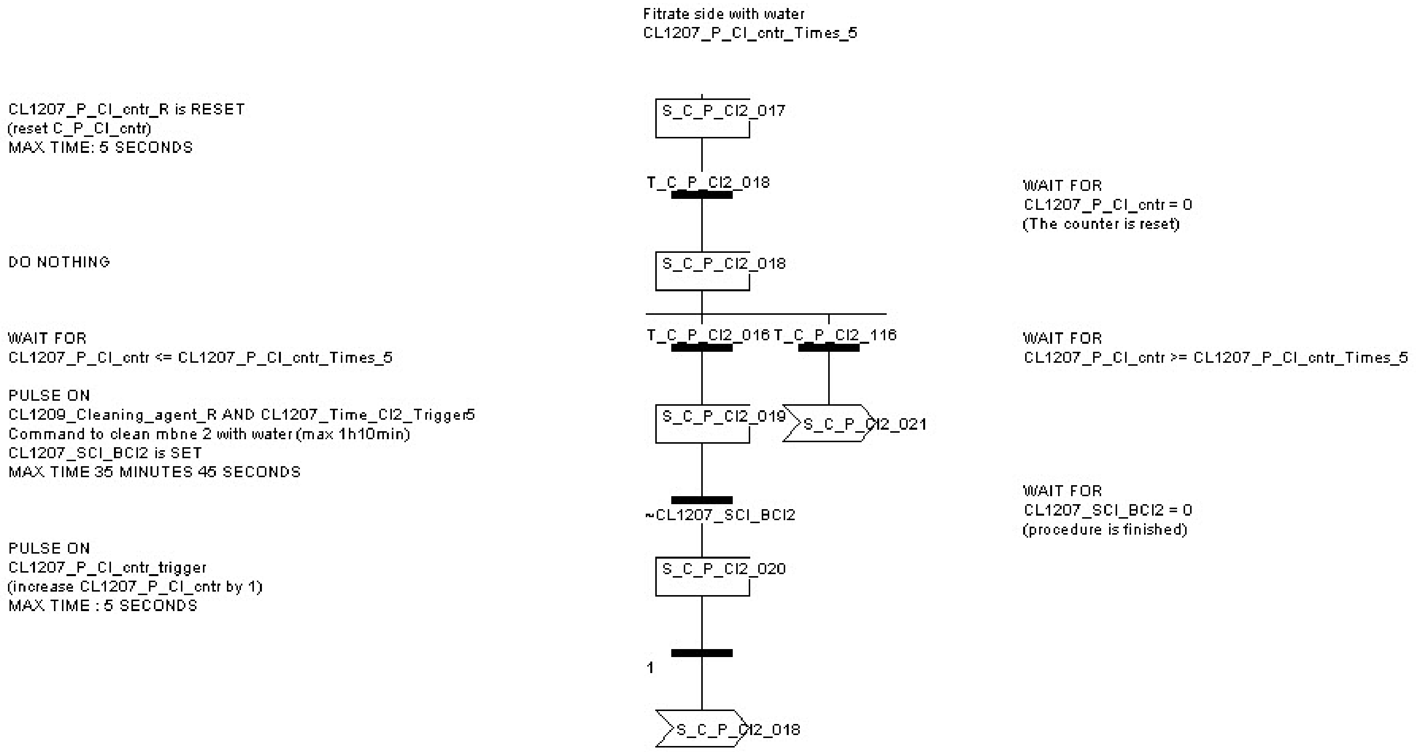
CLEAN THE FILTRATE SIDE WITH CLEANING AGENT
The tag CL1207_P_CI_cntr_Times_3 represents
the number of time where the procedure BCI2 is executed



CLEAN THE RETENTATE AND THE FILTRATE SIDE WITH WATER
The tag CL1207_P_CI_cntr_Times_4 represents
the number of time where the procedure CI2 is executed



CLEAN THE FILTRATE SIDE WITH WATER
The tag CL1207_P_CI_cntr_Times_5 represents
the number of time where the procedure BCI2 is executed



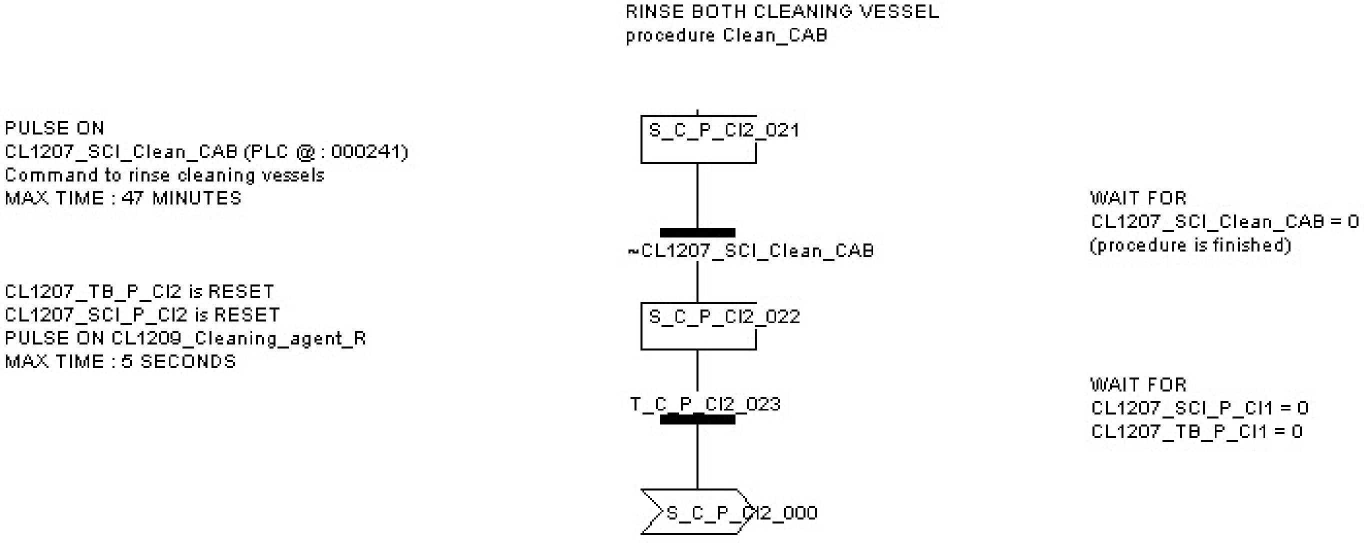
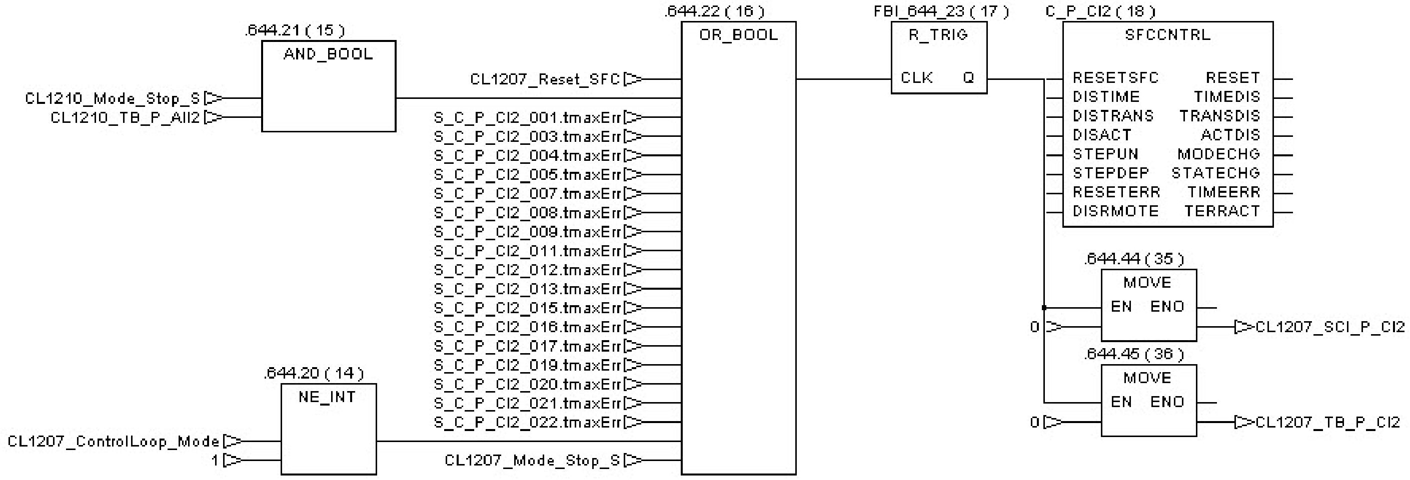


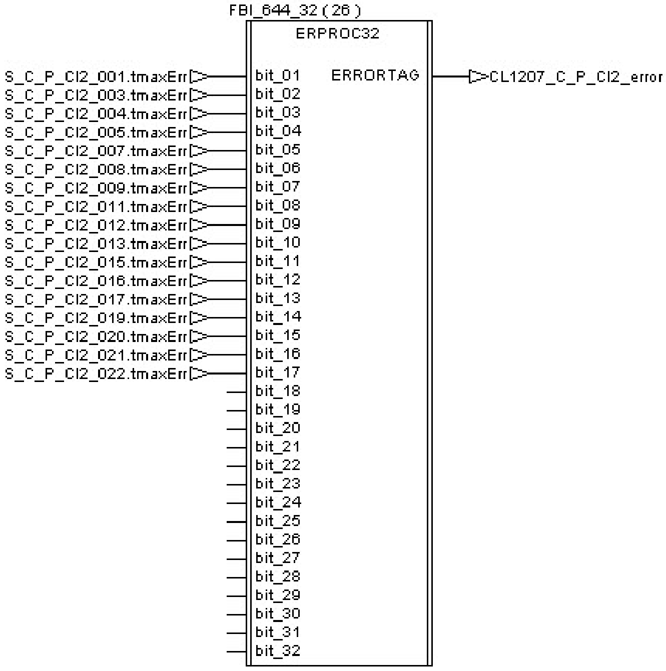
Figure 136: PLC protocol: C_P_Cl2

5.57.6.Protocol management

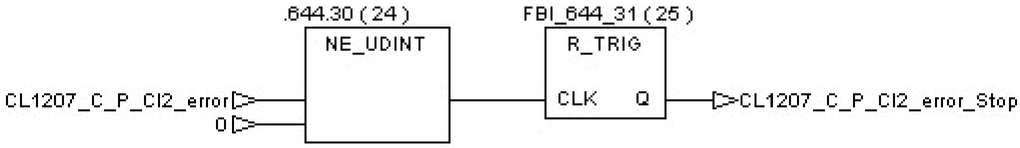
Reset of the protocol:
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the protocol and the tag linked to the protocol.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



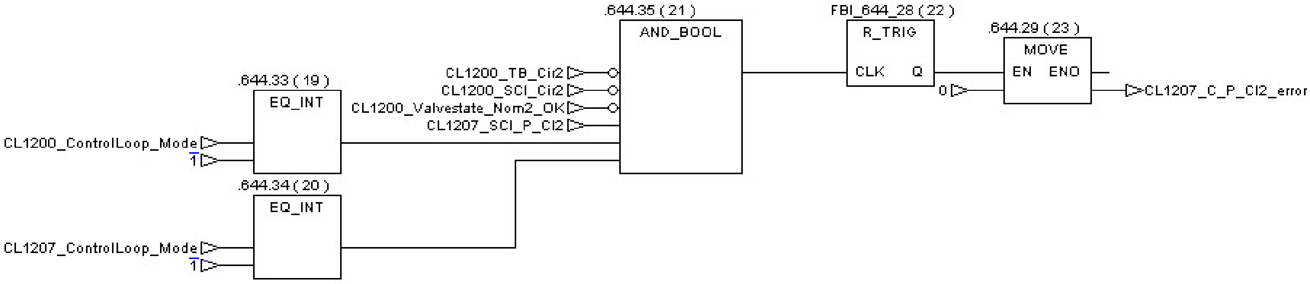
Protocol error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC32 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1207_C_P_Cl2_error_Stop" receives a pulse and then the Cleaning Unit is stopped thanks to the procedure "C_Stop".



The error number is displayed until the protocol is re-started.



5.57.7.Error number description

Error number	Procedure Action Step	problem description

Error number	Procedure Action Step	problem description
1	S_C_P_Cl2_001	The Protocol counter is not reset to 0
2	S_C_P_Cl2_003	Problem during the execution of the procedure "C_CL2" (CLEANING THE RETENTATE SIDE OF LF_1200_02 WITH WATER ONLY) The procedure "C_CL2" should also have an error code
4	S_C_P_Cl2_004	No transition, no possible error
8	S_C_P_Cl2_005	The Protocol counter is not reset to 0
16	S_C_P_Cl2_007	Problem during the execution of the procedure "C_CL2" (CLEANING THE RETENTATE SIDE OF LF_1200_02 WITH CLEANING AGENT) The procedure "C_CL2" should also have an error code
32	S_C_P_Cl2_008	No transition, no possible error
64	S_C_P_Cl2_009	The Protocol counter is not reset to 0
128	S_C_P_Cl2_011	Problem during the execution of the procedure "C_BCL2" (CLEANING THE FILTRATE SIDE OF LF_1200_02 WITH CLEANING AGENT) The procedure "C_BCL2" should also have an error code
256	S_C_P_Cl2_012	No transition, no possible error
512	S_C_P_Cl2_013	The Protocol counter is not reset to 0
1024	S_C_P_Cl2_015	Problem during the execution of the procedure "C_CL2" (CLEANING THE RETENTATE SIDE OF LF_1200_02 WITH WATER ONLY) The procedure "C_CL2" should also have an error code
2048	S_C_P_Cl2_016	No transition, no possible error
4096	S_C_P_Cl2_017	The Protocol counter is not reset to 0
8192	S_C_P_Cl2_019	Problem during the execution of the procedure "C_BCL2" (CLEANING THE FILTRATE SIDE OF LF_1200_02 WITH WATER) The procedure "C_BCL2" should also have an error code
16384	S_C_P_Cl2_020	No transition, no possible error
32768	S_C_P_Cl2_021	Problem during the execution of the procedure "C_CLEAN_CAB" (CLEAN THEN RINSE VSSL_1209_01 AND VSSL_1209_02) The procedure "C_CLEAN_CAB" should also have an error code

Error number	Procedure Action Step	problem description
65536	**S_C_P_Cl2_022**	Tag reset problem (Tracing bit or Start button)

5.58. Procedure 57: Cleaning of Filtration Unit: setting autonomous daily execution of a sequence of procedures to clean membrane LF_1200_01 / LF_1200_02

5.58.1. Scope

IMPORTANT POINT:
THIS AUTOMATED PROTOCOL HAS NEVER EXISTED. THE EPAS COMPANY HAD DEVELOPPED 25% OF IT.
HOWEVER, THE PROCEDURES AND PROTOCOLS CALLED NEED TO HAVE AN OPERATOR PRESENT DUE TO THE CLEANING AND STERILIZATION PHASE OF THE PROCESS (OPERATOR PANEL THAT OPERATOR SHOULD CONFIRM AND STEAM GENERATOR NOT CONTROLLED BY THE PLC).
DESPITE THIS, WE HAVE DECIDED TO KEEP IT IN THE REPORT TO INFORM ABOUT THE POSSIBILITY OFFERS BY THIS PROTOCOL. IN THE FUTURE, IF THE STEAM GENERATOR WILL BE CONNECTED TO THE PLC, THIS COMPLETE AUTOMOMOUS EXECUTION COULD BE IMPLEMENTED.

This procedure autonomously calls PROCEDURE 56: Cleaning of Filtration Unit: automated execution of a sequence of procedures to clean membrane LF_1200_01 / LF_1200_02 every day at a time that can be set. An operator must be present at that time to perform actions like filling cleaning agent into VSSL_1209_03.
If only one membrane is present the FU will be forced to bypass mode during cleaning. If both membranes are present, the FU will switch to filtration to the other membrane before the cleaning starts.

Procedure
It is important to indicate the time settings for both membranes. Make sure SYS_Clock_Time is at current time. Choose the time for execution by setting:
CL1207_SCI_P_Time (PLC Address: 400406)
and enable this functionality by CL1207_SCI_P_Enable (PLC Address: 000261).
It is also possible to run this procedure just once by CL1207_SCI_P.
This procedure starts procedure 56 at the time of the day defined by the operator.

Used Variables:

CL1207_SCI_P_Time (PLC Address: 400406) defines the time of the day
CL1207_SCI_P_Enable (PLC Address: 000261) enables the function

CL1207_SCI_P (PLC Address: 000256) starts manually the function

5.58.2.PLC Subroutine: C_P

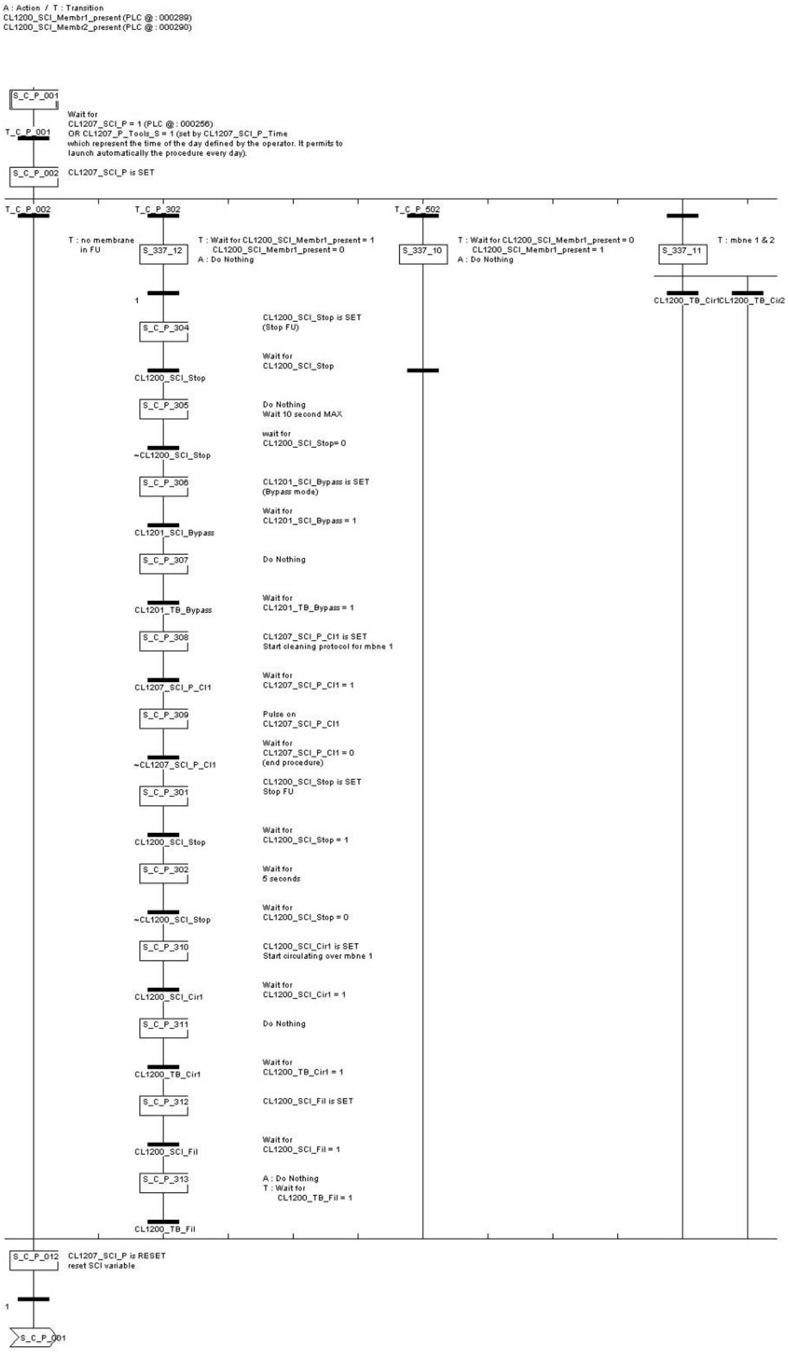


Figure 137: PLC protocol: C_P

Variables Used (I/O):

All variables involved in PROCEDURE 34, 35, 49, 50, 58, 59, 60, 61, 62, 63, 64 and 65.

PLC Subroutine called:

F_Bypass, F_Cir1/ F_Cir2/ F_Fill C_C1/C_Cl2, C_BCl1/ C_BCl2, C_Empty_CA, C_Empty_CB, C_Clean_CAB, C_Fill_CA, C_Fill_WA, C_Fill_CB, C_Rinse_CA, C_Rinse_CB

5.59. Procedure 58: Empty VSSL_1209_01

5.59.1.Scope

This Procedure can only be activated when the CIP control Loop mode button is in Automatic mode.

Empty the VSSL_1209_01.
After a CIP procedure is interrupted during its execution, by the PLC because of an error or by a stop CIP or the emergency stop button water or cleaning agent may remain in the cleaning agent vessel.
Before the vessel is filled, it should be empty. No cleaning agent should remain inside to be sure that the composition of every cleaning batch is constant.
If the PLC detects that a vessel is not empty when it attempts to fill it, the procedure will interrupt its execution. The procedure timeout will stop any active CIP procedure
This procedure is executed to empty VSSL_1209_01 when the cases enounced above happen. Afterwards it should be followed by PROCEDURE 64: Rinse VSSL_1209_01 or PROCEDURE 60: Clean VSSL_1209_01and VSSL_1209_02.

Procedure:
Use the HMI to start PLC procedure C_Empty_CA:
CL1209_SCI _Empty_CA

CL1209_TB_Empty_CA is set
Wait for the PLC procedure to finish.

Used Variables:
CL1209_SCI _Empty_CA (PLC Address: 000244)
CL1209_TB_Empty_CA (PLC Address: 000376)

5.59.2.PLC Subroutine: C_Empty_CA

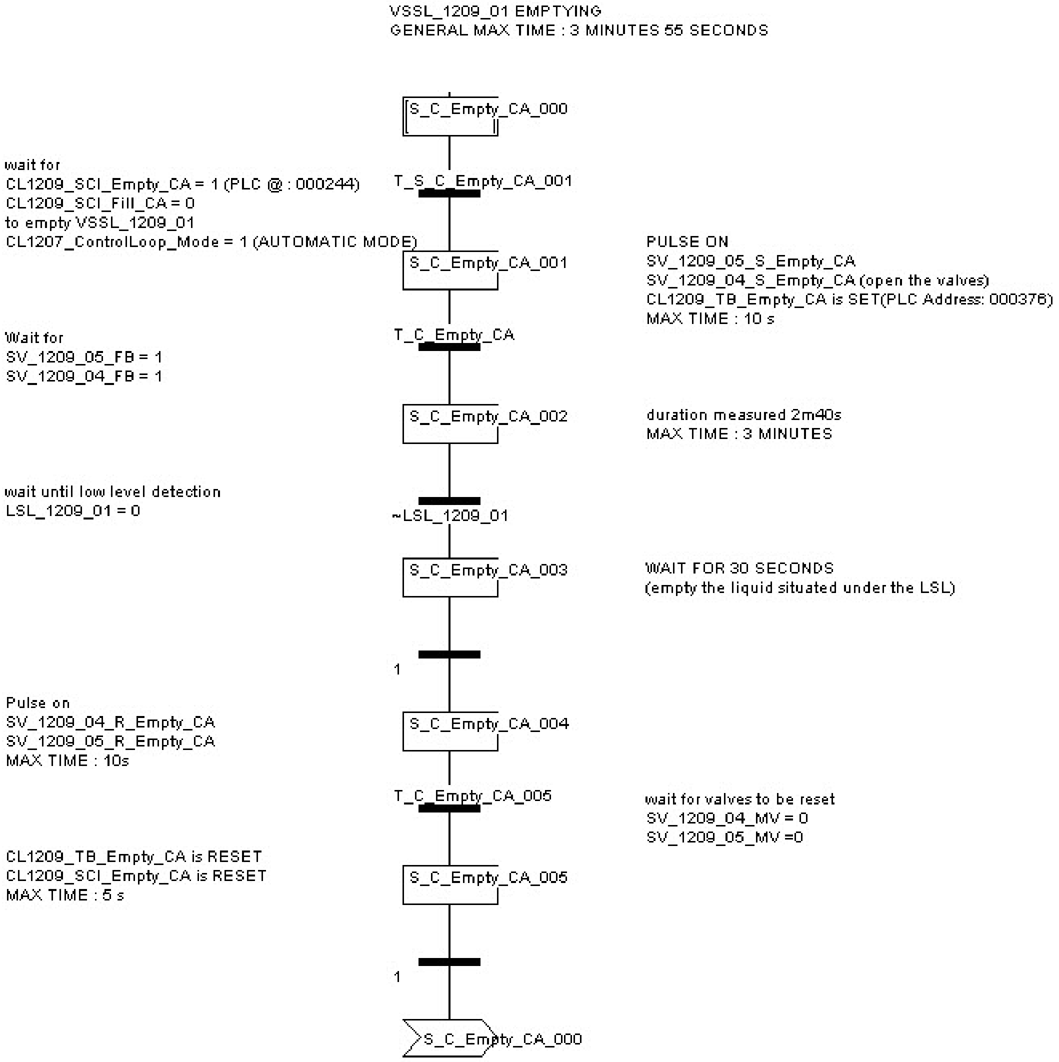


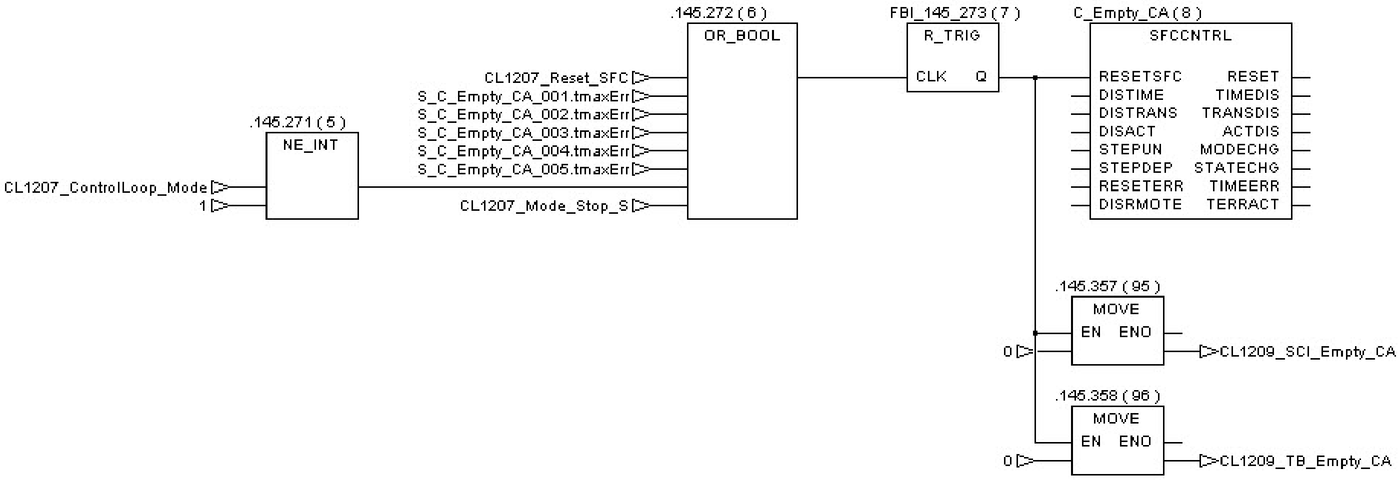
Figure 138: PLC procedure: C_Empty_CA

Variables Used (I/O):
SV_1209_04_MV / SV_1209_05_MV
SV_1209_04_FB / SV_1209_05_FB
LSL_1209_01

5.59.3.Procedure management

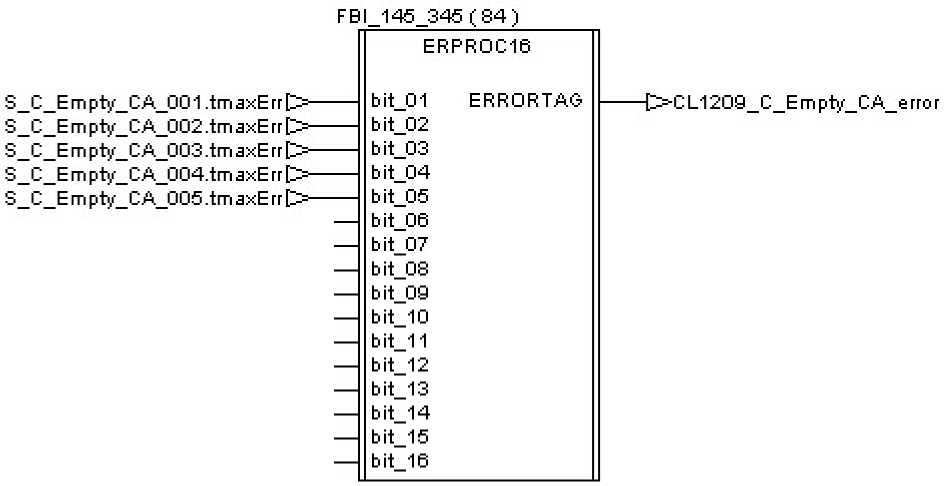
<u>Reset of the procedure:</u>
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.

The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.

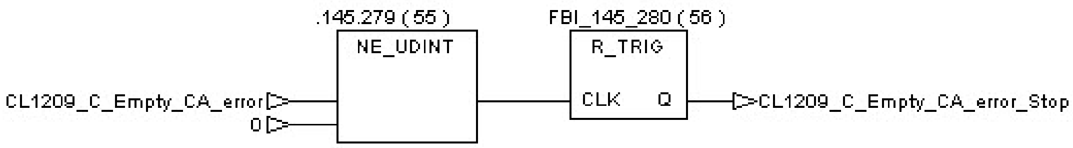


Procedure error management:

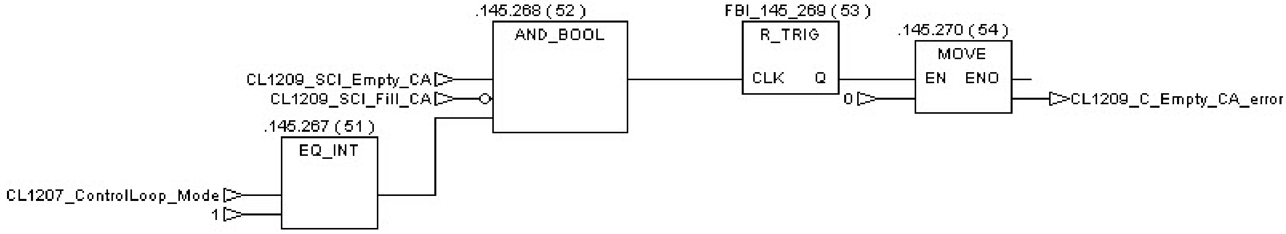
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag “CL1207_C_EMPTY_CA_error_Stop” receives a pulse and then the Cleaning Unit is stopped thanks to the procedure “C_Stop”.



The error number is displayed until the procedure is re-started.



5.59.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_C_Empty_CA_001**	valve(s) status Error operator has to look for valve alarm
2	**S_C_Empty_CA_002**	Level switch low LSL_1209_01 faillure
4	**S_C_Empty_CA_003**	Just a delay, no possible error
8	**S_C_Empty_CA_004**	valve(s) status Error operator has to look for valve alarm
16	**S_C_Empty_CA_005**	Tag reset problem (Tracing bit or Start button)

5.60. Procedure 59: Empty VSSL_1209_02

5.60.1.Scope

This Procedure can only be activated when the CIP control Loop mode button is in Automatic mode.

After a CIP procedure is interrupted during its execution, by the PLC because of an error or by a stop CIP or the emergency stop button water or cleaning agent may remain in the cleaning agent vessel.
Before the vessel is filled, it should be empty. No cleaning agent should remain inside to be sure that the composition of every cleaning batch is constant.
If the PLC detects that a vessel is not empty when it attempts to fill it, the procedure will interrupt its execution. The procedure timeout will stop any active CIP procedure
This procedure is executed to empty VSSL_1209_01 when the cases enounced above happen. Then it should be followed by procedure PROCEDURE 65: Rinse VSSL_1209_02

Procedure:
Use the HMI to start PLC procedure C_Empty_CB: CL_1209_SCI_Empty_CB
Wait for the PLC procedure to finish.

Used Variables:
CL_1209_SCI_Empty_CB (PLC Address: 000245)
CL1209_TB_Empty_CB (PLC Address: 000377)

5.60.2.PLC Subroutine: C_Empty_CB

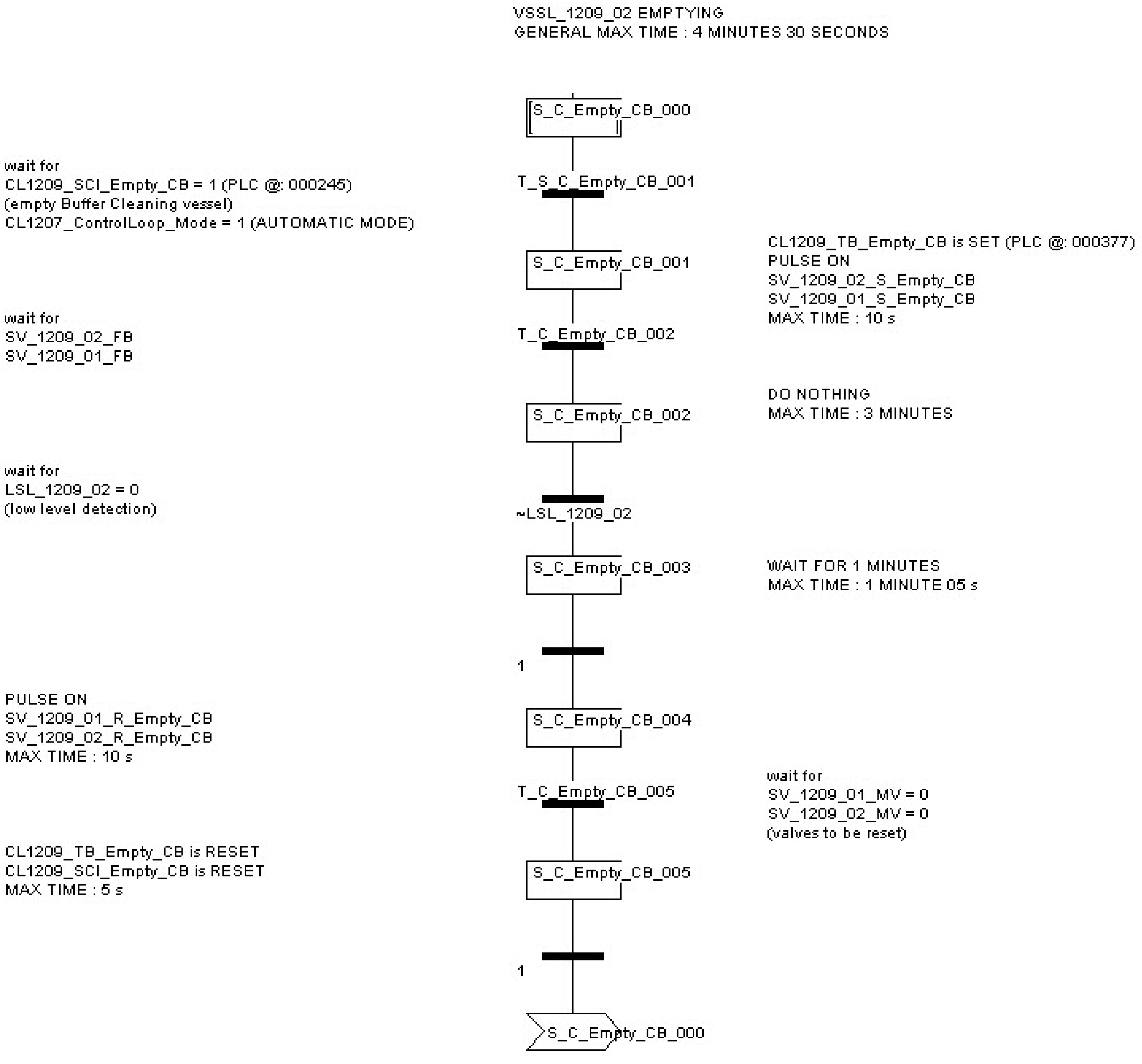


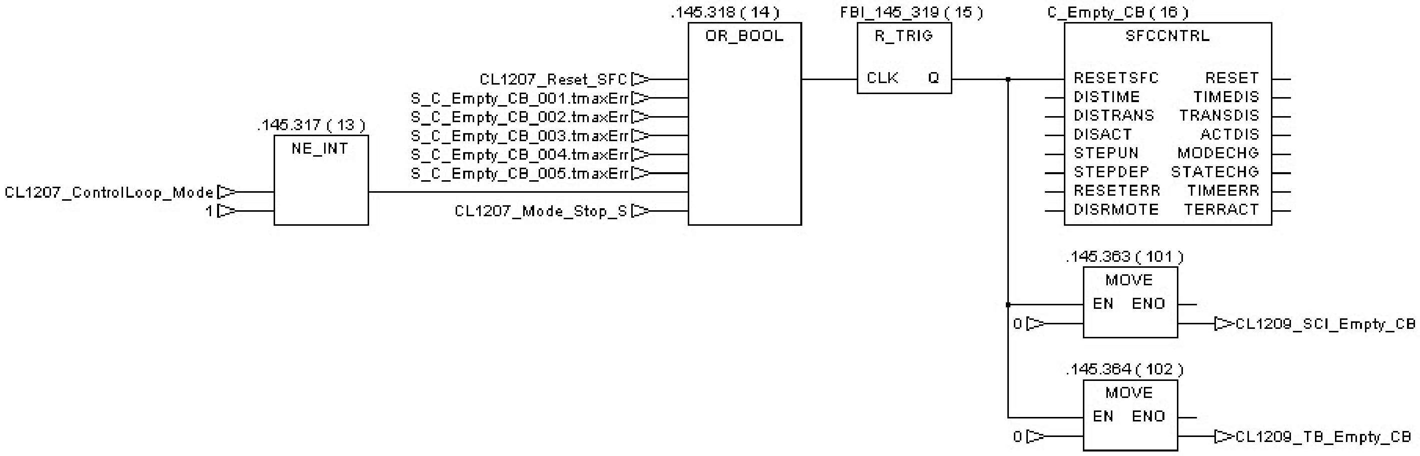
Figure 139: PLC procedure: C_Empty_CB

Variables Used (I/O):

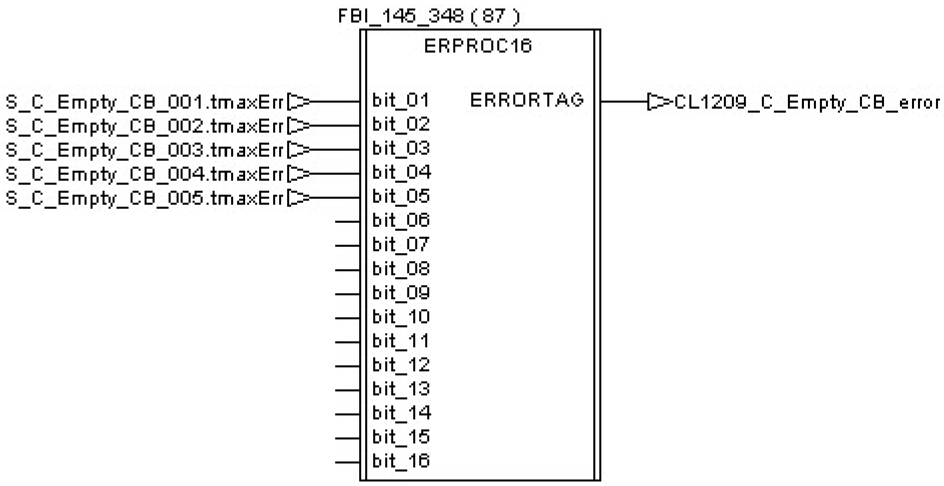
SV_1209_01_MV / SV_1209_02_MV
SV_1209_01_FB / SV_1209_02_FB
LSL_1209_02

5.60.3.Procedure management

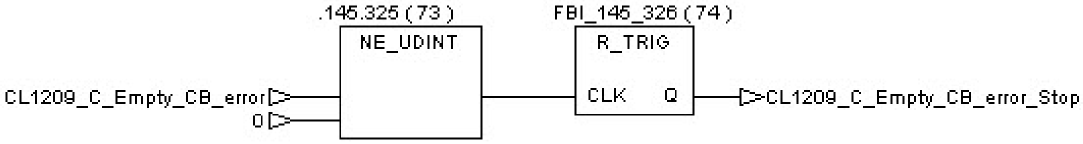
Reset of the procedure:
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



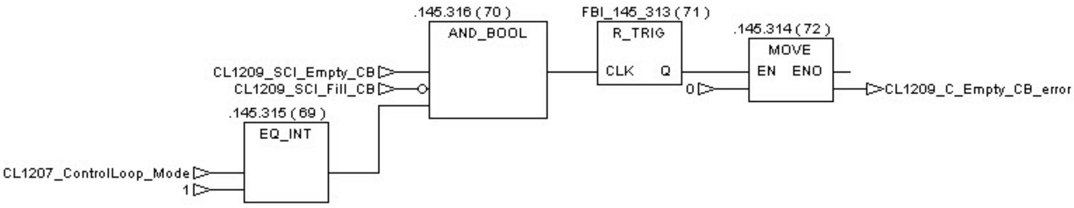
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1207_C_EMPTY_CB_error_Stop" receives a pulse and then the Cleaning Unit is stopped thanks to the procedure "C_Stop".



The error number is displayed until the procedure is re-started.



5.60.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_C_Empty_CB_001**	valve(s) status Error operator has to look for valve alarm
2	**S_C_Empty_CB_002**	Level switch low LSL_1209_02 failure
4	**S_C_Empty_CB_003**	Just a delay, no possible error
8	**S_C_Empty_CB_004**	valve(s) status Error operator has to look for valve alarm
16	**S_C_Empty_CB_005**	Tag reset problem (Tracing bit or Start button)

5.61. Procedure 60: Clean VSSL_1209_01 and VSSL_1209_02

5.61.1.Scope

This Procedure can only be activated when the CIP control Loop mode button is in Automatic mode.

Clean both vessels VSSL_1209_01and -02.
Vessel VSSL_1209_01 is filled with water and cleaning agent. This is used to clean VSSL_1209_02 by CP_1207_01. At the same time also VSSL_1209_01 is cleaned. Both vessels are drained afterwards. Then VSSL_1209_01 is filled with water, which is used to rinse VSSL_1209_02.

Procedure
Fill cleaning agent into VSSL_1209_03.
Use the HMI to start PLC procedure C_Clean_CAB: CL1207_SCI _Clean_CAB
Wait for the PLC procedure to finish.

Used Variables:
CL1207_SCI_Clean_CAB (PLC Address: 000241)
CL1207_TB_Clean_CAB (PLC Address: 000378)

5.61.2.PLC Subroutine: C_Clean_CAB

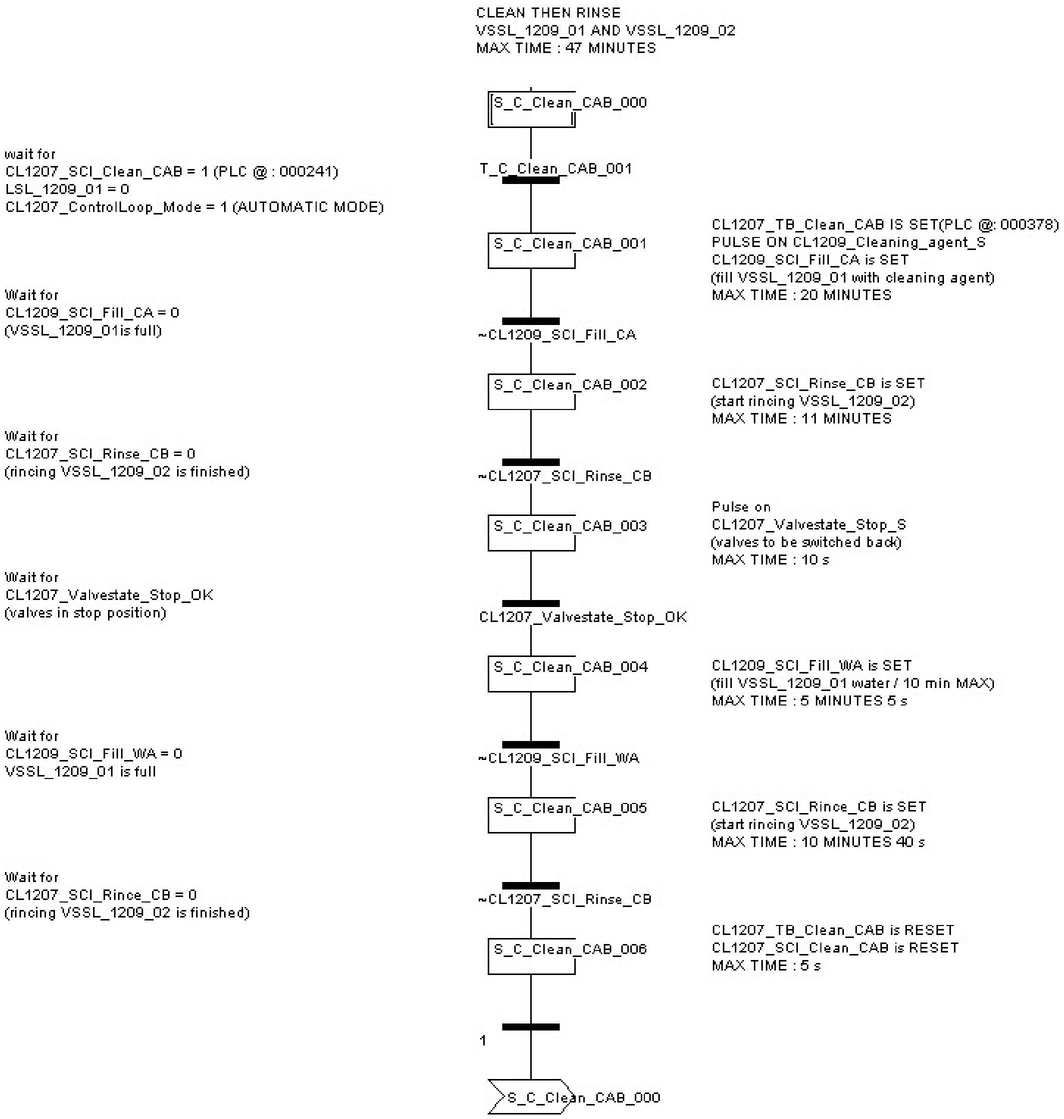


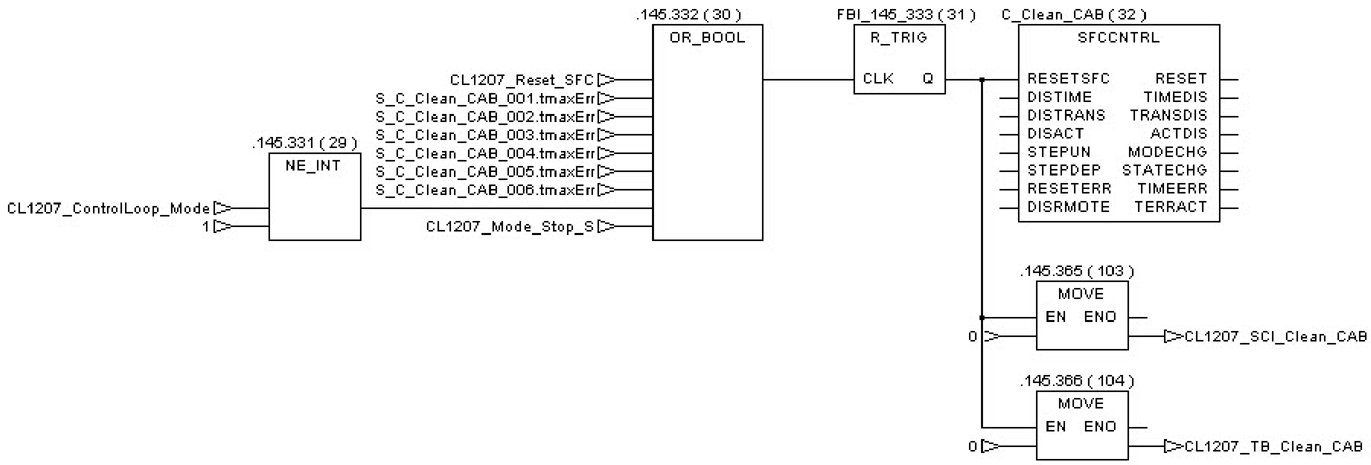
Figure 140: PLC procedure: C_Clean_CAB

PLC Subroutine called:
C_Fill_CA, C_Fill_WA, C_Rinse_CB

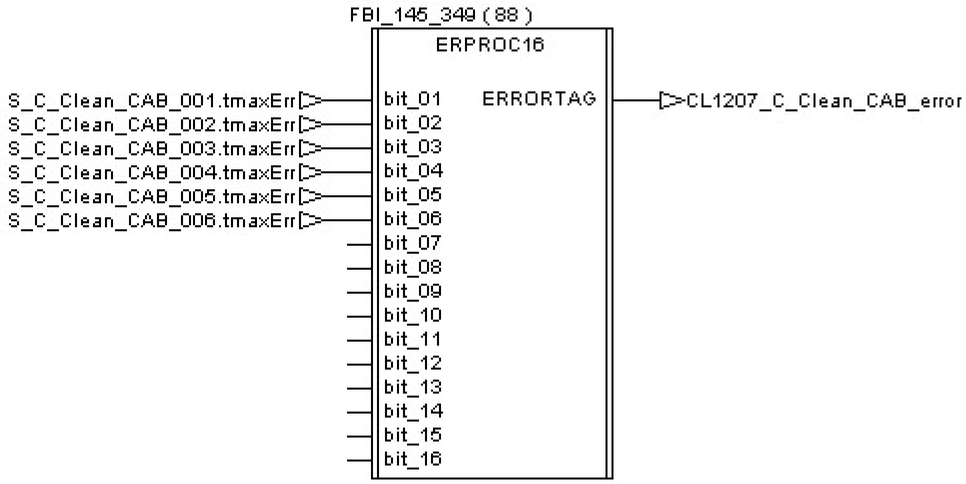
Variables Used (I/O):
All variables involved in cleaning operation, all variables used in PROCEDURE 61, PROCEDURE 62 and PROCEDURE 65

5.61.3.Procedure management

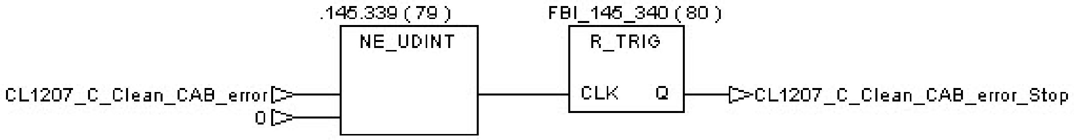
<u>Reset of the procedure:</u>
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



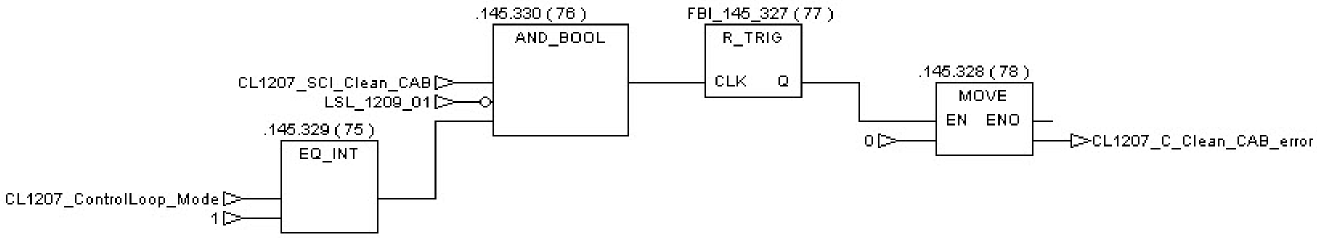
<u>Procedure error management:</u>
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1207_C_CLEAN_CAB_error_Stop" receives a pulse and then the Cleaning Unit is stopped thanks to the procedure "C_Stop".



The error number is displayed until the procedure is re-started.



5.61.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_C_Clean_CAB_001**	Problem during the execution of the procedure "C_Fill_CA" (filling of the cleaning buffer VSSL_1209_01) The procedure "C_Fill_CA" should also have an error code
2	**S_C_Clean_CAB_002**	Problem during the execution of the procedure "C_Rinse_CB" (filling of the cleaning buffer VSSL_1209_01) The procedure "C_Rinse_CB" should also have an error code
4	**S_C_Clean_CAB_003**	valve(s) status Error operator has to look for valve alarm
8	**S_C_Clean_CAB_004**	Problem during the execution of the procedure "C_Fill_WA" (filling of the cleaning buffer VSSL_1209_01) The procedure "C_Fill_WA" should also have an error code
16	**S_C_Clean_CAB_005**	Problem during the execution of the procedure "C_Rinse_CB" (filling of the cleaning buffer VSSL_1209_01) The procedure "C_Rinse_CB" should also have an error code
32	**S_C_Clean_CAB_006**	Tag reset problem (Tracing bit or Start button)

5.61.5.Controlled Valves

CL1207_Valvestate_Stop_S

Added Valves in **CL1207_Valvestate_Stop_S (2009)**

	VALVES	ADDRESS	COMMENTS
CIP General			
	S3V_1207_03_MV	000069	RESET
	S3V_1207_04_MV	000070	RESET
	SV_1207_01_MV	000074	RESET
	SV_1207_02_MV	000075	RESET
	SV_1207_03_MV	000076	RESET
	SV_1207_04_MV	000077	RESET
	SV_1207_05_MV	000059	RESET
	SV_1207_06_MV	000067	RESET
	SV_1207_07_MV	000068	RESET
	SV_1207_08_MV	000072	RESET
	SV_1207_09_MV	000071	RESET
	SV_1207_10_MV	000057	RESET
	SV_1207_11_MV	000058	RESET
	SV_1207_12_MV	000110	RESET
	SV_1207_13_MV	000109	RESET
CIP Filling control			
	SV_1209_01_MV	000078	RESET
	SV_1209_02_MV	000079	RESET
	SV_1209_03_MV	000080	RESET
	SV_1209_04_MV	000065	RESET
	SV_1209_05_MV	000066	RESET

5.61.6.Awaited Feedback

CL1207_Valvestate_Stop_OK

Added Feedback in **CL1207_Valvestate_Stop_OK (2009)**

	VALVES	ADDRESS	COMMENTS
CIP General			
	S3V_1207_03_FB	100096	RESET
	S3V_1207_04_FB	100095	RESET
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_04_FB	100104	RESET
	SV_1207_05_FB	100090	RESET
	SV_1207_06_FB	100098	RESET
	SV_1207_07_FB	100097	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_09_FB	100094	[AND (CL1210_SCI_P_AII1 = 0)] OR [AND (CL1210_SCI_P_AII1 = 1) AND (CL1207_SCI_CI1 = 1)] RESET
	SV_1207_10_FB	100092	[AND (CL1210_SCI_P_AII1 = 0)] RESET
	SV_1207_11_FB	100091	[AND (CL1210_SCI_P_AII2 = 0)] RESET
	SV_1207_12_FB	100140	RESET
	SV_1207_13_FB	100139	RESET
CIP Filling controll			
	SV_1209_01_FB	100103	RESET
	SV_1209_02_FB	100102	RESET
	SV_1209_03_FB	100101	RESET
	SV_1209_04_FB	100100	RESET
	SV_1209_05_FB	100099	RESET

5.62. Procedure 61: Fill cleaning agent into VSSL_1209_01

5.62.1.Scope

This Procedure can only be activated when the CIP control Loop mode button is in Automatic mode.

Fill cleaning agent from VSSL_1209_03 into VSSL_1209_01 and fill it up with water.
This procedure can be seen as a ‘sub-procedure’ in the PLC code. It is called from other procedures. It can also be called manually on the HMI.

Prerequisite
VSSL_1209_01 must be empty to start the procedure.

Procedure
Fill cleaning agent into VSSL_1209_03.
Configure the time during the pump 1209_01 will run with
CL1209_SCI_Fill_CA_DetergtTime (400402)
This time can be monitored by variable
CL1209_SCI_Fill_CA_DetergtTimer (PLC Address:400404)
Use the HMI to start PLC procedure C_Fill_CA: CL1209_SCI_Fill_CA
Wait for the PLC procedure to finish.

Used Variables:
CL1209_SCI_Fill_CA (PLC Address: 000248)
CL1209_TB_Fill_CA (PLC Address: 000379)
CL1209_SCI_Fill_CA_DetergtTime (PLC Address: 400701)
CL1209_SCI_Fill_CA_DetergtTimer (PLC Address: 400705)
CL1207_OP_CleaningAgent (PLC Address: 000260)
CL1207_OP_CleaningAgent_OK (PLC Address: 000385)

5.62.2.PLC Subroutine: C_Fill_CA

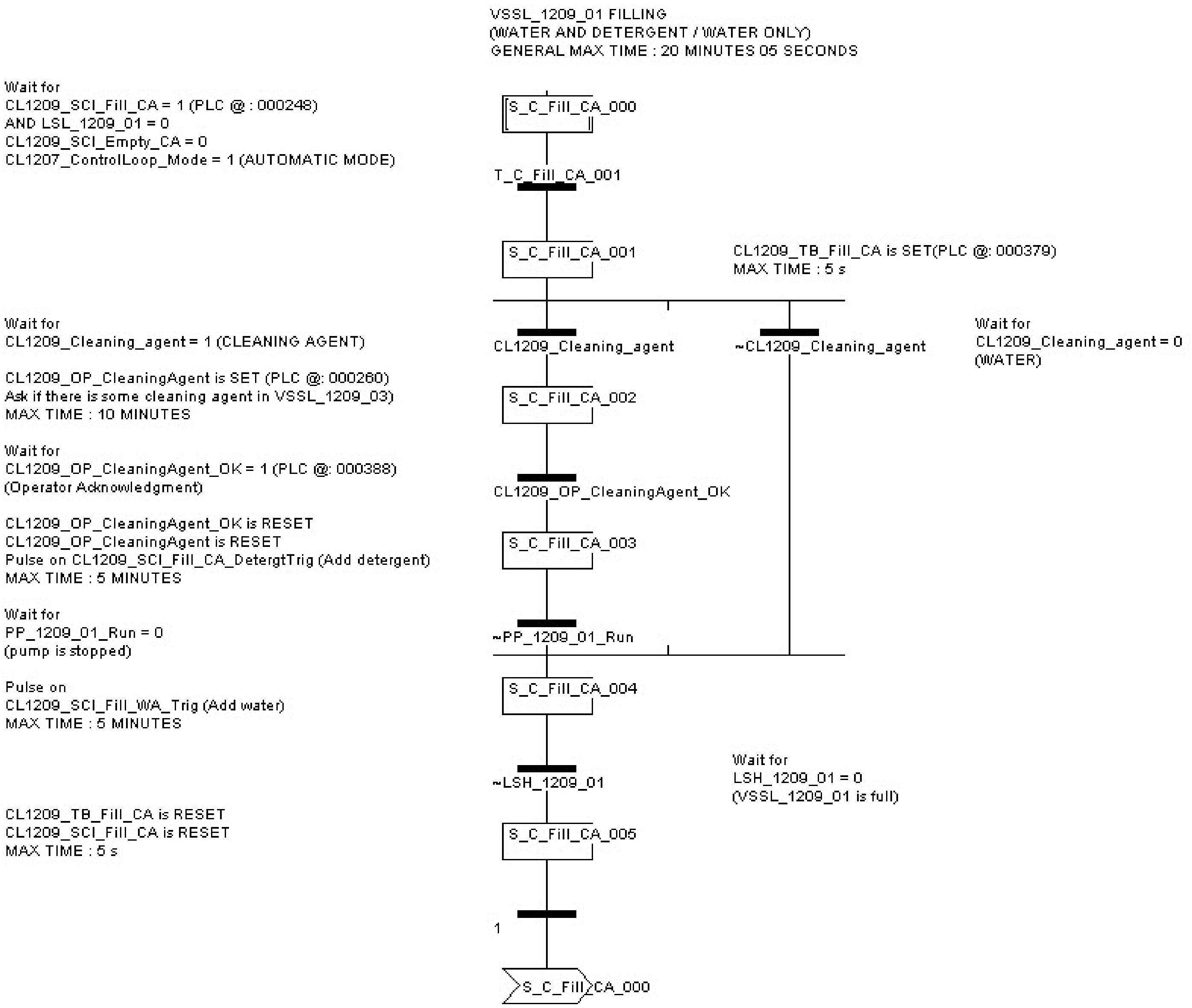


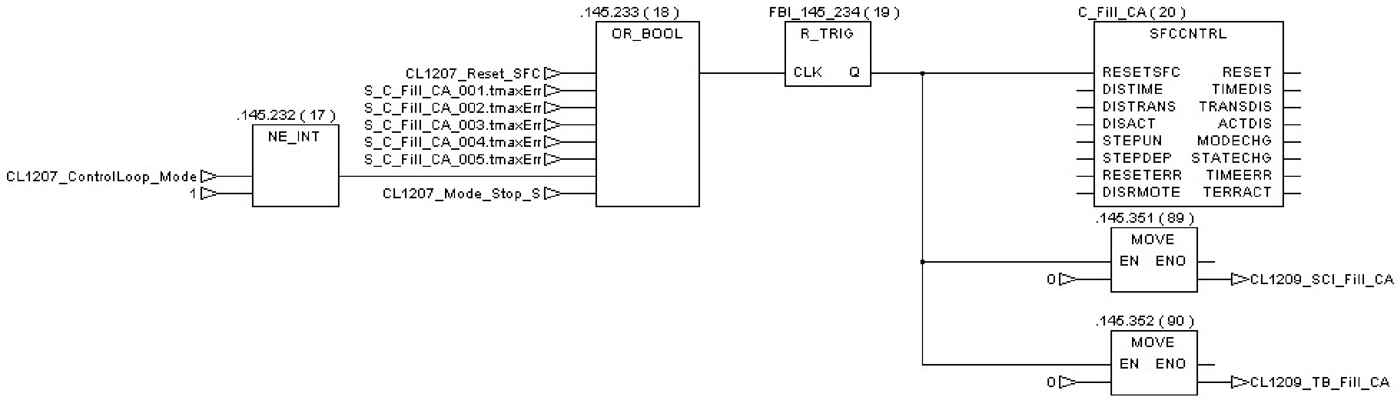
Figure 141: PLC procedure: C_Fill_CA

Variables Used (I/O):
LSL_1209_01, LSH_1209_01,
SV_1209_05_MV

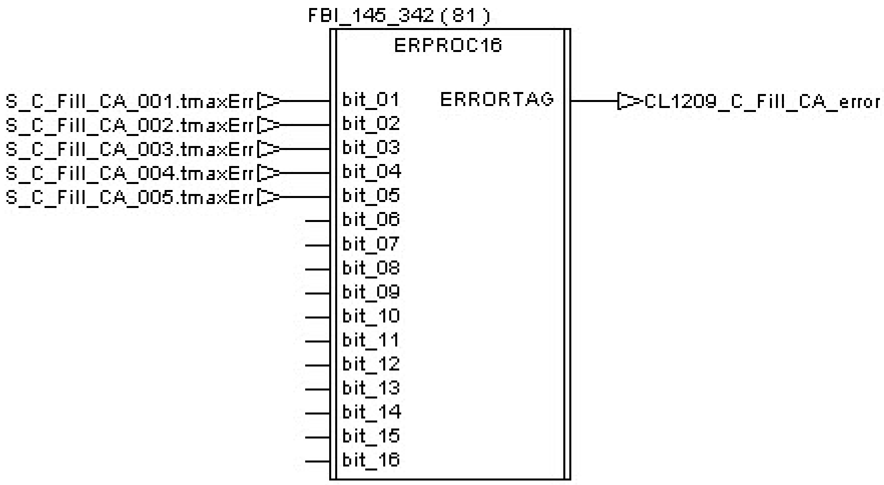
5.62.3.Procedure management

<u>Reset of the procedure:</u>
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.

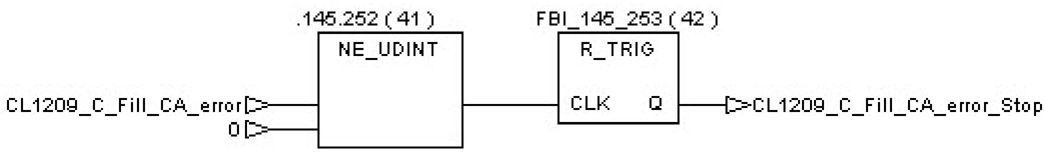
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



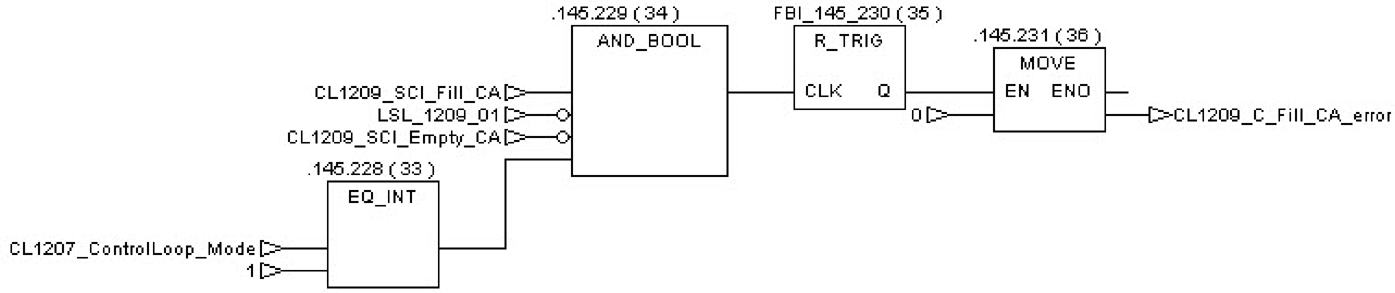
<u>Procedure error management:</u>
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1207_C_FILL_CA_error_Stop" receives a pulse and then the Cleaning Unit is stopped thanks to the procedure "C_Stop".



The error number is displayed until the procedure is re-started.



5.62.4.Error number description

Error number	Procedure Action Step	problem description
1	S_C_Fill_CA_001	PLC internal memory failure
2	S_C_Fill_CA_002	The operator didn't answer to the operator panel (Is there some cleaning agent in vessel VSSL_1209_03?) The time (10 minutes) is elapsed
4	S_C_Fill_CA_003	The pump PP_1209_01 didn't stop
8	S_C_Fill_CA_004	Level switch high LSH_1209_01 failure or valve(s) status Error operator has to look for valve alarm or water utility problem
16	S_C_Fill_CA_005	Tag reset problem (Tracing bit or Start button)

5.63. Procedure 62: Fill water into VSSL_1209_01

5.63.1.Scope

This Procedure can only be activated when the CIP control Loop mode button is in Automatic mode.

Fill water into VSSL_1209_01.
This procedure can be seen as a ‘sub-procedure’ in the PLC code. It is called from other procedures. It can also be called manually on the HMI.

Procedure
Use the HMI to start PLC procedure C_Fill_WA:
CL1209_SCI_Fill_WA (PLC Address: 000253)
Wait for the PLC procedure ending: LSL_1209_01 = 0 (Level high)
If SV_1209_03 is open for more than 3 minutes, an error is set (CL1209_Fill_WA_Timeout = 1), then SV_1209_03 and SV_1209_05 are Reset.

Used Variables:
CL1209_SCI_Fill_WA (PLC Address: 000253)
CL1209_TB_Fill_WA (PLC Address: 000380)

5.63.2.PLC Subroutine: C_Fill_WA

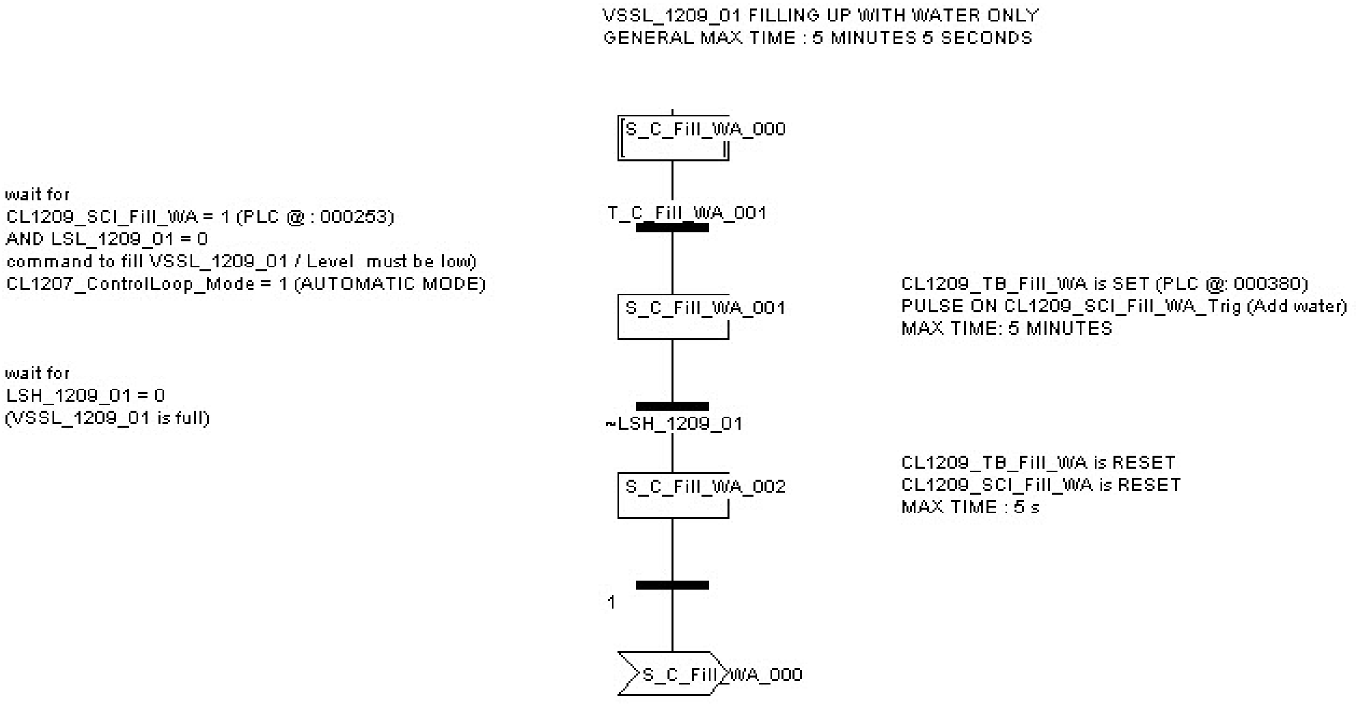
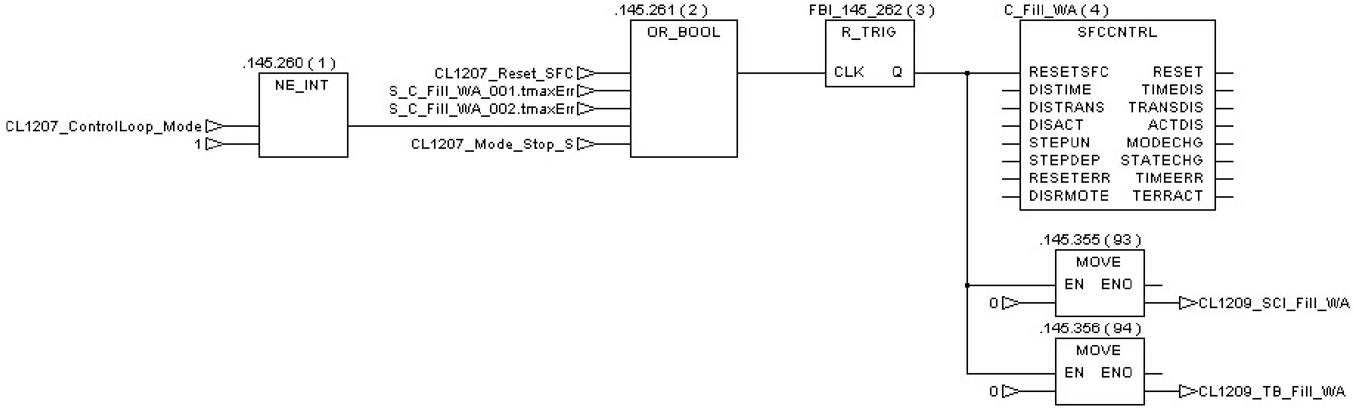


Figure 142: PLC procedure: C_Fill_WA

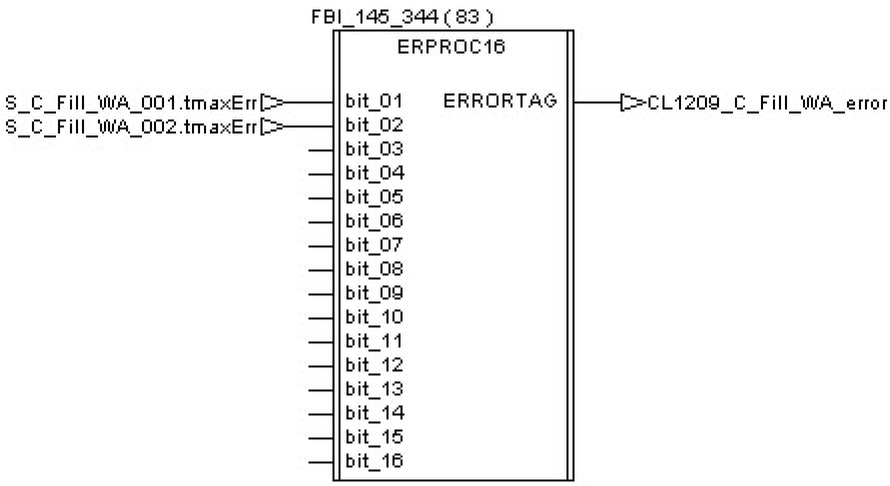
Variables Used (I/O):
LSH_1209_01 / LSL_1209_01
SV_1209_03_MV, SV_1209_05_MV

5.63.3.Procedure management

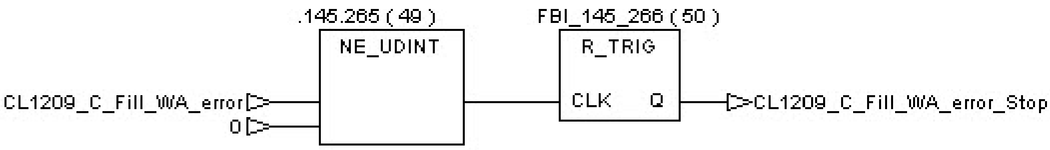
<u>Reset of the procedure:</u>
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



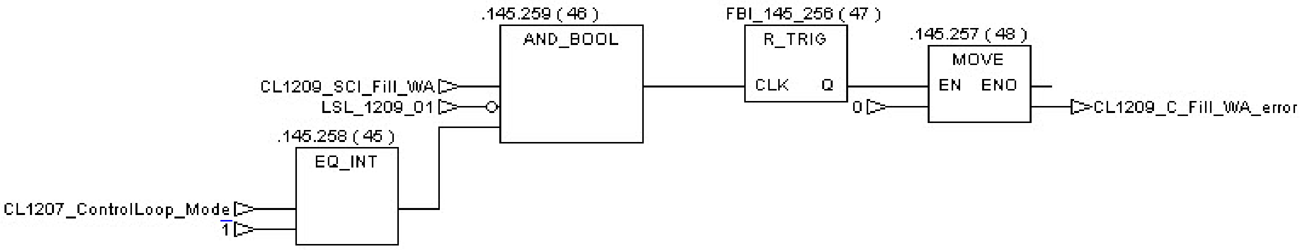
<u>Procedure error management:</u>
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1207_C_FILL_WA_error_Stop" receives a pulse and then the Cleaning Unit is stopped thanks to the procedure "C_Stop".



The error number is displayed until the procedure is re-started.



5.63.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_C_Fill_WA_001**	Level switch high LSH_1209_01 failure or valve(s) status Error operator has to look for valve alarm or water utility problem
2	**S_C_Fill_WA_002**	Tag reset problem (Tracing bit or Start button)

5.64. Procedure 63: Fill Cleaning agent into VSSL_1209_02

5.64.1.Scope

This Procedure can only be activated when the CIP control Loop mode button is in Automatic mode.

Fill the contents from VSSL_1209_01 into VSSL_1209_02.
This procedure can be seen as a ‘sub-procedure’ in the PLC code. It is called from other procedures. It can also be called manually on the HMI.

Prerequisite
VSSL_1209_01 must contain water or cleaning agent
VSSL_1209_02 must be empty

Procedure
Use the HMI to start PLC procedure C_Fill_CB: CL1209_SCI_Fill_CB
Wait for the PLC procedure to finish.

Used Variables:
CL1209_SCI_Fill_CB (PLC Address: 000251)
CL1209_TB_Fill_CB (PLC @: 000381)

5.64.2.PLC Subroutine: C_Fill_CB

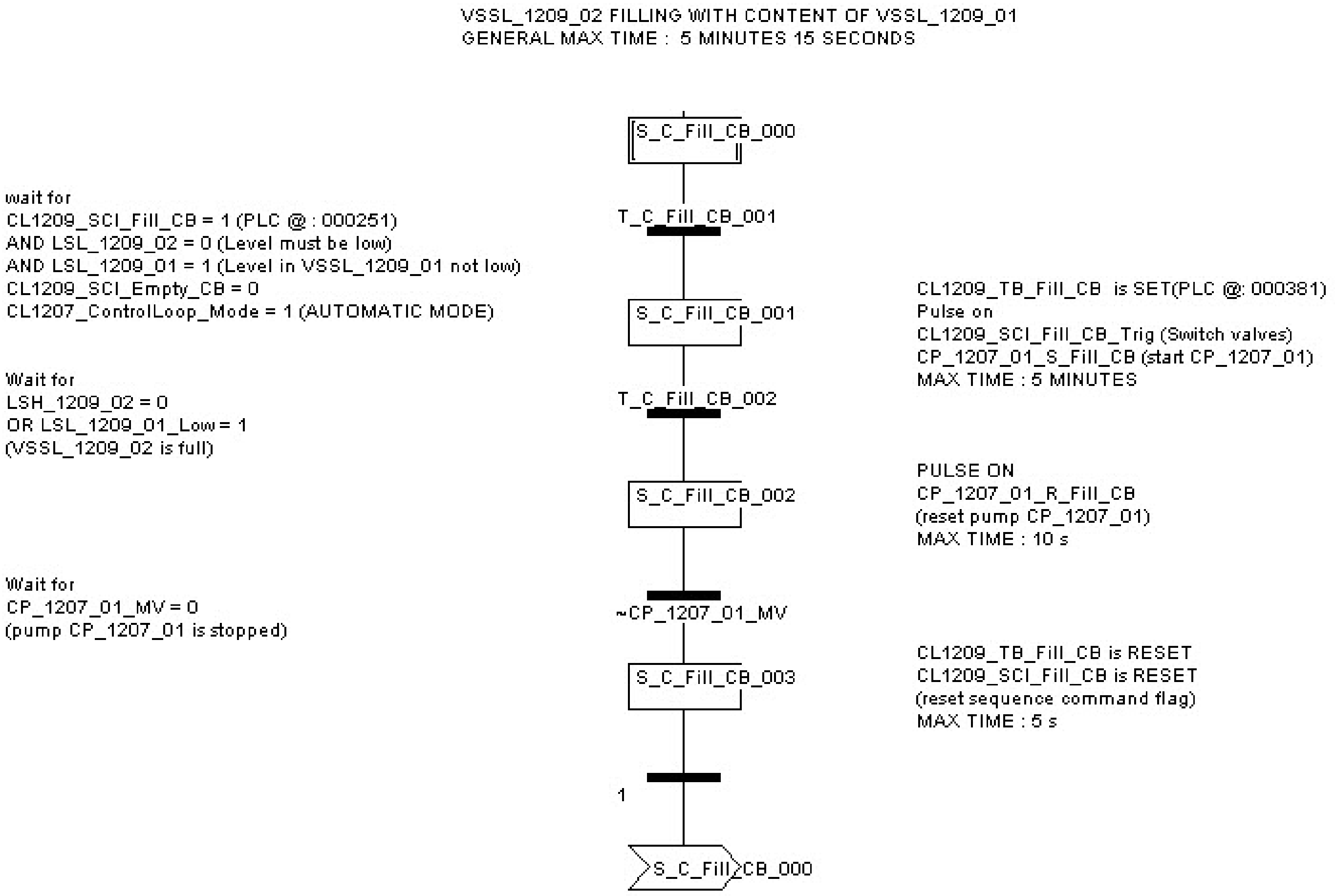
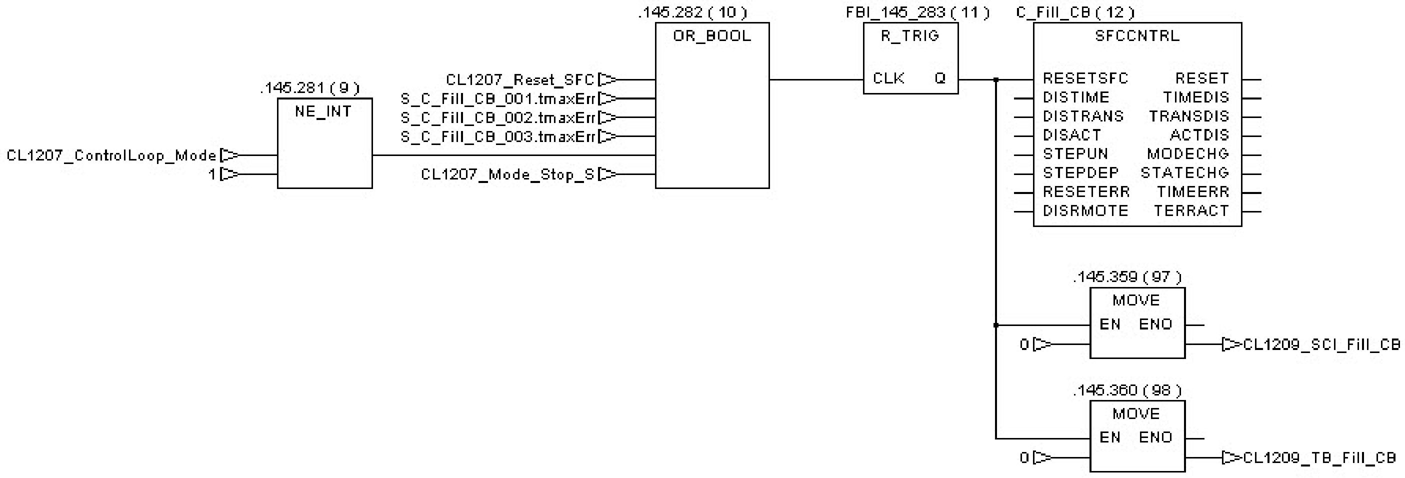


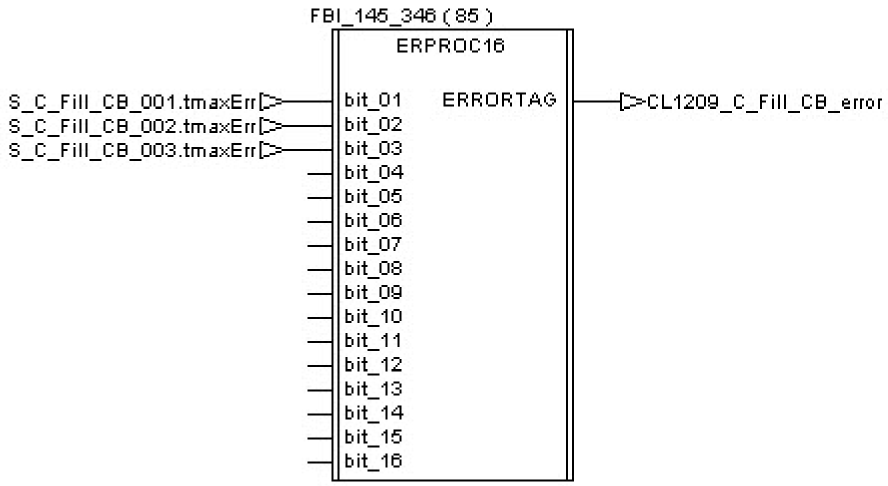
Figure 143: PLC procedure: C_Fill_CB

5.64.3.Procedure management

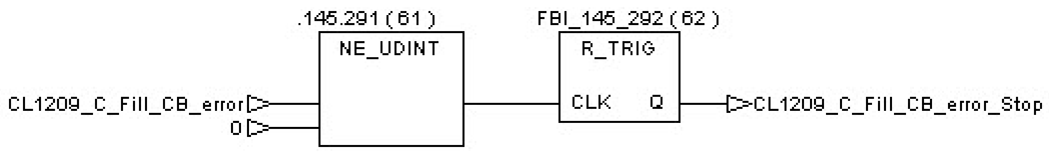
<u>Reset of the procedure:</u>
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



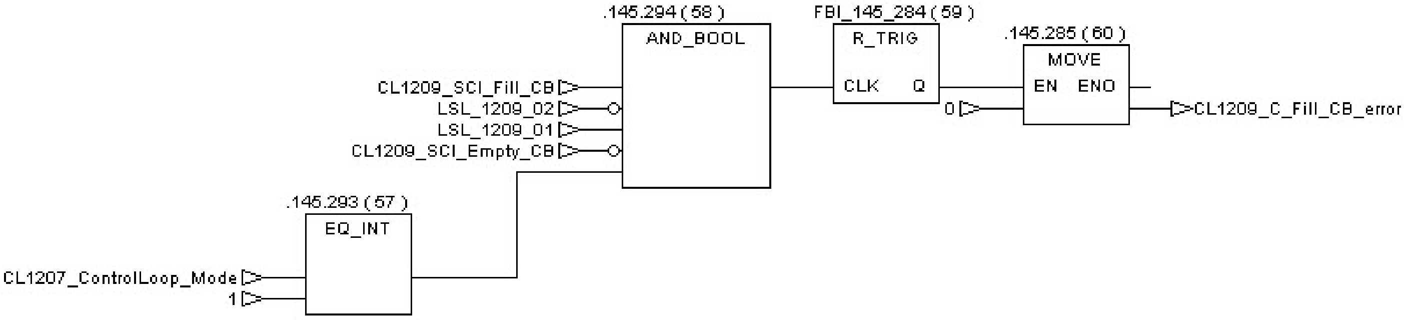
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1207_C_FILL_CB_error_Stop" receives a pulse and then the Cleaning Unit is stopped thanks to the procedure "C_Stop".



The error number is displayed until the procedure is re-started.



5.64.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_C_Fill_CB_001**	Level switch high LSH_1209_02 failure or Level switch high LSL_1209_01 failure or valve(s) status Error operator has to look for valve alarm or the cleaning pump CP_1207_01 didn't start
2	**S_C_Fill_CB_002**	CP_1207_01 didn't stop
4	**S_C_Fill_CB_003**	Tag reset problem (Tracing bit or Start button)

5.64.5.Controlled valves

CL1209_SCI_Fill_CB_Trig

Added Valves in CL1209_SCI_Fill_CB_Trig (2009/03)

	VALVES	ADDRESS	COMMENTS
CIP General			
	SV_1207_01_MV	000074	RESET
	SV_1207_02_MV	000075	RESET
	SV_1207_03_MV	000076	RESET
	SV_1207_04_MV	000077	SET
	SV_1207_05_MV	000059	RESET
CIP Filling control			
	SV_1209_02_MV	000079	SET
	SV_1209_05_MV	000066	SET

No awaited feedback.

5.65. Procedure 64: Rinse VSSL_1209_01

5.65.1.Scope

This Procedure can only be activated when the CIP control Loop mode button is in Automatic mode.

VSSL_1209_01 is rinsed for ten seconds with water. The vessel is emptied using PROCEDURE 58: Empty VSSL_1209_01
This procedure can be seen as a 'sub-procedure' in the PLC code. It is called from other procedures. It can also be called manually on the HMI.

Procedure
Use the HMI to start PLC procedure C_Rinse_CA: CL1207_SCI_Rinse_CA
Wait for the PLC procedure to finish.

Used Variables:
CL1207_SCI_Rinse_CA (PLC Address: 000264)
CL1207_TB_Rinse_CA (PLC Address: 000382)

5.65.2.PLC Subroutine: C_Rinse_CA

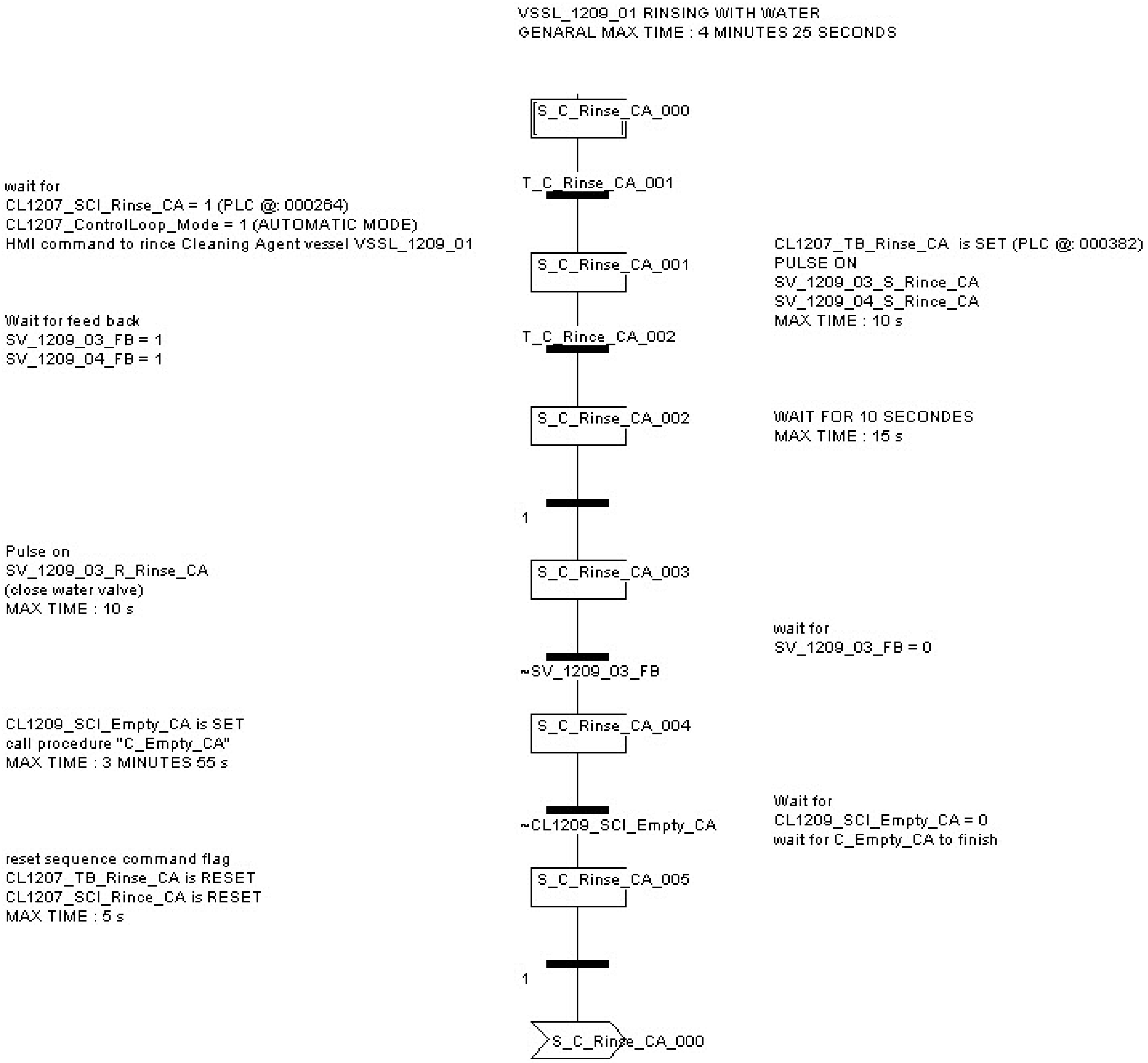
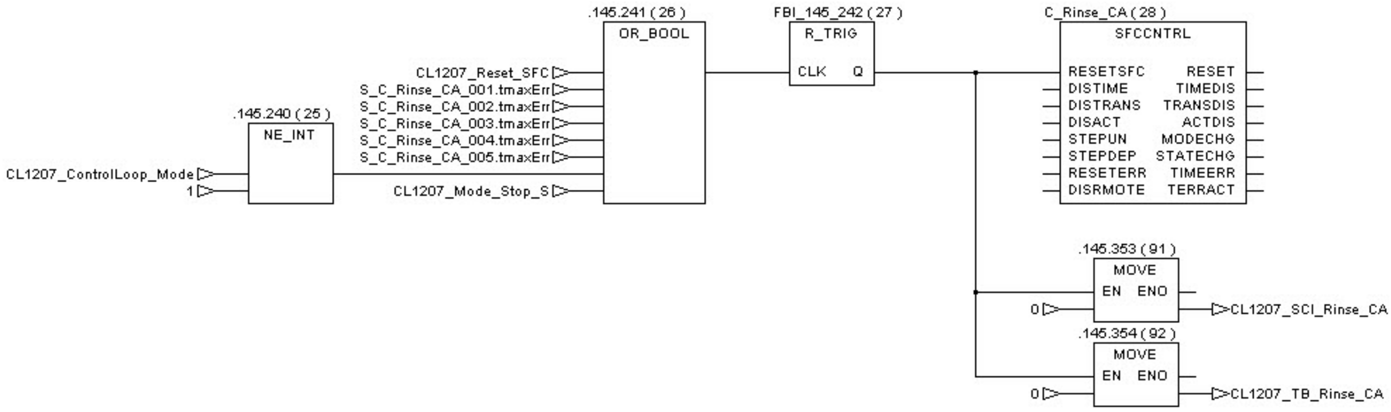


Figure 144: PLC procedure: C_Rinse_CA

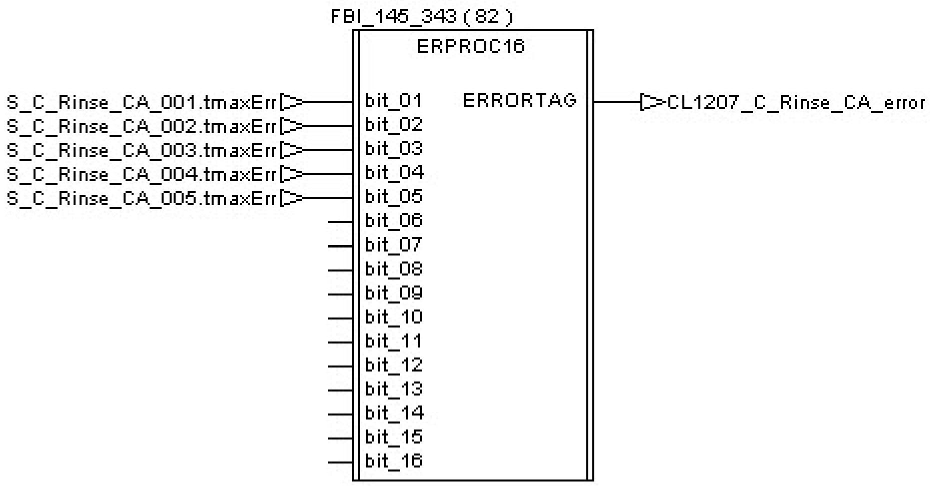
Variables Used (I/O):
SV_1209_03_MV / SV_1209_04_MV
SV_1209_03_FB/ SV_1209_04_FB

5.65.3.Procedure management

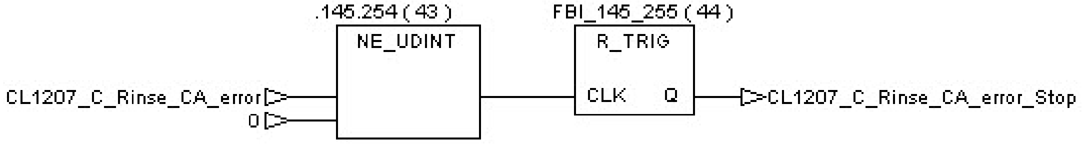
<u>Reset of the procedure:</u>
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



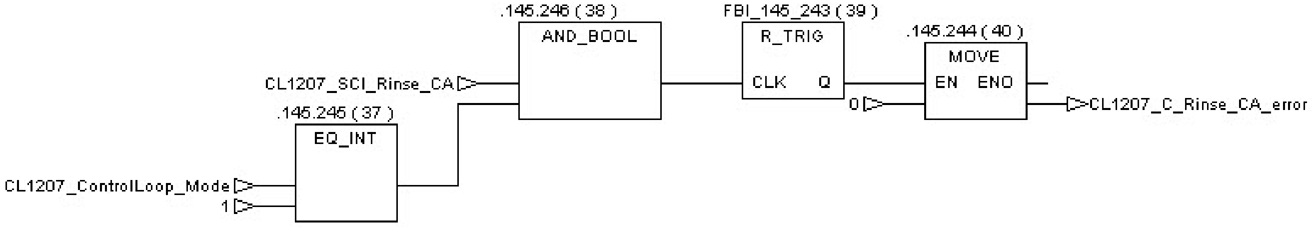
<u>Procedure error management:</u>
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1207_C_RINSE_CA_error_Stop" receives a pulse and then the Cleaning Unit is stopped thanks to the procedure "C_Stop".



The error number is displayed until the procedure is re-started.



5.65.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_C_Rinse_CA_001**	valve(s) status Error operator has to look for valve alarm
2	**S_C_Rinse_CA_002**	Just a delay, no possible error
4	**S_C_Rinse_CA_003**	SV_1209_03 failure
8	**S_C_Rinse_CA_004**	Problem during the execution of the procedure "C_EMPTY_CA" (Emptying of the cleaning buffer VSSL_1209_01) The procedure "C_EMPTY_CA" should also have an error code
16	**S_C_Rinse_CA_005**	Tag reset problem (Tracing bit or Start button)

5.66. Procedure 65: Rinse VSSL_1209_02

5.66.1.Scope

This Procedure can only be activated when the CIP control Loop mode button is in Automatic mode.

VSSL_1209_02 is rinsed with the contents of VSSL_1209_01 (which normally should be water). Both vessels VSSL_1209_01 and VSSL_1209_02 are emptied afterwards using PROCEDURE 58: Empty VSSL_1209_01 and PROCEDURE 59: Empty VSSL_1209_02
This procedure can be seen as a ‘sub-procedure’ in the PLC code. It is called from other procedures. It can also be called manually on the HMI.

Prerequisite
VSSL_1209_01 must contain water or cleaning agent (use PROCEDURE 61: Fill cleaning agent into VSSL_1209_01 / PROCEDURE 62: Fill water into VSSL_1209_01).

Procedure
Use the HMI to start PLC procedure C_Rinse_CB:
CL1207_SCI_Rinse_CB (PLC Address : 000265)
Wait for the PLC procedure to finish.

Used Variables:
CL1207_SCI_Rinse_CB (PLC Address : 000265)
CL1207_TB_Rinse_CB (PLC Address : 000383)

5.66.2.PLC Subroutine: C_Rinse_CB

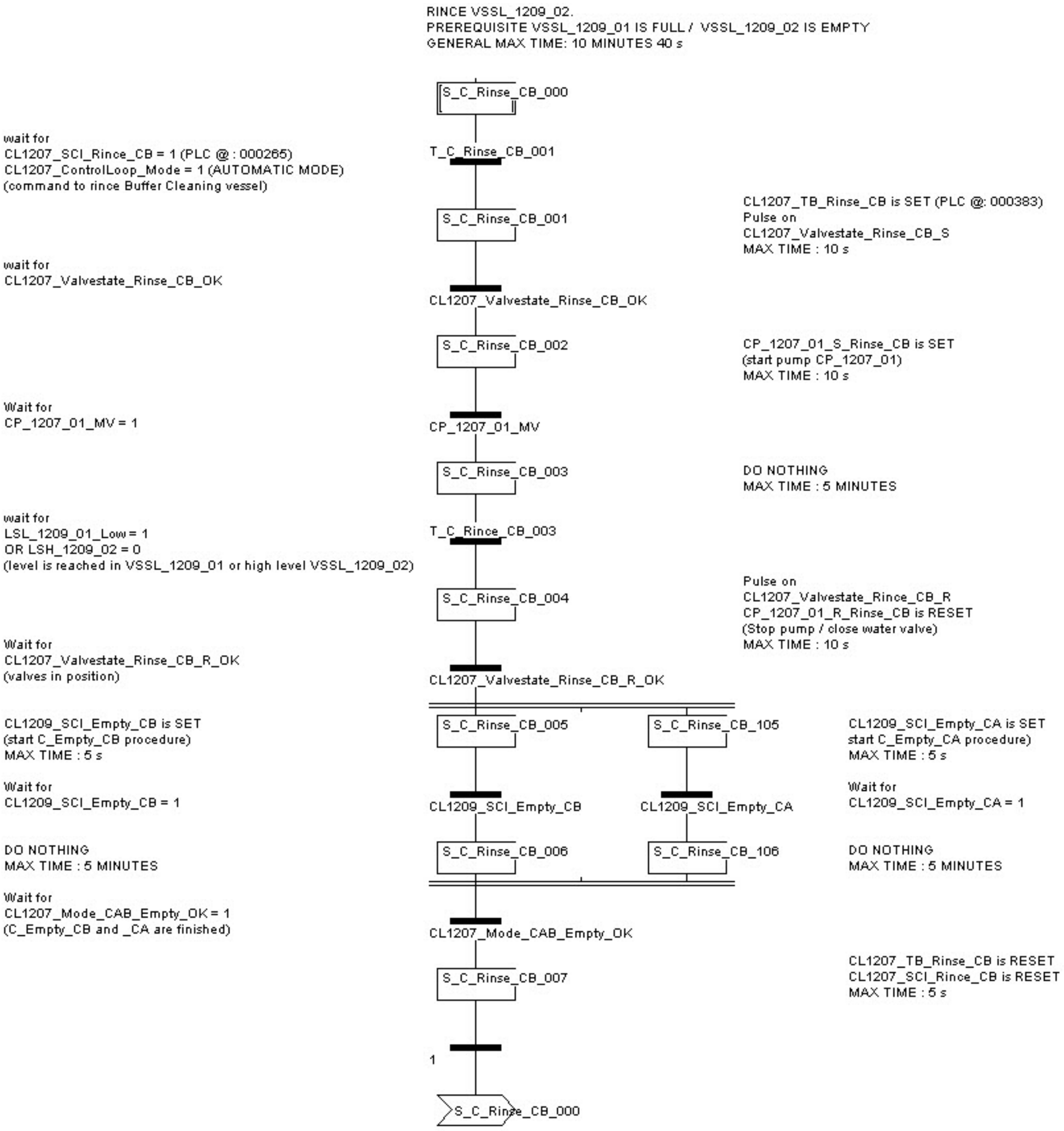
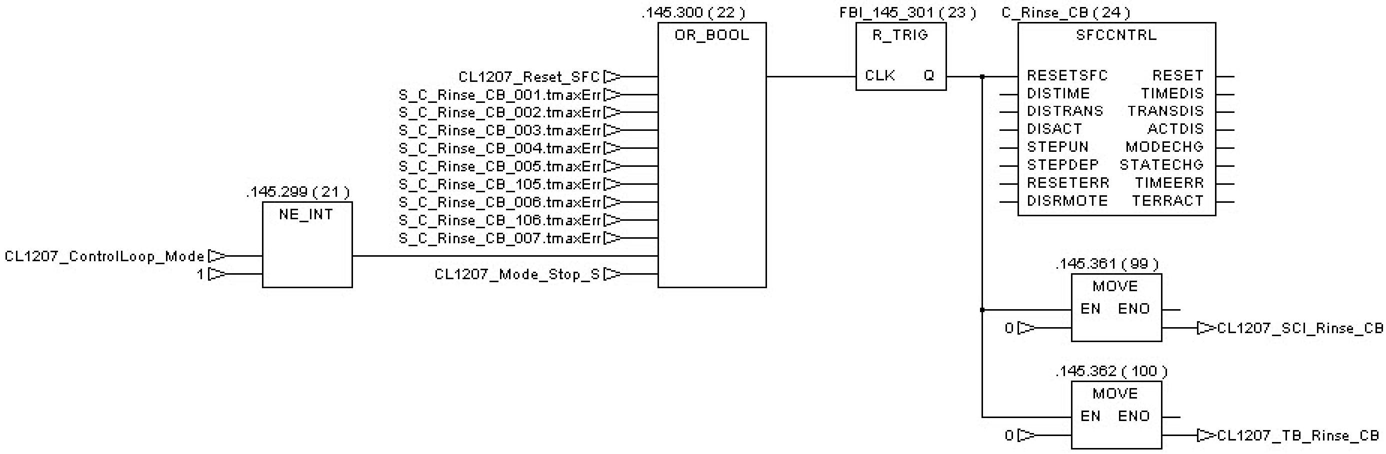


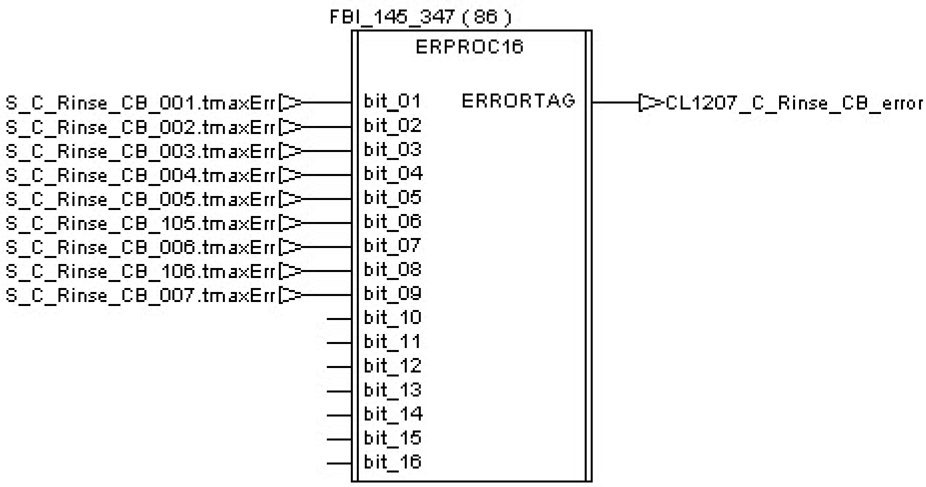
Figure 145: PLC procedure: C_Rinse_CB

5.66.3.Procedure management

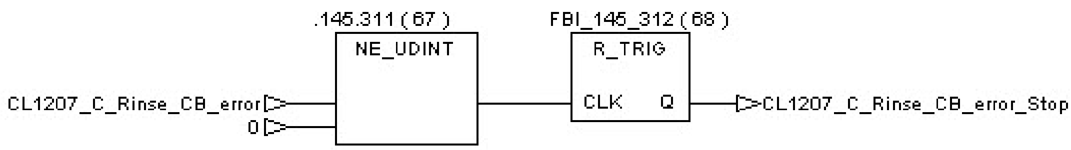
<u>Reset of the procedure:</u>
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



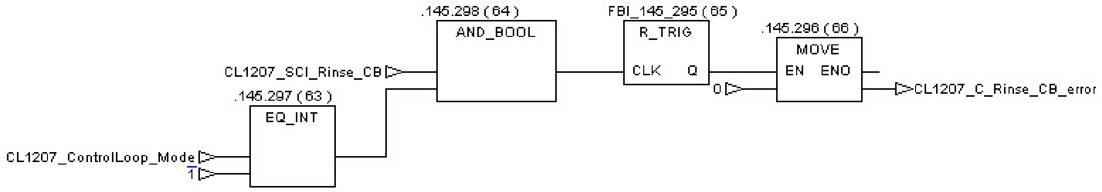
<u>Procedure error management:</u>
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag “CL1207_C_RINSE_CB_error_Stop” receives a pulse and then the Cleaning Unit is stopped thanks to the procedure “C_Stop”.



The error number is displayed until the procedure is re-started.



5.66.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_C_Rinse_CB_001**	valve(s) status Error operator has to look for valve alarm
2	**S_C_Rinse_CB_002**	the cleaning pump CP_1207_01 didn't start
4	**S_C_Rinse_CB_003**	Level switch low LSL_1209_01 failure or Level switch High LSH_1209_02 failure
8	**S_C_Rinse_CB_004**	valve(s) status Error operator has to look for valve alarm
16	**S_C_Rinse_CB_005**	Tag reset problem (Tracing bit or Start button)
32	**S_C_Rinse_CB_105**	Tag reset problem (Tracing bit or Start button)
64	**S_C_Rinse_CB_006**	One of the two cleaning vessels didn't finish its empting. One of the two procedures "C_Empty_CA" or "C_Empty_CB" should have an error code.
128	**S_C_Rinse_CB_106**	One of the two cleaning vessels didn't finish its empting. One of the two procedures "C_Empty_CA" or "C_Empty_CB" should have an error code.
256	**S_C_Rinse_CB_007**	Tag reset problem (Tracing bit or Start button)

5.66.5.Controlled valves

CL1207_Valvestate_Rince_CB_S

Added Valves in **CL1207_Valvestate_Rince_CB_S(2009/03)**

	VALVES	ADDRESS	COMMENTS
CIP General			
	SV_1207_01_MV	000074	RESET
	SV_1207_02_MV	000075	RESET
	SV_1207_03_MV	000076	RESET
	SV_1207_04_MV	000077	SET
CIP Filling control			
	SV_1209_01_MV	000078	SET
	SV_1209_02_MV	000079	SET
	SV_1209_05_MV	000066	SET

CL1207_Valvestate_Rince_CB_R

Added Valves in **CL1207_Valvestate_Rince_CB_R(2009/03)**

	VALVES	ADDRESS	COMMENTS
CIP General			
	SV_1207_04_MV	000077	RESET
CIP Filling control			
	SV_1209_01_MV	000078	RESET
	SV_1209_02_MV	000079	RESET
	SV_1209_05_MV	000066	RESET

5.66.6. Awaited Feedback

CL1207_Valvestate_Rince_CB_OK

Added Feedback (2009_03)

	VALVES	ADDRESS	COMMENTS
CIP General			
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_04_FB	100104	SET
CIP Filling controll			
	SV_1209_01_FB	100103	SET
	SV_1209_02_FB	100102	SET
	SV_1209_05_FB	100099	SET

CL1207_Valvestate_Rince_CB_R_OK

Added Feedback **CL1207_Valvestate_Rince_CB_R_OK**(2009_03)

	VALVES	ADDRESS	COMMENTS
CIP General			
	SV_1207_01_FB	100110	RESET
	SV_1207_02_FB	100111	RESET
	SV_1207_03_FB	100112	RESET
	SV_1207_04_FB	100104	RESET
CIP Filling controll			
	SV_1209_01_FB	100103	RESET
	SV_1209_02_FB	100102	RESET
	SV_1209_05_FB	100099	RESET

5.67. Procedure 66: (Nominal) Shut Down of SIP activities

5.67.1.Scope

The procedure which manages the Stop of the SIP can only be activated (as all the other procedures) in automatic mode. Its aim is to Stop any SIP action being active.
This procedure should normally not be used because any SIP procedure should terminate itself autonomously. This may be very useful to stop any SIP procedure that is initiated wrongly.
A section named “Stop sterilization procedure management” situated in the SIP General chapter, detailed the different ways offered by the software to stop the sterilization functions.

Procedure
Use the HMI to start PLC procedure S_Stop: CL1210_SCI_Stop.
Close the valve on Steam Generator (Old SG_1210_01) and wait for the PLC procedure Ending.
CL1210_TB_Stop (PLC Address: 000340) is SET.
Open the steam generator if no another SIP action is fore seen. The pressure vessel should be depressurized using PROCEDURE 67: SIP: Release pressure in Steam Generator (SG_1210_01)

Used Variables:
CL1210_SCI_Stop (PLC Address: 000312)
CL1210_TB_Stop (PLC Address: 000384)

5.67.2.PLC Subroutine: S_Stop

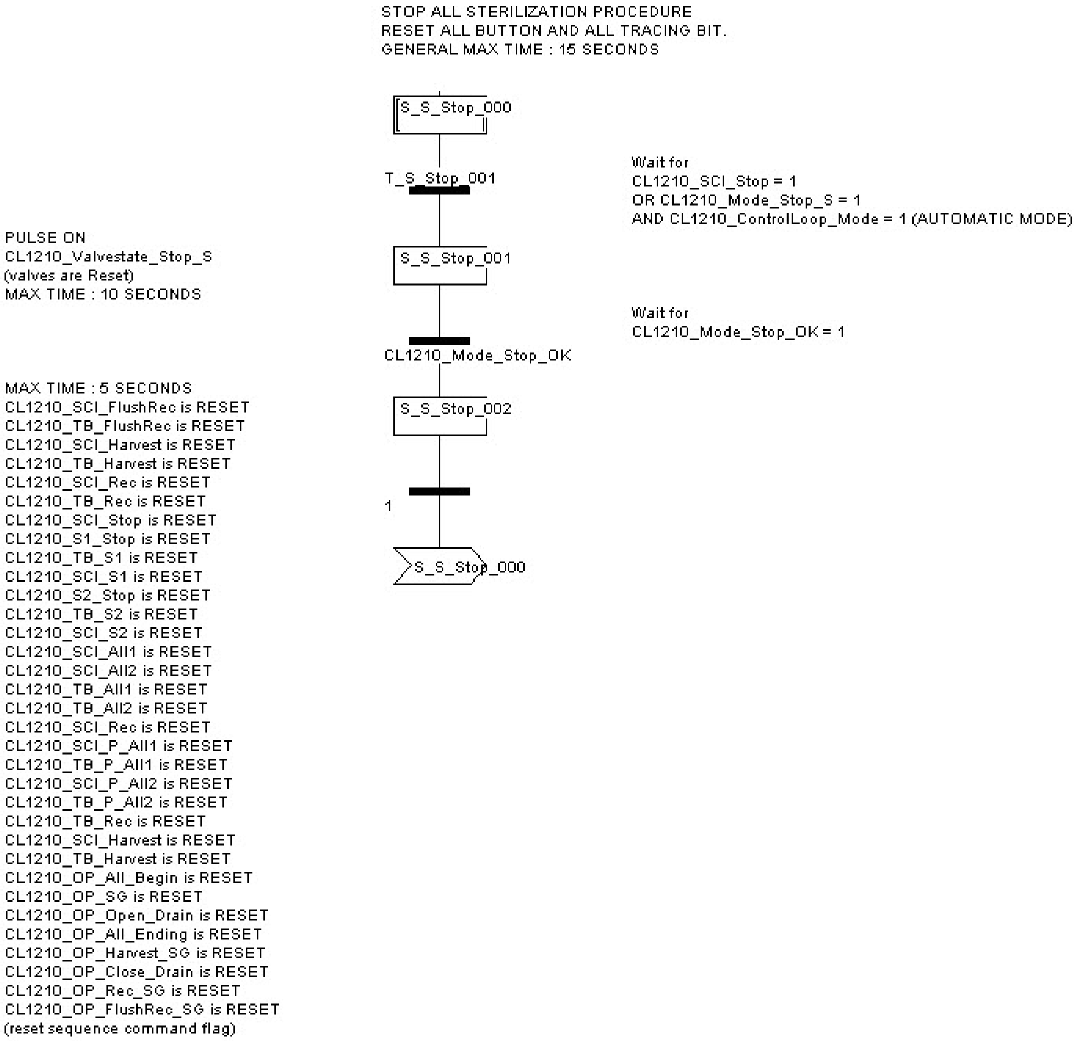
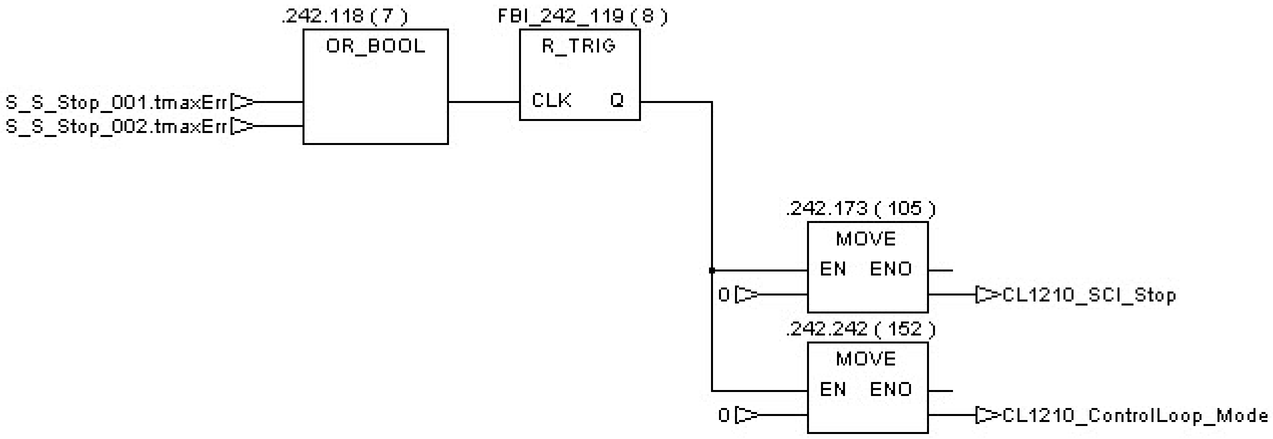


Figure 146: PLC procedure: S_Stop

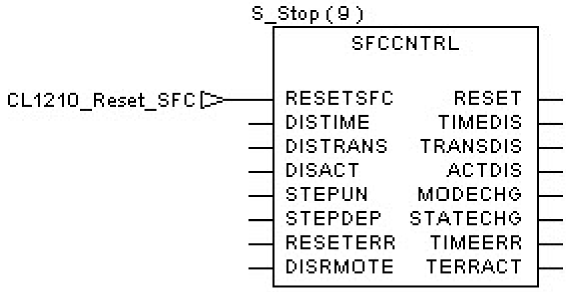
5.67.3.Procedure management

If a time error occurs during the execution of the procedure, the start procedure button variable is reset and the Control Loop Mode is triggered to OFF mode. (If the stop procedure has a problem, the only way to solve it is to set all equipments in default position by the OFF mode).



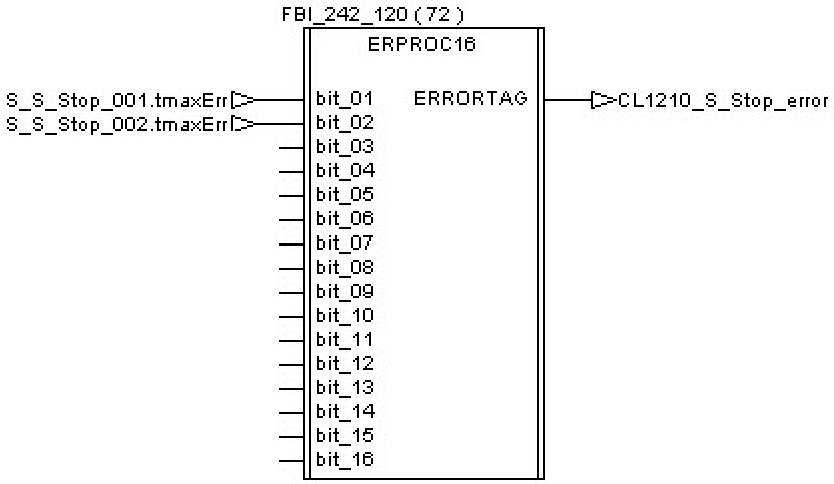
In Parallel, the procedure named “CL1210_ RESET_PROC” is started. This procedure, detailed further on, triggers a general reset (SIP procedures and equipments) to ensure the default status of all the Sterilization functions when automatic mode is re-started.

The block “SFC_CNTRL” permits to reset the procedure S_Stop. It is done thanks to the variable “CL1210_Reset_SFC” (set by proc “CL1210_RESET_PROC”).

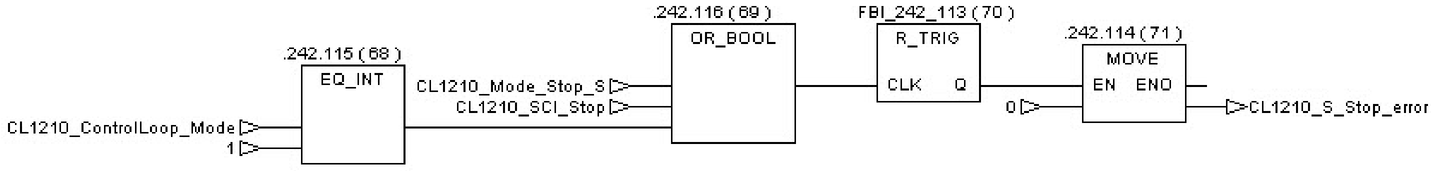


<u>Procedure error management:</u>

The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



The error number is displayed until the procedure is re-started.



5.67.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_S_Stop_001**	valve(s) status Error operator has to look for valve alarm
2	**S_S_Stop_002**	No transition, no possible error

5.67.5.Controlled valves

CL1210_Valvestate_Stop_S

Added Valves in **CL1210_Valvestate_Stop_S (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Filtrate Flow Control			
	SV_1202_01_MV	000050	AND (CL1210_SCI_AII1) => RESET
	SV_1202_02_MV	000099	AND (CL1210_SCI_AII2) => RESET
	SV_1202_03_MV	000051	AND (CL1210_SCI_AII2) => RESET
	SV_1202_04_MV	000100	AND (CL1210_SCI_AII1) => RESET
Filtration Unit Pressure control			
	SV_1203_03_MV	000038	AND [(CL1210_SCI_AII1) OR (CL1210_SCI_AII2)] => RESET
	SV_1203_04_MV	000107	AND [(CL1210_SCI_AII1) OR (CL1210_SCI_AII2)] => RESET
Effluent Tank General			
	SV_1204_01_MV	000052	AND [(CL1210_SCI_AII1) OR (CL1210_SCI_AII2)] => RESET
	SV_1204_03_MV	000101	AND [(CL1210_SCI_AII1) OR (CL1210_SCI_AII2)] => RESET
CIP General			
	SV_1207_12_MV	000110	AND [(CL1210_SCI_S2) OR (CL1210_SCI_AII2)] => RESET
	SV_1207_13_MV	000109	AND [(CL1210_SCI_S1) OR (CL1210_SCI_AII1)] => RESET
SIP General			
	SV_1210_01_MV	000086	RESET
	SV_1210_02_MV	000085	RESET
	SV_1210_03_MV	000088	RESET
	SV_1210_04_MV	000030	RESET
	SV_1210_05_MV	000029	RESET
	SV_1210_06_MV	000026	RESET
	SV_1210_07_MV	000025	RESET
	SV_1210_08_MV	000028	RESET
	SV_1210_09_MV	000027	RESET
	SV_1210_10_MV	000103	RESET (no feed back)
	SV_1210_11_MV	000111	RESET
	SV_1210_12_MV	000104	RESET (no feed back)
	SV_1210_13_MV	000112	RESET
	SV_1210_14_MV	000113	RESET
	SV_1210_15_MV	000102	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_MV	000105	RESET
	SV_1211_02_MV	000106	RESET
	SV_1211_03_MV	000108	RESET

5.67.6.Awaited Feedback

CL1210_Valvestate_Stop_OK

Added Feedback in **CL1210_Valvestate_Stop_OK (2009/03)**

	VALVES	ADDRESS	COMMENTS
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_02_FB	100108	RESET
	SV_1210_03_FB	100108	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_05_FB	100056	RESET
	SV_1210_06_FB	100059	RESET
	SV_1210_07_FB	100060	RESET
	SV_1210_08_FB	100057	RESET
	SV_1210_09_FB	100058	RESET
	SV_1210_10_FB		no feedback
	SV_1210_11_FB	100141	RESET
	SV_1210_12_FB		no feed back
	SV_1210_13_FB	100142	RESET
	SV_1210_14_FB	100143	RESET
	SV_1210_15_FB	100134	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET
	SV_1211_02_FB	100136	RESET
	SV_1211_03_FB	100138	RESET

5.68. Procedure 67: SIP: Release pressure in SG_1210_01

Scope

When SIP actions finishes the pressure vessel of the steam generator SG_1210_01 should be depressurized.

Procedure

Make sure the decompression vessel is attached to the outlet at the red valve on the bottom and that enough water is present to cool down the hot steam mass when it enters the vessel, and that enough space is freer to allow steam to enter the vessel.

Use the yellow accessory on the hook at the back of SG_1210_01 to open the red valve at the bottom. This valve may be hot.

Use the same accessory to close the valve and put it back on its hook.

All this procedure is done manually by the OPERATOR.

5.69. Procedure 68: SIP: membrane LF_1200_01 / LF_1200_02

5.69.1. Scope

This Procedure can only be activated when the FU, the CIP and the SIP control Loop mode button are in Automatic mode.

The membranes are cleaned on a regular basis in order to extend their lifetimes. After every CIP procedure the filtrate side of the membrane must be made sterile again. The retentate side of the membrane is included in the process to avoid pressure differences between filtrate and retentate.

Prerequisite
The membrane has been cleaned and rinsed on both sides

Protocol

For Membrane 1:
<u>Purging phase</u>
Open SV_1210_09 and SV_1210_02
Open SV_1210_05 and SV_1210_07
Temperature and pressure are rising inside the membrane
The pressure is controlled to maintain 1,7 Bar in the membrane by opening and closing SV_1210_09 and SV_1210_02 (Steam input)

<u>Sterilization phase</u>
Sterilization timer starts when TT_1200_02 >=122ºC and remains superior to 121ºC during Dt=30min (if interruption, need to start again the timer)

<u>Cooling phase</u>
SV_1210_09 and SV_1210_02 are closed
Wait 5 s
Open SV_1211_01 to flow N2 into SV_1210_07 and _05 until TT_1200_02<55ºC
The membrane is sterilized and ready to use

Close SV_1211_01, SV_1210_05, and SV_1210_07

For Membrane 2:
<u>Purging phase</u>
Open SV_1210_08 and SV_1210_01
Open SV_1210_04 and SV_1210_06
Temperature and pressure are rising inside the membrane.

The pressure is controlled to maintain 1,7 Bar in the membrane by opening and closing SV_1210_09 and SV_1210_02 (Steam input)

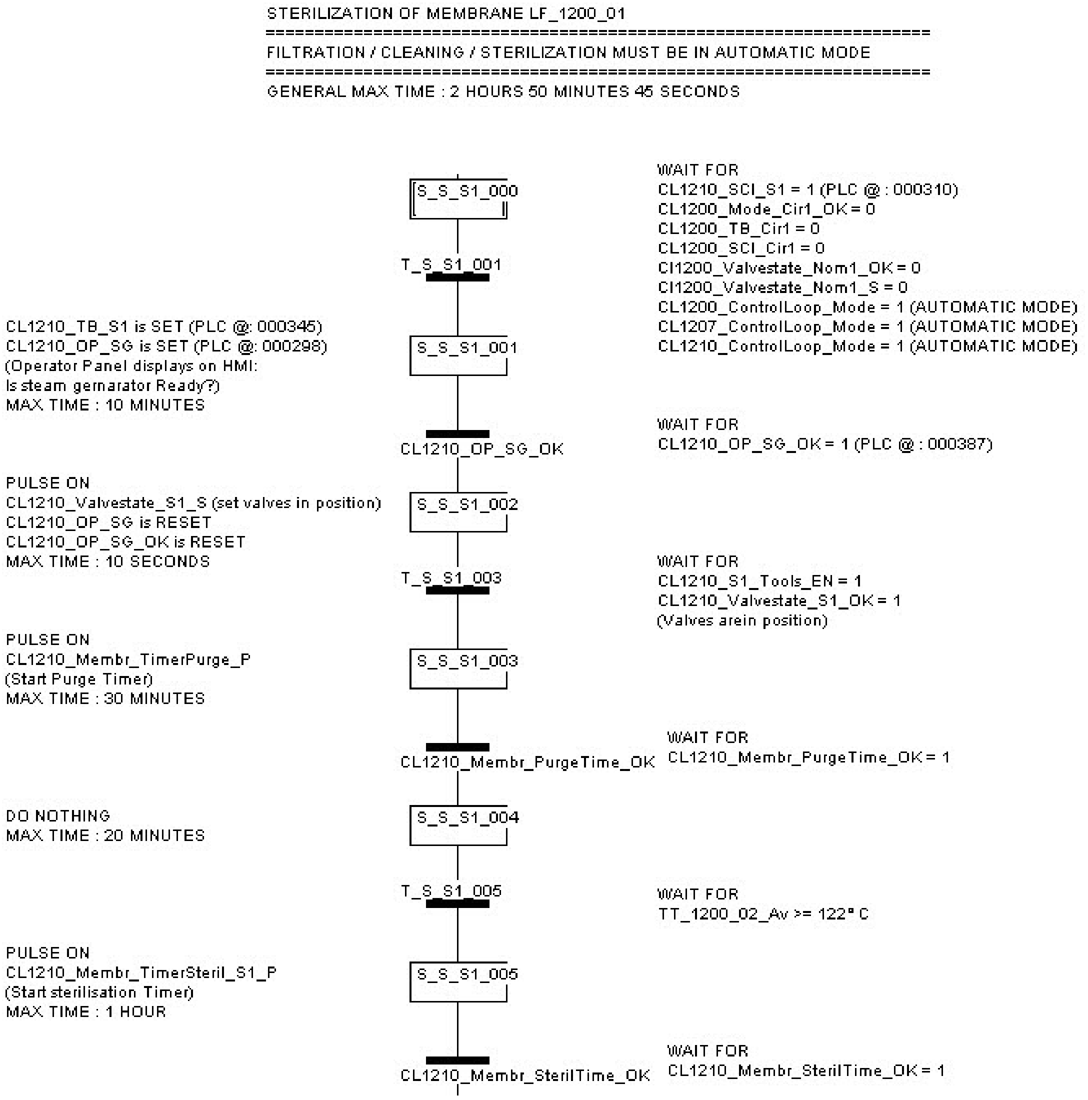
Sterilization phase
Sterilization timer starts when TT_1200_03 >=122ºC and remains superior to 121ºC during Dt=30min (if interruption, need to start again the timer)

Cooling phase
SV_1210_08 and SV_1210_01 are closed
Wait 5 s
Open x to flow N2 into SV_1210_04 and SV_1210_06 until TT_1200_02<55ºC
The membrane is sterilized and ready to use

Close SV_1211_02, SV_1210_04, and SV_1210_06

Used Variables:
CL1210_SCI_S1 (PLC Address: 000310)
CL1210_SCI_S2 (PLC Address: 000311)
CL1210_OP_SG (PLC Address: 000298)
CL1210_OP_SG_OK (PLC Address: 000387)
CL1210_TB_S1 (PLC Address: 000345)
CL1210_TB_S2 (PLC Address: 000346)
CL1210_Membr_PurgeTime (PLC Address: 400703)
CL1210_Membr_PurgeTime_CFG (PLC Address: 400707)
CL1210_Membr_SterilTime (PLC Address: 400711)
CL1210_Membr_SterilTime_CFG (PLC Address: 400715)
CL1210_Membr_CoolingTime (PLC Address: 400719)
CL1210_Membr_CoolingTime_CFG (PLC Address: 400723)

5.69.2.PLC Subroutine: S_S1



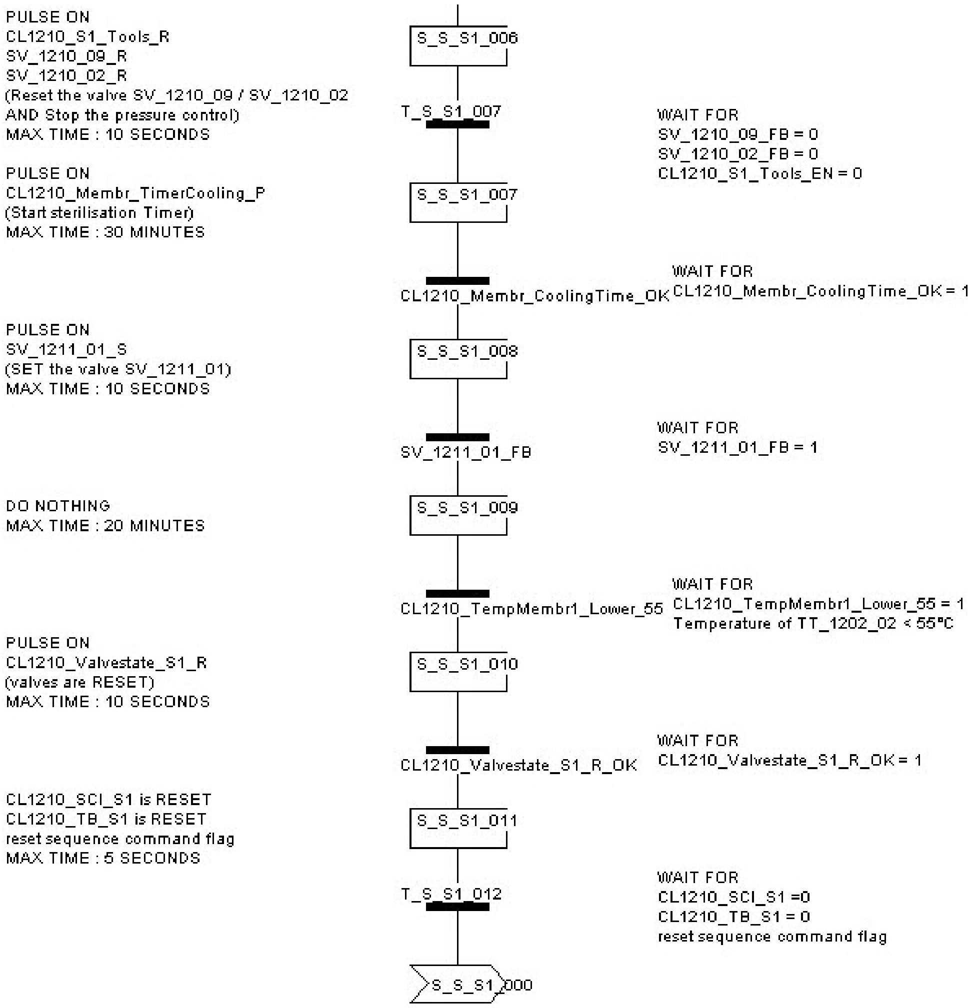
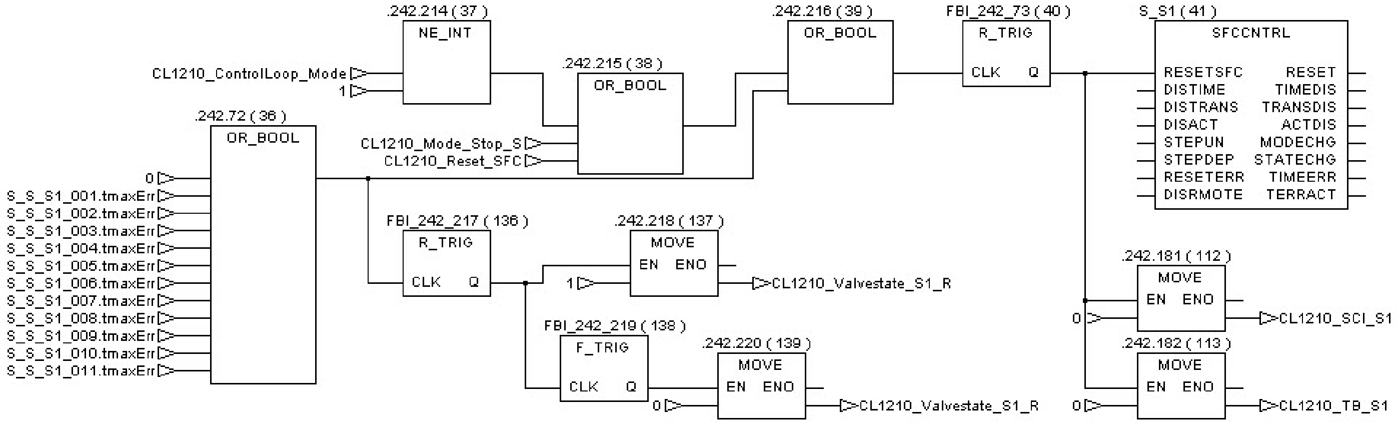


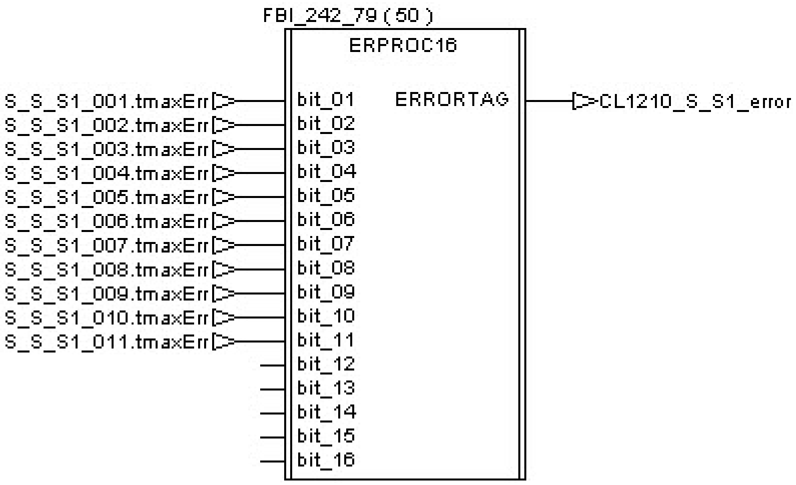
Figure 147: PLC procedure: S_S1

5.69.3.Procedure management

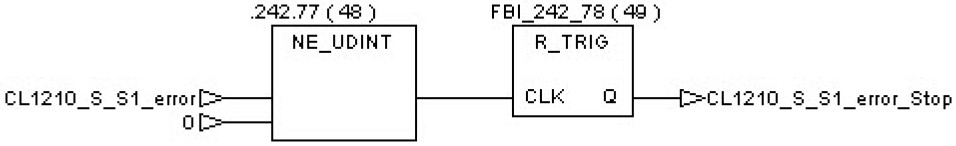
Reset of the procedure:
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



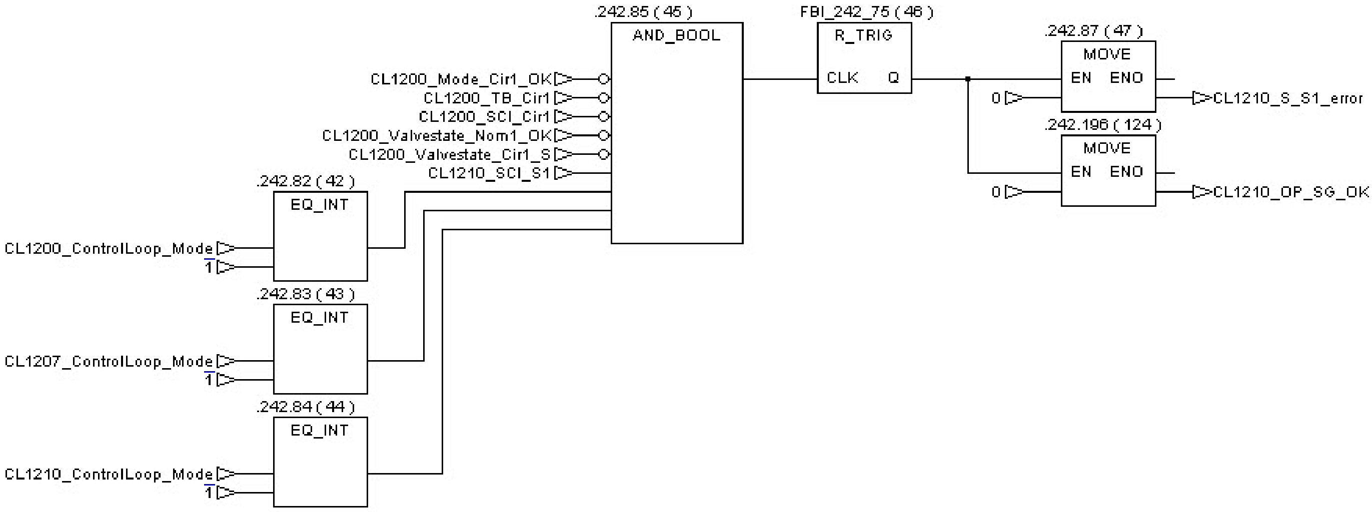
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1210_S_S1_error_Stop" receives a pulse and then the Sterilization Unit is stopped thanks to the procedure "S_Stop".



The error number is displayed until the procedure is re-started.



5.69.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_S_S1_001**	The operator didn't answer to the operator panel question ("Is Steam generator is ready?") The time (10 minutes) is elapsed
2	**S_S_S1_002**	valve(s) status Error operator has to look for valve alarm
4	**S_S_S1_003**	Problem with the purge timer The tag CL1210_Membr_PurgeTime_OK has not been set.
8	**S_S_S1_004**	the probe TT_1200_02 has not reached 122°C
16	**S_S_S1_005**	Problem with the sterilization timer The tag CL1210_Membr_SterilTime_OK has not been set. This error can be linked to the steam temperature
32	**S_S_S1_006**	valve(s) status Error operator has to look for valve alarm
64	**S_S_S1_007**	Problem with the cooling timer The tag CL1210_Membr_CoolingTime_OK has not been set.

128	**S_S_S1_008**	The valve SV_1211_01 is not opened
256	**S_S_S1_009**	The temperature of the probe TT_1202_02 is still greater than 55°C
512	**S_S_S1_010**	valve(s) status Error operator has to look for valve alarm
1024	**S_S_S1_011**	Tag reset problem (Tracing bit or Start button)

5.69.5.Controlled valves

CL1210_Valvestate_S1_S

Added Valves in **CL1210_Valvestate_S1_S (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_MV	000063	RESET (changed from SET to RESET)
	SV_1201_05_MV	000062	RESET (changed from SET to RESET)
	SV_1201_07_MV	000041	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_MV	000050	RESET (changed from SET to RESET)
CIP General			
	SV_1207_07_MV	000068	RESET
	SV_1207_09_MV	000071	RESET
	SV_1207_11_MV	000058	RESET
	SV_1207_13_MV	000109	RESET
SIP General			
	SV_1210_01_MV	000086	RESET
	SV_1210_02_MV	000085	PRESSURE CONTROL (PID)
	SV_1210_03_MV	000088	RESET
	SV_1210_04_MV	000030	RESET
	SV_1210_05_MV	000029	SET
	SV_1210_06_MV	000026	RESET
	SV_1210_07_MV	000025	SET
	SV_1210_08_MV	000028	RESET
	SV_1210_09_MV	000027	PRESSURE CONTROL (PID)
	SV_1210_11_MV	000111	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_MV	000105	RESET

CL1210_Valvestate_S1_R

Added Valves in **CL1210_Valvestate_S1_R (2009/03)**

	VALVES	ADDRESS	COMMENTS
SIP General			
	SV_1210_05_MV	000029	RESET
	SV_1210_07_MV	000025	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_MV	000105	RESET

5.69.6.Awaited Feedback

CL1210_Valvestate_S1_OK

Added Feedback in **CL1210_Valvestate_S1_OK (2009/03)**

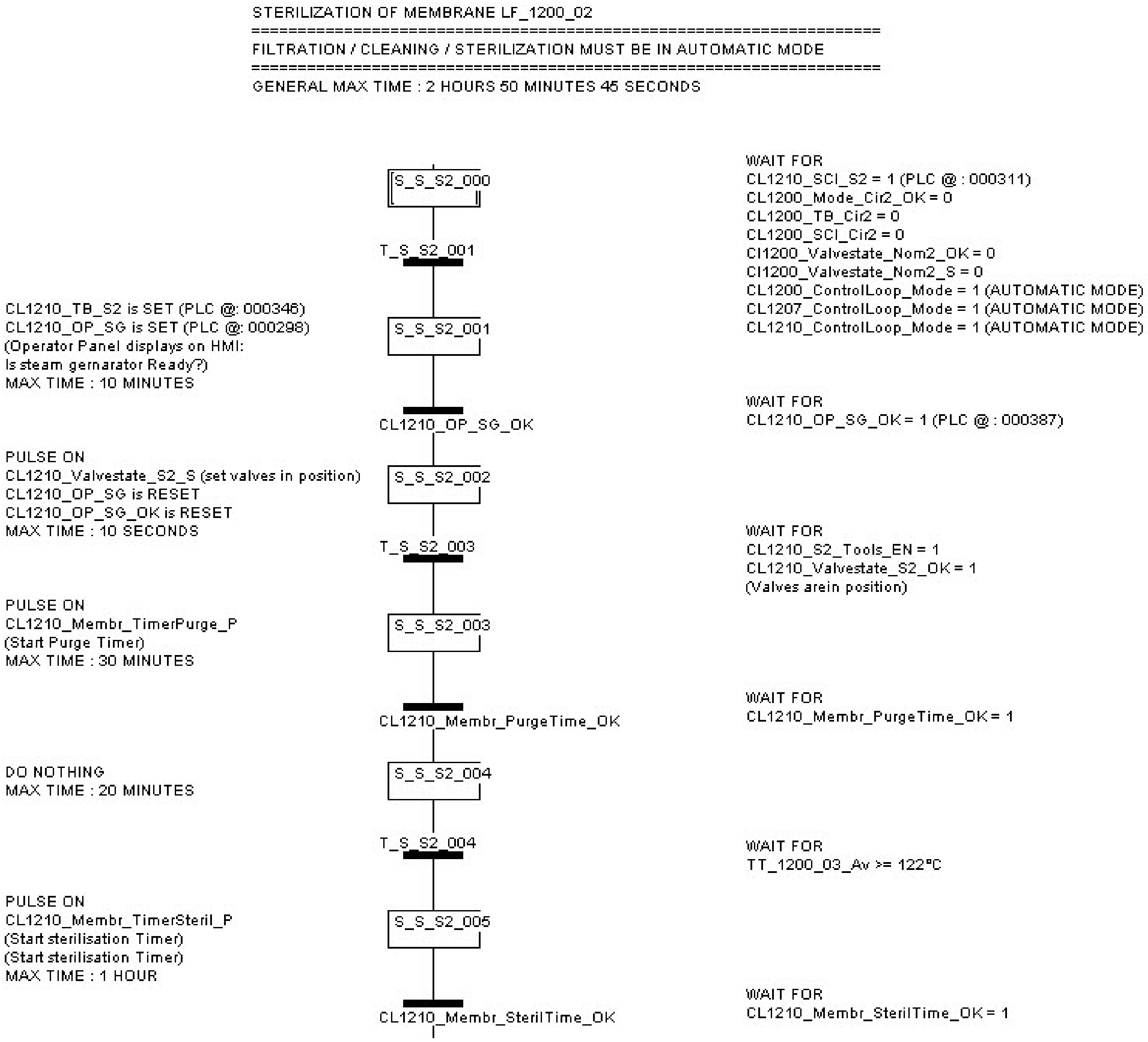
	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_FB	100086	RESET
	SV_1201_05_FB	100087	RESET
	SV_1201_07_FB	100076	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	RESET
CIP General			
	SV_1207_07_FB	100097	RESET
	SV_1207_09_FB	100094	RESET
	SV_1207_11_FB	100091	RESET
	SV_1207_13_FB	100139	RESET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_03_FB	100108	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_05_FB	100056	SET
	SV_1210_06_FB	100059	RESET
	SV_1210_07_FB	100060	SET
	SV_1210_08_FB	100057	RESET
	SV_1210_11_FB	100141	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET

CL1210_Valvestate_S1_R_OK

Added Feedback in **CL1210_Valvestate_S1_R_OK (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_FB	100086	RESET
	SV_1201_05_FB	100087	RESET
	SV_1201_07_FB	100076	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	RESET
CIP General			
	SV_1207_07_FB	100097	RESET
	SV_1207_09_FB	100094	RESET
	SV_1207_11_FB	100091	RESET
	SV_1207_13_FB	100139	RESET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_02_FB	100105	RESET
	SV_1210_03_FB	100108	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_05_FB	100056	RESET
	SV_1210_06_FB	100059	RESET
	SV_1210_07_FB	100060	RESET
	SV_1210_08_FB	100057	RESET
	SV_1210_09_FB	100058	RESET
	SV_1210_11_FB	100141	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET

5.69.7.PLC Subroutine: S_S2



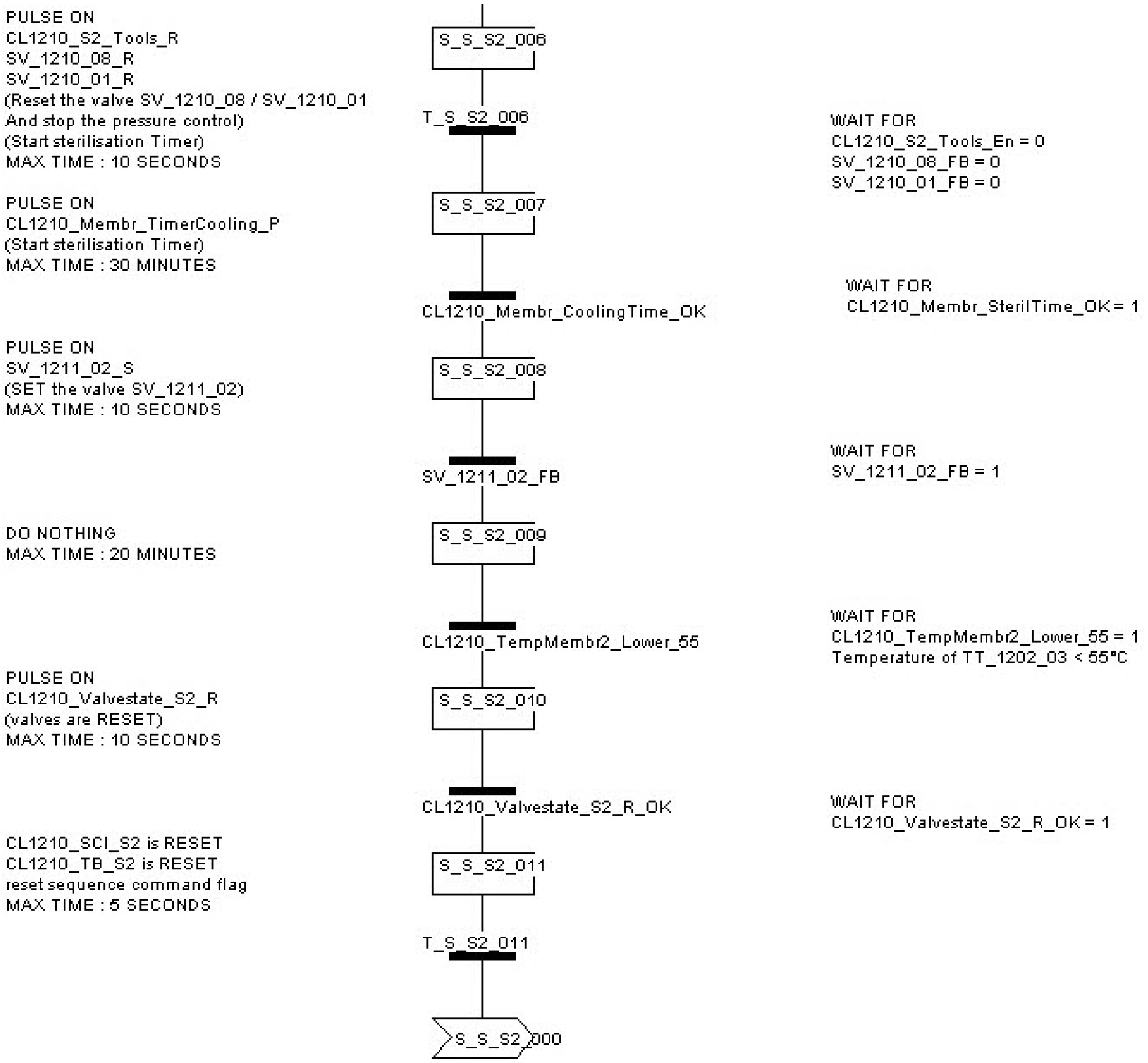
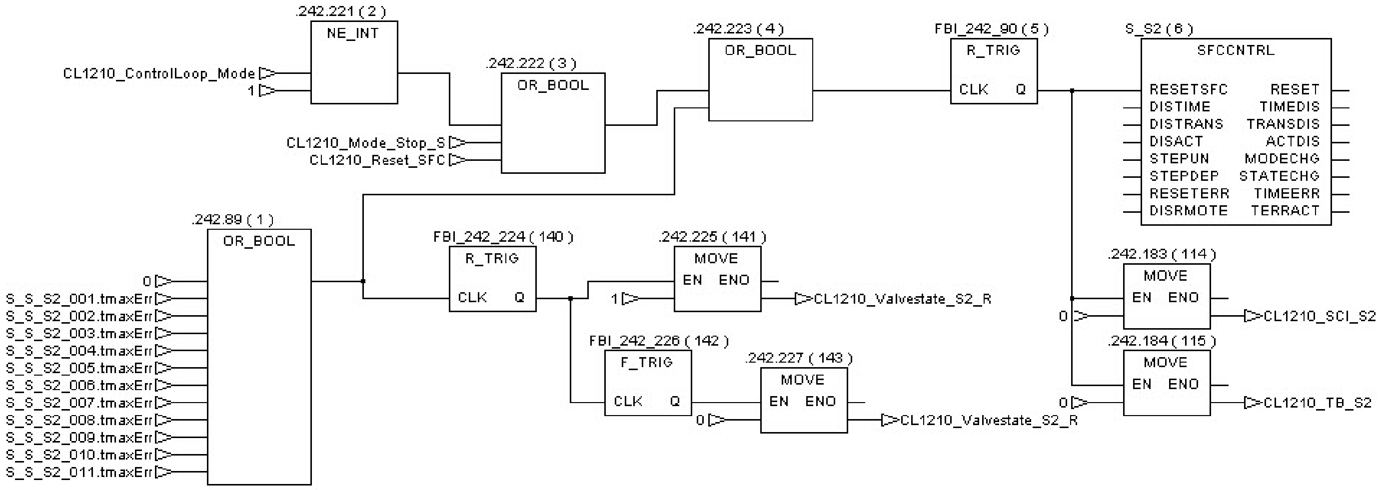


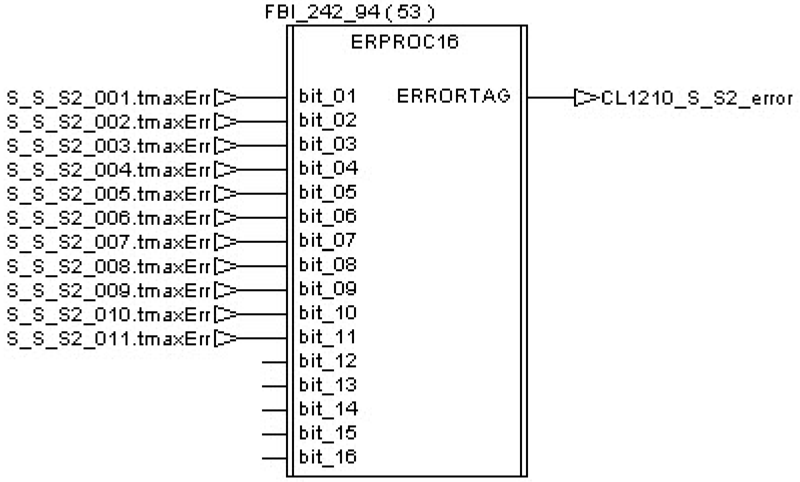
Figure 148: PLC procedure: S_S2

5.69.8.Procedure management

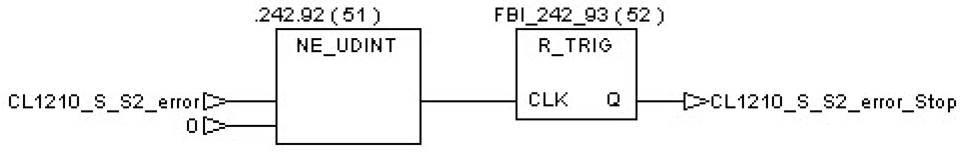
Reset of the procedure:
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



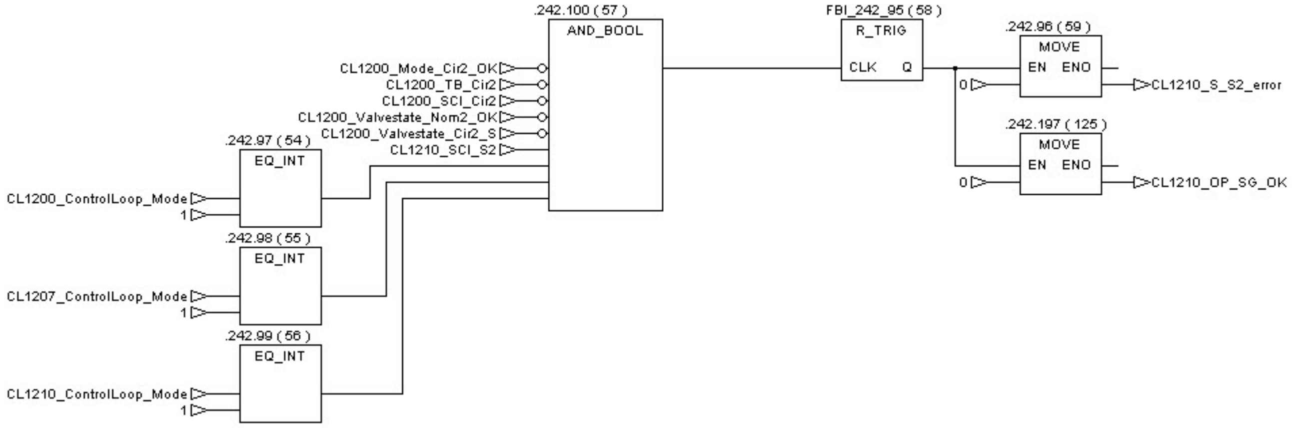
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1210_S_S2_error_Stop" receives a pulse and then the Sterilization Unit is stopped thanks to the procedure "S_Stop".



The error number is displayed until the procedure is re-started.



5.69.9.Error number description

Error number	Procedure Action Step	problem description
1	S_S_S2_001	The operator didn't answer to the operator panel question ("Is Steam generator is ready?") The time (10 minutes) is elapsed
2	S_S_S2_002	valve(s) status Error operator has to look for valve alarm
4	S_S_S2_003	Problem with the purge timer The tag CL1210_Membr_PurgeTime_OK has not been set.
8	S_S_S2_004	the probe TT_1200_03 has not reached 122°C
16	S_S_S2_005	Problem with the sterilization timer The tag CL1210_Membr_SterilTime_OK has not been set. This error can be linked to the steam temperature
32	S_S_S2_006	valve(s) status Error operator has to look for valve alarm

64	**S_S_S2_007**	Problem with the cooling timer The tag CL1210_Membr_CoolingTime_OK has not been set.
128	**S_S_S2_008**	The valve SV_1211_02 is not opened
256	**S_S_S2_009**	The temperature of the probe TT_1202_03 is still greater than 55°C
512	**S_S_S2_010**	valve(s) status Error operator has to look for valve alarm
1024	**S_S_S2_011**	Tag reset problem (Tracing bit or Start button)

5.69.10.Controlled Valves

CL1210_Valvestate_S2_S

Added Valves in **CL1210_Valvestate_S2_S (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_04_MV	000098	RESET
	SV_1201_06_MV	000097	RESET
	SV_1201_08_MV	000056	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_02_MV	000099	RESET
CIP General			
	SV_1207_06_MV	000067	RESET
	SV_1207_08_MV	000072	RESET
	SV_1207_10_MV	000057	RESET
	SV_1207_12_MV	000110	RESET
SIP General			
	SV_1210_02_MV	000085	RESET
	SV_1210_03_MV	000088	RESET
	SV_1210_04_MV	000030	SET
	SV_1210_05_MV	000029	RESET
	SV_1210_06_MV	000026	SET
	SV_1210_07_MV	000025	RESET
	SV_1210_09_MV	000027	RESET
	SV_1210_11_MV	000111	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_MV	000106	RESET

CL1210_Valvestate_S2_R

Added Valves in **CL1210_Valvestate_S2_R (2009/03)**

	VALVES	ADDRESS	COMMENTS
SIP General			
	SV_1210_04_MV	000030	RESET
	SV_1210_06_MV	000026	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_MV	000106	RESET

5.69.11.Awaited Feed Back

CL1210_Valvestate_S2_OK

Added Feedback in **CL1210_Valvestate_S2_OK (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_04_FB	100130	RESET
	SV_1201_06_FB	100129	RESET
	SV_1201_08_FB	100077	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_02_FB	100131	RESET
CIP General			
	SV_1207_06_FB	100098	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_12_FB	100140	RESET
SIP General			
	SV_1210_02_FB	100105	RESET
	SV_1210_03_FB	100108	RESET
	SV_1210_04_FB	100054	SET
	SV_1210_05_FB	100056	RESET
	SV_1210_06_FB	100059	SET
	SV_1210_07_FB	100060	RESET
	SV_1210_09_FB	100058	RESET
	SV_1210_11_FB	100141	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_FB	100136	RESET

CL1210_Valvestate_S2_R_OK

Added Feedback in **CL1210_Valvestate_S2_R_OK (2009/03)**

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_04_FB	100130	RESET
	SV_1201_06_FB	100129	RESET
	SV_1201_08_FB	100077	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_02_FB	100131	RESET
CIP General			
	SV_1207_06_FB	100098	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_12_FB	100140	RESET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_02_FB	100105	RESET
	SV_1210_03_FB	100108	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_05_FB	100056	RESET
	SV_1210_06_FB	100059	RESET
	SV_1210_07_FB	100060	RESET
	SV_1210_08_FB	100057	RESET
	SV_1210_09_FB	100058	RESET
	SV_1210_11_FB	100141	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_FB	100136	RESET

5.70. Procedure 69: SIP: membrane LF_1200_01 / LF_1200_02, filtrate line and Filtrate tank VSL2_1204_01

5.70.1. Scope

This Procedure can only be activated when the FU, the CIP and the SIP control Loop mode button are in Automatic mode.

Before starting filtration over a membrane and after cleaning, it is useful to sterilize the entire filtrate line in order to avoid contamination of eventual reproducing species that may have past the membrane in very small amounts during the previous batch. The retentate side of the membrane is also put under steam pressure because pressure and temperature differences between both sides of the membrane increase the chance for it to break.

Prerequisite

The CIP procedures for both membrane sides and effluent vessel must precede this procedure. The entire filtrate line, including effluent vessel and the membrane inside filter must contain only water and gas.

The filter LF_1200_03 has also to be sterilized and must be present in the module.

Tube must be installed on filtration pump PP_1202_01. This is a good time to replace the tube by a new one.

PP_1202_01 tubing is unclenched from the peristaltic wheel

HV_1204_02 connected to a pipe to protect from steam jet

Cooling agent must be removed from the double jacket on the effluent vessel VSL2_1204_01. Use the red handle valves and a recipient. Leave open the valves that close this jacket to release any steam from remaining agent during SIP

Protocol

Fill the steam generator SG_1210_01 with 8 l tap water.

Switch the main switch and the two green switches on SG_1210_01 to 1.

Use the HMI to start the procedure (S-All1 /S-All2 in the PLC):

CL1210_SCI_All1 (PLC @ = 000299)

CL1210_SCI_All2 (PLC @ = 000302)

Wait until pressure in SG_1210_01 is 4 barg. This can be checked on pressure indicator. Make sure the valve on top of SG_1210_01 (that connects to the FU) is entirely open.

Let the PLC know that:

_SG_1210_01 is ready

_SV_1204_02 outlet is protected and opened

_Pump PP_1202_01 tubing is unclenched

_HV_1210_is opened

by Displaying an Operator Panel on the HMI:

CL1210_OP_All_Begin (PLC @ : 000301) is SET by PLC then HMI opens an operator panel with an acknowledge button, **CL1210_OP_All_Begin_OK** (000300). Once the operator push the HMI button the PLC starts the following actions.

Purging phase

Open SV_1210_09 and SV_1210_02
Open Sv_1210_05 and SV_1210_07
Open SV_1202_01 and SV_1202_04
Let the PLC knows that HV_1204_02 outlet is protected / collected and valve opened:
CL1210_OP_Open_Drain (PLC @: 000389) is SET by PLC then HMI displays an operator panel with an acknowledge button, **CL1210_OP_Open_Drain_OK** (PLC @: 000390)
Upon acknowledgment by operator, the PLC opens SV_1210_03, SV_1204_03 and SV_1204_01 then Wait 10 sec.
Open SV_1210_14, SV_1210_12 and SV_1203_04
CL1210_OP_Close_Drain (PLC @: 000358) is SET by PLC then HMI displays an operator panel with an acknowledge button, **CL1210_OP_Close_Drain_OK** (PLC @: 000359) asking operator to close HV_1204_02.
Once the acknowledge button is SET, the PLC proceeds to the following actions:

Sterilization phase

Sterilization timer starts when (TT_1200_02 >=122ºC and TT_1205_01 >=122ºC) and these temperatures have to remain superior to 121ºC during Dt = 30min (if interruption, need to start again the timer)

Cooling phase

SV_1210_09 closed, SV_1210_03 closed, SV_1210_12 closed
Wait 5 s
Open SV_1211_01 and SV_1203_03 to flow N2 into SV_1210_07 and SV_1210_05 and SV_1210_14 until TT_1200_02 and TT_1205_01 are lower than 55ºC
The membrane is sterilized and ready to use.

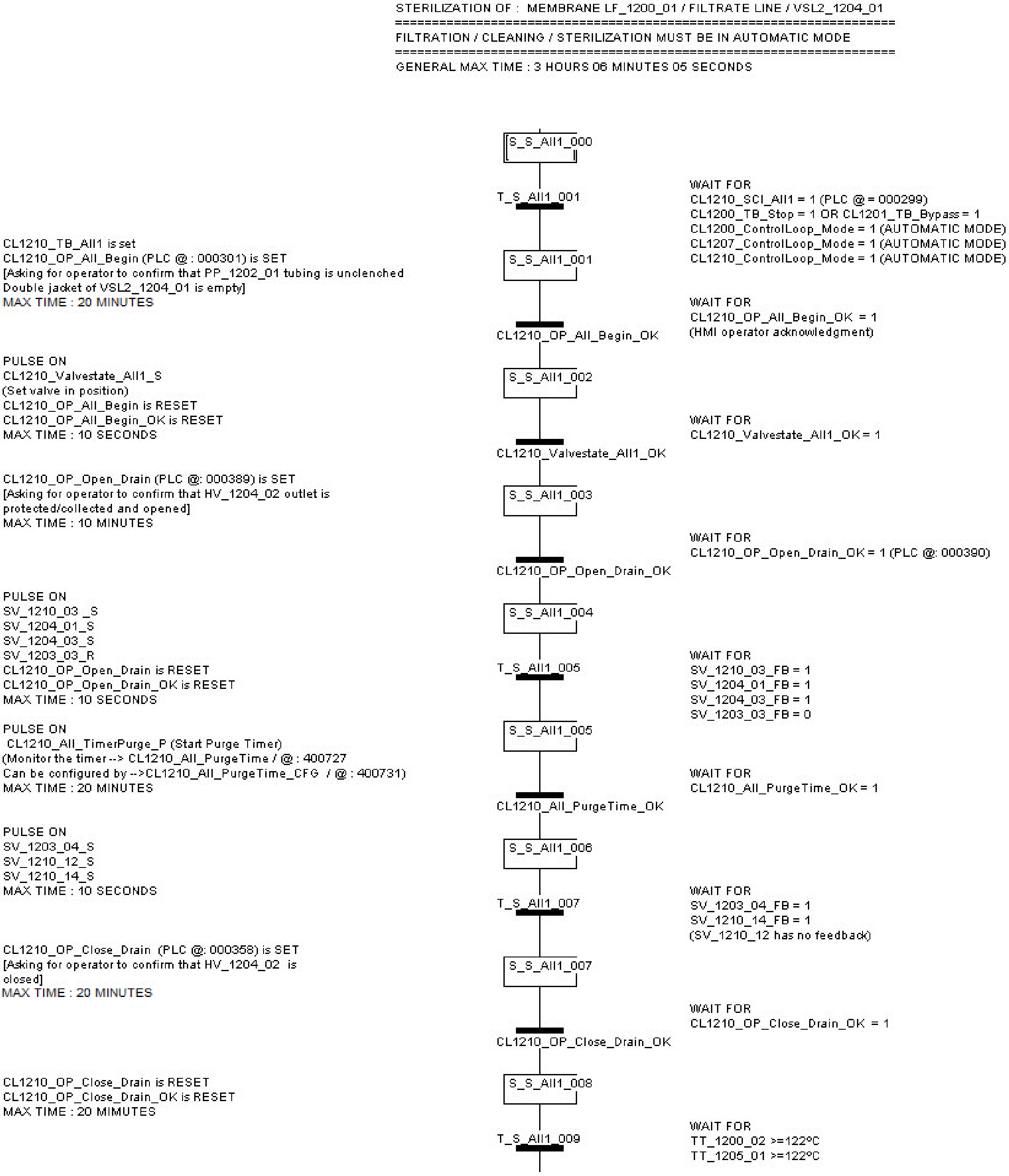
Used Variables:

For the sub procedure **S_All1 / S_All2**
CL1210_SCI_All1 (PLC @ = 000299)
CL1210_TB_All1 (PLC @ = 000347)
CL1210_SCI_All2 (PLC @ = 000302)
CL1210_TB_All2 (PLC @ = 000348)
CL1210_OP_All_Begin (PLC @ = 000301)
CL1210_OP_All_Begin_OK (PLC @ = 000300)
CL1210_OP_Open_Drain (PLC @ = 000389)
CL1210_OP_Open_Drain_OK (PLC @ = 000390)
CL1210_OP_All_Ending (PLC @ = 000349)
CL1210_OP_All_Ending_OK (PLC @ = 000350)
CL1210_All_PurgeTime (PLC @ = 400727)
CL1210_All_PurgeTime_CFG (PLC @ = 400731)
CL1210_All_SterilTime (PLC @ = 400735)

CL1210_All_SterilTime_CFG (PLC @ = 400739)
CL1210_All_CoolingTime (PLC @ = 400743)
CL1210_All_CoolingTime_CFG (PLC @ = 400747)

For the Protocol **S_P_All1 / S_P_All2**
CL1210_SCI_P_All1 (PLC @ = 000306)
CL1210_TB_P_All1 (PLC @ = 000385)
CL1210_SCI_P_All2 (PLC @ = 000307)
CL1210_TB_P_All2 (PLC @ = 000386)

5.70.2.PLC Subroutine: S_All1



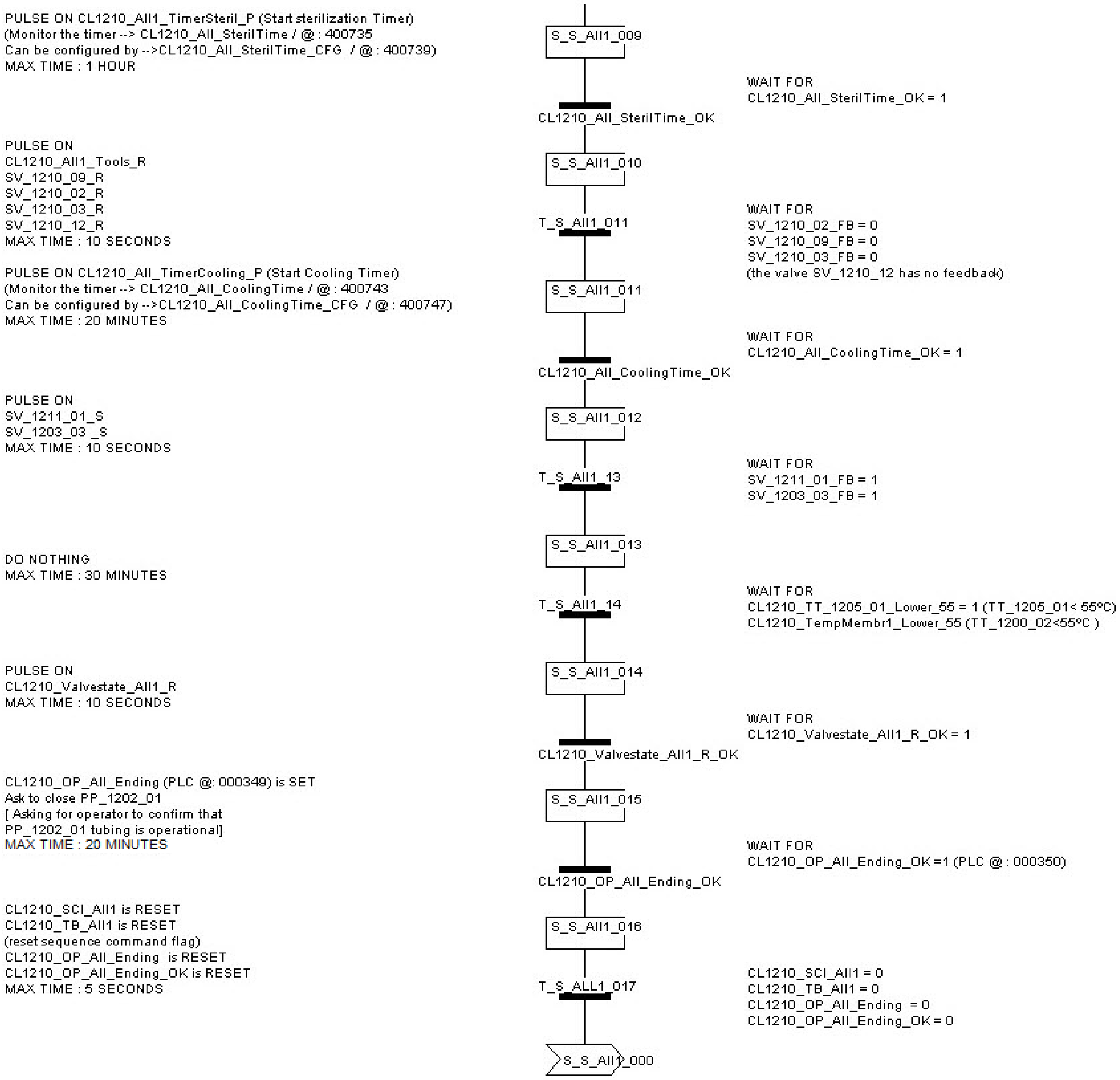


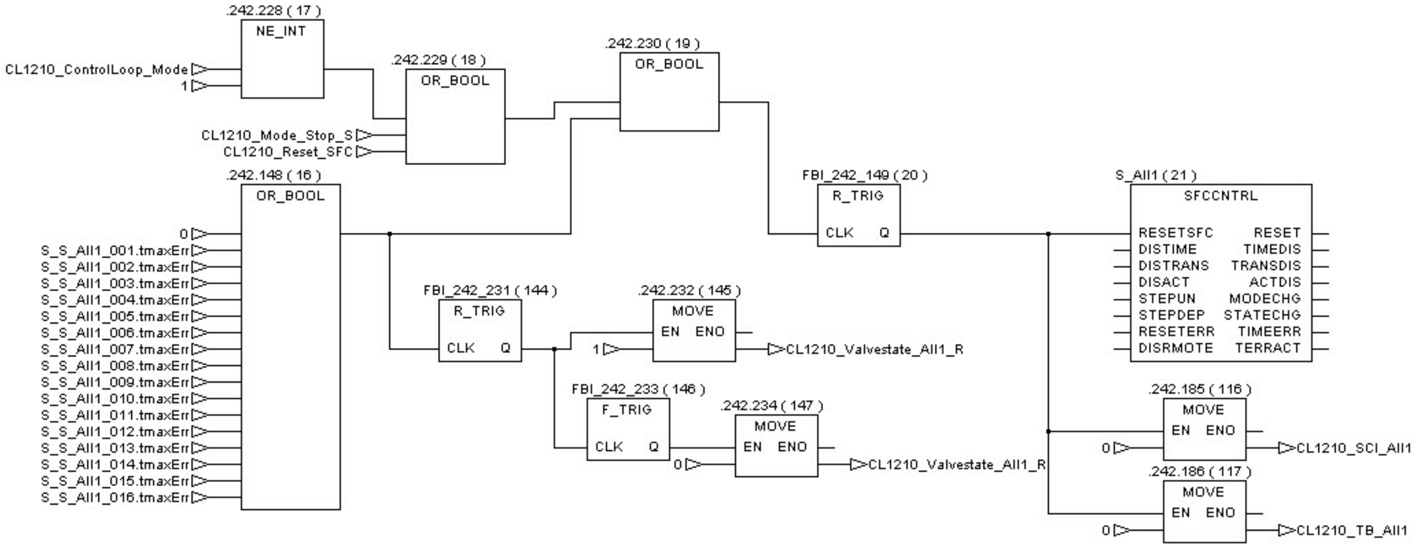
Figure 149: PLC procedure: S_All1

5.70.3.Procedure management

<u>Reset of the procedure:</u>

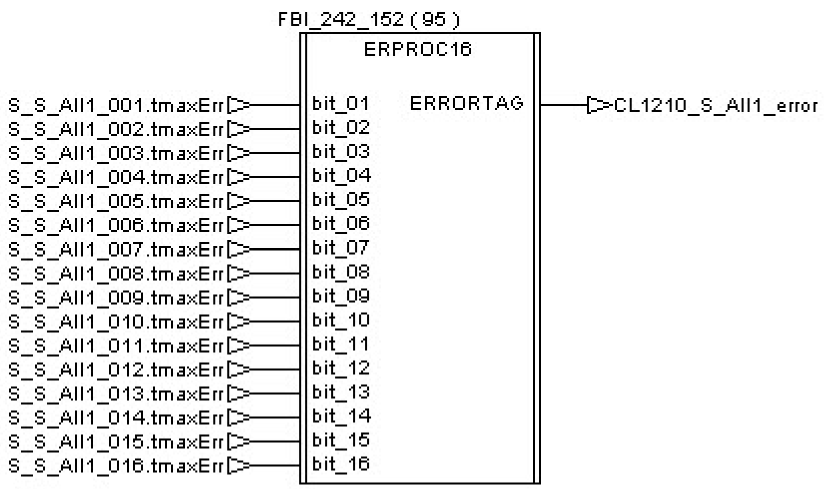
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.

The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.

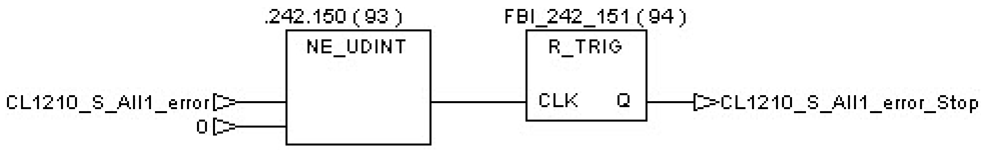


<u>Procedure error management:</u>

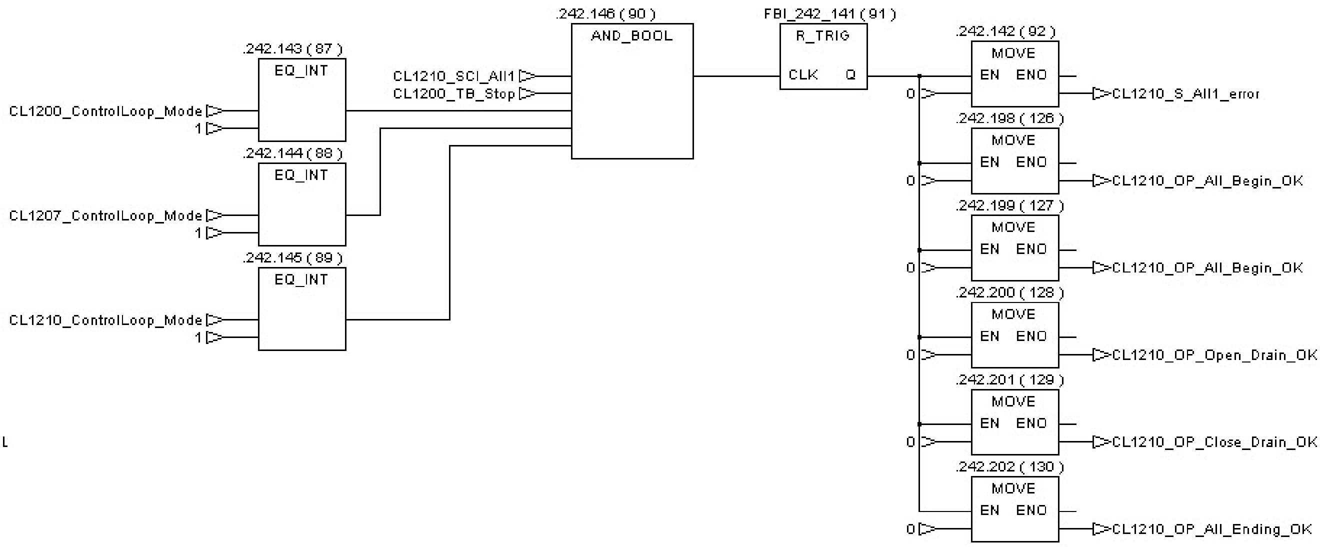
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag “CL1210_S_ALL1_error_Stop” receives a pulse and then the Sterilization Unit is stopped thanks to the procedure “S_Stop”.



The error number is displayed until the procedure is re-started.



5.70.4.Error number description

Error number	Procedure Action Step	problem description
1	S_S_All1_001	The operator didn't confirm that: PP_1202_01 tubing is unclenched Double jacket of VSL2_1204_01 is empty The time (10 minutes) is elapsed
2	S_S_All1_002	valve(s) status Error operator has to look for valve alarm
4	S_S_All1_003	The operator didn't confirm that: HV_1204_02 is protected and opened The time (10 minutes) is elapsed
8	S_S_All1_004	valve(s) status Error operator has to look for valve alarm

Error number	Procedure Action Step	problem description
16	**S_S_All1_005**	Problem with the purge timer The tag CL1210_All_PurgeTime_OK has not been set.
32	**S_S_All1_006**	valve(s) status Error operator has to look for valve alarm
64	**S_S_All1_007**	The operator didn't confirm that: HV_1204_02 is closed The time (10 minutes) is elapsed
128	**S_S_All1_008**	the probes TT_1200_02 and TT_1205_01 has not reached 122°C
256	**S_S_All1_009**	Problem with the sterilization timer The tag CL1210_All_SterilTime_OK has not been set. This error can be linked to the steam temperature
512	**S_S_All1_010**	valve(s) status Error operator has to look for valve alarm
1024	**S_S_All1_011**	Problem with the cooling timer The tag CL1210_All_CoolingTime_OK has not been set.
2048	**S_S_All1_012**	valve(s) status Error operator has to look for valve alarm
4096	**S_S_All1_013**	the probes TT_1200_02 and TT_1205_01 are still greater than 55°C
8192	**S_S_All1_014**	valve(s) status Error operator has to look for valve alarm
16384	**S_S_All1_015**	The operator didn't confirm that: PP_1202_01 tubing is operational The time (10 minutes) is elapsed
32768	**S_S_All1_016**	Tag reset problem (Tracing bit or Start button)

5.70.5.Controlled valves

CL1210_Valvestate_All1_S

Added Valves in **CL1210_Valvestate_All1_S** (2009/03)

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_MV	000063	RESET
	SV_1201_05_MV	000062	RESET
	SV_1201_07_MV	000041	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_MV	000050	SET
	SV_1202_02_MV	000099	RESET
	SV_1202_03_MV	000051	RESET
	SV_1202_04_MV	000100	SET
CIP General			
	SV_1207_07_MV	000068	RESET
	SV_1207_09_MV	000071	RESET
	SV_1207_11_MV	000058	RESET
	SV_1207_13_MV	000109	SET
SIP General			
	SV_1210_01_MV	000086	RESET
	SV_1210_02_MV	000085	RESET
	SV_1210_03_MV	000088	RESET
	SV_1210_04_MV	000030	RESET
	SV_1210_05_MV	000029	SET
	SV_1210_06_MV	000026	RESET
	SV_1210_07_MV	000025	SET
	SV_1210_08_MV	000028	RESET
	SV_1210_09_MV	000027	SET
	SV_1210_11_MV	000111	RESET
	SV_1210_13_MV	000112	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_MV	000105	RESET

CL1210_Valvestate_All1_R

Added Valves in **CL1210_Valvestate_All1_R**(2009/03)

	VALVES	ADDRESS	COMMENTS
Filtration Unit Filtrate Flow Control			
	SV_1202_01_MV	000050	RESET
	SV_1202_04_MV	000100	RESET
Filtration Unit Pressure control			
	SV_1203_03_MV	000038	SET
	SV_1203_04_MV	000107	RESET
Effluent Tank General			
	SV_1204_01_MV	000052	SET
	SV_1204_03_MV	000101	RESET
CIP General			
	SV_1207_13_MV	000109	RESET
SIP General			
	SV_1210_05_MV	000029	RESET
	SV_1210_07_MV	000025	RESET
	SV_1210_14_MV	000113	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_MV	000105	RESET

5.70.6.Awaited Feedback

CL1210_Valvestate_All1_OK

Added Feedback in **CL1210_Valvestate_All1_OK** (2009/03)

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_FB	100086	RESET
	SV_1201_05_FB	100087	RESET
	SV_1201_07_FB	100076	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	SET
	SV_1202_02_FB	100131	RESET
	SV_1202_03_FB	100082	RESET
	SV_1202_04_FB	100132	SET
CIP General			
	SV_1207_07_FB	100097	RESET
	SV_1207_09_FB	100094	RESET
	SV_1207_11_FB	100091	RESET
	SV_1207_13_FB	100139	SET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_02_FB	100105	RESET
	SV_1210_03_FB	100108	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_05_FB	100056	SET
	SV_1210_06_FB	100059	RESET
	SV_1210_07_FB	100060	SET
	SV_1210_08_FB	100057	RESET
	SV_1210_09_FB	100058	SET
	SV_1210_11_FB	100141	RESET
	SV_1210_13_FB	100142	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET

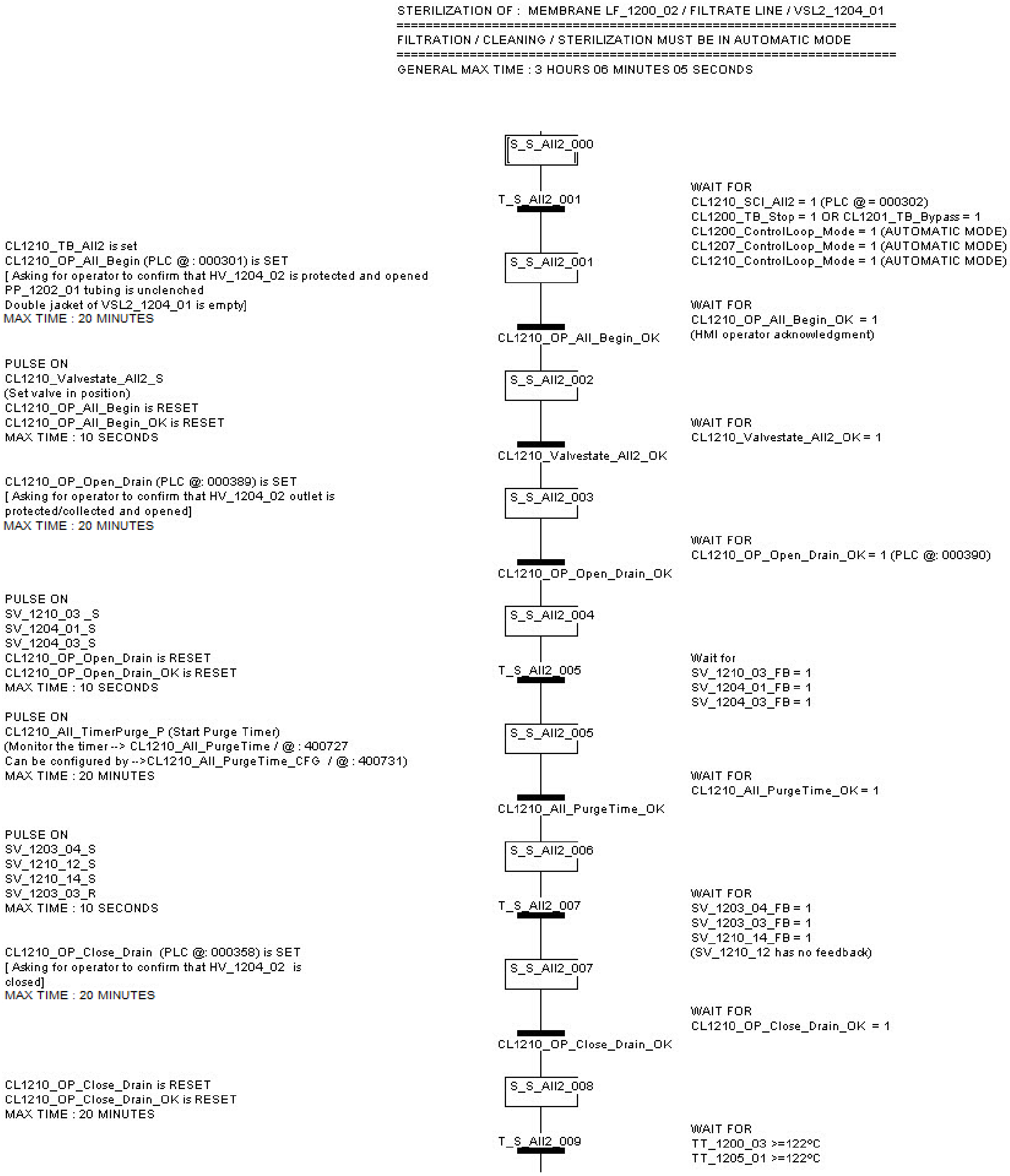
CL1210_Valvestate_All1_R_OK

Added Feedback in **CL1210_Valvestate_All1_R_OK** (2009/03)

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_03_FB	100086	RESET
	SV_1201_05_FB	100087	RESET
	SV_1201_07_FB	100076	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	RESET
	SV_1202_02_FB	100131	RESET
	SV_1202_03_FB	100082	RESET
	SV_1202_04_FB	100132	RESET
Filtration Unit Pressure control			
	SV_1203_03_FB	100063	RESET
	SV_1203_04_FB	100137	RESET
Effluent Tank General			
	SV_1204_01_FB	100081	RESET
	SV_1204_03_FB	100133	RESET
CIP General			
	SV_1207_07_FB	100097	RESET
	SV_1207_09_FB	100094	RESET
	SV_1207_11_FB	100091	RESET
	SV_1207_13_FB	100139	RESET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_02_FB	100105	RESET
	SV_1210_03_FB	100108	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_05_FB	100056	RESET
	SV_1210_06_FB	100059	RESET
	SV_1210_07_FB	100060	RESET
	SV_1210_08_FB	100057	RESET
	SV_1210_09_FB	100058	RESET
	SV_1210_11_FB	100141	RESET
	SV_1210_13_FB	100142	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_FB	100135	RESET

Description: The current procedure is used in the main SIP protocol.

5.70.7.PLC Subroutine: S_All2



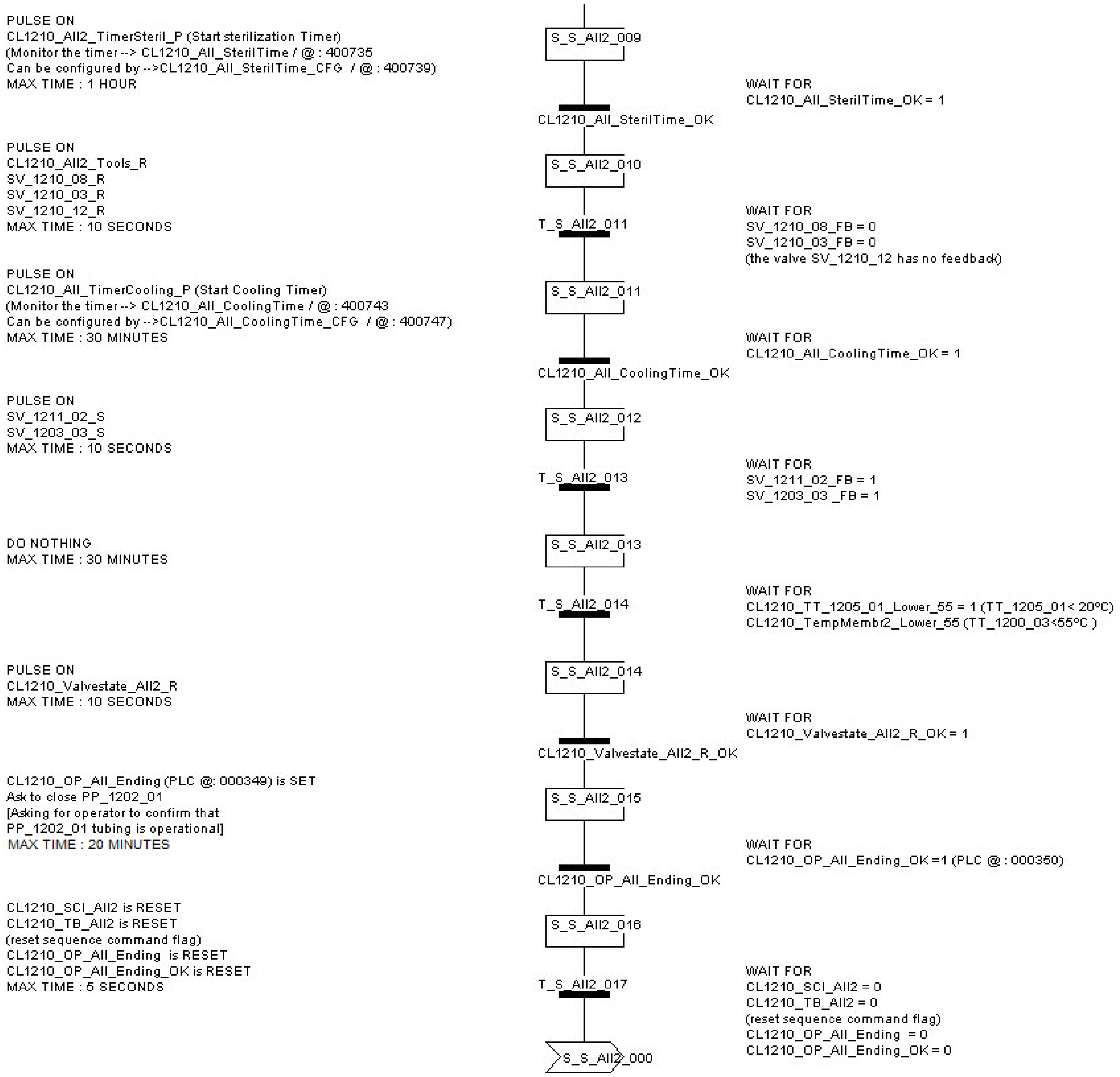
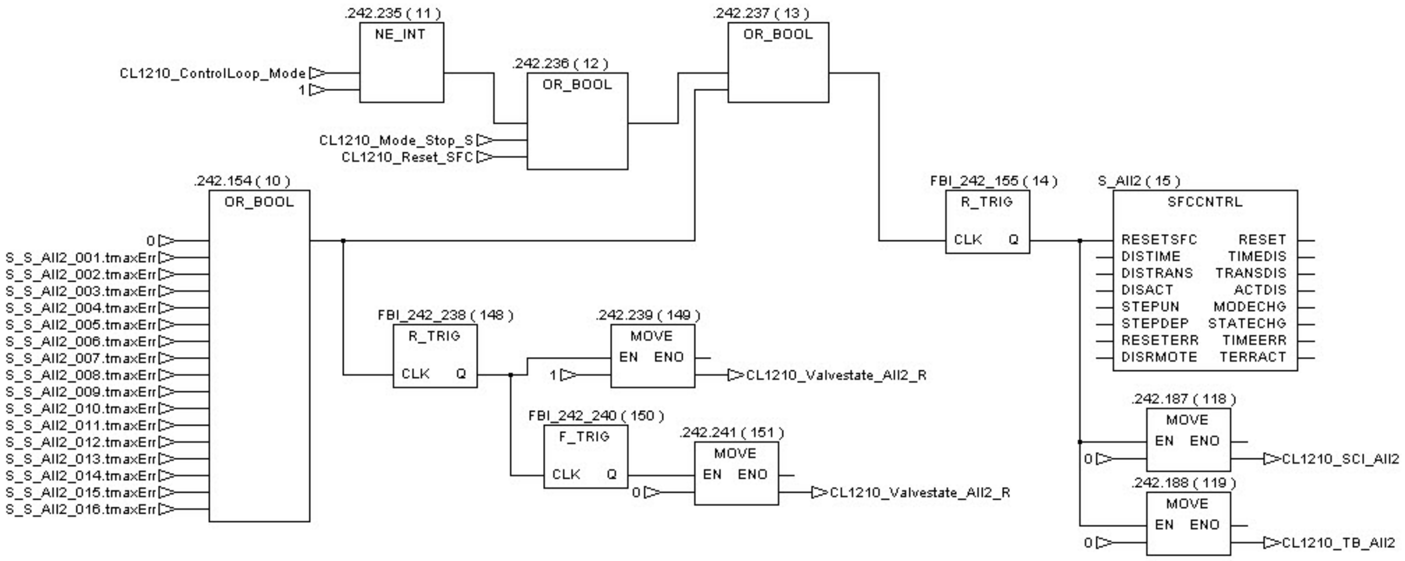


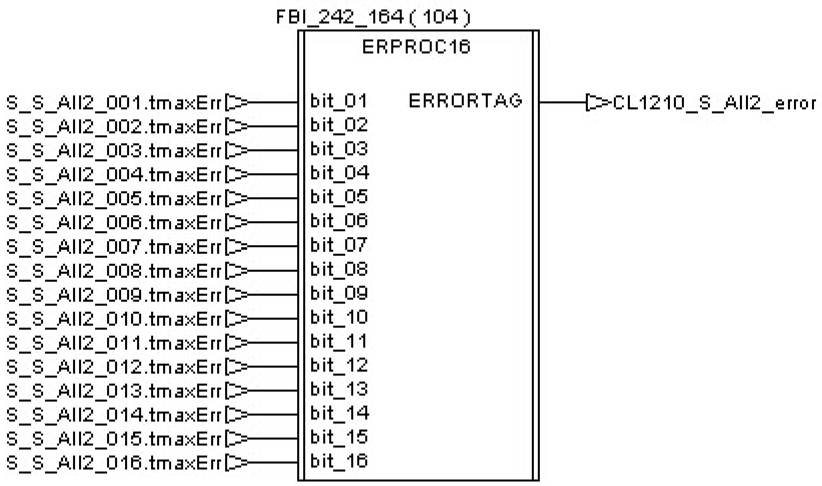
Figure 150: PLC procedure: S_All2

5.70.8.Procedure management

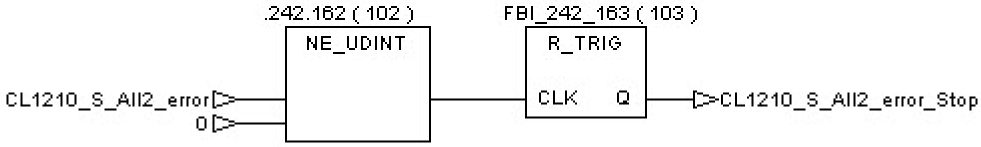
<u>Reset of the procedure:</u>
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



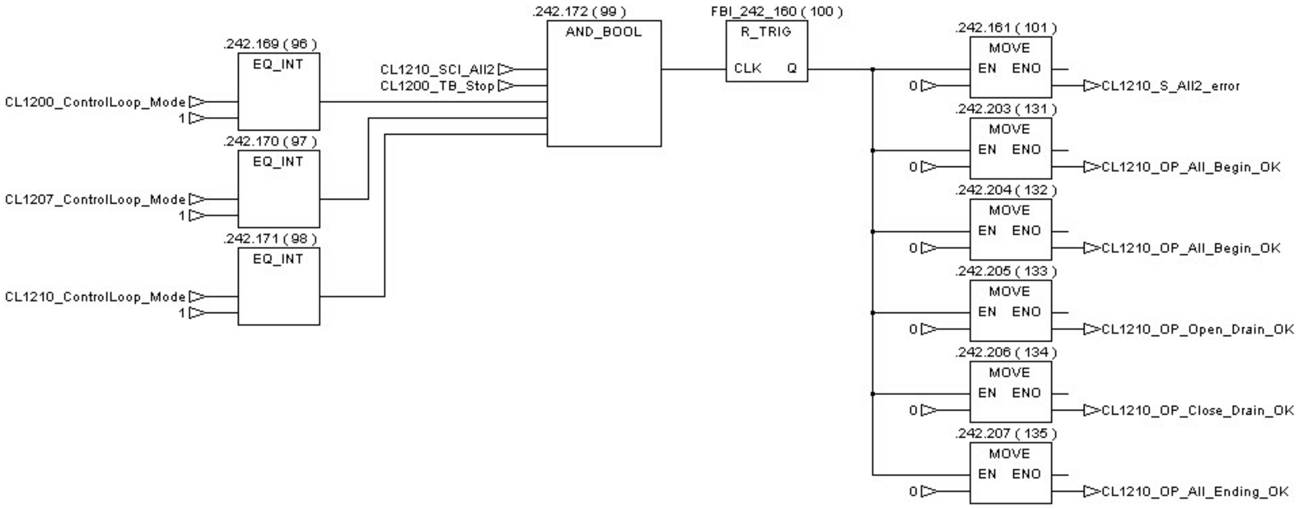
<u>Procedure error management:</u>
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1210_S_ALL2_error_Stop" receives a pulse and then the Sterilization Unit is stopped thanks to the procedure "S_Stop".



The error number is displayed until the procedure is re-started.



5.70.9.Error number description

Error number	Procedure Action Step	problem description
1	**S_S_All1_001**	The operator didn't confirm that: PP_1202_01 tubing is unclenched Double jacket of VSL2_1204_01 is empty The time (10 minutes) is elapsed
2	**S_S_All1_002**	valve(s) status Error operator has to look for valve alarm
4	**S_S_All1_003**	The operator didn't confirm that: HV_1204_02 is protected and opened The time (10 minutes) is elapsed
8	**S_S_All1_004**	valve(s) status Error operator has to look for valve alarm
16	**S_S_All1_005**	Problem with the purge timer The tag CL1210_All_PurgeTime_OK has not been

Error number	Procedure Action Step	problem description
		set.
32	**S_S_All1_006**	valve(s) status Error operator has to look for valve alarm
64	**S_S_All1_007**	The operator didn't confirm that: HV_1204_02 is closed The time (10 minutes) is elapsed
128	**S_S_All1_008**	the probes TT_1200_03 and TT_1205_01 has not reached 122°C
256	**S_S_All1_009**	Problem with the sterilization timer The tag CL1210_All_SterilTime_OK has not been set. This error can be linked to the steam temperature
512	**S_S_All1_010**	valve(s) status Error operator has to look for valve alarm
1024	**S_S_All1_011**	Problem with the cooling timer The tag CL1210_All_CoolingTime_OK has not been set.
2048	**S_S_All1_012**	valve(s) status Error operator has to look for valve alarm
4096	**S_S_All1_013**	the probes TT_1200_03 and TT_1205_01 are still greater than 55°C
8192	**S_S_All1_014**	valve(s) status Error operator has to look for valve alarm
16384	**S_S_All1_015**	The operator didn't confirm that: PP_1202_01 tubing is operational The time (10 minutes) is elapsed
32768	**S_S_All1_016**	Tag reset problem (Tracing bit or Start button)

5.70.10.Controlled Valves

CL1210_Valvestate_All2_S

Added Valves in **CL1210_Valvestate_All2_S** (2009/03)

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_04_MV	000098	RESET
	SV_1201_06_MV	000097	RESET
	SV_1201_08_MV	000056	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_MV	000050	RESET
	SV_1202_02_MV	000099	SET
	SV_1202_03_MV	000051	RESET
	SV_1202_04_MV	000100	SET
CIP General			
	SV_1207_06_MV	000067	RESET
	SV_1207_08_MV	000072	RESET
	SV_1207_10_MV	000057	RESET
	SV_1207_12_MV	000110	SET
SIP General			
	SV_1210_01_MV	000086	RESET
	SV_1210_02_MV	000085	RESET
	SV_1210_03_MV	000088	RESET
	SV_1210_04_MV	000030	SET
	SV_1210_05_MV	000029	RESET
	SV_1210_06_MV	000026	SET
	SV_1210_07_MV	000025	RESET
	SV_1210_08_MV	000028	SET
	SV_1210_09_MV	000027	RESET
	SV_1210_11_MV	000111	RESET
	SV_1210_13_MV	000112	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_MV	000106	RESET

CL1210_Valvestate_All1_R

Added Valves in **CL1210_Valvestate_All1_R**(2009/03)

	VALVES	ADDRESS	COMMENTS
Filtration Unit Filtrate Flow Control			
	SV_1202_01_MV	000050	RESET
	SV_1202_04_MV	000100	RESET
Filtration Unit Pressure control			
	SV_1203_03_MV	000038	RESET
	SV_1203_04_MV	000107	RESET
Effluent Tank General			
	SV_1204_01_MV	000052	RESET
	SV_1204_03_MV	000101	RESET
CIP General			
	SV_1207_13_MV	000109	RESET
SIP General			
	SV_1210_05_MV	000029	RESET
	SV_1210_07_MV	000025	RESET
	SV_1210_14_MV	000113	RESET
GN2 loop for underpressure breaking			
	SV_1211_01_MV	000105	RESET

5.70.11.Awaited Feedback

CL1210_Valvestate_All2_OK

Added Feedback in **CL1210_Valvestate_All2_OK** (2009_03)

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_04_FB	100130	RESET
	SV_1201_06_FB	100129	RESET
	SV_1201_08_FB	100077	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	RESET
	SV_1202_02_FB	100131	SET
	SV_1202_03_FB	100082	RESET
	SV_1202_04_FB	100132	SET
CIP General			
	SV_1207_06_FB	100098	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_12_FB	100140	SET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_02_FB	100105	RESET
	SV_1210_03_FB	100108	RESET
	SV_1210_04_FB	100054	SET
	SV_1210_05_FB	100056	RESET
	SV_1210_06_FB	100059	SET
	SV_1210_07_FB	100060	RESET
	SV_1210_08_FB	100057	SET
	SV_1210_09_FB	100058	RESET
	SV_1210_11_FB	100141	RESET
	SV_1210_13_FB	100142	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_FB	100136	RESET

CL1210_Valvestate_All2_R_OK

Added Feedback in **CL1210_Valvestate_All2_R_OK** (2009_03)

	VALVES	ADDRESS	COMMENTS
Filtration Unit Retentate Flow Control			
	SV_1201_04_FB	100130	RESET
	SV_1201_06_FB	100129	RESET
	SV_1201_08_FB	100077	RESET
Filtration Unit Filtrate Flow Control			
	SV_1202_01_FB	100083	RESET
	SV_1202_02_FB	100131	RESET
	SV_1202_03_FB	100082	RESET
	SV_1202_04_FB	100132	RESET
Filtration Unit Pressure control			
	SV_1203_03_FB	100063	RESET
	SV_1203_04_FB	100137	RESET
Effluent Tank General			
	SV_1204_01_FB	100081	RESET
	SV_1204_03_FB	100133	RESET
CIP General			
	SV_1207_06_FB	100098	RESET
	SV_1207_08_FB	100093	RESET
	SV_1207_10_FB	100092	RESET
	SV_1207_12_FB	100140	RESET
SIP General			
	SV_1210_01_FB	100106	RESET
	SV_1210_02_FB	100105	RESET
	SV_1210_03_FB	100108	RESET
	SV_1210_04_FB	100054	RESET
	SV_1210_05_FB	100056	RESET
	SV_1210_06_FB	100059	RESET
	SV_1210_07_FB	100060	RESET
	SV_1210_08_FB	100057	RESET
	SV_1210_09_FB	100058	RESET
	SV_1210_11_FB	100141	RESET
	SV_1210_13_FB	100142	RESET
GN2 loop for underpressure breaking			
	SV_1211_02_FB	100136	RESET

5.71. Procedure 70: Influent sampling

5.71.1.Scope

To perform the offline analysis on the influent a sample has to be taken.

Protocol
Wear lab coat, goggles and gloves!
Open valve HV_1000_04 on the bottom of the reactor
The drained influent is collected in a sampling residue

Frequency of sampling
One sample must be taken on each batch of prepared influent, once a week.
When high fluctuations are found, analysis should be re-done on a new sample.

Amount
200Ml

All this procedure is done manually by the OPERATOR.

5.72. Procedure 71: Bioreactor content sampling

5.72.1.Scope

To perform the offline analysis on the reactor content a sample has to be taken.

Protocol
Wear lab coat, goggles and gloves!
Open valve HV_1007_02 on the bottom of the reactor
The drained reactor content is collected in a sampling residue

Frequency of sampling
3 samples per week must be taken (1 on Monday, Wednesday and Friday)

Amount
Small volumes (80 to 150) are taken, thus they can be neglected compared to the total liquid volume (but their volumes are included in the calculations of efficiencies).

All this procedure is done manually by the OPERATOR.

5.73. Procedure 72: Gas sampling

5.73.1.Scope

Measuring the amount of O_2, CH_4, CO_2 and H_2 in the bioreactor and the influent vessel

Protocol

The amount of O_2, CH_4, CO_2 and H_2 is measured with an offline gas analyser

Bioreactor

Place an empty syringe in the tube on valve HV_1007_04

Make sure there is no leakage

Open valve HV_1007_04

Fill the syringe with 50 ml gas of the bioreactor

Close the valve

Influent vessel

Place an empty syringe in the tube on valve HV_1000_02, HV_1000_03

Make sure there is no leakage

Open valve HV_1000_02, HV_1000_03

Fill the syringe with 50 ml gas of the bioreactor

Close the valve

All this procedure is done manually by the OPERATOR.

5.74. Procedure 73: Filtrate sampling

5.74.1.Scope

Testing the sterility of the filtration unit

Material
Ethanol
Bunsen burner
Sterile syringe and needle
Cotton wick

Protocol
Wear lab coat, goggles and gloves!
Disinfect the working environment and your gloves with ethanol
Light the Bunsen burner
Sterile sampling is possible via the Keofitt Micro Port (HV_1204_01).

Figure: Sterile Filtrate sampling port

Sterilization of the Micro Port
Remove the cap
Soak cotton wick in ethanol
Put the soaked wick in the cap
Rub the inside of the Micro Port with the soaked wick
Close the cap with the wick in place
Sampling
Connect the sterile syringe and needle near the Bunsen burner
Remove the cap of the Micro Port after sterilization
Pierce the membrane with the sterile needle
Extract the sample
Put the sterile filtrate in a sterile sampling recipient
Sterilize the Micro port and put cap in place with wick

Amount

A sterile filtrate sample should be taken once a week. This can be adapted when long time experience shows that one can assume the filtrate to stay sterile for a longer time or increased if the sterility of the filtrate becomes more important.

All this procedure is done manually by the OPERATOR.

5.75. Procedure 74: General follow-up

5.75.1.Scope

On the sheet of follow-up, this is an excel file, the elements for general information are reported. After completing this file the data is automatically stored and printed. This data can be used to complete the database where all the information is collected. This database has to be filled in on a regular basis, for example once a week.

Material
Follow up sheet

Protocol
Elements for general information must be reported, and for more specific information:
Date, hour, and analyst name
Check-list for good operation of the system
Results of on-line measurements
All remarks concerning running of the system, specific operations, changes...
Feeding (semi-continuous or batch)
Whether or not the reactor is opened and nitrogen is flushed

Frequency
Daily

All this procedure is done manually by the OPERATOR.

5.76. Procedure 75: Follow-up Influent tank VSL2_1000_01

5.76.1.Scope

On the sheet of follow-up, this is an excel file, the data of the follow up of the influent tank are reported. After completing this file the data is automatically stored and printed.
This data can be used to complete the database where all the information is collected. This database has to be filled in on a regular basis, for example once a week.

Material
Follow up sheet

Protocol
The influent vessel must be carefully checked. All remarks must be reported on the follow-up sheet.
The check point is:
Reactor mixing
Information related to operation of the pilot must also be reported on the follow-up sheet.
Results of online measurements can be found on the computer.
It will concern:
Temperature (3°-7°C) (TT_1002_01), pressure (PT_1003_01) and liquid volume of the influent vessel (VSL2_1000_01_Volume_Filtered)
Sample volumes and the amount also have to be reported.

Frequency
Daily

All this procedure is done manually by the OPERATOR.

5.77. Procedure 76: Follow-up Bioreactor VSL2_1007_01

5.77.1.Scope

On the sheet of follow-up, this is an excel file; the data of follow up of the bioreactor are reported. After completing this file the data is automatically stored and printed. This data can be used to complete the database where all the information is collected. This database has to be filled in on a regular basis, for example once a week.

Material
Follow up sheet

Protocol
The reactor must be carefully checked regarding several points. All remarks must be reported on the follow-up sheet.
The check points are:
 Running of pH control
 Presence and amount of acid/base in pH control bottle
 Presence of water in warm water bath
 Reactor mixing
Information related to operation of the pilot must also be reported on the follow-up sheet.
Results of online measurements can be found on the computer.
It will concern:
Temperature (55°C) (TT_1008_01 on the computer screen) , pH (around 5.5) (AT_1011_01and AT_1011_01), pressure (< 300 mbar) (PT_1009_01) and liquid volume (VSL2_1007_01_Volume_Filtered) of the bioreactor
Sample volumes and the amount also have to be reported.

Frequency
Daily

All this procedure is done manually by the OPERATOR.

5.78. Procedure 77: Follow-up Gas Loop

5.78.1.Scope

On the sheet of follow-up, this is an excel file; the data of follow up of the gas loop are reported. After completing this file the data is automatically stored and printed.
This data can be used to complete the database where all the information is collected.
This database has to be filled in on a regular basis, for example once a week.

Material
Follow up sheet

Protocol
The gas loop must be carefully checked regarding several points. All remarks must be reported on the follow-up sheet.
The check points are:
Running of the pump of the active gas loop (PP_1100_01)
Making sure the gas analyzer has not stopped (service, this corresponds with an orange lighting signal)
Information related to operation of the pilot must also be reported on the follow-up sheet.
Results of online measurements can be found on the computer.
It will concern:
Biogas production, pressure in the buffer vessel, the percentage of CO2 and CH4
Sample volumes and the amount also have to be reported.

Frequency
Daily

All this procedure is done manually by the OPERATOR.

5.79. Procedure 78: Follow-up Filtration Unit

5.79.1.Scope

On the sheet of follow-up, this is an excel file, the data of the follow up of the gas loop are reported. After completing this file the data is automatically stored and printed.
This data can be used to complete the database where all the information is collected. This database has to be filled in on a regular basis, for example once a week.

Material
Follow up sheet

Protocol
The filtrate tank must be carefully checked. All remarks must be reported on the follow-up sheet.
The check points are:
Running of the filtration pump (PP_1202_01)
Information related to operation of the pilot must also be reported on the follow-up sheet.
Results of online measurements can be found on the computer.
It will concern:
TMP membrane 1, the tangential membrane pressure (LF_1200_01), Cross Flow, pressure1, pressure 2, pressure 3, pressure 9, Retentate flow, Turbidity, temperature influent tank (3-7 °C), temperature retentate, the amount of volume filtrated, till which volume the filtrate is drained.
Sample volumes and the amount also have to be reported.

Frequency
Daily

All this procedure is done manually by the OPERATOR.

5.80. Procedure 79: Calibration of pH sensors AT_1011_01 / AT_1011_02

5.80.1.Scope

The pH meters have to be calibrated regularly. The regular comparison between on-line and offline measurements will allow to detect the moment when a calibration is required.

Material
Demineralised water
pH 4.00 buffer solution
pH 7.00 buffer solution

Protocol
The pH calibration procedure can be found in the Stratos 2401 & 2402 instruction manual pg
78-81: Automatic calibration with Calimatic. Temperature detection automatic or manual
Press CALL, enter CODE 1100 (select with arrows)
“CALL 1” appears on the window of the transmitter
Remove the pH-electrode from the bioreactor
Rinse the electrode with demineralised water
Immerse the electrode in the first buffer solution (in any order)
Stir a moment and press ENTER on the transmitter
“CALL 2” appears on the window of the transmitter
Rinse the electrode with demineralised water
Put the electrode in the other buffer solution
Stir a moment and press ENTER on the transmitter
Retract the electrode, rinse off and reinstall
End the calibration with ENTER
PH value and Hold are displayed alternately, proceed with enter

Frequency
When the difference between the online measurements is higher than pH 0.15 and/or
The difference between the online and offline measurements is higher than pH 0.15.

All this procedure is done manually by the OPERATOR.

5.81. Procedure 80: SIP: Purge and sterilize recycle line

5.81.1.Scope

This Procedure can only be activated when the SIP control Loop mode button is in Automatic mode.

This procedure is used to sterilize the Recycle line before entering in Recycle mode.

Prerequisite
Be sure (HMI control) that SV_1202_03, SV_1210_11 are closed
HV_1007_06 is closed.

Procedure:

Operator pushes the HMI Button:
CL1210_SCI _Rec (PLC Address: 000351)

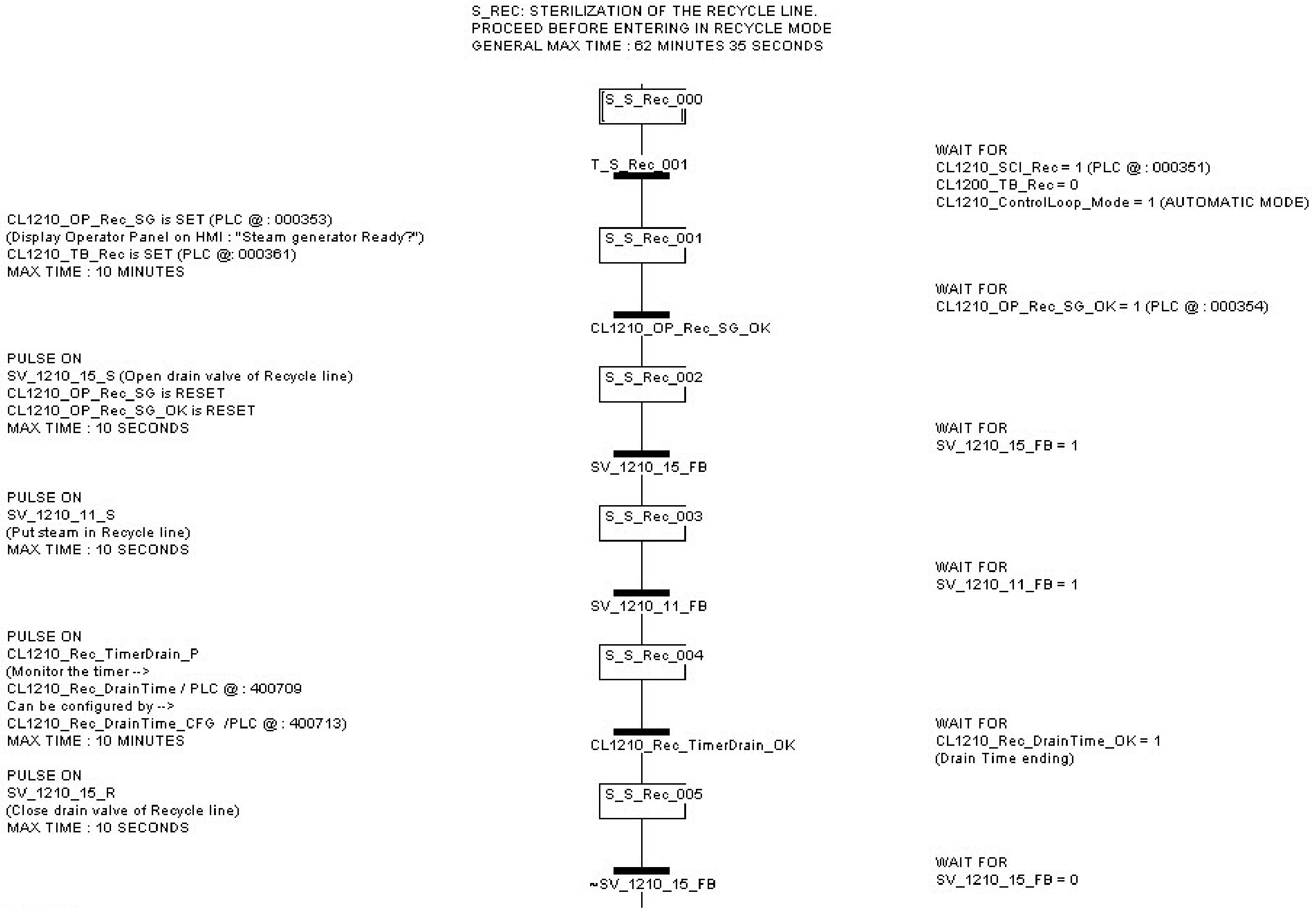
The PLC starts the following action:
A window appears on the HMI screen to validate that steam generator is ready
Once the operator has acknowledged,
Open drain SV_1210_15.
Open SV_1210_11 to push steam into recycle line during “drain time” (Defined by operator)
Close SV_1210_15 (drain).
Open SV_1210_10
Wait for “sterilization time” (Defined by operator)
Close SV_1210_11.
Wait for “Cooling time” (Defined by operator)
Open SV_1211_03 (N2 vacuum breaking)
Wait 1 minute
Wait “Flushing Time” (Defined by operator)
Close SV_1210_10 and SV_1211_03

OPEN the Manual valve HV_1007_07

Variables Used (I/O):
CL1210_SCI _Rec (PLC Address: 000351)
CL1210_TB_Rec (PLC Address: 000361)
CL1210_OP_Rec_SG (PLC Address: 000353)
CL1210_OP_Rec_SG_OK (PLC Address: 000354)
CL1210_Rec_DrainTime (PLC Address: 400709)
CL1210_Rec_SterilisationTime (PLC Address: 400717)
CL1210_Rec_CoolingTime (PLC Address: 400725)
CL1210_Rec_FlushingTime (PLC Address: 400733)

CL1210_Rec_DrainTime_CFG (PLC Address: 400713)
CL1210_Rec_SterilisationTime_CFG (PLC Address: 400721)
CL1210_Rec_CoolingTime_CFG (PLC Address: 400729)
CL1210_Rec_FlushingTime_CFG (PLC Address: 400737)

5.81.2.PLC Subroutine: S_Rec



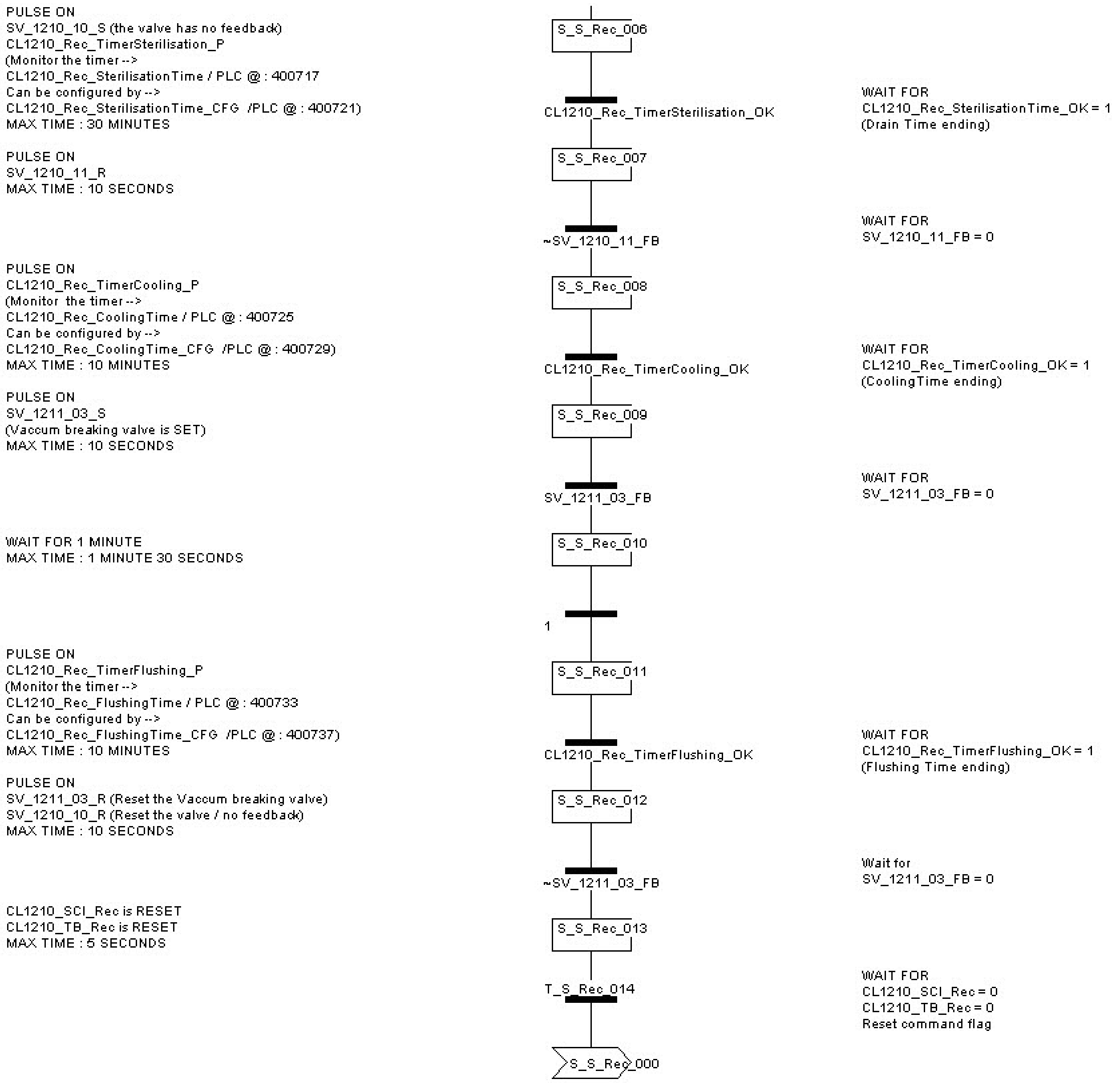
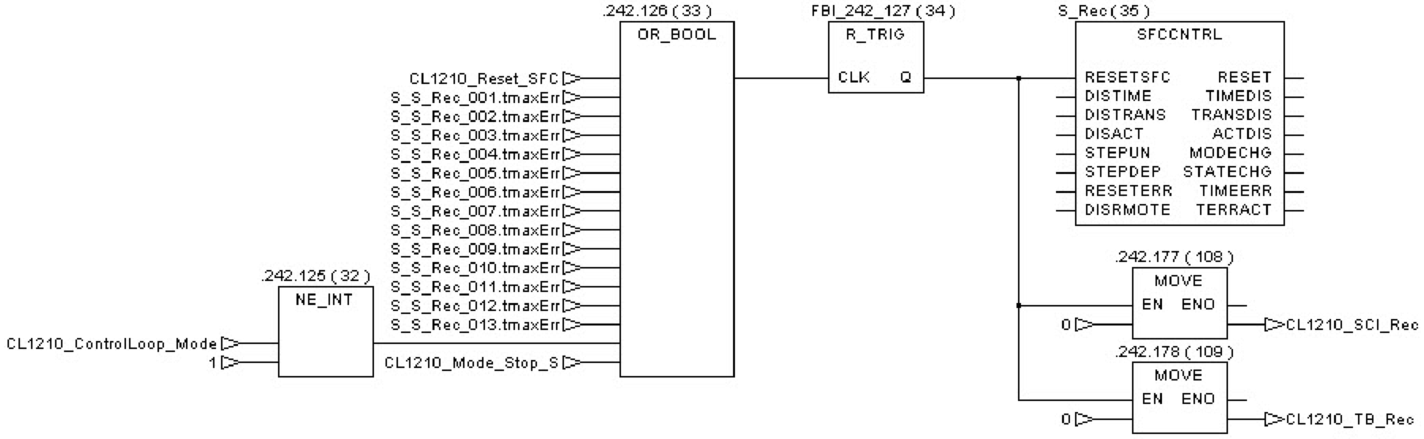


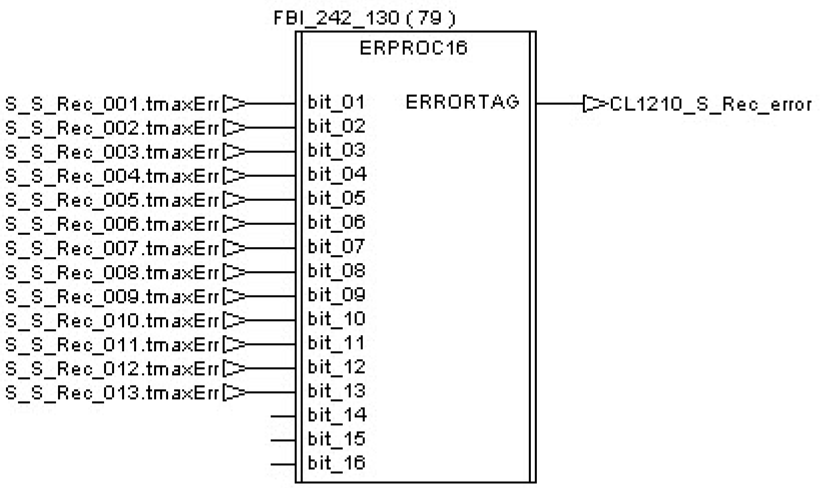
Figure 151: PLC procedure: S_Rec

5.81.3.Procedure management

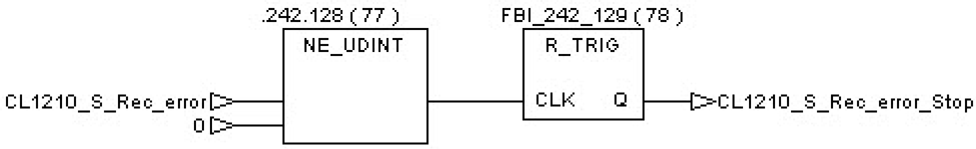
Reset of the procedure:
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



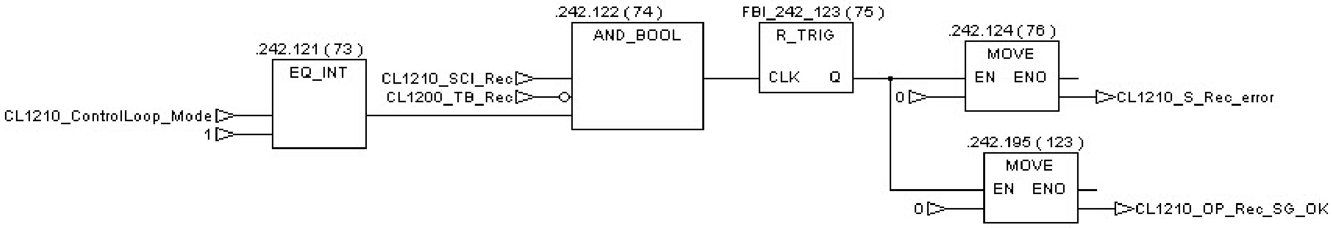
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1210_S_REC_error_Stop" receives a pulse and then the Sterilization Unit is stopped thanks to the procedure "S_Stop".



The error number is displayed until the procedure is re-started.



5.81.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_S_REC_001**	The operator didn't answer to the operator panel question ("Is Steam generator is ready?") The time (10 minutes) is elapsed
2	**S_S_REC_002**	SV_1210_15 (drain valve of Recycle line) is not opened
4	**S_S_REC_003**	SV_1210_11 (Put steam in Recycle line) is not opened
8	**S_S_REC_004**	Problem with the drain timer The tag CL1210_Rec_TimerDrain_OK has not been set
16	**S_S_REC_005**	SV_1210_15_R (drain valve of Recycle line) is not Closed
32	**S_S_REC_006**	Problem with the sterilization timer The tag CL1210_Rec_TimerSterilisation_OK has not been set. This error can be linked to the steam temperature
64	**S_S_REC_007**	SV_1210_11 (Put steam in Recycle line) is not closed
128	**S_S_REC_008**	Problem with the cooling timer The tag CL1210_Rec_TimerCooling_OK has not been set.
256	**S_S_REC_009**	The valve SV_1211_03 (Vaccum breaking valve) is not opened
512	**S_S_REC_010**	Just a delay, no possible error
1024	**S_S_REC_011**	Problem with the flushing timer The tag CL1210_Rec_TimerFlushing_OK has not been set.
2048	**S_S_REC_012**	The valve SV_1211_03 has not been closed
4096	**S_S_REC_013**	Tag reset problem (Tracing bit or Start button)

5.82. Procedure 81: SIP: Purge and sterilize Harvesting line

5.82.1.Scope

This Procedure can only be activated when the SIP control Loop mode button is in Automatic mode.

This procedure is used to sterilize the harvesting line before transferring to the external harvest tank

Prerequisite
Be sure (HMI control) that SV_1204_01, SV_1210_14, SV_1210_13 are closed
HV_1204_02 is closed.

Procedure:

Operator pushes the HMI Button: **CL1210_SCI_Harvest** (PLC Address: 000354)
Open HV_1204_02
Steam generator is ON
Open HV_1210_01

The PLC starts the following action:
A window appears on the HMI screen to validate that steam generator is ready
Once the operator has acknowledged,

Open SV_1210_13 to push steam into harvesting line
Wait for “drain time”
Close SV_1210_13
A window appears on the HMI screen to validate that operator has closed HV_1210_13
Once the operator has acknowledged,
Open SV_1210_13 and SV_1210_14
Wait for “Sterilization Time”
Close SV_1210_13
Wait for “Cooling Time” (defined by operator)
Close SV_1210_14

The line is sterilized and then the harvesting can be started without contamination.

Variables Used (I/O):
CL1210_SCI _Harvest (PLC Address: 000355)
CL1210_TB_ Harvest (PLC Address: 000360)
CL1210_OP_Harvest_SG (PLC Address: 000356)
CL1210_OP_Harvest_SG_OK (PLC Address: 000357)
CL1210_OP_Close_Drain (PLC Address: 000358)

CL1210_OP_Close_Drain_OK (PLC Address: 000359)
CL1210_ Harvest _DrainTime (PLC Address: 400741)
CL1210_ Harvest _SterilTime (PLC Address: 400749)
CL1210_ Harvest _CoolingTime (PLC Address: 400757)
CL1210_ Harvest _DrainTime_CFG (PLC Address: 400745)
CL1210_ Harvest _SterilTime_CFG (PLC Address: 400753)
CL1210_ Harvest _CoolingTime_CFG (PLC Address: 400761)

5.82.2.PLC Subroutine: S_Harvest

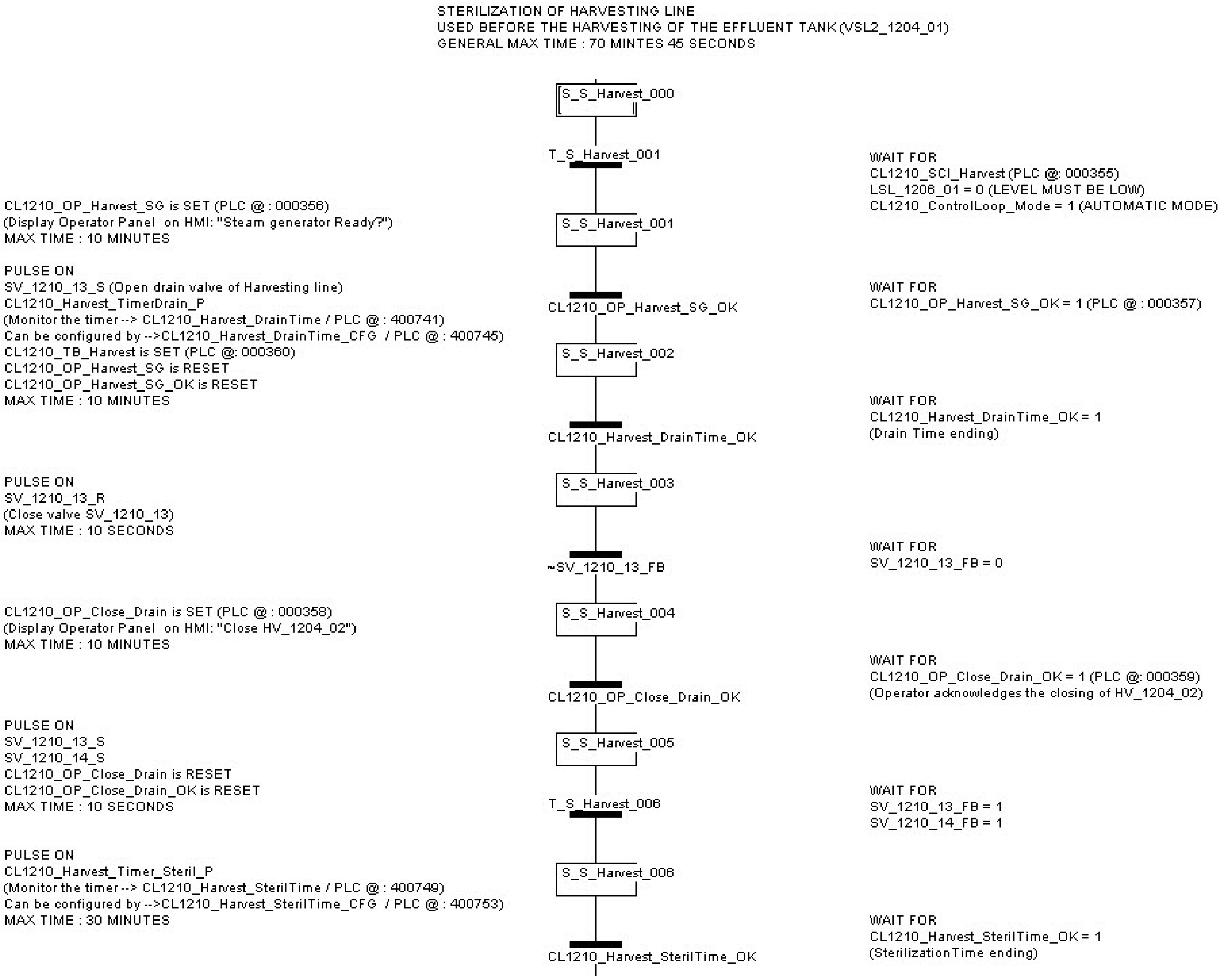
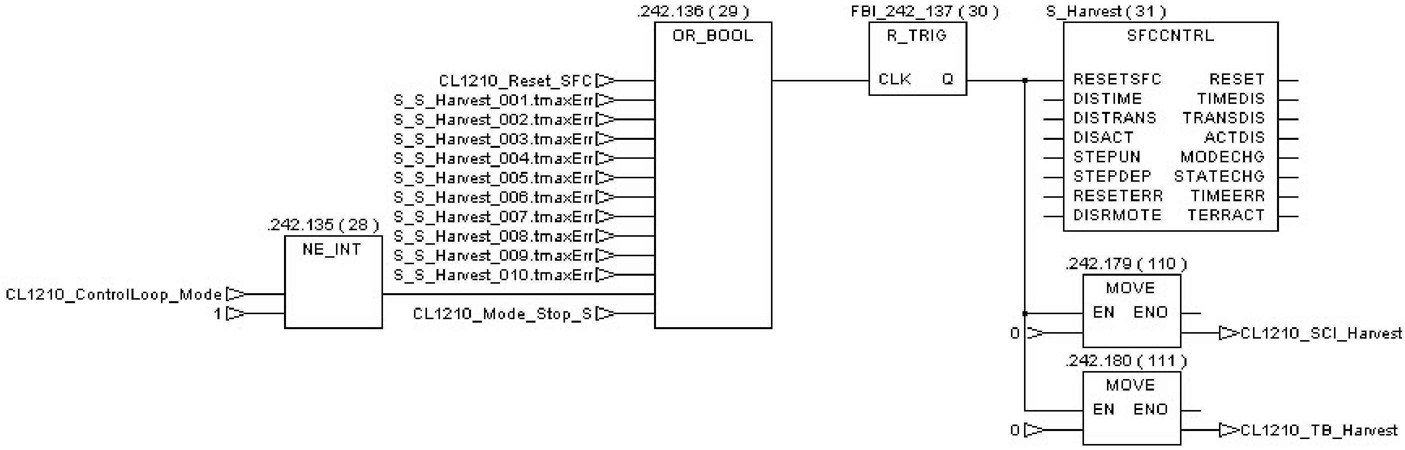


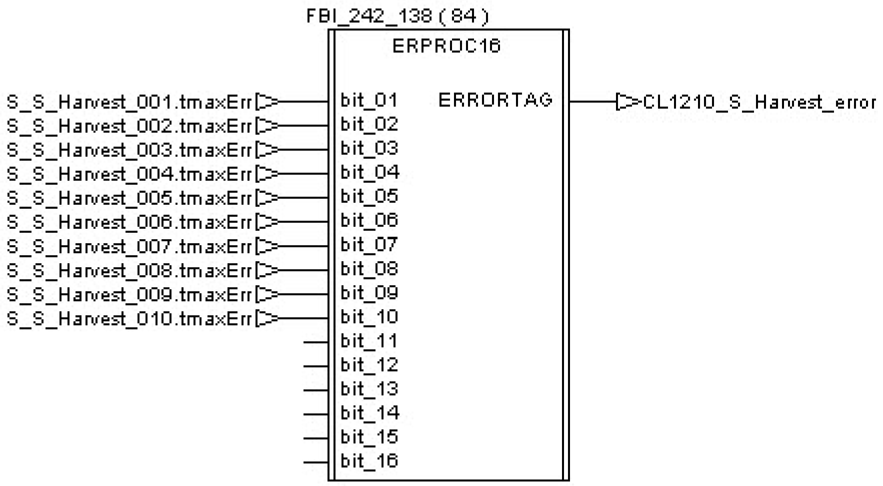
Figure 152: PLC procedure: S_Harvest

5.82.3.Procedure management

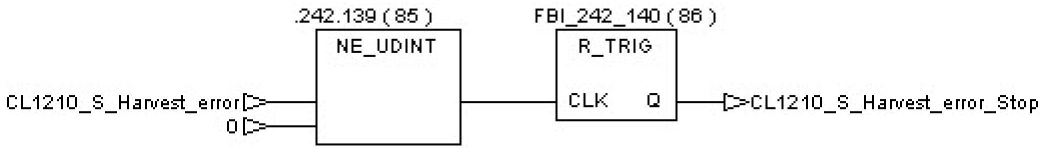
Reset of the procedure:
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



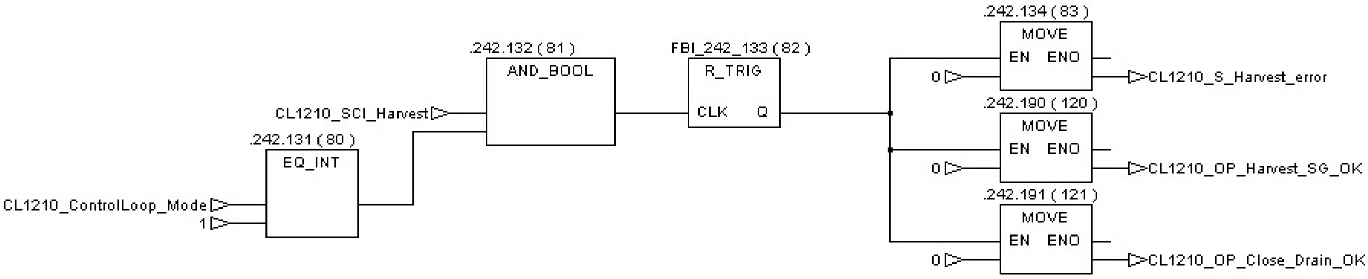
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1210_S_Harvest_error_Stop" receives a pulse and then the Sterilization Unit is stopped thanks to the procedure "S_Stop".



The error number is displayed until the procedure is re-started.



5.82.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_S_Harvest_001**	The operator didn't answer to the operator panel question ("Is Steam generator is ready?") The time (10 minutes) is elapsed
2	**S_S_Harvest_002**	Problem with the drain timer The tag CL1210_Harvest_DrainTime_OK has not been set
4	**S_S_Harvest_003**	SV_1210_13 is not Closed
8	**S_S_Harvest_004**	The operator didn't click validate the operator panel (""Close HV_1204_02"") The time (10 minutes) is elapsed
16	**S_S_Harvest_005**	valve(s) status Error operator has to look for valve alarm
32	**S_S_Harvest_006**	Problem with the sterilization timer The tag CL1210_Harvest_SterilTime_OK has not been set.
64	**S_S_Harvest_007**	The valve SV_1210_13 is not closed
128	**S_S_Harvest_008**	Problem with the cooling timer The tag CL1210_Harvest_CoolingTime_OK has not been set
256	**S_S_Harvest_009**	The valve SV_1210_14 is not closed
512	**S_S_Harvest_010**	Tag reset problem (Tracing bit or Start button)

5.83. Procedure 82: SIP: Flush recycle line with Steam

5.83.1.Scope

This procedure is used to flush steam into Recycle Line when operator asks for Nominal Mode after a recycle mode

Prerequisite
HV_1007_07 must be closed

Procedure:

When Operator wants to trigger the process in nominal mode after a recycle mode, The PLC executes the procedure 38 (Enter in recycle mode). At the end of procedure, the Variable **CL1210_SCI_FlushRec** (PLC Address: 000364) is SET. It starts the following Actions

A window appears on the HMI screen to validate that steam generator is ready and HV_1007_06 is closed.
Once the operator has acknowledged
- Open steam 2-way valve SV_1210_11 and drain 2-way valve SV_1210_15
- Count Flushing time
- Close steam valve SV_1210_11 and drain valve SV_1210_15

Variables Used (I/O):
CL1210_SCI_FlushRec (PLC Address: 000364)
CL1210_TB_FlushRec is SET (PLC Address: 000367)
CL1210_OP_FlushRec_SG is SET (PLC Address: 000365)
CL1210_OP_FlushRec_SG_OK = 1 (PLC Address: 000366)
CL1210_Rec_FlushingTime (PLC Address: 400733)
CL1210_Rec_FlushingTime_CFG (PLC Address: 400737)

5.83.2.PLC Subroutine: S_Rec_Flush

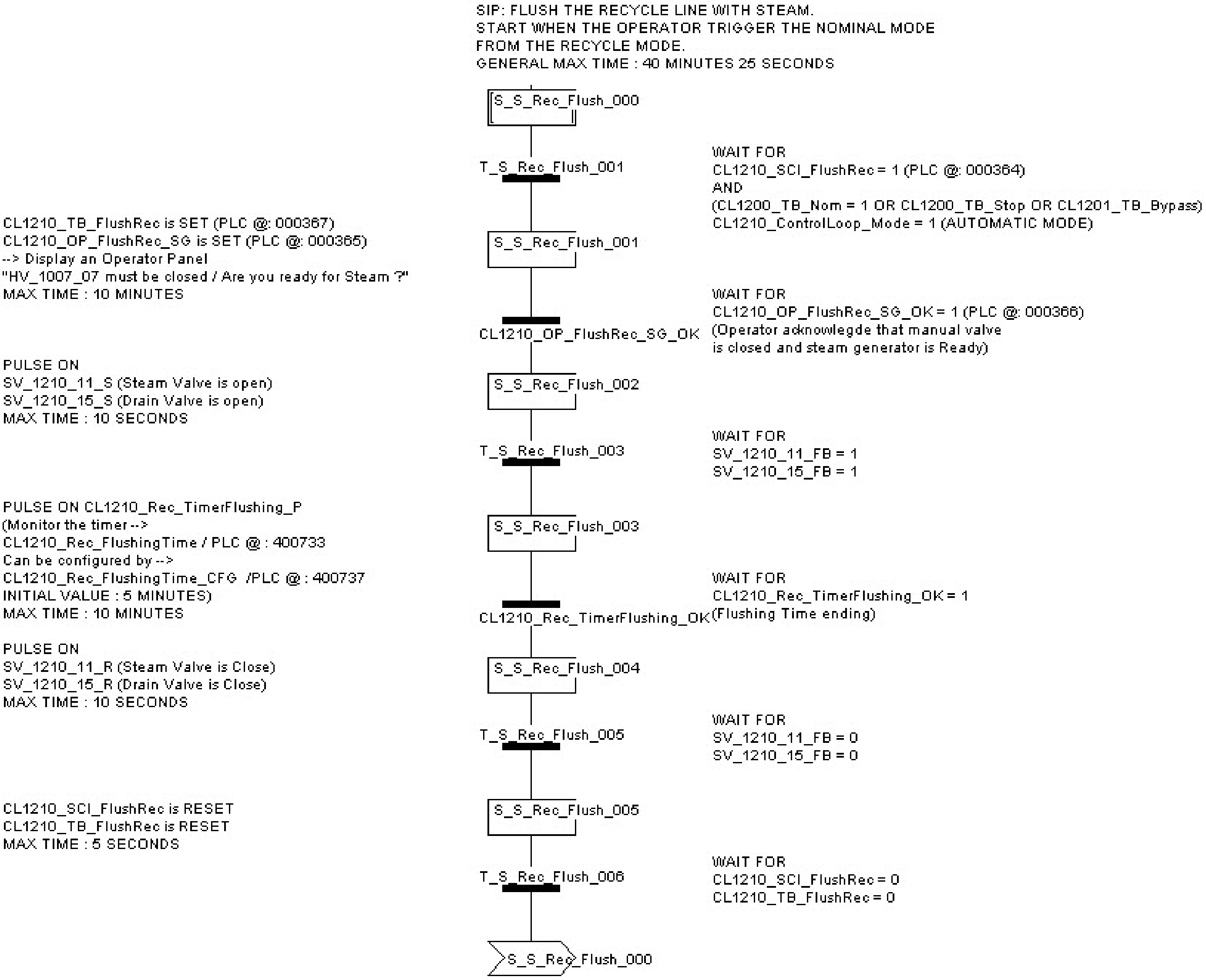
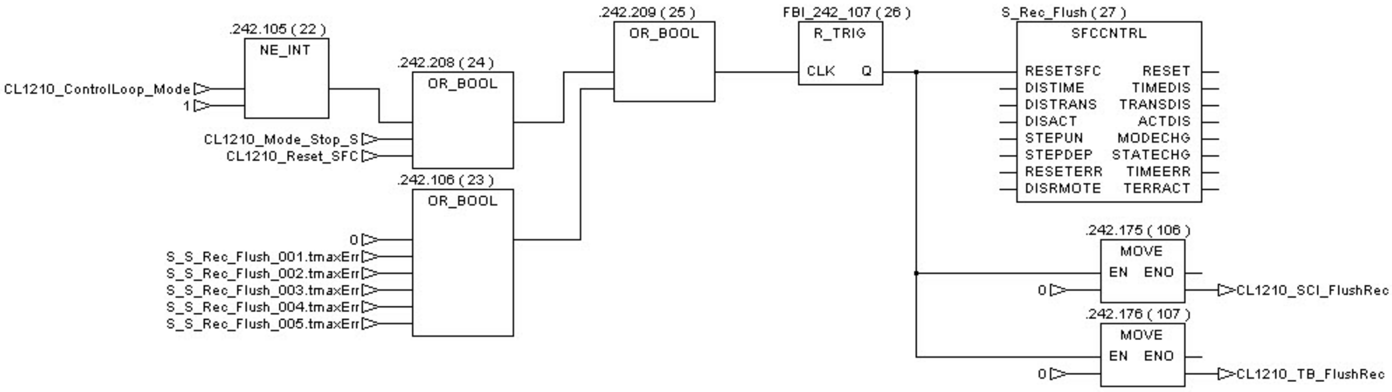


Figure 153: PLC procedure: S_Rec_Flush

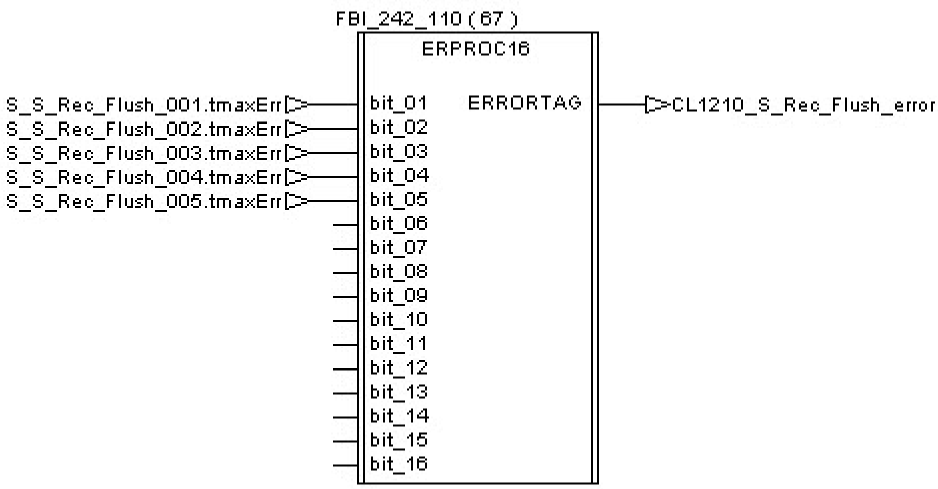
5.83.3.Procedure management

Reset of the procedure:
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.

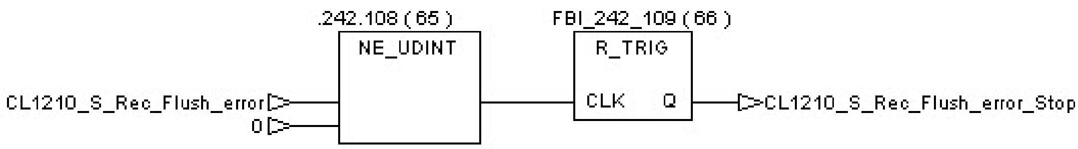
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



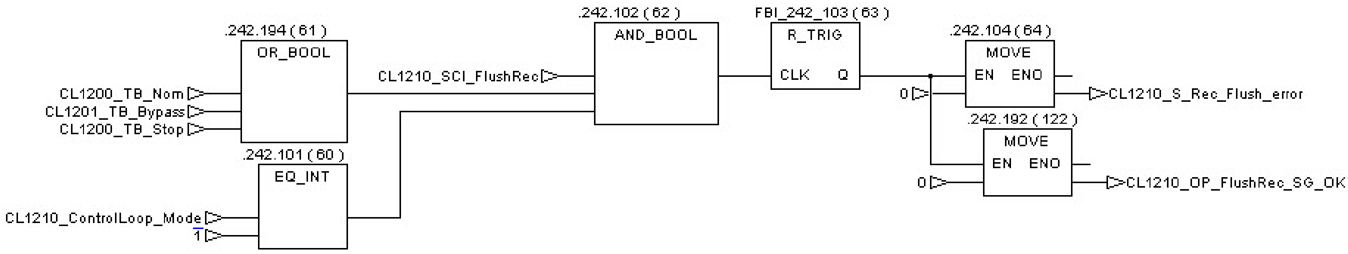
<u>Procedure error management:</u>
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1210_S_REC_Flush_error_Stop" receives a pulse and then the Sterilization Unit is stopped thanks to the procedure "S_Stop".



The error number is displayed until the procedure is re-started.



5.83.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_S_Rec_Flush_001**	The operator didn't answer to the operator panel question ("HV_1007_07 must be closed / Are you ready for Steam?") The time (10 minutes) is elapsed
2	**S_S_Rec_Flush_002**	valve(s) status Error operator has to look for valve alarm
4	**S_S_Rec_Flush_003**	Problem with the timer managing the N2 flush. The tag CL1210_Rec_TimerFlushing_OK has not been set
8	**S_S_Rec_Flush_004**	valve(s) status Error operator has to look for valve alarm
16	**S_S_Rec_Flush_005**	Tag reset problem (Tracing bit or Start button)

5.84. Procedure 83: Filtration Unit: Enter in By Pass Mode automatically when LSH_1206_01 is set

5.84.1.Scope

This Procedure can only be activated when the Filtration Unit control Loop mode button is in Automatic mode.

This procedure is used to pass the filtration Unit in Bypass mode automatically when LSH_1206_01 is Set.
The PLC asks to operator to harvest, to pass in Recycle Mode or to cancel when Level of VSL2_1204_01 reaches 15 litres. If the operator does not answer, the PLC uses this procedure to switch in safety state.

Procedure:

If the process is in nominal mode and the Level switch high of VSL2_1204_01 is set, the PLC starts the Filtration Unit in By Pass mode by calling procedure 34

5.84.2.PLC Subroutine: F_Auto_Bypass

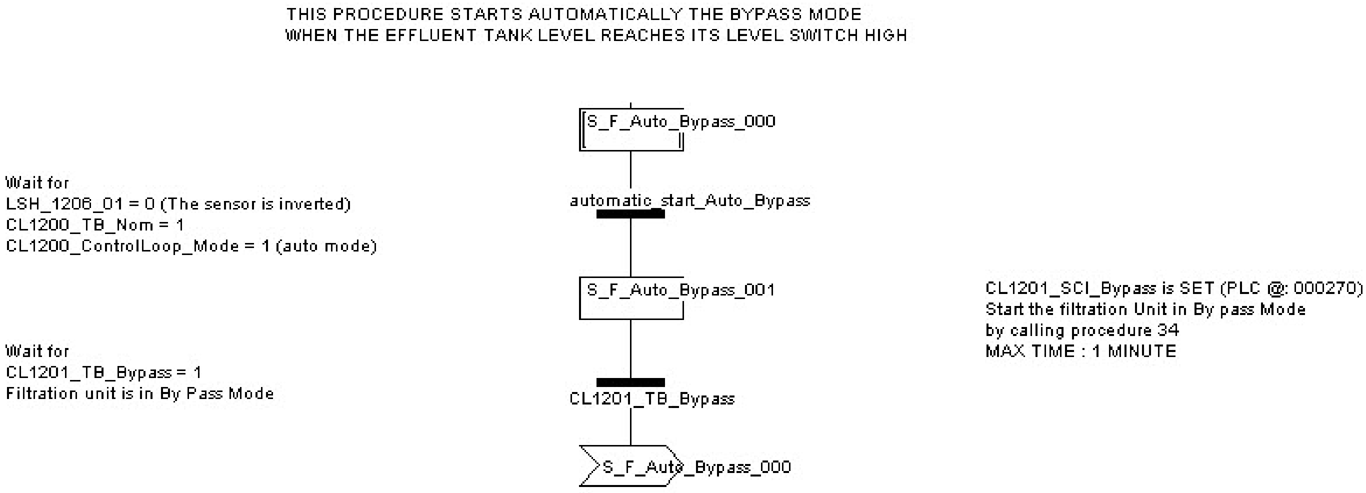
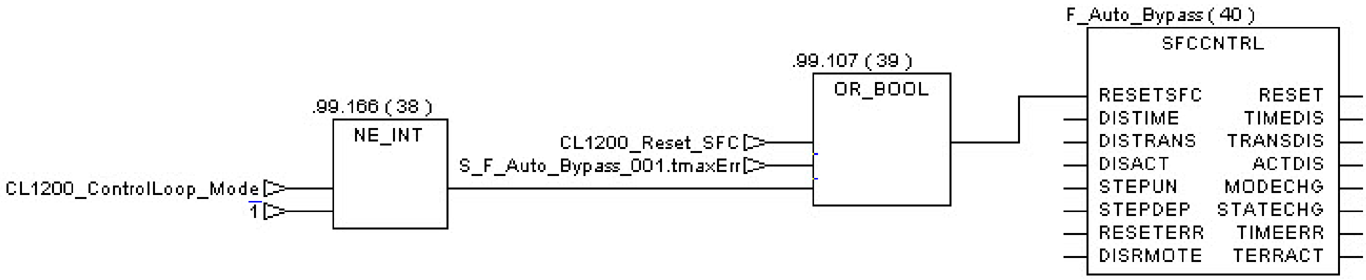


Figure 154: PLC procedure: F_Auto_Bypass

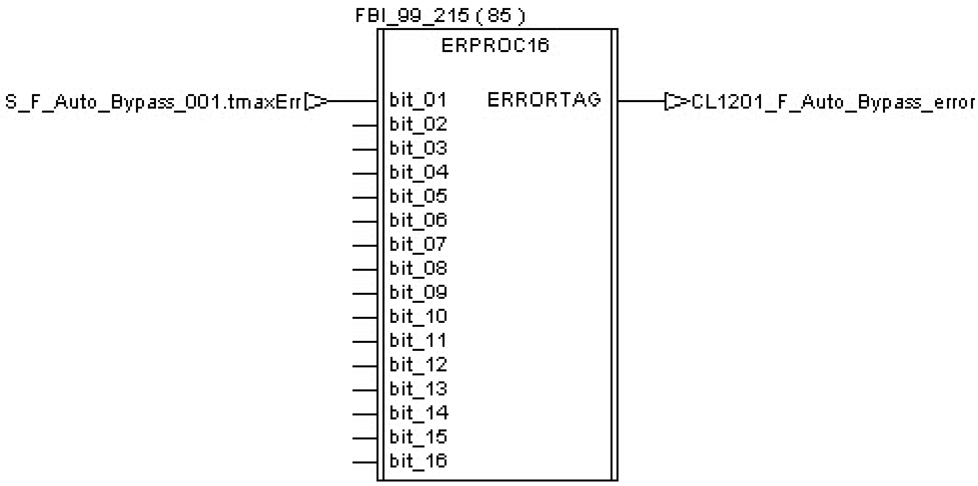
Variables Used (I/O):
CL1201_SCI_Bypass (PLC @: 000270)

5.84.3.Procedure management

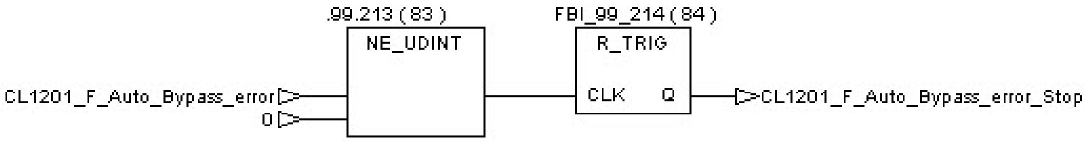
Reset of the procedure:
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



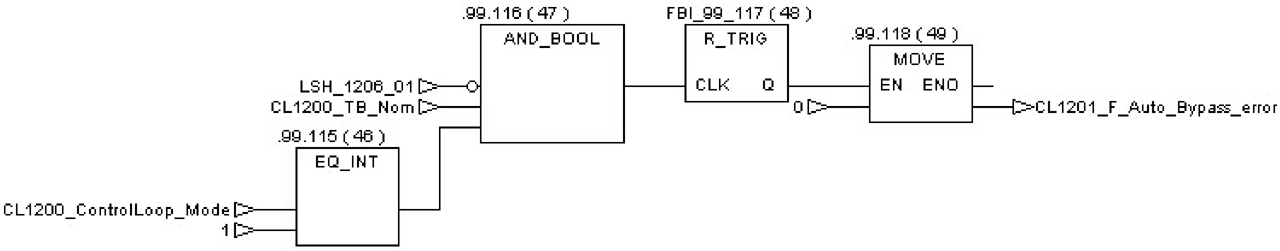
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag “CL1201_F_AUTO_Bypas_error_Stop” receives a pulse and then the Filtration Unit is stopped thanks to the procedure “F_Stop”.



The error number is displayed until the procedure is re-started.



5.84.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_F_Auto_Bypass_001**	Problem during the execution of the procedure "F_Bypass" The procedure "F_Bypass" should also have an error code

5.85. Procedure 84: SIP: membrane LF_1200_01 / LF_1200_02, filtrate line and Filtrate tank VSL2_1204_01

5.85.1. Scope

This Procedure can only be activated when the FU, the CIP and the SIP control Loop mode button are in Automatic mode.

The Sterilization protocols are created to provide a complete cleaning and sterilization of the membrane, filtrate line and Effluent vessel.

Prerequisite
The filtration unit must work in bypass mode or be stopped.
An operator must be present during the protocol to fill the cleaning agent into VSSL_1209_03 and to acknowledge operator panels.
The operator must know the three procedure called by the Protocol (PROCEDURE 56, 54, 69)

Protocol
The user asks to begin the protocol by pushing the HMI button:
For membrane 1: **CL1210_SCI_P_All1** (PLC @ = 000306)
For membrane 2: **CL1210_SCI_P_All2** (PLC @ = 000307)
The PLC proceeds to the following actions:
-Call the Cleaning Protocol of the desired membrane (PROCEDURE 56)
-Call the cleaning procedure of the Effluent Vessel (PROCEDURE 54)
-Call the Sterilization of the Filtrate line and Effluent vessel (Procedure 69)

Used Variables:

For the Protocol **S_P_All1**
CL1210_SCI_P_All1 (PLC @ = 000306)
CL1210_TB_P_All1 (PLC @ = 000385)
CL1210_SCI_P_All2 (PLC @ = 000307)
CL1210_TB_P_All2 (PLC @ = 000386)

5.85.2.PLC Subroutine: S_P_All1 (protocol)

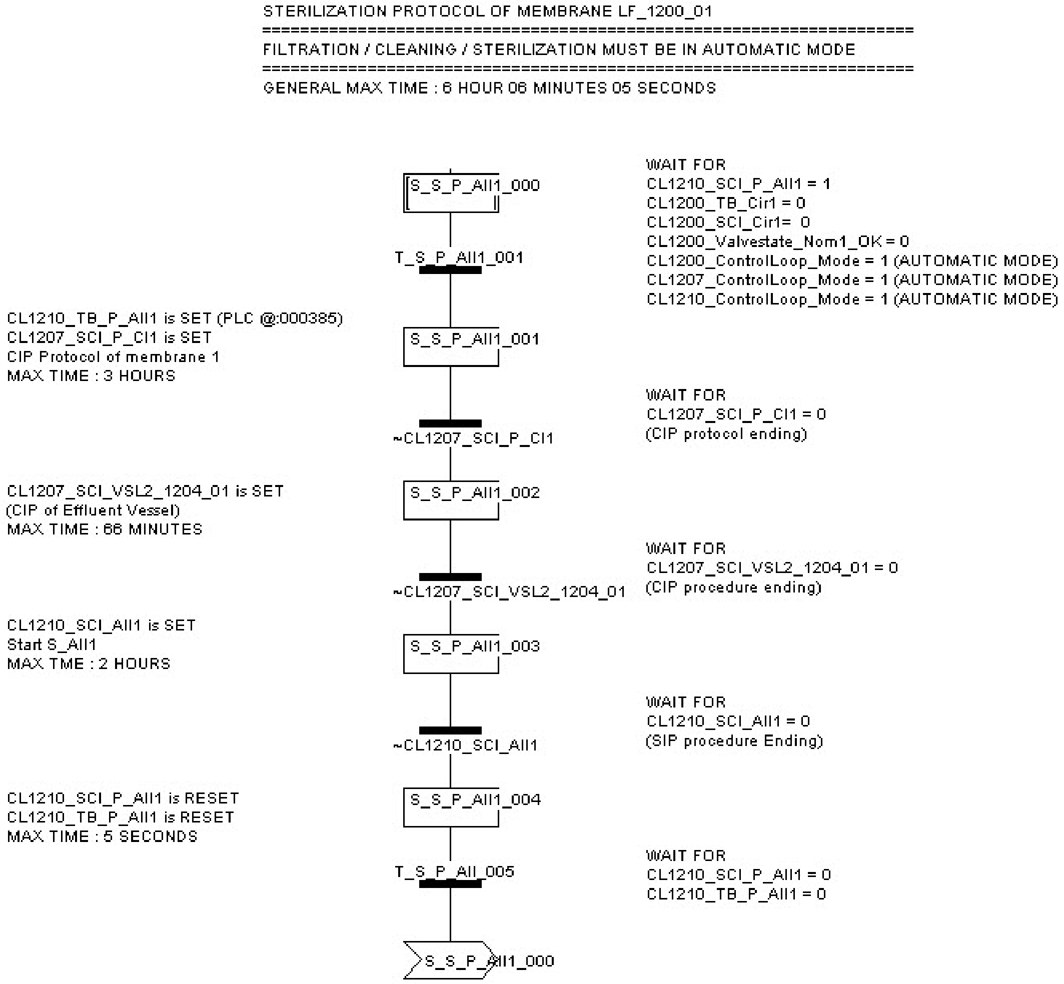
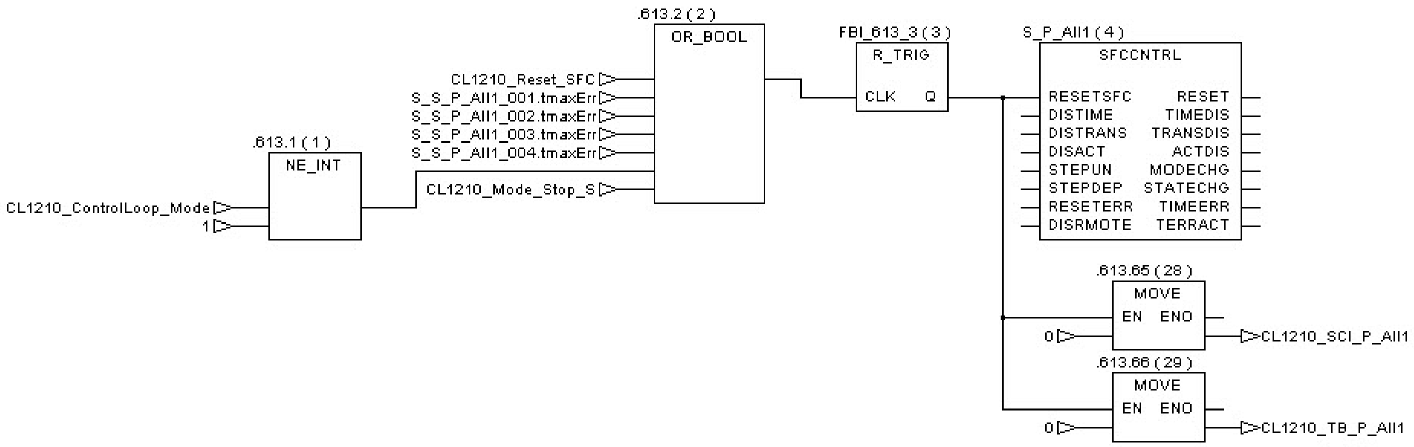


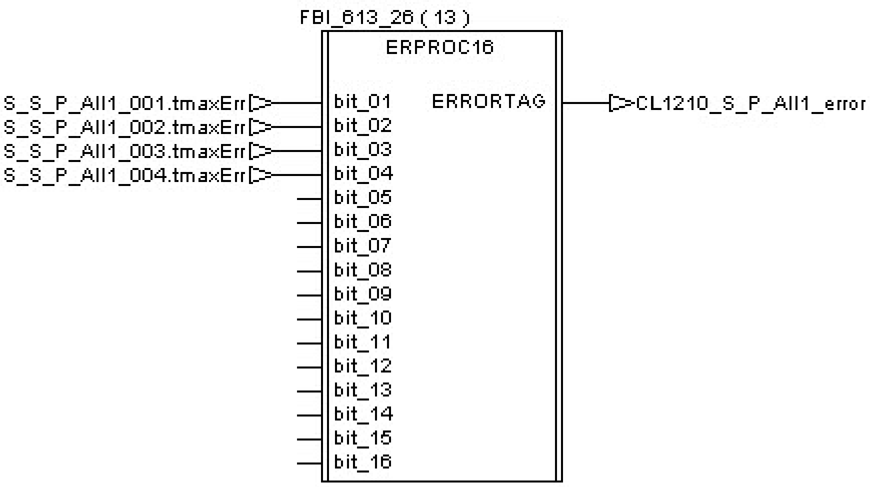
Figure 155: PLC protocol: S_P_All1

5.85.3.Procedure management

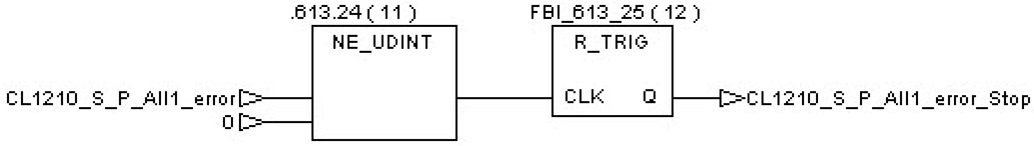
<u>Reset of the procedure:</u>
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



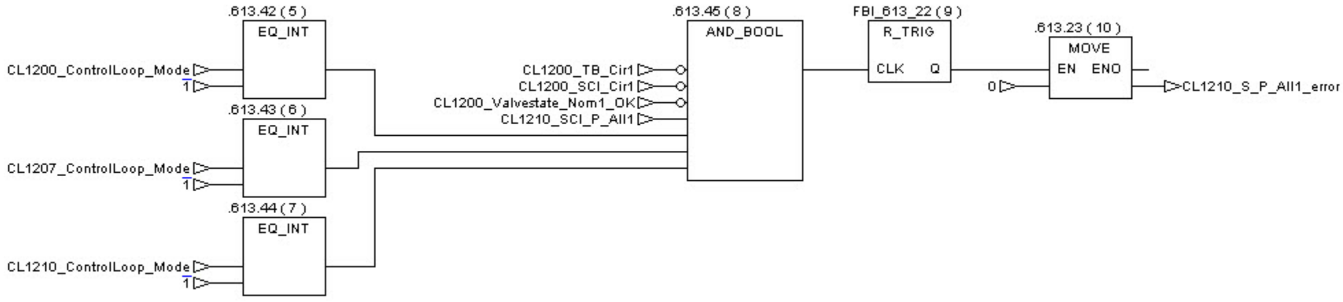
<u>Procedure error management:</u>
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag “CL1210_S_P_ALL1_error_Stop” receives a pulse and then the Sterilization Unit is stopped thanks to the procedure “S_Stop”.



The error number is displayed until the procedure is re-started.



5.85.4.Error number description

Error number	Procedure Action Step	problem description
1	**S_S_P_All1_001**	Problem during the execution of the protocol "C_P_CL1" (CLEANING PROTOCOL OF MEMBRANE 1) The protocol "C_P_CL1" and one of its procedure called should also have an error code
2	**S_S_P_All1_002**	Problem during the execution of the procedure "C_R_F_01" (CLEANING OF THE EFFLUENT TANK) The procedure "C_R_F_01" should also have an error code
4	**S_S_P_All1_003**	Problem during the execution of the procedure "S_ALL1" (STERILIZATION OF : MEMBRANE LF_1200_01 / FILTRATE LINE / VSL2_1204_01) The procedure "S_ALL1" should also have an error code
8	**S_S_P_All1_004**	Tag reset problem (Tracing bit or Start button)

5.85.5.PLC Subroutine: S_P_All2 (protocol)

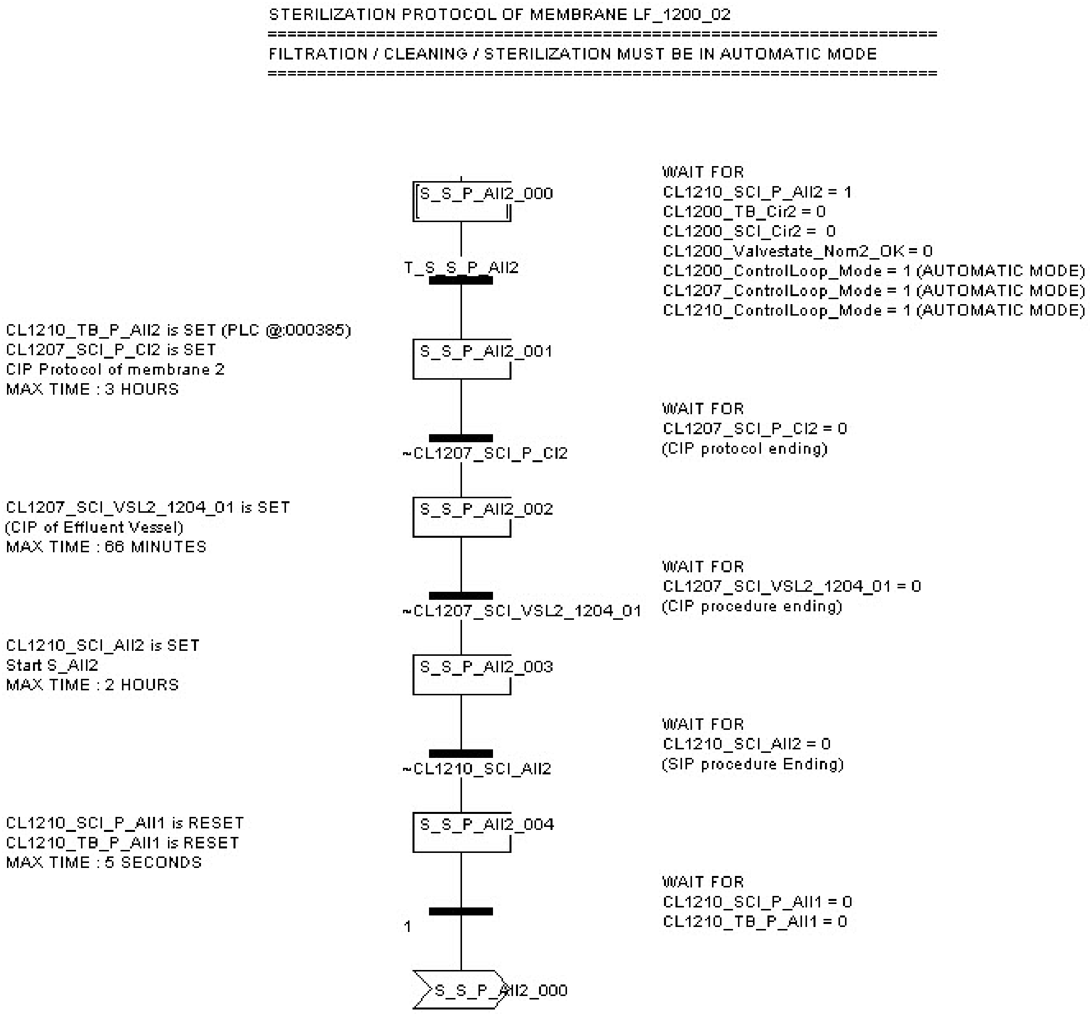
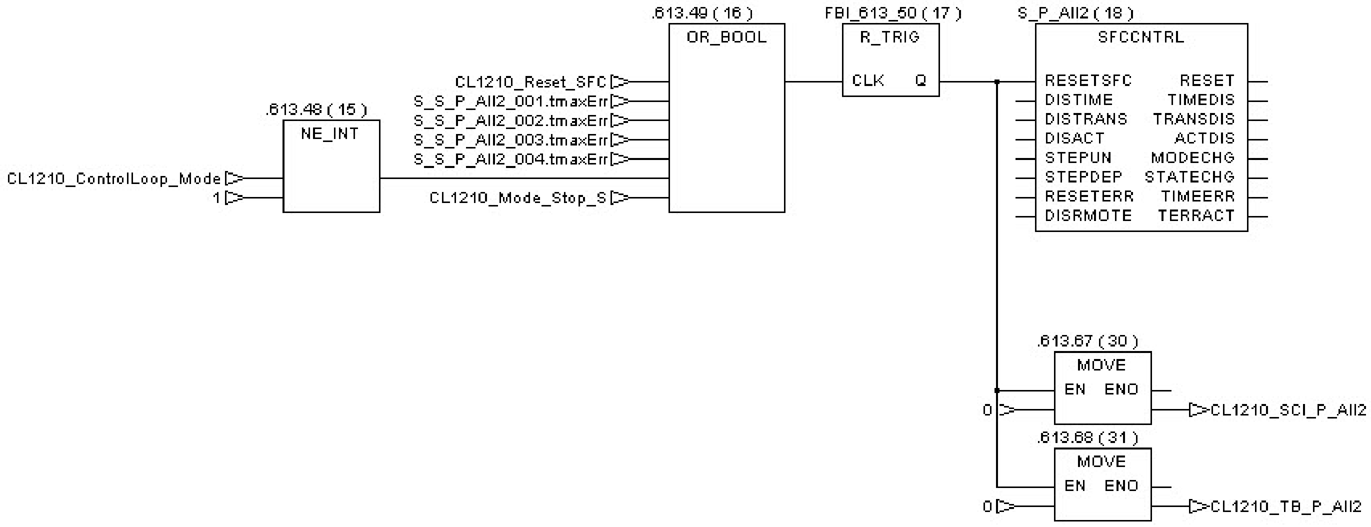


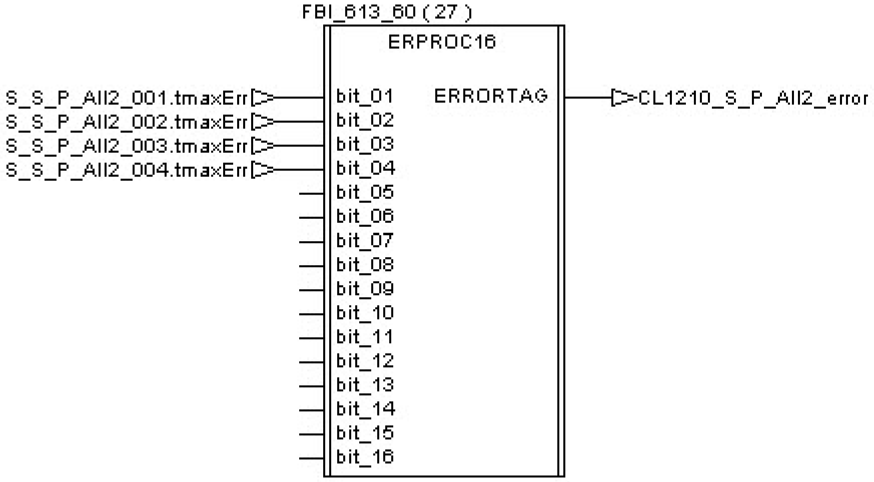
Figure 156: PLC protocol: S_P_All2

5.85.6.Procedure management

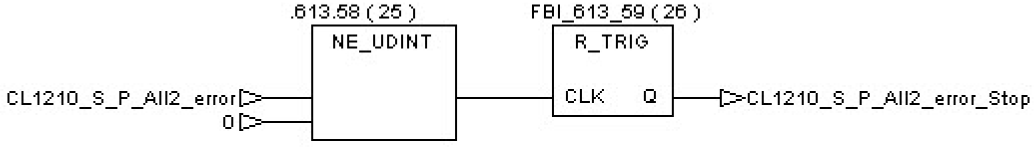
Reset of the procedure:
If a time error occurs during the execution of the procedure, SFC_CNTRL resets the procedure and the tag linked to the procedure.
The same reset is done when the control Loop mode button is triggered to OFF or MANUAL Mode during the procedure execution.



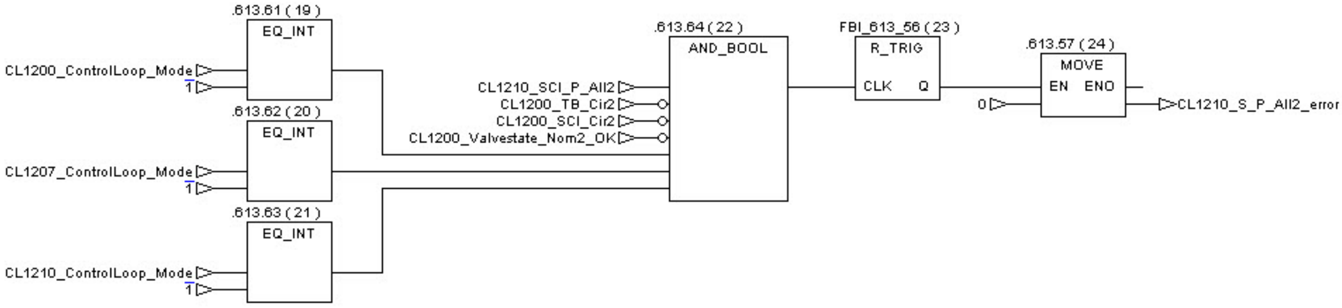
Procedure error management:
The step which triggers the error (When defined time is elapsed) is referenced by a number. The Created block ERPROC16 (detailed in annex) monitors each action step. In case of error, the number is recorded and displayed on the HMI (error code procedure window) to permit the diagnostic of the problem.



If an error is detected during the execution of the procedure, the tag "CL1210_S_P_ALL2_error_Stop" receives a pulse and then the Sterilization Unit is stopped thanks to the procedure "S_Stop".



The error number is displayed until the procedure is re-started.



5.85.7.Error number description

Error number	Procedure Action Step	problem description
1	**S_S_P_All2_001**	Problem during the execution of the protocol "C_P_CL2" (CLEANING PROTOCOL OF MEMBRANE 2) The protocol "C_P_CL2" and one of its procedure called should also have an error code
2	**S_S_P_All2_002**	Problem during the execution of the procedure "C_R_F_01" (CLEANING OF THE EFFLUENT TANK) The procedure "C_R_F_01" should also have an error code
4	**S_S_P_All2_003**	Problem during the execution of the procedure "S_ALL2" (STERILIZATION OF : MEMBRANE LF_1200_02 / FILTRATE LINE / VSL2_1204_01) The procedure "S_ALL2" should also have an error code
8	**S_S_P_All2_004**	Tag reset problem (Tracing bit or Start button)

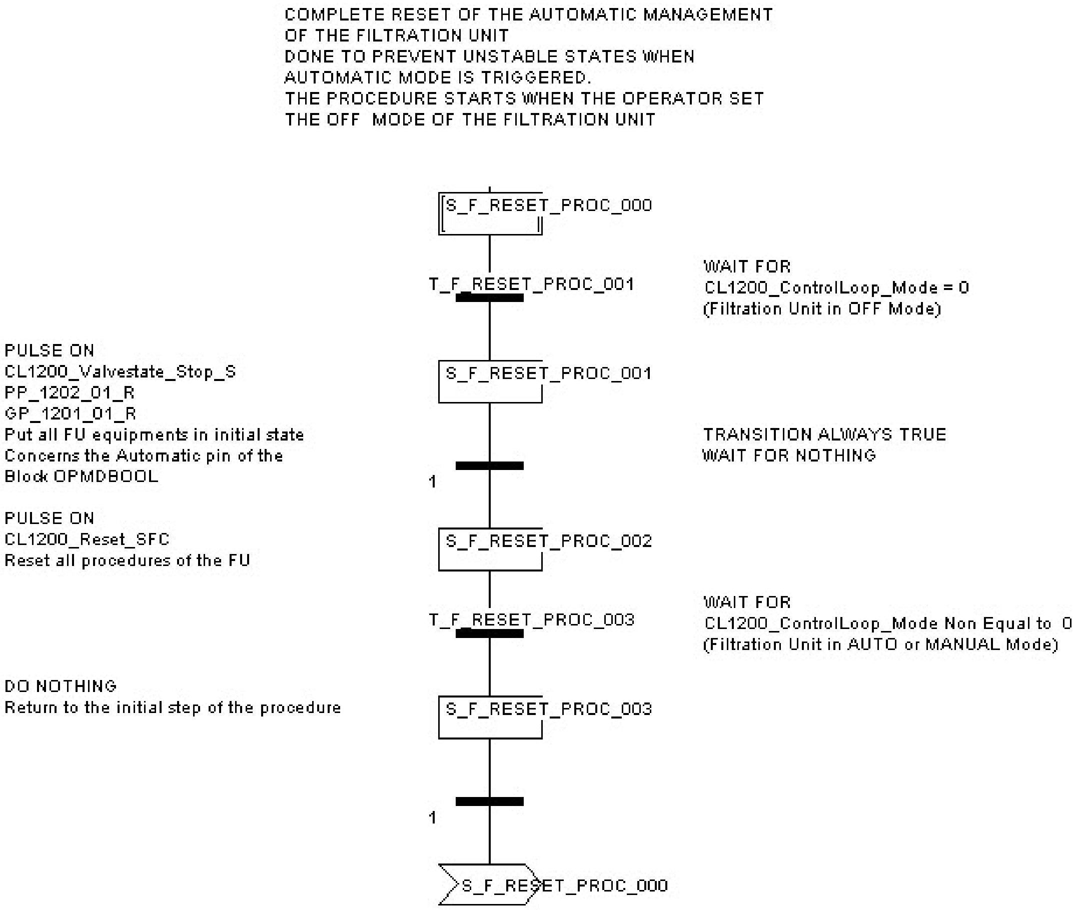
5.86. Procedure 85: Reset automatic control of Filtration Unit

5.86.1.Scope

The aim of this procedure is to reset all the automatic controls (Equipments and Procedures) of the filtration unit. When the Control Loop Mode button is set in OFF mode, the procedure CL1200_RESET_PROC resets all the filtration valves and pumps, sends a pulse on the tag “CL1200_Reset_SFC” (reset all the FU procedures) then waits on action step two (S_F_RESET_PROC_002). The procedure returns to its initial step when the automatic mode or the manual mode is re-started.
Its execution is completely transparent for the operator and ensures a stable state of the automatic mode management.

Used Variables:
CL1200_ControlLoop_Mode

5.86.2.PLC Subroutine: CL1200_RESET_PROC



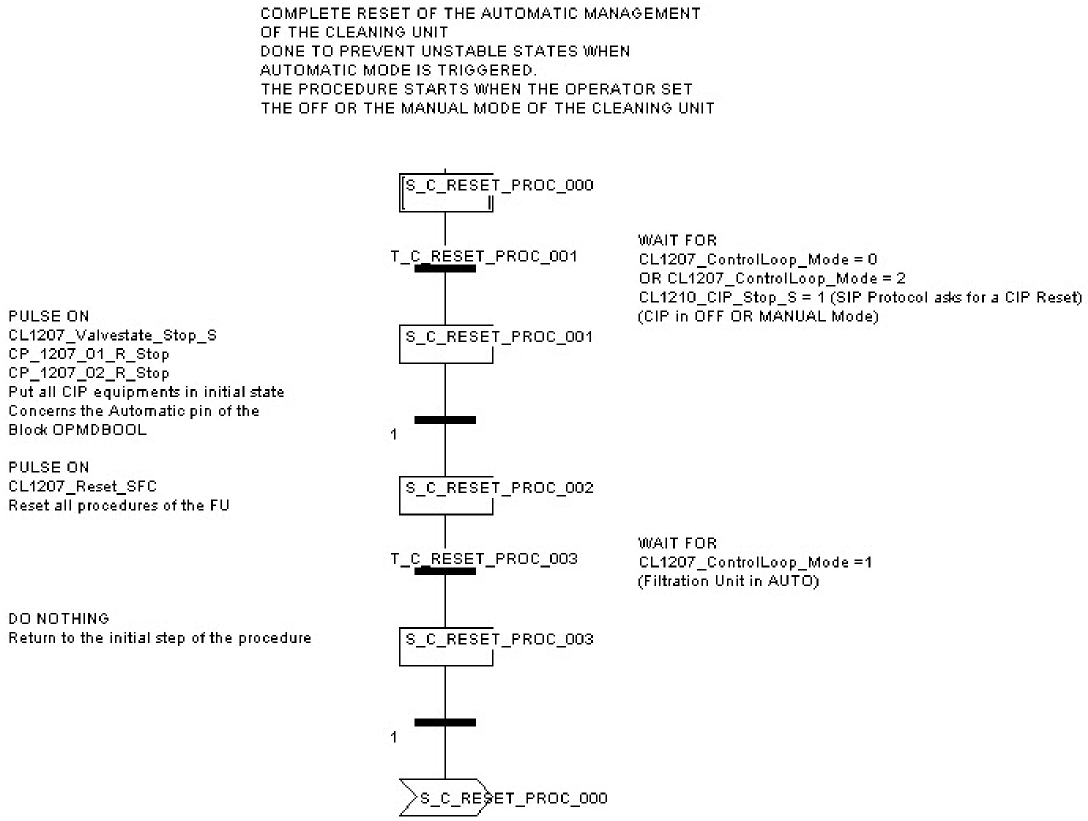
5.87. Procedure 86: Reset automatic control of cleaning Unit

5.87.1.Scope

The aim of this procedure is to reset all the automatic controls (Equipments and Procedures) of the Cleaning unit. When the Control Loop Mode button is set in OFF or MANUAL mode, the procedure CL1207_RESET_PROC resets all the Cleaning valves and pumps, sends a pulse on the tag “CL1207_Reset_SFC” (reset all the CIP procedures) then waits on action step two (S_C_RESET_PROC_002). The procedure returns to its initial step when the automatic mode is re-started.
Its execution is completely transparent for the operator and ensures a stable state of the automatic mode management.

Used Variables:
CL1207_ControlLoop_Mode

5.87.2.PLC Subroutine: CL1207_RESET_PROC



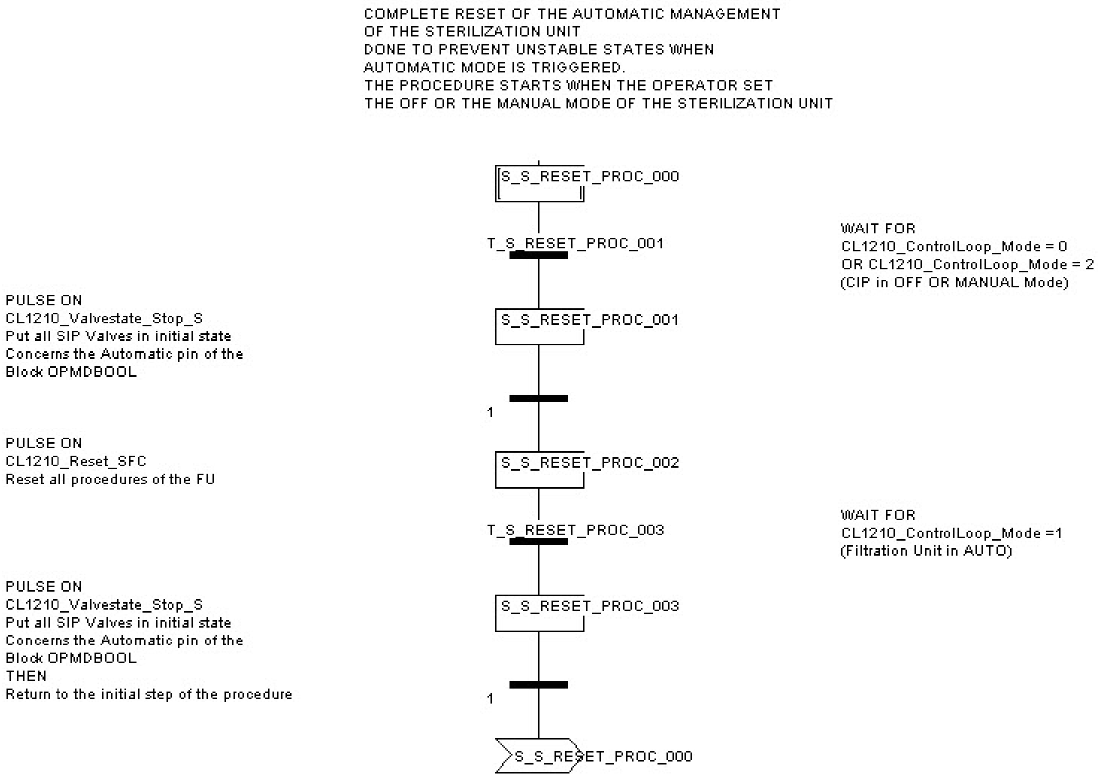
5.88. Procedure 87: Reset automatic control of Sterilization Unit

5.88.1.Scope

The aim of this procedure is to reset all the automatic controls (Equipments and Procedures) of the Sterilization unit. When the Control Loop Mode button is set in OFF or MANUAL mode, the procedure CL1210_RESET_PROC resets all the Sterilization valves and pumps, sends a pulse on the tag “CL1210_Reset_SFC” (reset all the SIP procedures) then waits on action step two (S_S_RESET_PROC_002). The procedure returns to its initial step when the automatic mode is re-started.
Its execution is completely transparent for the operator and ensures a stable state of the automatic mode management.

Used Variables:
CL1210_ControlLoop_Mode

5.88.2.PLC Subroutine: CL1210_RESET_PROC



6. ANNEXES

6.1. Annex A: Predictive Control. PCR description

Predictive Control

This chapter provides information about the general principles of predictive control and general information about PCR.

General Principles of Model Based Predictive Control

Introduction

A Model Based Predictive Controller is a controller that uses a model in real time for the computation of the control action to be applied. The main aspects of this controller are given below.

Model

The model which is embedded in the controller is a mathematical equation that computes a 'model' output which is comparable to the process output PV.
The model represents the relationship linking the process input(s) to the process output.
This model must be identified: the parameters of the model are to be estimated from recorded plant tests.
The model is used to predict the process output and to compute the control action in order to satisfy a given target specified on the PV.

Future Desired Trajectory

At present time (n), the process output is `PV(n)` and the set point value is `SP(n)`. The future desired trajectory (so-called reference trajectory) is the desired behaviour of the process output to move from its present value `PV(n)` to `SP(n)` in the future.

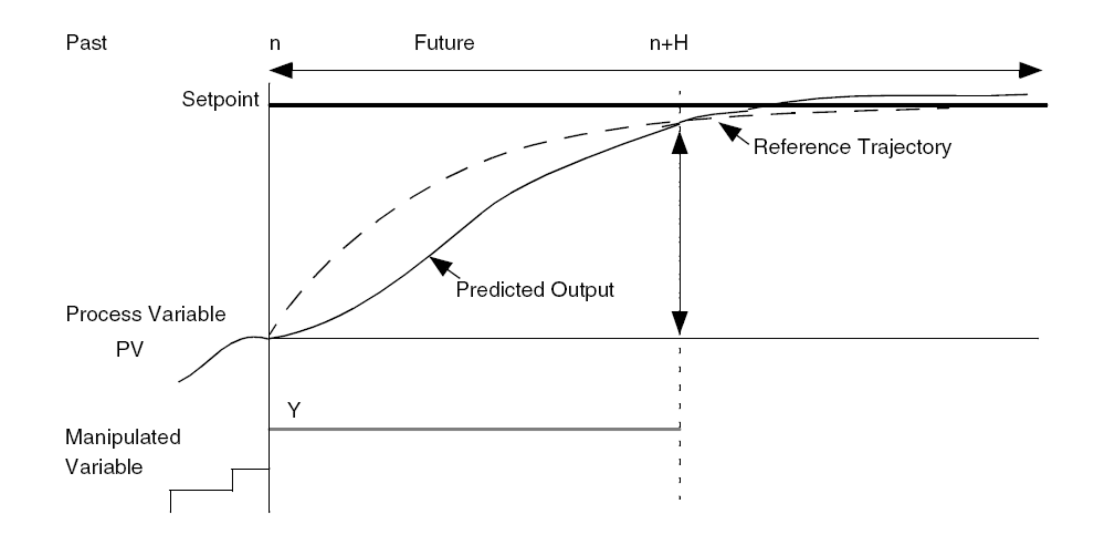


Figure 157: Future desired trajectory

The reference trajectory is computed by a first order system (see above) and the response time of this trajectory is the closed loop response time: the PV will respond to a set point step change with the response time given by the user.
The closed loop response time (TRBF) is a specification which defines the strength or the smoothness of the controller. There is a trade-off between dynamic performance and robustness. The controller is more robust when the specified TRBF is longer.
An intermediate target is selected along that trajectory at a future time (n+H), where H is called the coincidence point. A simple rule for the coincidence point is to set it to the third of the 95% response time: H=TRBF/3.

Solver

The solver is the part of the controller which computes the control action to be applied in such a way the predicted output at time (n+H) is equal to the reference trajectory at the same future instant.
The computed control action takes into account the constraints which limit the input moves (high and low limits and rate of change).

Self Compensation

Some non measured variables may disturb the process.
With unmeasured ramp-type disturbance, a bias between PV and SP may appear. The aim of the self-compensator is to reject this kind of disturbance, and to avoid such a bias.

PCR Description

Introduction

PCR belongs to the Model Based Predictive Control technology and is dedicated to SISO (Single Input Single Output) processes, including feed forwarding facilities.

PCR Design

PCR was initially designed to cope with the control issues met on chemical reactors (batch or continuous). Therefore, that led to some physical modelling of the typical architectures of heat exchanges used on such chemical plants.
The obtained relationships can be represented by non linear first order systems and model based predictive controllers were designed to cope with these targets.
Several complementary functions were developed as complements to these controllers to match the specific requirements of reactor temperature control, such as an efficient SPLIT RANGE module and a smart temperature profile builder linked with a predictive functional controller, which together perform a close tracking of such profiles without overshoots.
Since non linear first order controllers were developed, they can be used profitably on any other kind of SISO process.

Function Blocks

Each PCR module is a programme which is represented as a block with inputs and outputs.
When a control structure is to be integrated, the blocks can be graphically linked (according to the IEC 1131-3 norm) in case of PLCs or DCS boards or embedded into a global programme in case of integration into computers.

6.2. Annex B: PCR_EF1 block

Brief Description

Function Description

PCR_EF1 is an EFB for enhanced control of first order process with pure time delay.
PCR_EF1 algorithm is based on predictive control principles:
An internal model of process is used to predict the future behaviour of the system. The model is composed of 3 parameters:

- KM: static gain
- TM: time constant
- DM: pure time delay

The following constraints on the manipulated variable (Y) can be taken into account:

- YMIN: minimum value for Y
- YMAX: maximum value for Y
- YRATE: maximum variation for Y

Additional Functions

Compared to PCR_SF1, PCR_EF1 provides the following additional functions:
FEED FORWARD COMPENSATION:

- to take in account a disturbance variable (issued from a disturbance modelling, see PCR_FF1, or from an other controller)

SPLIT RANGE COMPENSATION:

- to optimise the association of controllers, see PCR_SR1

SELF COMPENSATOR:

- to reject unmeasured ramp type disturbances

Representation

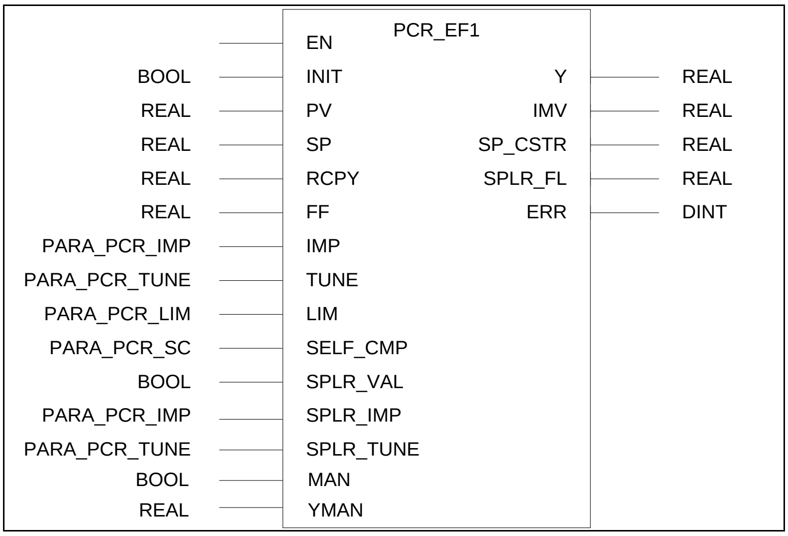


Figure 158: PCR_EF1 block

Parameter Description

Inputs:		
Parameter	**Data Type**	**Meaning**
INIT	BOOL	Command for model INITialization if True
PV	REAL	Process Variable
SP	REAL	Set Point value
RCPY	REAL	ReCoPY of applied Y value
FF	REAL	Feed-forward compensation
IMP	PARA_PCR_IMP	Internal Model Parameters
TUNE	PARA_PCR_TUNE	Predictive control TUNing parameters
LIM	PARA_PCR_LIM	LIMitations on manipulated variable Y
SELF_CMP	PARA_PCR_SC	Self Compensator parameters
SPLR_VAL	BOOL	If True, Split-Range Validation
SPLR_IMP	PARA_PCR_IMP	Internal Model Parameters from associated controller
SPLR_TUNE	PARA_PCR_TUNE	Predictive control TUNing parameters from associated controller
MAN	BOOL	TRUE = Manual mode
YMAN	REAL	Manual Manipulated Variable

Outputs:		
Parameter	**Data Type**	**Meaning**
Y	REAL	Manipulated variable
IMV	REAL	Internal Model Value: process value estimated by model
SP_CSTR	REAL	Set point transferred to upper level
SPLR_FL	REAL	Feed back value for associated controller
ERR	DINT	ERRor code

Type Description

PARA_PCR_IMP: Internal Model Parameters		
Parameter	**Data Type**	**Meaning**
KM	REAL	Static gain
TM	TIME	Time constant
DM	TIME	Pure time delay

PARA_PCR_TUNE: Predictive control TUNing parameters		
Parameter	**Data Type**	**Meaning**
TS	TIME	Sampling time
H	TIME	Coincidence point
TRBF	TIME	95% closed-loop response time

PARA_PCR_LIM: LIMitations on manipulated variable Y		
Parameter	**Data Type**	**Meaning**
YMIN	REAL	MINimum value for Y
YMAX	REAL	MAXimum value for Y
YRATE	REAL	Maximum variation for Y (in unit per second)

PARA_PCR_SC: Self Compensator parameters		
Parameter	**Data Type**	**Meaning**
KSC	REAL	Static gain
TSC	TIME	Time constant

Runtime Errors

Value	Meaning	Behaviour
ERR,0: 1	TS = 0	TS is forced to 1
ERR,1: 2	ABS(KM) < 1.0 e-6	KM is forced to +/- 1.0 e-6
ERR,2: 4	DM < 0	DM is forced to 0
ERR,3: 8	DM > 127 * TS	DM is forced to 127 * TS
ERR,4: 16	YRATE < 0	YRATE is forced to 0
ERR,5: 32	YMAX < YMIN	YMIN <-> YMAX and YRATE is forced to 0
ERR,6: 64	TRBF < 0	TRBF is forced to 0
ERR,7: 128	H < TS	H is forced to TS
Invalid setting in Split Range parameters:		
ERR,8: 256	DM < 0	DM is forced to 0
ERR,9: 512	DM > 127 * TS	DM is forced to 127 * TS
ERR,10: 1024	TRBF < 0	TRBF is forced to 0
ERR,11: 2048	H < TS	H is forced to TS
Invalid setting in Self Compensator parameters:		
ERR,14: 16384	TSC < 0	TSC is forced to 0
ERR,15: 32768	KSC < 0	KSC is forced to 0
ERR,16: 65536	KSC >KSC_MAX	KSC is forced to KSC_MAX (2.0)

The runtime error system uses binary type outputs (power of 2). So you can detect several runtime errors occurring at the same time. The output number is the sum of all ERR bits.

Detailed Description

Cascade Configuration

When a `PCR_EF1` controller is used as a SLAVE controller in a cascaded architecture, it receives a set point from the MASTER controller. If the output Y, computed by the SLAVE controller, is constrained, the MASTER Controller **must know** the value of the set point that can be satisfied by the SLAVE controller.
That value is computed by the SLAVE controller (`SP_CSTR`) and sent back to the master controller.

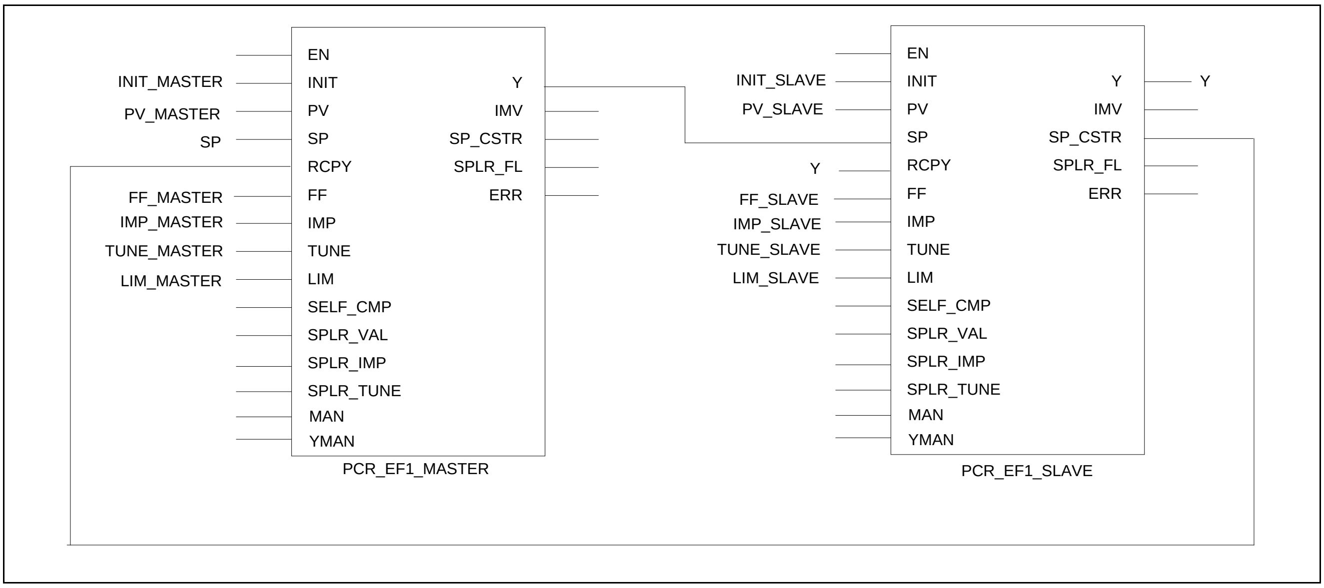


Figure 159: Example of cascade configuration, using PCR_EF1 blocks

Tuning of the Self Compensator Parameters

Some non measured variables may disturb the process. With unmeasured ramp-type disturbance, a bias between `PV` and `SP` may appear. The aim of the self-compensator is to reject this kind of disturbance.
The gain `KSC` and the time constant `TSC` are the parameters of the `PARA_PCR_SC` structure used with the `SELF_CMP` input.
For stability sake, usual values are:
$0 \leq KSC \leq 1$ (KSC=0 means no Self Compensation)
$TSC \geq \max(30*TS, 3*TM, TRBF)$

6.3. Annex C: PCR_IF1 block

Brief Description

Function Description

PCR_IF1 is an EFB for control of integrative first order process with pure time delay. The algorithm is based on predictive control principles:
An internal model of process is used to predict the future behaviour of the integrative system with delay. The model is composed of 3 parameters (see Figure 160):

- KM: static gain
- TM: time constant
- DM: pure time delay

The integrative part is decomposed. This is tuned by DECOMP input. For stability sake, it is better to set this input at the maximum value among: 30*TS, 3*TM, TRBF
The following constraints on the manipulated variable (Y) can be taken into account:

- YMIN: minimum value for Y
- YMAX: maximum value for Y
- YRATE: maximum variation for Y

Transfer Function

The continuous transfer function of the internal model is:

$$u \rightarrow \boxed{\frac{KM}{s \cdot (1 + TM.s)} \cdot e^{-DM \cdot s}} \rightarrow y_m$$

Figure 160: integrative 1st order model

Note for initialization

When the process variable PV varies as a ramp before switching on the controller, it is necessary to estimate the slope of this process variable PV in order to initialize correctly the model. This estimation is performed during the initialization phase, as long as INIT equals TRUE. The duration of this phase must be long enough to perform an estimation not biased by the noise. In case of heavy noise, more than ten periods may be required.

Representation

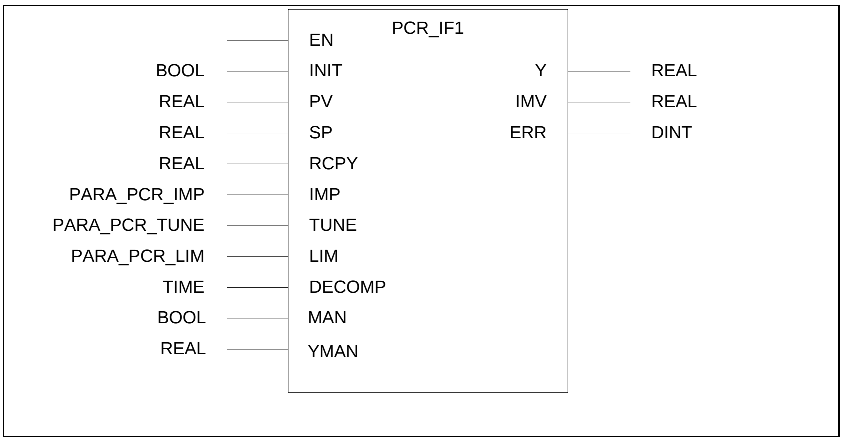


Figure 161: PCR_IF1 block

Parameter Description

Inputs:		
Parameter	**Data Type**	**Meaning**
INIT	BOOL	Command for model INITialization if True
PV	REAL	Process Variable
SP	REAL	Set Point value
RCPY	REAL	ReCoPY of applied Y value
IMP	PARA_PCR_IMP	Internal Model Parameters
TUNE	PARA_PCR_TUNE	Predictive control TUNing parameters
LIM	PARA_PCR_LIM	LIMitations on manipulated variable Y
DECOMP	TIME	Decomposition time constant
MAN	BOOL	TRUE = Manual mode
YMAN	REAL	Manual Manipulated Variable

Outputs:		
Parameter	**Data Type**	**Meaning**
Y	REAL	Manipulated variable
IMV	REAL	Internal Model Value: process value estimated by model
ERR	DINT	ERRor code

Type Description

PARA_PCR_IMP: Internal Model Parameters		
Parameter	**Data Type**	**Meaning**
KM	REAL	Static gain

TM	TIME	Time constant
DM	TIME	Pure time delay

PARA_PCR_TUNE: Predictive control TUNing parameters		
Parameter	**Data Type**	**Meaning**
TS	TIME	Sampling time
H	TIME	Coincidence point
TRBF	TIME	95% closed-loop response time

PARA_PCR_LIM: LIMitations on manipulated variable Y		
Parameter	**Data Type**	**Meaning**
YMIN	REAL	MINimum value for Y
YMAX	REAL	MAXimum value for Y
YRATE	REAL	Maximum variation for Y (in unit per second)

Runtime Errors

Value	Meaning	Behaviour
ERR,0: 1	TS = 0	TS is forced to 1
ERR,1: 2	ABS(KM) < 1.0 e-6	KM is forced to +/- 1.0 e-6
ERR,2: 4	DM < 0	DM is forced to 0
ERR,3: 8	DM > 127 * TS	DM is forced to 127 * TS
ERR,4: 16	YRATE < 0	YRATE is forced to 0
ERR,5: 32	YMAX < YMIN	YMIN <-> YMAX and YRATE is forced to 0
ERR,6: 64	TRBF < 0	TRBF is forced to 0
ERR,7: 128	H < TS	H is forced to TS
ERR,8: 256	DECOMP < 0	Decomposition time constant DECOMP is forced to 0

The runtime error system uses binary type outputs (power of 2). So you can detect several runtime errors occurring at the same time. The output number is the sum of all ERR bits.

6.4. Annex D: PCR_ZTR block

Brief Description

Function Description

PCR_ZTR is an EFB for changing automatically the Closed-loop Time-Response (TRBF) when the process variable PV is inside or outside a zone.
PCR_ZTR algorithm is based on basic principle:
When the PV is outside the zone, TRBF is set to TRBF_LO. The Controller will put the system back inside the zone.
When the PV is inside the zone, TRBF varies linearly between TRBF_LO and TRBF_HI as a function of the (PV-SP) deviation.

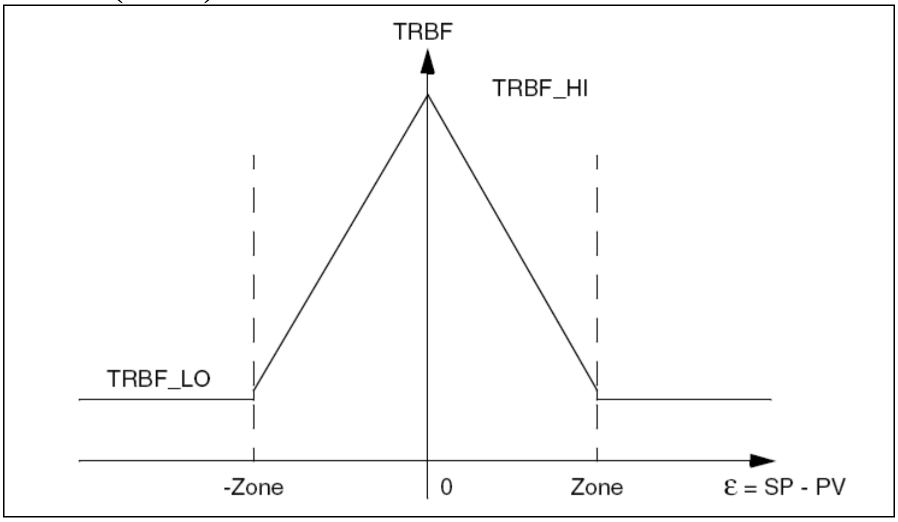


Figure 162: Evolution of TRBF

Representation

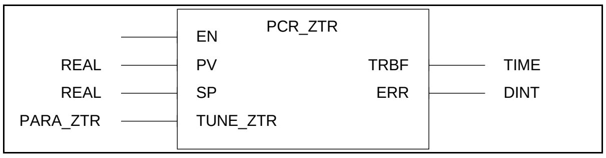


Figure 163: PCR_ZTR block

Parameter Description

Inputs:		
Parameter	**Data Type**	**Meaning**
PV	REAL	Process Variable
SP	REAL	Set Point value
TUNE_ZTR	PARA_ZTR	ZTR Parameters

Outputs:		
Parameter	**Data Type**	**Meaning**
TRBF	TIME	95% closed-loop response time
ERR	DINT	ERRor code

Type Description

PARA_ZTR: ZTR Parameters		
Parameter	**Type**	**Meaning**
ZONE	REAL	Zone value
TRBF_LO	TIME	TRBF Low value
TRBF_HI	TIME	TRBF High value

Runtime Errors

Value	Meaning	Behaviour
ERR,0: 1	TRBF_HI<TRBF_LO	TRBF_HI is set to TRBF_LO
ERR,1: 2	ZONE < 0	ZONE is set to 0

The runtime error system uses binary type outputs (power of 2). So you can detect several runtime errors occurring at the same time. The output number is the sum of all ERR bits.

Detailed Description

Principles

The zone control is a way to obtain a smoother controller when the PV is rather close to its set point in order to avoid active control actions produced by noisy measurements.
The controller is thus less active than when the PV is far from the set point. This technique is not equivalent to a dead zone which does not act as long as the PV is within the dead zone.
The zone control does not leave any constant deviation. It will make the PV move back slowly to the set point value.
When PV is outside the zone, the TRBF is set to TRBF_LO (fastest response)
When PV is inside the zone, TRBF is computed as follows:
`TRBF = TRBF_HI – (TRBF_HI – TRBF_LO) x |EPS| / ZONE`
with: `EPS = SP – PV`
This continuous variation of TRBF with EPS avoids bumps when crossing the zone borders and makes the controller strength proportional to the deviation.

Usage

The output TRBF is to be one of the parameters of the PARA_PCR_TUNE of a controller block.

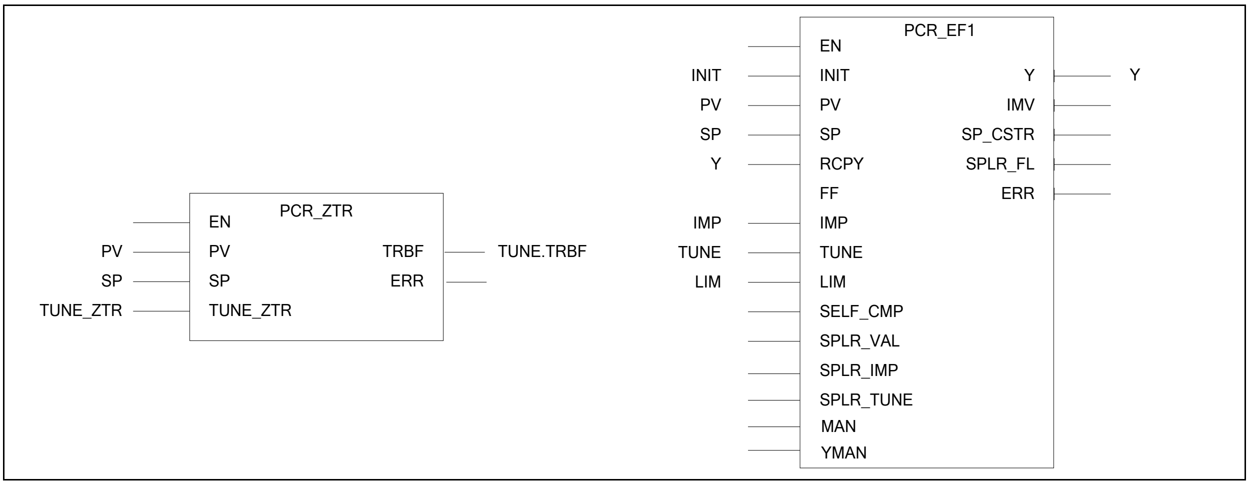


Figure 164: Use of zone control with a PCR_EF1 block

6.5. Annex E: PWM Block

Brief description

Reference: Schneider - "Concept software documentation"

Block usage
Actuators are driven not only by analog quantities, but also through binary actuating signals. The conversion of analog values into binary output signals is achieved for example, through pulse width modulation (PWM) or pulse duration modulation (PDM).In this context, the preset mean energy level of the actuator is to correspond to the analog input value (X) of the block.

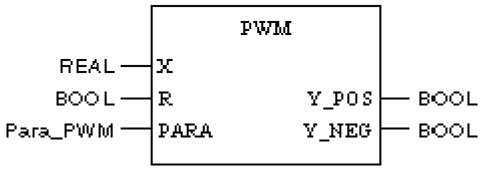
Function description
The function block PWM serves to convert analog values into digital output signals for Concept. In pulse width modulation (PWM), a 1-signal is emitted, at a constant clock rate, for a duration that is a function of the analog value. The adjusted average energy corresponds to the quotient of the fixed duty cycle T_on and the variable cycle period. In order that the adjusted average energy also corresponds to the analog input variable X, the following must apply:
$T\_on \sim X$
EN and ENO can be projected as additional parameter

Display

General information about the actuator drive
In general, the binary actuator drive is performed by two binary signals Y_POS and Y_NEG. On a motor the output Y_POS corresponds to the signal "clockwise rotation" and the output Y_NEG the signal "counter-clockwise rotation". For an oven the outputs Y_POS and Y_NEG could be interpreted as corresponding to "heating" and "cooling". Should the actuating drive in question be a motor, it is possible that to avoid over travel for non-self-locking gearboxes, a brake pulse must be output after the engage signal. In order to protect the power electronics, there must be a pause time after switching on T_on and before the brake impulse t_brake so as to avoid short circuits.

Symbol

Block display



PWM parameter description

Block parameter description

Parameter	Data type	Meaning
X	REAL	Input variable
R	BOOL	Reset mode ("1" = Reset)
PARA	Para_PWM	Parameter
Y_POS	BOOL	Positive X value output
Y_NEG	BOOL	Negative X value output

Parameter description Para_PWM

Data structure description

Element	Data type	Meaning
t_period	TIME	Length of period
t_pause	TIME	Pause time
t_brake	TIME	Braking time
t_min	TIME	Minimum actuating pulse time (in sec)
t_max	TIME	Maximum actuating pulse time (in sec)
up_pos	REAL	Upper limiting value for positive X values
up_neg	REAL	Upper limiting value for negative X values

Formulas

The pulse length for Y_POS and Y_NEG

The pulse length T_on for output Y_pos amd Y_neg is determined by the following equations:

Output	Formula	Condition
Y_POS	$T\_on = t\_period \times \frac{X}{up\_pos}$	$0 \leq X \leq up\_pos$
Y_NEG	$T\_on = t\_period \times \frac{\lvert X \rvert}{up\_neg}$	$up\_neg \leq -X \leq 0$

Parametering rule

For correct operation the following rules should be observed:

- $(2 \times t\_pause + t\_brake + t\_max) \leq t\_period$
- From the parameters up_pos and up_neg only the value is evaluated.

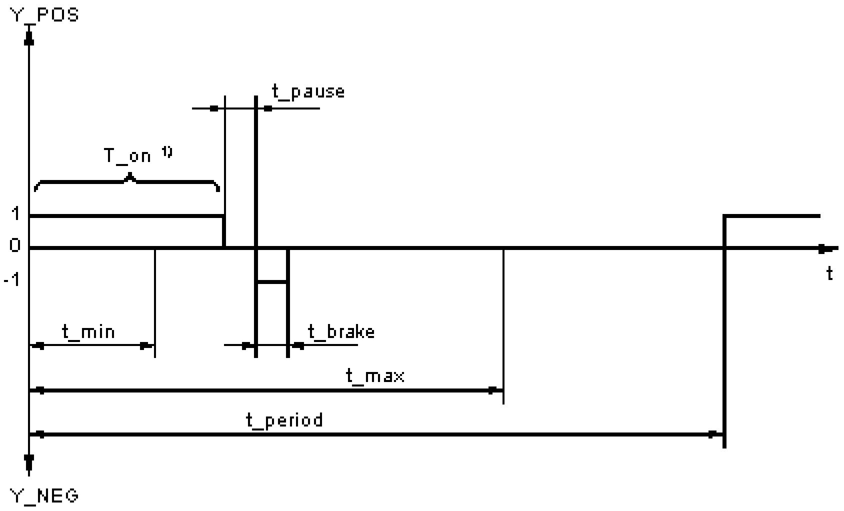
Detailed description

Block mode of operation

The period determines the time, in which the actuating pulses ("1" signal on output Y_POS resp. Y_NEG) are regularly output, i.e. in a constant time-slot pattern. The parameter t_min specifies the minimum pulse length, i.e. the shortest time span for which the output Y_POS and/or Y_NEG should carry "1" signal. If the length of impulse calculated according to the equation in the section "Formulas" is shorter than t_min, then there will be no impulse throughout the whole period. The parameter t_max specifies the minimum pulse length, i.e. the shortest time span in which the output Y_POS resp. Y_NEG should carry "1" signal. Pulse output length is then limited to t_max, should the pulse duration calculated by the above stated formula be greater. It is advisable to perform a freely definable pause time of t_pause = 10 or 20 ms between the actuating and brake pulses to protect the power electronics (hopefully preventing simultaneous firing of the anti parallel connected thyristors).Parameter t_pause specifies the time interval that should be waited after the "1" signal on output Y_POS (Y_NEG), before the opposite output Y_NEG (Y_POS) goes to "1" signal for time span t_brake. The action in question here is a brake pulse, which should take place after the pause time. A pause time of t_pause = 20 ms (t_pause =0.02) corresponds to an interruption of the firing angle control for two half waves. That should guarantee a sufficiently large safety margin for the prevention of short-circuits resp. triggering of the suppressor circuitry as a consequence of antiparallel thyristors firing.

Time ratios display

An overview of the ratios between times is shown in the following diagram:



1 Variable turn-on time. The parameter up_pos mark those positive values of input variable X, for which output Y_POS would continuously carry "1", assuming:

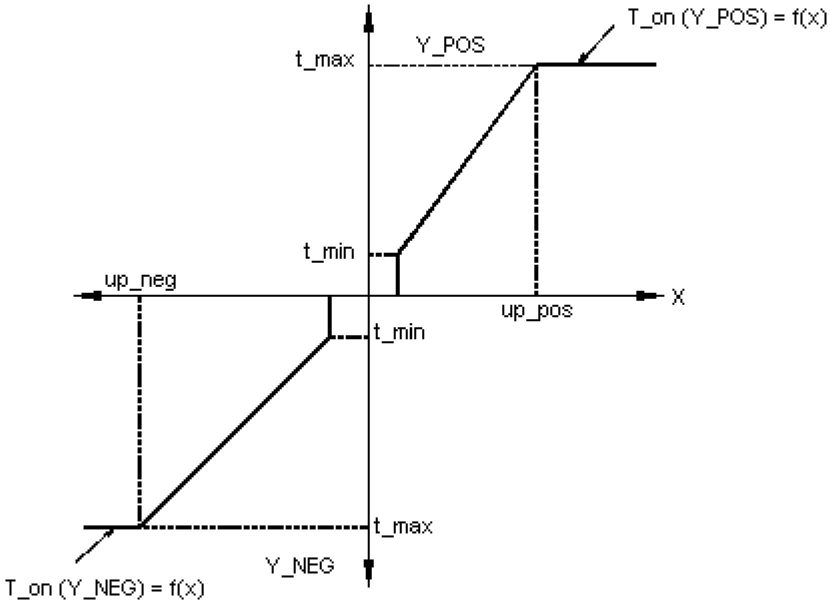
t_pause = t_brake = 0 and t_max = t_period.

The parameter up_neg mark those positive values of input variable X, for which output Y_NEG would continuously carry "1", assuming:

t_pause = t_brake = 0 and t_max = t_period.

Time-span dependency

The dependency of the time duration in which the output Y_POS (Y_NEG) carries a 1-signal, on the input variable X is illustrated in the following diagram (again the figure has put t_pause = t_brake = 0)



Operating mode

In reset mode R = "1", outputs Y_POS and Y_NEG are set to "0" signal. The internal time meters are also standardized, so that the function block begins the transfer to R=0 with the output of a new 1 signal on the associated output.

Boundary conditions

If the PWM block is operated together with a PID controller, then the period t_period should be so selected, that it corresponds to the PID controller's scan time. It is then guaranteed that every new actuating signal from the PID controller within the period time can be fully processed. The PDM scan time should be in proportion with the period vs. pulse time. Though this the smallest possible actuating pulse will be specified. The following ratio is recommended:

t_period/scan time (PWM) >= 10

Example for the PWM block

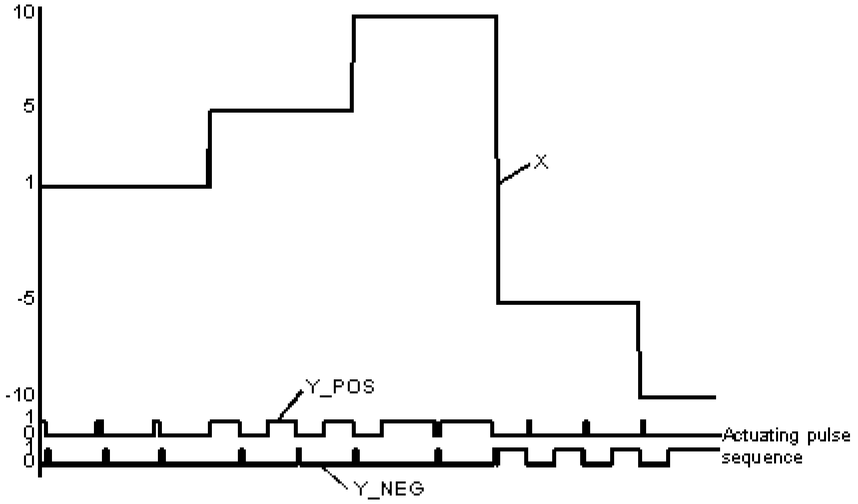
Overview
In the examples, the signal sequences on the outputs Y_POS and Y_NEG are shown for various X input signal values. The examples differ with respect to their selected parameter assignments. The following examples on the PMW function block are to be found in this section
Step Response 1
Step Response 2

Step Response 1

The following parameter specifications apply to the step response 1 display:

Parameter	Settings
t_period	4 s
t_min	0,2 s
t_max	3,8 s
t_pause	0.1 s
t_brake	0.2 s
up_pos	10
up_neg	10

Step Response 1 timing diagram



X analog signal

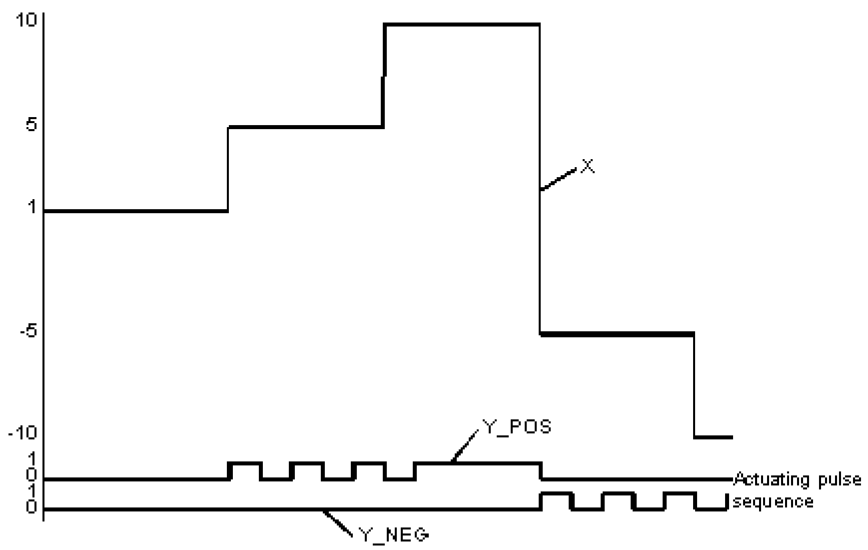
It is easily seen that the time span in which output Y_POS carries "1" signal is directly proportional to input signal X. In addition, it can be seen that a short Y_NEG-signal follows every Y_POS signal, and vice versa. This can be attributed to the non-"0" t_brake parameter. Y_NEG output time span is directly proportional to negative X input signal values. A short Y_POS pulse as brake pulse also follows the Y_NEG pulse here as well.

Step Response 2

The following parameter specifications apply to the step response 2 display:

Parameter	**Settings**
t_period	4 s
t_min	0.5 s
t_max	4 s
t_pause	0 s
t_brake	0 s
up_pos	10
up_neg	10

Step Response 2 timing diagram



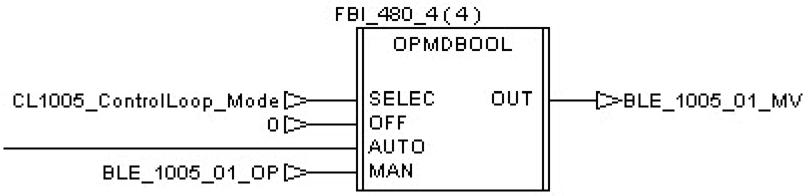
X analog signal

The difference to the example "step response 1" is, that here the pause and brake pulses are dropped, as here the appropriate parameters were configured to "0". It is noticeable that pulses are no longer output for very small X input signals. This is directly attributable to the effect of time t_min. Moreover a continuous pulse is output for large X input signals (X = up_pos or up_neg). This is related to having selected t_max = t

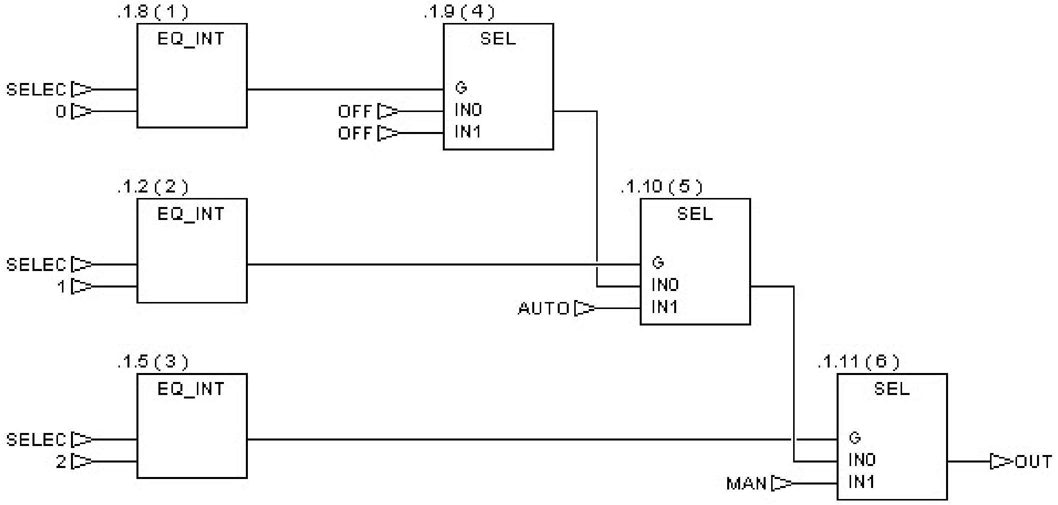
6.6. Annex F: Created Concept Blocks

6.6.1.“OPMDBOOL” block

The block OPMDBOOL manages the Boolean equipment without feedback depending on the Control Loop mode selection (OFF/MANUAL/AUTOMATIC).
The variable used as selector (named “CLxxxx_ControlLoop_Mode”) is an “Integer”. Depending on its value, the output of the block will be managed by the input OFF (value 0), AUTO (value 1) or MAN (value 2).



Internally, three selector blocks manage the input which will control the output.



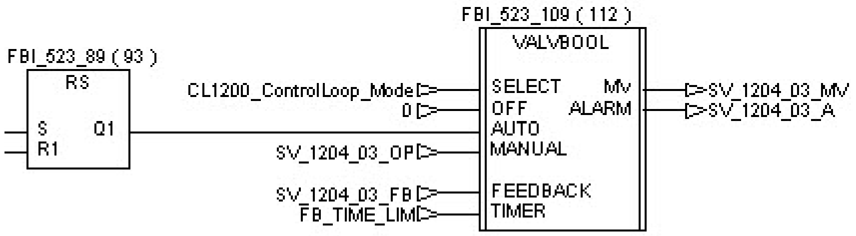
6.6.2. "VALVBOOL" block

The "VALVBOOL" block manages Boolean equipments with feedback. The logic of the input selection is the same than the "OPMDBOOL" block described above.
A variable used as selector (named "CLxxxx_ControlLoop_Mode") is an "Integer". Depending on its value, the output of the block will be managed by the input OFF (value 0), AUTO (value 1) or MAN (value 2).
An additional function is added to provide the alarm management. This function is implemented thanks to the ACT_DIA. This block triggers an output depending on the state of two inputs and a defined time.
The two added inputs are:

- The Feedback of the equipment (FEEDBACK)
- The time limit triggering the alarm (TIME)

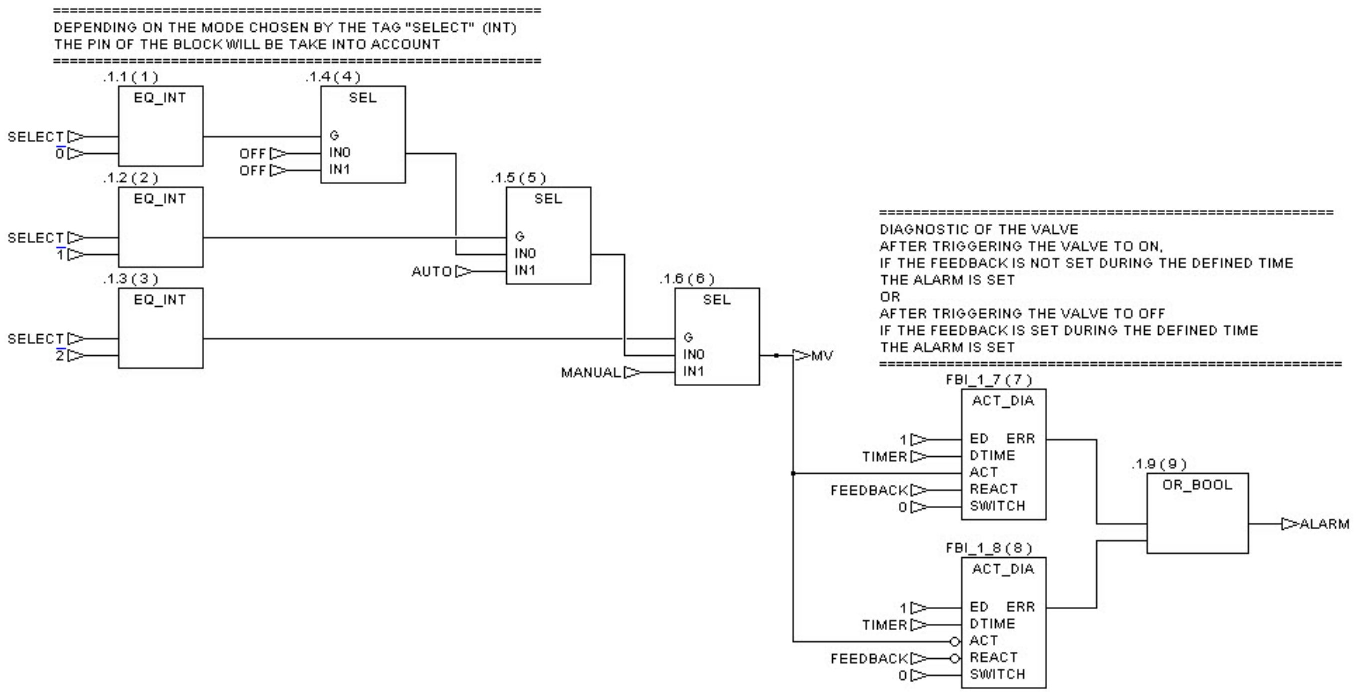
The output added is:

- The equipment alarm.



Internally, the output of the equipment is connected to two ACT_DIA blocks.
The alarm output is set if the two following condition happens:

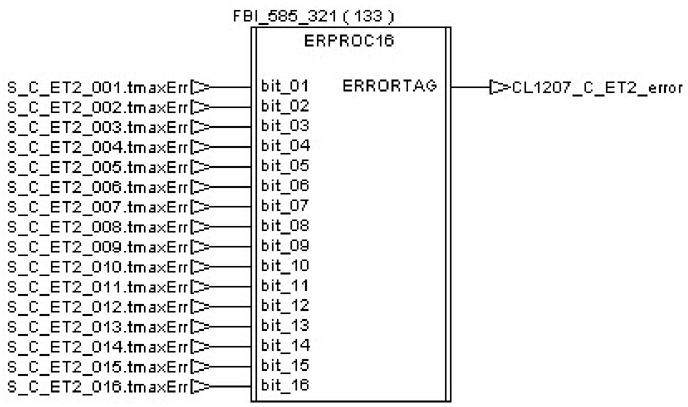
1- The equipment is set and its feedback is still reset after the defined time.
2- The equipment is reset and its feedback is still set after the defined time.



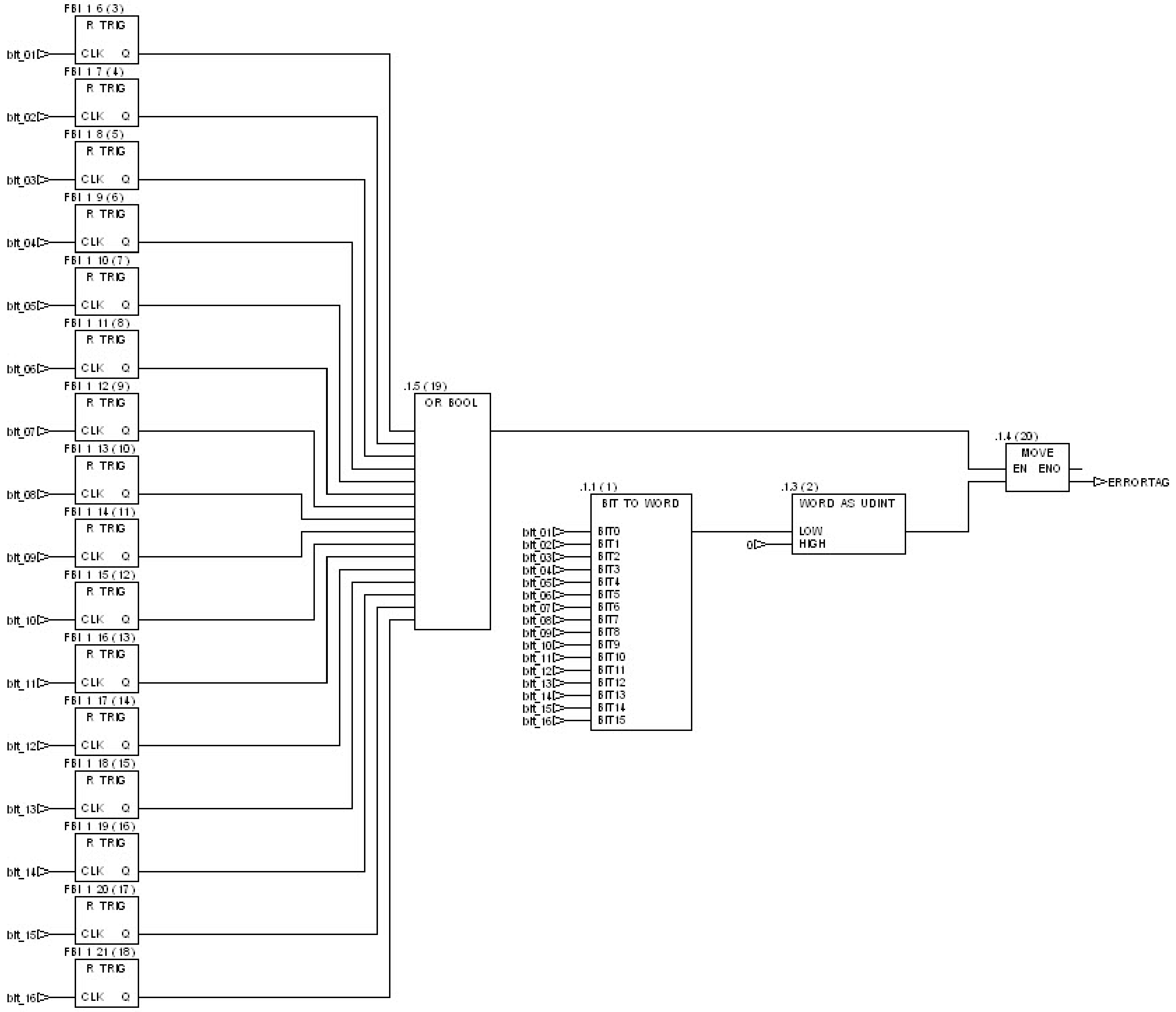
6.6.3.“ERPROC16” block

The block “ERPROC16” permits to record the error code number linked to a procedure failure. During the procedure execution each action proceeds is controlled by a defined time. If this time is elapsed, the procedure is reset and the responsible step is referenced by an error code.

Example:

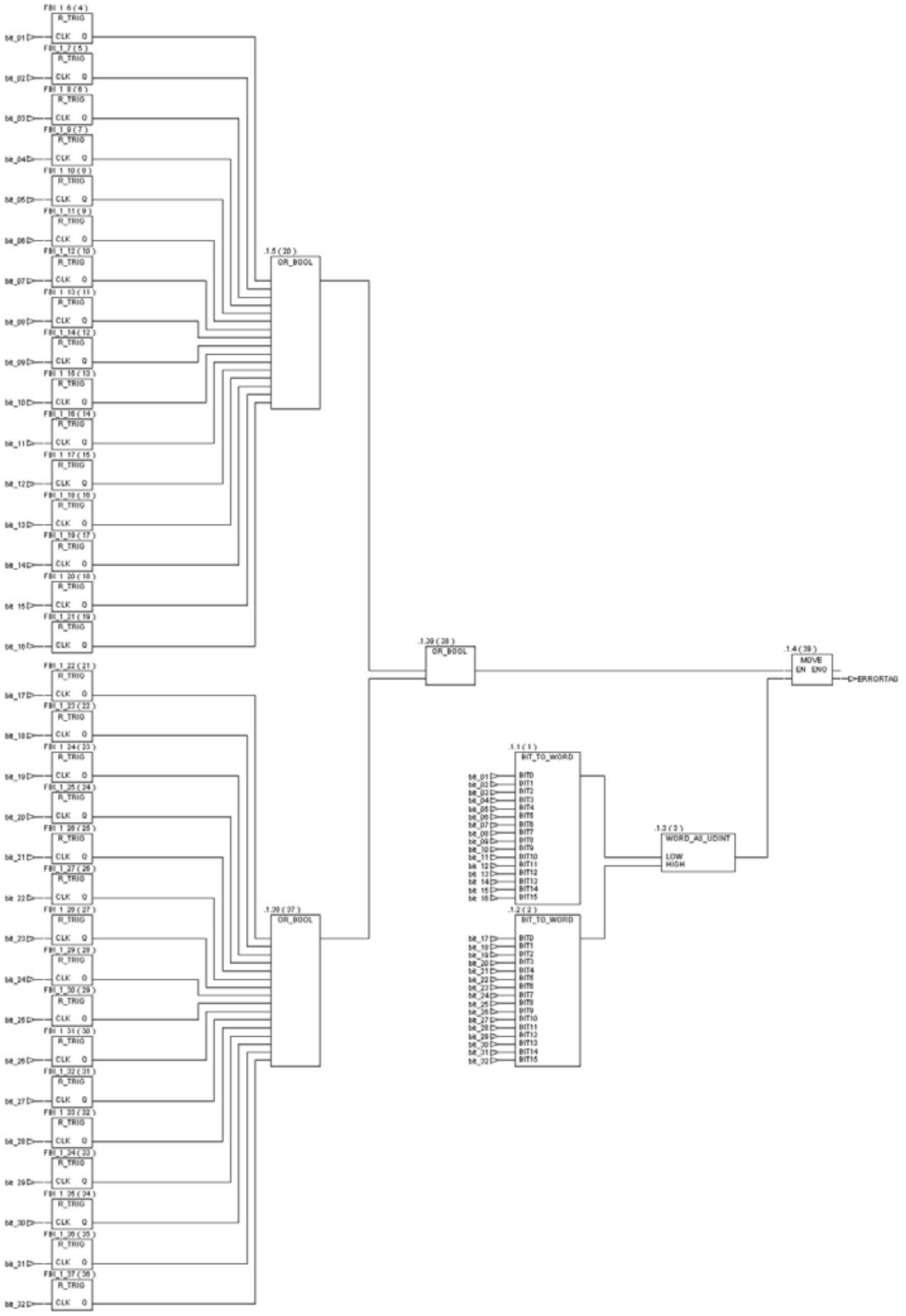


Internally, each step represents a bit of a word (16 bits). When an error appears, the "R_TRIG" block sends a pulse and activates for one PLC Cycle a "MOVE block". At the same time, the same bit is recorded as a UDINT (Unsigned integer variable: 32 bits) in the tag situated at the output of the "ERPROC16" block.
As the output of the block is no more activated after the pulse, the error is frozen. The reset of this error variable is done when the procedure is re-started.



6.6.4.“ERPROC32” Block

The logic is exactly the same than the “ERPROC16” block, but 16 bit entries are added. The internal logic is adjusted to provide the recording error function.



6.7. Annex G: PLC Card configuration

P L C - C o n f i g u r a t i o n

PLC Selection

PLC Type	140 CPU 434 12
Exec Id	883
Memory Size	64 K logic
Extended Memory	96K
IEC Runtime	Enabled
IEC Usable Memory Size	892

PLC Memory Partition

Coils	(0x)	1536	000001-001536
Discrete Inputs	(1x)	512	100001-100512
Input registers	(3x)	512	300001-300512
Holding registers	(4x)	1872	400001-401872

ASCII Setup

Total Message	0
Message area size	0
ASCII Ports	0

Configuration Extensions

Data Protection	No
Peer Cop	No
Hot Standby	No
Ethernet	1
Profibus DP	No

Specials

Battery Coil	No
Timer Register	No
Time Of Day	400763 - 400770
Duplicate coils	No
First Coil Address	-
Watchdog Timeout [ms*10]	30
Online Editing Timeslice [ms]	20

Ethernet Parameters								
Slot	Module Name	IP Cfg	Internet Addr	Subnet Mask	Gateway Addr	Frame Type	Health Block	Diag Block
1-3	140-NOE-771-01	Specify	172.016.000.129	255.255.255.000	172.016.000.001	Ethernet II		

Modbus Port Settings (Bridge Mode: Yes)									
Port	Baudrate	Data bits	Stop bits	Parity	Delay (ms)	Address	Head Slot	Mode	Protocol
1	19200	8	1	even	10	1	0	RTU	RS232
2	9600	8	1	even	10	1	0	RTU	RS232
3	9600	8	1	even	10	1	0	RTU	RS232

I / O Map

Remote (Head slot 0)							
Drop	Type	Modules	Holdup [ms]	Input-Bits	Output-Bits	Status Reg.	Activate
1	Quantum I/O	16	300	976	192		-

Local Drop

Drop Type: Quantum I/O Drop 1

Slot	Module name	Input Range	Output Range	Module description	In/Out-Type	Timeout-State
1-1	CPS-114-x0			AC PS 115V/230 8A, CPS114-10 summab>		
1-3	NOE-771-01			ENET 10/100 TCP/IP I/O Scanner		
1-4	ACI-040-00	300001-300017		Analog Input 16 Ch Current		
1-5	ACI-040-00	300018-300034		Analog Input 16 Ch Current		
1-6	ACI-040-00	300035-300051		Analog Input 16 Ch Current		
1-7	ACO-020-00		400001-400004	Analog Output 4 Ch Current		
1-8	DDI-353-00	100001-100032		DC Input 24V 4x8	BIN	
1-9	DDI-353-00	100033-100064		DC Input 24V 4x8	BIN	
2-1	CPS-114-x0			AC PS 115V/230 8A, CPS114-10 summab>		
2-2	DDI-353-00	100065-100096		DC Input 24V 4x8	BIN	
2-3	DDI-353-00	100097-100128		DC Input 24V 4x8	BIN	
2-4	DDO-353-00		000001-000032	DC Output 24V 4x8	BIN	0000 0000
2-5	DDO-353-00		000033-000064	DC Output 24V 4x8	BIN	0000 0000
2-6	DDO-353-00		000065-000096	DC Output 24V 4x8	BIN	0000 0000
2-7	DDO-353-00		000097-000128	DC Output 24V 4x8	BIN	0000 0000
2-8	DDI-353-00	100129-100160		DC Input 24V 4x8	BIN	

Parameter ACI-040-00 (Slot 1-4)

Channel	Range	Channel	Range
1	4..20mA, 0-16000	9	4..20mA, 0-16000
2	4..20mA, 0-16000	10	4..20mA, 0-16000
3	4..20mA, 0-16000	11	4..20mA, 0-16000
4	4..20mA, 0-16000	12	4..20mA, 0-16000
5	4..20mA, 0-16000	13	4..20mA, 0-16000
6	4..20mA, 0-16000	14	4..20mA, 0-16000
7	4..20mA, 0-16000	15	4..20mA, 0-16000
8	4..20mA, 0-16000	16	4..20mA, 0-16000

Parameter ACI-040-00 (Slot 1-5)

Channel	Range	Channel	Range
1	4..20mA, 0-16000	9	4..20mA, 0-16000
2	4..20mA, 0-16000	10	4..20mA, 0-16000
3	4..20mA, 0-16000	11	4..20mA, 0-16000
4	4..20mA, 0-16000	12	4..20mA, 0-16000
5	4..20mA, 0-16000	13	4..20mA, 0-16000
6	4..20mA, 0-16000	14	4..20mA, 0-16000
7	4..20mA, 0-16000	15	4..20mA, 0-16000
8	4..20mA, 0-16000	16	4..20mA, 0-16000

Parameter ACI-040-00 (Slot 1-6)

Channel	Range	Channel	Range
1	4..20mA, 0-16000	9	4..20mA, 0-16000
2	4..20mA, 0-16000	10	4..20mA, 0-16000
3	4..20mA, 0-16000	11	4..20mA, 0-16000
4	4..20mA, 0-16000	12	4..20mA, 0-16000
5	4..20mA, 0-16000	13	4..20mA, 0-16000
6	4..20mA, 0-16000	14	4..20mA, 0-16000
7	4..20mA, 0-16000	15	4..20mA, 0-16000
8	4..20mA, 0-16000	16	4..20mA, 0-16000

Parameter ACO-020-00 (Slot 1-7)

Channel	Input-/Output-Type	Timeout Value
1	Last Value	
2	Last Value	
3	Last Value	
4	Last Value	

MELISSA CI CONTROL CABINET HARDWARE DESIGN DOCUMENT

APPROVAL LIST		
NAME	SIGNATURE	DATE
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Revised by: Jordi Carbonell Marti Bassas		
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Arnaud Fossen		MPP

CHANGE RECORD			
AUTHOR	ISSUE	DATE	CHANGE
Toni López			First Version

CONTENTS

1. acronyms list

MELISSA	Micro-Ecological Life support System Alternative
MPP	MELISSA Pilot Plant
CI	Compartment I
VR	Vessel Reactor
FR	Filtration Reactor
HMI	Human Machine interface
IFix	Commercial supervision software
MAGELIS	Panel pc from Schneider
Panel pc	Small touch screen and embedded pc all in one.
DI	Digital Input
DO	Digital Output
AI	Analog Input
AO	Analog Output
AVI	Analog Voltage Input
ACI	Analog Current Input
GPIO	General Purpose Input Output

2. MELISSA CI system overview

MELISSA Compartment I (CI) is first compartment of MELISSA loop. This compartment transform wastes to CO2 and volatile fatty acids. See Figure 1 and MELISSA documentation to further information.

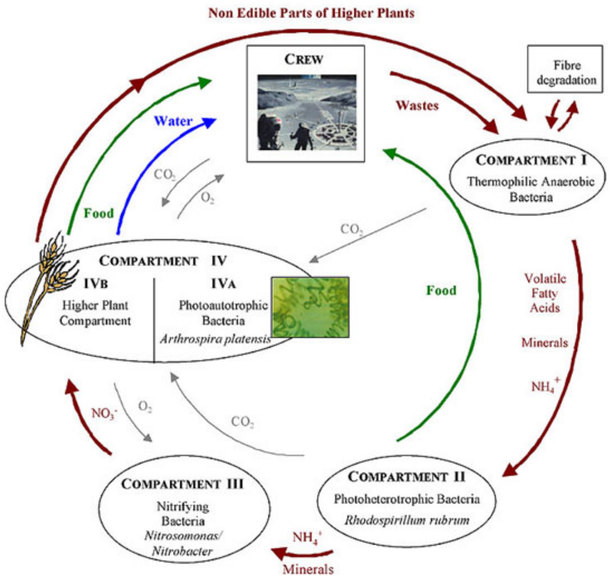


Figure 1 MELISSA LOOP CONCEPT

MELISSA CI system can be represent by five main hardware blocks. All these hardware is needed to correct operation. MELISSA CI system overview is show in Figure 2

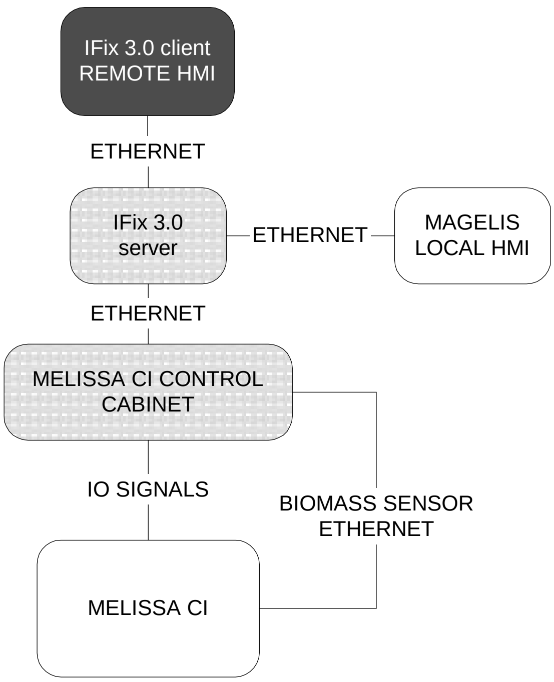


Figure 2 MELISSA CI system overview

2.1 MELISSA CI control system overview

MELISSA CI SYSTEM have three main blocks: MELISSA CI, CONTROL CABINET and Scada Supervisor system. See figure 4.

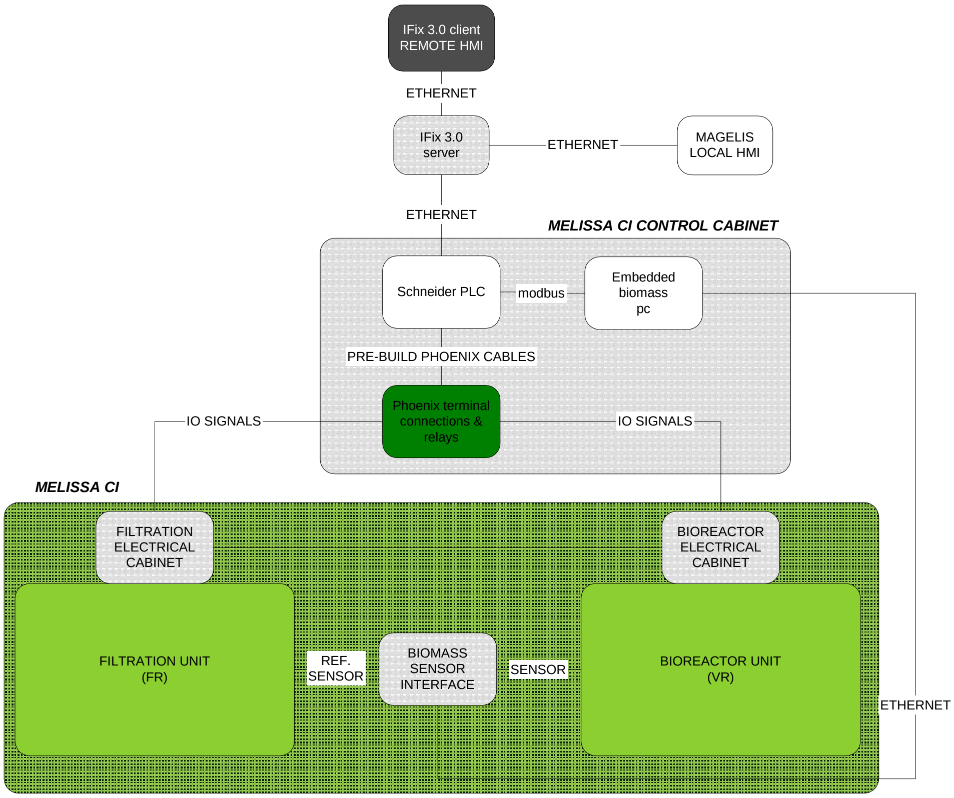


Figure 3 MELISSA CI system second approach

Detail connection of Biomass sensor is described in NTE-VSS-HB-017 document. Basically there are two sensor connectors (sensor and reference sensor) and one cross Ethernet wire.

Connections between filtration electrical cabinet and bioreactor electrical cabinet are describe in EPAS documentation.

Connections between filtration electrical cabinet, bioreactor electrical cabinet and MELISSA CI CONTROL CABINET, are described in this document. At the end of this documents there are wiring tables that explain.

In following sections all these blocks are explained.

2.1.1 MELISSA CI

From control point of view is a set of sensors and actuators. There are about 250 sensors and actuators. All these signals are divided in two electrical cabinets: Filtration Unit Cabinet and Bioreactor Cabinet. Each of these cabinet have: electrical protection, electrical power interfaces and electrical interfaces necessaries to connect directly to control cabinet. These means that all the power are in the electrical cabinets of Compartment I not in control cabinet.

Figure 4 MELISSA CI OVERVIEW

2.1.2 MELISSA CI CONTROL CABINET

It is the real-time stand-alone controller of MELISSA CI, Biomass sensor estimator and information MELISSA CI kernel.

2.1.3 SCADA SUPERVISION SYSTEM

Scada Supervisor system is divided in three main blocks: IFIX server, IFIX client (remote HMI) and MAGELIS (local HMI). IFIX server store in real-time all the MELISSA CI variables. From IFIX client it is possible to: set commands, read information in real-time, analyze historical information, customize graph.
For further information MEL-03320-HB-042-NTE.

3. MELISSA CI Control cabinet overview

It is a single 600x600x1800 mm rittal electrical cabinet with two panel assembly and two synthetic glass doors. One side contains electrical components and the other side electrical connections of MELISSA CI. See Figure 5

The electrical components side has: plc, power supplies, embedded pc and electrical protections.

The electrical connection side contents phoenix interface connectors, digital IOs have implemented a small relays of control, while analog output are connected directly with plc cards.

Figure 5 electrical connection side (left hand-side), side view and electrical components side

Distribution of all components is show in a draw of figure 6. Side A is electronic side while Side B is phoenix terminal connector side. Side B are prepared for a IOs expansion. The limitation of IOs expansion is determinate by PLC bus and wire section.

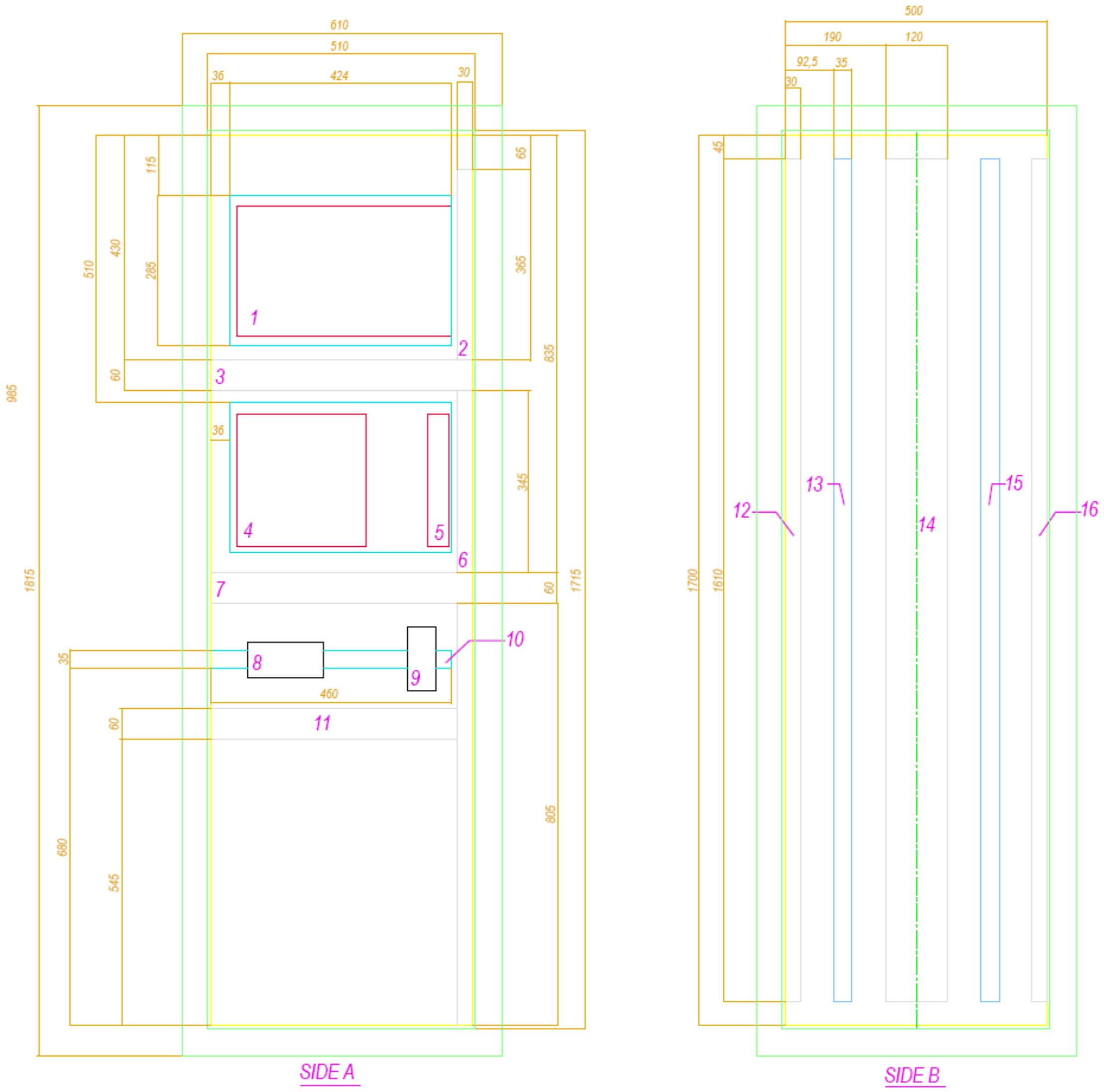


Figure 6 Mounted plate layout.

Mount plate layout component description:
Side A, Electronic side:

1. PLC BACKPLANE
2. MOUNT PLATE
3. GREY PLASTIC GUIDE WIRE
4. PLC EXPANSION
5. EXPANSION CARD
6. GREY PLASTIC GUIDE WIRE
7. GREY PLASTIC GUIDE WIRE
8. ELECTRICAL CONNECTIONS
9. POWER SUPPLY
10. DIN RAIL
11. GREY PLASTIC GUIDE WIRE

Side B, Electrical side:

12. GREY PLASTIC GUIDE WIRE
13. DIN RAIL
14. GREY PLASTIC GUIDE WIRE
15. METALIC DIN RAIL

16. GREY PLASTIC GUIDE WIRE

4. MELISSA CI control cabinet description

Control cabinet diagram is show in Figure 7. Basically there are 3 subsystems:

1. ENERGY DISTRIBUTION
    1.1. ELECTRICAL PROTECTIONS
    1.2. POWER SUPPLIES
        1.2.1. 24 VDC
        1.2.2. 24 VDC
        1.2.3. PLC POWER SUPPLY
2. ELECTRONICS
    2.1. PLC
        2.1.1. IOs
    2.2. BIOMASS PANEL PC
3. TERMINAL BLOCKS
    3.1. AIO CONNECTORS
    3.2. DIO RELAYS CONNECTORS

All this subsystems will be detail described in following chapters

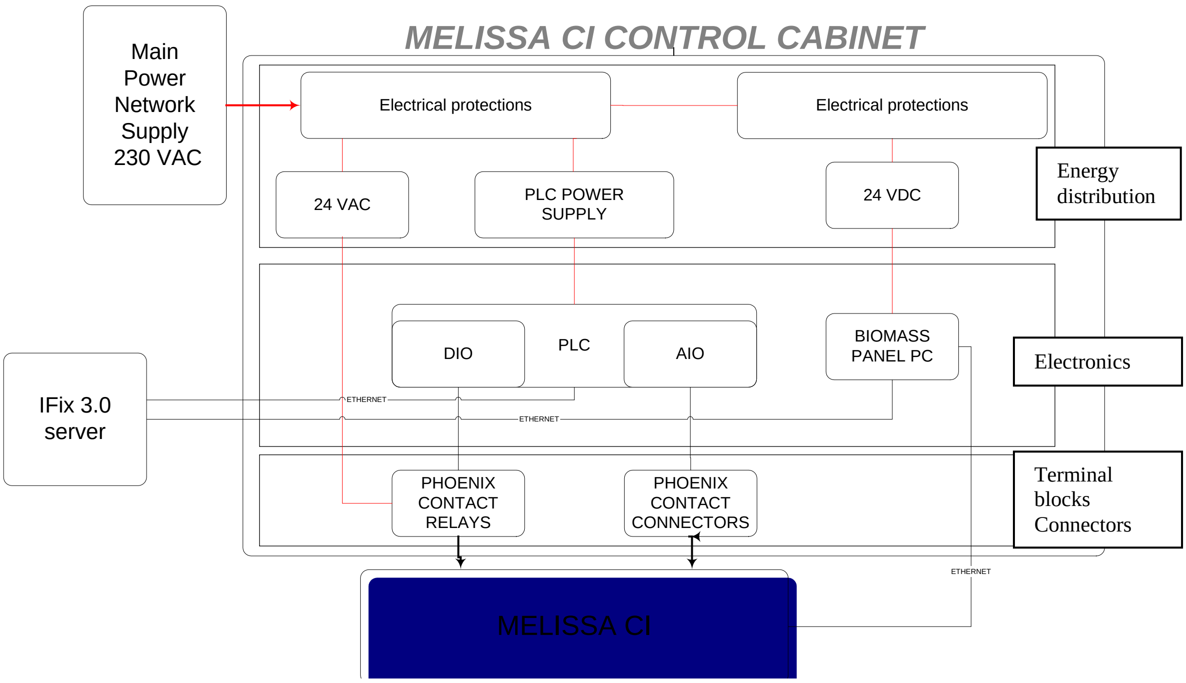


Figure 7 MELISSA CI CONTROL CABINET DETAIL VIEW

4.1 MELISSA CI CONTROL CABINET ENERGY DISTRIBUTION

This subsystem supply energy at all components of control cabinet. Power devices like pump, fan and other actuators will be feed from other sources (see section 2.1.1)

Components of ENERGY DISTRIBUTION SUBSYSTEM:

- ELECTRICAL PROTECTIONS
- POWER SUPPLIES
  - 24 VDC IOs
  - 24 VDC Embedded PC
  - PLC POWER SUPPLY

TABLE 1 show all loads of MELISSA CI HPC control cabinet, These consumptions are nominal worse case. Regular nominal operation power consumption is lower.

DEVICE	*POWER CONSUPTION [W]*	*Operational range voltage*
24VDC POWER SUPPLY	150 W	relay power supply
24VDC POWER SUPPLY	48 W	Embedded pc power supply
CABINET FANS	50 W	230 V
PLC POWER SUPPLY x 2	300 W	plc power supply
Total	**548 W**	

TABLE 1 ELECTRICAL LOADS OF MELISSA CIVB HPC CONTROL CABINET

MELISSA CI power consumption in worse case is below 1Kw, so 1mm2 for main supply is enough. In order to simplify wiring all plc control cabinet is wired with 1 mm2 of section.

4.2 CI ELECTRONICS

4.2.1 IOs PLC

Compartmet CI Quantum (by Schneider) Programmable Logic Controller is mounted on two backplane with 10 available slots in each backplane. The PLC module and PLC I/O expansion distribution is displayed in the following tables, showing the manufacturer reference identification (140XXXXXXXX), the description of the module and the mnemonic identification used in CI_RACK.

PLC									
1	2	3	4	5	6	7	8	9	10
A	B	C	D	E	F	G	H	I	Intentionally blank
140CPS11420	140CPU43412A	140NOE77101	140ACI04000	140ACI04000	140ACI04000	140ACO2000	140DDI35300	140DDI35300	140XBE10000
Backplane Power Supply module	CPU module	Ethernet module	16 Analog input 4-20 mA	16 Analog input 4-20 mA	16 Analog input 4-20 mA	4 Analog output 4-20 mA	32 Digital inputs 10-60 VCC	32 Digital inputs 10-60 VCC	Rack expansion
CI_PLC_CPS	CI_PLC_CPU	CI_PLC_NOE	CI_PLC_IO_ACI	CI_PLC_IO_ACI	CI_PLC_IO_ACI	CI_PLC_IO_ACO	CI_PLC_IO_DDI	CI_PLC_IO_DDI	CI_PLC_XBE

TABLE 2 PLC BACKPLANE CARD DISTRIBUTION

PLC EXPANSION									
1	2	3	4	5	6	7	8	9	10
Intentionally blank	J	K	L	M	N	Intentionally blank	Intentionally blank	Intentionally blank	Intentionally blank
140CPS11420	140DDI35300	140DDI35300	140DDO35300	140DDO35300	140DDO35300	Intentionally blank	Intentionally blank	Intentionally blank	140XBE10000
Backplane Power Supply module	32 Digital inputs 10-60 VCC	32 Digital inputs 10-60 VCC	32 Digital output 10-60VCC	32 Digital output 10-60VCC	32 Digital output 10-60VCC	Intentionally blank	Intentionally blank	Intentionally blank	Rack expansion
CI_PLC_CPS	CI_PLC_IO_DDI	CI_PLC_IO_DDI	CI_PLC_IO_DDO	CI_PLC_IO_DDO	CI_PLC_IO_DDO	Intentionally blank	Intentionally blank	Intentionally blank	CIVb_PLC_XBE

TABLE 3 PLC BACKPLANE EXPANSION CARD DISTRIBUTION

Each card has a specific number of IOs. Table 2 show IOs available for each card reference.

CARD	*Number of cards*	*IO type*	*IO per card*	*total IO*
140ACI4000	3	current in	16	48
140ACO2000	1	current out	4	4
140DDI35300	4	digital in	32	128
140DDO35300	3	digital out	32	96

TABLE 4 plc card and I/O available in the control cabinet

Table 3 explains distribution of IOs. For example VR (Vessel Reactor) use 64 IOs while FR (Filtration Reactor) use 188 IOs. Free IOs are just 24, 16 DI and 8 DO.

I/Os	**ACI**	**ACO**	**DDI**	**DDO**	***Total***
Available	48	4	128	96	276
USE IN VR	16	0	32	16	64
USE IN FR	32	4	80	72	188
TOTAL USE	48	4	112	88	252
Free	0	0	16	8	24

TABLE 5 overview of I/O needed, available and free IOs

4.2.2 Embedded pc

Embedded pc is the interface between biomass sensor and PLC. The current version takes data from biomass sensor box (bioimpedance value) and sends it to the plc through serial modbus. In future version, it will estimate the biomass present in the bioreactor. For further information see NTE-VSS-HB-017 and NTE-VSS-HB-018 documents.

4.3 CI TERMINALS BLOCKS

4.3.1 VARIOFACE PHOENIX PLUGGABLE SYSTEM

MELISSA CI control cabinet is wiring with PHOENIX VARIOFACE PLUGGABLE SYSTEM. In Figure 8, there is compare traditional wiring system and pluggable phoenix wiring system. Phoenix system uses two idc connectors instead of 80 screws of traditional plc wiring. Main parts of phoenix pluggable system are: plc Schneider adaptor, idc phoenix wire and phoenix terminal block.

MELISSA CI control cabinet is wired from plc to terminals phoenix blocks. From user point of view all IOs are disposable in terminal phoenix block. Plc manipulation IOs is not necessary in any circumstance. All relationship between plc and terminal block are described in IOs table section 4.5.

Further information is available in http://www.phoenixcontact.com

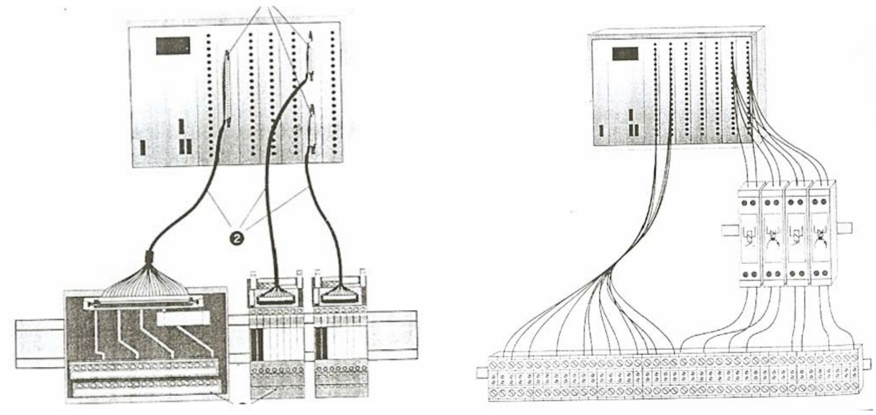
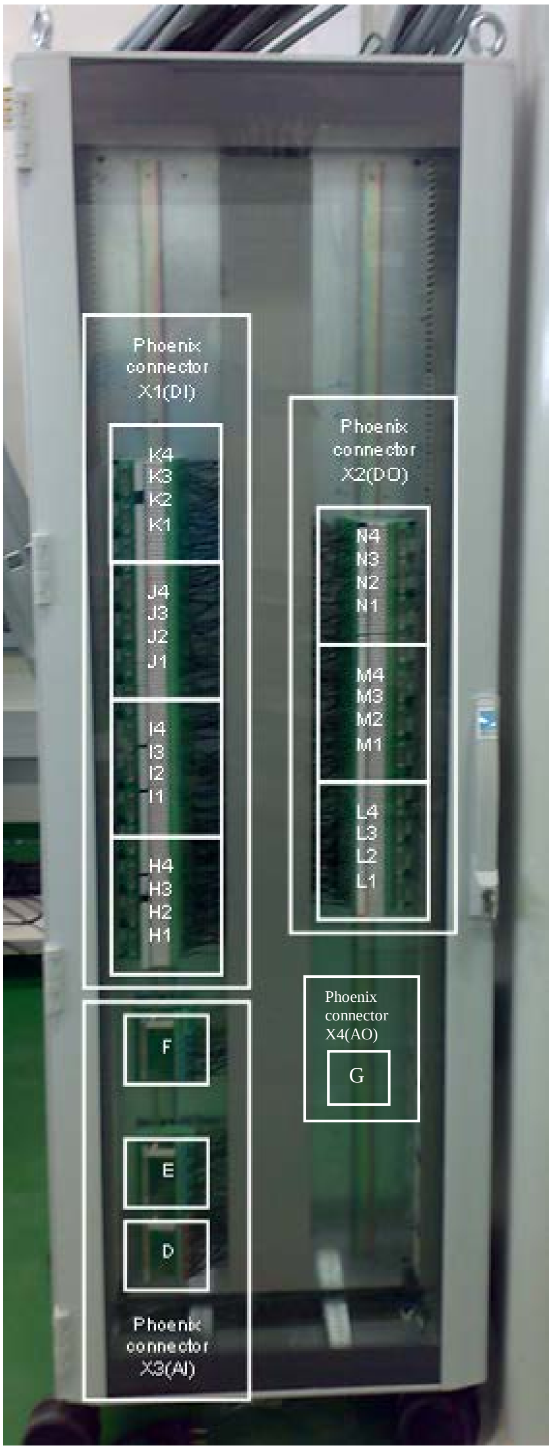


Figure 8 PHOENIX VARIOFACE PLUGGABLE SYSTEM vs TRADITIONAL WIRING SYSTEM

4.4 PHOENIX TERMINAL IDENTIFICATION



4.4.1 CS CI control cabinet terminal identification

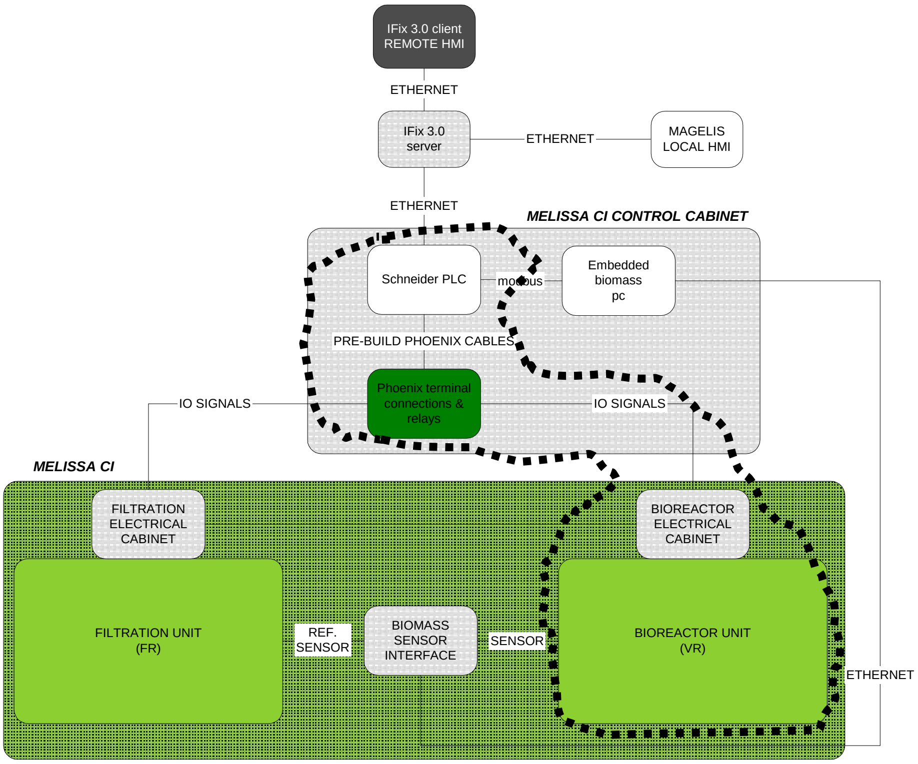
CS-CI control cabinet terminals are divided in four major BLOCKS (DI(128),DO(96),AI(48),AO(4)). Each of them is divided in TERMINAL SET of (DI(32),DO(32),AI(16)). Again some of them are divided in SUBSET (DI(8),DO(8)). See figure x . Each pin of each block is identified by a number labeling.

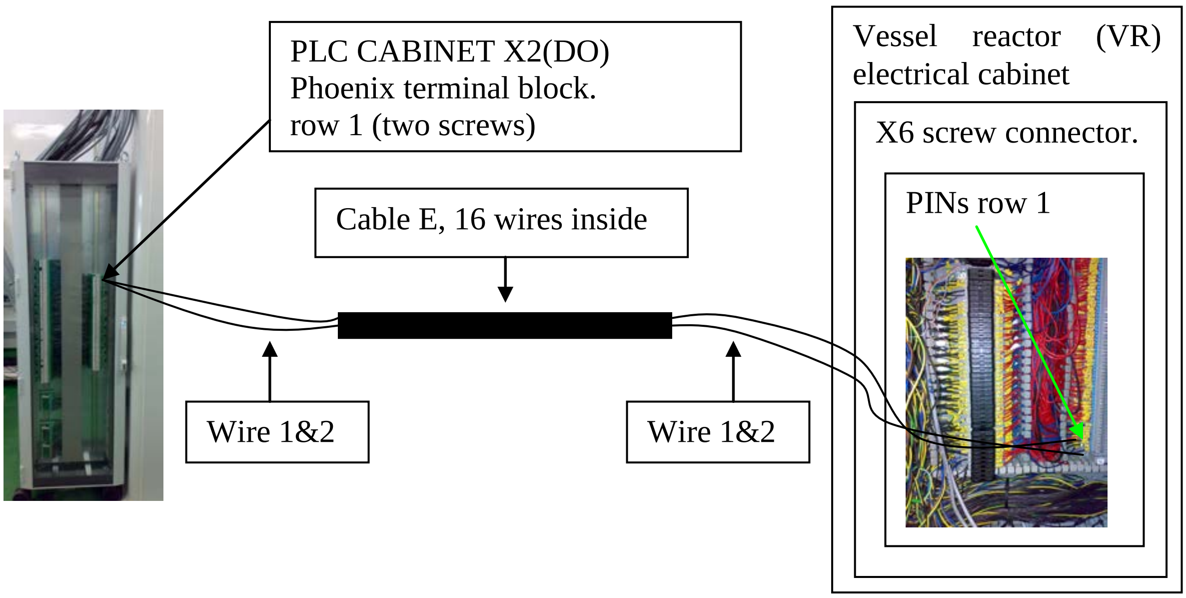
- PHOENIX Digital Input BLOCK (128 DI)
  - PHOENIX TERMINAL SET H (32 DI)
    - PHOENIX TERMINAL SUBSET H1 (8 DI)
      - DI_1
      - …..
      - DI_8
    - PHOENIX TERMINAL SUBSET H2 (8 DI)
    - PHOENIX TERMINAL SUBSET H3 (8 DI)
    - PHOENIX TERMINAL SUBSET H4 (8 DI)
  - ……………
  - PHOENIX TERMINAL SET K (32 DI)
    - PHOENIX TERMINAL SUBSET K1 (8 DI)
    - PHOENIX TERMINAL SUBSET K2 (8 DI)
    - PHOENIX TERMINAL SUBSET K3 (8 DI)
    - PHOENIX TERMINAL SUBSET K4 (8 DI)
- PHOENIX Digital Output BLOCK (96 DO)
  - PHOENIX TERMINAL SET L (32 DO)
    - PHOENIX TERMINAL SUBSET L1 (8 DO)
      - DO1
      - …
      - DO8
    - PHOENIX TERMINAL SUBSET L2 (8 DO)
    - PHOENIX TERMINAL SUBSET L3 (8 DO)
    - PHOENIX TERMINAL SUBSET L4 (8 DO)
  - ……………
  - PHOENIX SET TERMINAL N (32 DO)
    - PHOENIX TERMINAL SUBSET N1 (8 DO)
    - PHOENIX TERMINAL SUBSET N2 (8 DO)
    - PHOENIX TERMINAL SUBSET N3 (8 DO)
    - PHOENIX TERMINAL SUBSET N4 (8 DO)
- PHOENIX Analog inputs BLOCK (48 AI)
  - PHOENIX SET TERMINAL D (16 AI)
  - PHOENIX SET TERMINAL E (16 AI)
  - PHOENIX SET TERMINAL F (16 AI)
- PHOENIX Analog outputs BLOCK (4 A0)

4.4.2 IOs connection table interpretation example

In this example is described the connection from CS-C1 control cabinet output1 and GP_1001_01_MV2 (Vessel bioreactor pump1)

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			VR CABINET	Compartment I electrical devices tags	
	X2 (D0)						X6	EPAS VARIABLE NAME	MPP VARIABLE NAME
000008	1	L1	L	E	1	2	1	PMP_V_01_Bwd	GP_1001_01_MV2





4.5 IOs Tables

4.5.1 Bioreactor Digital Output Table (BDOT)

PLC ADRESS	PLC CABINET X2 (D0)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			VR CABINET X6	Compartment I electrical devices tags: EPAS VARIABLE NAME	Compartment I electrical devices tags: MPP VARIABLE NAME	Comments
000008	1	L1	L	E	1	2	1	PMP_V_01_Bwd	GP_1001_01_MV2	Worm gearpump turning counterclockwise
000007	2			E	3	4	2	PMP_V_01_Fwd	GP_1001_01_MV1	Worm gear pump turning clockwise
000006	3			E	5	6	3	HX_R_001	HX_1008_01_MV	Pumps base in the bioreactor (R-R-01) to correct pH
000005	4			E	7	8	4	HX_V_001	HX_1002_01_MV	Pumps acid in the bioreactor (R-R-01) to correct Ph
000004	5			E	9	10	5	BL_R_01	BLE_1012_01_MV	Homogenize influent tank content (R-V-01)
000003	6			E	11	12	6	BL_V_01	BLE_1005_01_MV	Homogenize bioreactor content (R-R-01)
000002	7			E	13	14	7	PMP_R_02	PP_1011_02_MV	Heat bioreactor (R-R-01)
000001	8			E	15	16	8	PMP_R_01	PP_1011_01_MV	Cool down influent tank (R-V-01) to prevent pre-degradation
000016	9	L2		F	1	2	9	V_V_03	S3CV_1001_01_MV	Used to feed the bioreactor R-R-01 with influent at regular intervals of time
000015	10			F	3	4	10	V_V_04	S3CV_1001_02_MV	Used to fill in the influent tank R-V-01 with fresh influent or to circulate the influent in a loop
000014	11			F	5	6	11	V_V_07	SV_1003_01_MV	Siren + flashing light

PLC ADRESS	PLC CABINET X2 (D0)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			VR CABINET X6	Compartment I electrical devices tags EPAS VARIABLE NAME	MPP VARIABLE NAME	Comments
000013	12			F	7	8	12	V_R_19	SV_1009_01_MV	Releases gas from the influent tank (R-V-01) when the pressure increases to the point Pressure sensors PS-V-01 and LS-V-02 are about to go out of their ranges Powered 2-way valve(safety). During feeding of the influent tank it switches to release gas fast
000012	13			F	9	10	13	SIREN	SIREN_ALARM	Releases gas from bioreactor (R-R-01) when the pressure increases over the set point
000011	14			F	11	12	14	-	-	-
000010	15			F	13	14	15	-	-	-
000009	16			F	15	16	16	-	-	-

4.5.2 Filtration Unit Digital Output Table (FUDOT)

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X2 (DO)						X6	EPAS VARIABLE NAME	MPP VARIABLE NAME	
000024	17	L3	L	S	1	2	1	PMP_F_02	PP_1202_01_MV1	Pumps filtrate out of membranes Fi-F-01 and Fi-F-02 to filtrate tank R-F-01 and keeps the flux constant
000023	18			S	3	4	2	PMP_G_02	??_1101_01_MV	Pumps gas from the bioreactor through gas analyser
000022	19			S	5	6	3	PMP_G_01	??_1100_01_MV	Pumps gas from the bioreactor through the buffer vessel R-G-01 (active gas loop)
000021	20			S	7	8	4	PMP_F_05	PP_1204_01_MV	Pumps filtrate out of R-F-01 for harvesting
000020	21			S	9	10	5	PMP_C_03	??_1207_02_MV	Pumps cleaning agent from cleaning buffer R-C-02 to FU retentate line
000019	22			S	11	12	6	PMP_C_02	PP_1209_01_MV	Pumps pure detergent (R-C-03) to cleaning agent tank (R-C-01)
000018	23			S	13	14	7	PMP_C_01	??_1207_01_MV	Pumps cleaning agent or water to the tanks
000017	24			S	15	16	8	HX_C_01	HX_1208_01_MV	Heats cleaning buffer R-C-02
000032	25	L4		T	1	2	9	PMP_F_01	GP_1201_01_MV1	Pumps reactor content through membranes Fi-F-01 and Fi-F-02 in retentate loop. Is also used during cleaning of the retentate loop

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X2 (DO)						X6	EPAS VARIABLE NAME	MPP VARIABLE NAME	
000031	26			T	3	4	10	V_S_08	S3CV_1210_07_MV	Allows flow of steam and condens in effluent vessel VR-F-01 to steam trap V-S-14 and condensate vessel R-S-03 when activated
000030	27			T	5	6	11	V_S_07	S3CV_1210_06_MV	Allows flow of steam and condens at the filtration side of membrane Fi-F-02 to steam trap V-S-10 and condensate vessel R-S-02 when activated
000029	28			T	7	8	12	V_S_06	S3CV_1210_05_MV	Allows flow of steam and condens at the filtration side of membrane Fi-F-01 to steam trap V-S-10 and condensate vessel R-S-02 when activated
000028	29			T	9	10	13	V_S_05	S3CV_1210_04_MV	Allows steam in retentate side of membrane Fi-F-02 when activated
000027	30			T	11	12	14	V_S_04	S3CV_1210_03_MV	Allows steam in retentate side of membrane Fi-F-01 when activated
000026	31			T	13	14	15	V_S_03	S3CV_1210_02_MV	Allows flow of steam and condens at the retentate side of membrane Fi-F-02 to steam trap V-S-09 and condensate vessel R-S-01 when activated

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X2 (DO)						X6	EPAS VARIABLE NAME	MPP VARIABLE NAME	
000025	32			T	15	16	16	V_S_02	S3CV_1210_01_MV	Allows flow of steam and condens at the retentate side of membrane Fi-F-01 to steam trap V-S-09 and condensate vessel R-S-01 when activated
000040	33	M1	M	U	1	2	17	V_G_28	SV_1101_01_MV	
000039	34			U	3	4	18	V_G_25	SV_1100_05_MV	Opens/ closes gas flow from buffer vessel R-G-01 to bioreactor R-R-01
000038	35			U	5	6	19	V_G_21	SV_1103_02_MV	Used to flush N2 in the filtrate tank
000037	36			U	7	8	20	V_G_20	SV_1103_01_MV	Used to flush N2 in the retentate loop of the FU in order to prevent under pressure in the loop
000036	37			U	9	10	21			
000035	38			U	11	12	22	V_G_16	S3CV_1101_01_MV	Used to evacuate N2 gas from the gas analysis loop in case of gas analyser calibration
000034	39			U	13	14	23	V_G_10	SV_1102_01_MV	Opens/ closes condensate flow from buffer vessel R-G-01 to bioreactor R-R-01
000033	40			U	15	16	24	V_G_08	SV_1100_03_MV	Opens / closes outlet of gas from R-G-02 for produced biogas flow determination
000048	41	M2		V	1	2	25	V_G_05	SV_1100_01_MV	Opens/closes inlet of biogas in buffer vessel R-G-01
000047	42			V	3	4	26	V_G_03	S3CV_1100_02_MV	Used to by-pass the gas compressor PMP-G-01
000046	43			V	5	6	27	V_G_02	S3CV_1100_01_MV	Used to by-pass the gas compressor PMP-G-01

PLC ADDRESS	PLC CABINET X2 (DO)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET X6	Compartment I electrical devices tags: EPAS VARIABLE NAME	Compartment I electrical devices tags: MPP VARIABLE NAME	Comments
000045	44			V	7	8	28	V_G_01	S3CV_1103_01_MV	Used to connect N2 gas inlet to gas analysis loop for gas analyser calibration
000044	45			V	9	10	29	V_F_18	S3CV_1201_09_MV	Used to drain retentate from FU retentate line in R-C-04 or in a vessel
000043	46			V	11	12	30	V_F_17	S3CV_1201_08_MV	Used to drain retentate from FU retentate line in R-C-04 or in a vessel
000042	47			V	13	14	31	V_F_16	S3CV_1201_07_MV	Used to pump back retentate from R-C- 04 to retentate line in FU
000041	48			V	15	16	32	V_F_15	S3CV_1201_06_MV	Used to drain the retentate side of membrane Fi-F-01
000056	49	M3		W	1	2	33	V_F_14	S3CV_1201_05_MV	Used to drain the retentate side of membrane Fi-F-02
000055	50			W	3	4	34	V_F_13	SV_1203_01_MV	Used to keep atmospheric pressure in the retentate line by letting enter/escape air when draining/ filling the tubes
000054	51			W	5	6	35	V_F_12	SV_1204_02_MV	Is closed during SIP of effluent vessel R-F-01 to allow pressure and temperature to rise
000053	52			W	7	8	36	V_F_11		
000052	53			W	9	10	37	V_F_10	SV_1204_01_MV	Used to drain the filtrate tank R-F-01
000051	54			W	11	12	38	V_F_08	S3CV_1202_02_MV	Used to send back filtrate to bioreactor or to collect filtrate in filtrate tank R-F-01
000050	55			W	13	14	39	V_F_07	S3CV_1202_01_MV	Used to select outlet filtrate from membrane Fi-F-01 or Fi-F02

PLC ADDRESS	PLC CABINET X2 (DO)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET X6	Compartment I electrical devices tags: EPAS VARIABLE NAME	Compartment I electrical devices tags: MPP VARIABLE NAME	Comments
000049	56			W	15	16	40	V_F_06	SV_1201_02_MV	Opens/ closes retentate flow from FU to bioreactor R-R-01
000064	57	M4		X	1	2	41	V_F_05	S3CV_1201_04_MV	Used to bypass the FU
000063	58			X	3	4	42	V_F_04	S3CV_1201_03_MV	Used to select outlet retentate from membrane Fi-F-01 or Fi-F-02
000062	59			X	5	6	43	V_F_03	S3CV_1201_02_MV	Used to select inlet retentate of membrane Fi-F-01 or Fi-F02
000061	60			X	7	8	44	V_F_02	S3CV_1201_01_MV	Used to bypass the FU
000060	61			X	9	10	45	V_F_01	SV_1201_01_MV	Opens/ closes retentate flow from bioreactor R-R-01 to Filtration Unit
000059	62			X	11	12	46	V_C_21	SV_1207_05_MV	When activated, allows cleaning agent to filtratte side of membranes Fi-F-01 and -02 during backwashing
000058	63			X	13	14	47	V_C_19	S3CV_1207_08_MV	Activated during backwashing and cleaning of retentate side of membrane Fi-F-01
000057	64			X	15	16	48	V_C_18	S3CV_1207_07_MV	Activated during backwashing and cleaning of retentate side of membrane Fi-F-02
000072	65	N1	N	Y	1	2	49	V_C_17	S3CV_1207_06_MV	Activated for cleaning of retentate side of membrane Fi-F-02
000071	66			Y	3	4	50	V_C_16	S3CV_1207_05_MV	Activated for cleaning of retentate side of membrane Fi-F-01
000070	67			Y	5	6	51	V_C_15	S3CV_1207_04_MV	Activated during cleaning of retentate loop
000069	68			Y	7	8	52	V_C_14	S3CV_1207_03_MV	Activated during cleaning of retentate loop

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X2 (DO)						X6	EPAS VARIABLE NAME	MPP VARIABLE NAME	
000068	69			Y	9	10	53	V_C_13	S3CV_1207_02_MV	Activated for backwashiong mbne membrane Fi-F-01
000067	70			Y	11	12	54	V_C_12	S3CV_1207_01_MV	Activated for backwashing membrane Fi-F-02
000066	71			Y	13	14	55	V_C_11	SV_1209_05_MV	Allows outside air to enter during draining and rincing of cleaning agent vessel (R-C-01) and allows air to leave the vessel when it is being filled
000065	72			Y	15	16	56	V_C_10	SV_1209_04_MV	Used to drain and during rincing of cleaning agent vessel (R-C-01)
000080	73	N2		Z	1	2	57	V_C_09	SV_1209_03_MV	Used to fill R-C-01 with water
000079	74			Z	3	4	58	V_C_07	SV_1209_02_MV	Allows outside air to enter cleaning buffer vesel (R-C-02) while it is drained and allows air to leave the vessel when it is being filled
000078	75			Z	5	6	59	V_C_06	SV_1209_01_MV	Drains cleaning buffer vessel (R-C-02) when open
000077	76			Z	7	8	60	V_C_05	SV_1207_04_MV	Allows water to No-C-04 for rincing and filling cleaning buffer vessel (R-C-02)
000076	77			Z	9	10	61	V_C_04	SV_1207_03_MV	Allows water to No-C-03 for rincing of effluent vessel (R-F-01)
000075	78			Z	11	12	62	V_C_02	SV_1207_02_MV	Allows water to No-C-02 for rincing of bioreactor (R-R-01)
000074	79			Z	13	14	63	V_C_01	SV_1207_01_MV	Allows water to No-C-01 for rincing of Feeding Vessel (R-V-01)

PLC ADDRESS	PLC CABINET X2 (DO)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET X6	Compartment I electrical devices tags: EPAS VARIABLE NAME	Compartment I electrical devices tags: MPP VARIABLE NAME	Comments
~~000073~~	~~80~~			~~7~~	~~15~~	~~16~~	~~64~~	~~V_S_24~~	~~SV_1207_01_MV~~	~~Allows water to No-C-01 for rincing of Feeding Vessel (R-V-01)~~
000088	81	N3		2A	1	2	65	V_S_13	SV_1210_03_MV	Allows steam in efflluent vessel R-F-01 and the filtrate side of Fi-F-03 when activated
000087	82			2A	3	4	66	V_G_07	SV_1100_02_MV	Opens/ closes inlet of gas in R-G-02 for produced biogas flow determination
000086	83			2A	5	6	67	V_S_11	SV_1210_01_MV	Allows steam in filtrate side of membrane Fi-F-02 when activated
000085	84			2A	7	8	68	V_S_12	SV_1210_02_MV	Allows steam in filtrate side of membrane Fi-F-01 when activated
000084	85			2A	9	10	69	ST_F_01	SG_1210_01_MV	Generates steam of 3.8bara or 140°C when activated
000083	86			2A	11	12	NC	-	-	-
000082	87			2A	13	14	NC	-	-	-
000081	88			2A	15	16	NC	-	-	-
000096	89	N4					NC	-	-	-
000095	90						NC	-	-	-
000094	91						NC	-	-	-
000093	92						NC	-	-	-
000092	93						NC	-	-	-
000091	94						NC	-	-	-
000090	95						NC	-	-	-
000089	96						NC	-	-	-

4.5.3 Bioreactor Digital Inputs Table (BDIT)

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			VR CABINET	Compartment I electrical devices tags		Comments
	X1 (D0)						X6	EPAS VARIABLE NAME	MPP VARIABLE NAME	
100001	1	H1	H	A	1	2	1	E_RV_F4_F5	E_RV_F4_F5	Tension control Steering circuit 230VAC
100002	2			A	3	4	2	E_RV_F6_F8	E_RV_F6_F8	Tension control Steering circuit 24VDC
100003	3			A	5	6	3	E_RV_F9_F10	E_RV_F9_F10	Tension control Power circuit 230VAC
100004	4			A	7	8	NC	E_RV_F1_NC		
100005	5			A	9	10	NC	E_RV_F3_NC		
100006	6			A	11	12	NC	E_RV_F9_NC		
100007	7			A	13	14	7	E_RV_F14_F15	CL1008_E_RV_F14_F15	Cicuit Breaker 14 of PMP_R_03
100008	8			A	15	16	8	E_RV_F16_F17		Circuit Breaker 16 of PMP_V_02
100009	9	H2		B	1	2	9	E_RV_Q2_F19	CL1001_E_RV_Q2_F19	Motor Switch Q2
100010	10			B	3	4	10	E_RV_K1_F21	CL1001_E_RV_K2_F21	Control Contactor K1 Counterclockwise
100011	11			B	5	6	11	E_RV_K2_F20	CL1001_E_RV_K1_F20	Control Contactor K2 Clockwise
100012	12			B	7	8	12	E_RV_Q4_F23	CL1008_E_RV_Q4_F23	Control Circuit-breaker Q4
100013	13			B	9	10	13	E_RV_K4_F22	CL1008_E_RV_K4_F22	Control Contactor K4

PLC ADDRESS	PLC CABINET X1 (D0)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			VR CABINET X6	Compartment I electrical devices tags EPAS VARIABLE NAME	MPP VARIABLE NAME	Comments
100014	14			B	11	12	14	E_RV_Q3_F26	CL1002_E_RV_Q3_F27	Control Circuit-breaker Q3
100015	15			B	13	14	15	E_RV_K3_F27	CL1002_E_RV_K3_F27	Control Contactor K3
100016	16			B	15	16	16	E_RV_U1_ALM	CL1005_E_RV_U1_ALM	Alarm Frequency regulator U1
100017	17	H3		C	1	2	17	E_RV_F29_F31	CL1005_E_RV_F29_F31	Control Circuit-breaker F29
100018	18			C	3	4	18	E_RV_U2_ALM	CL1012_E_RV_U2_ALM	Alarm Frequency regulator U2
100019	19			C	5	6	19	E_RV_F33_F35	CL1012_E_RV_F33_F35	Control Circuit-breaker F33
100020	20			C	7	8	20	E_RV_pHT_R_01_ALM		Alarm Ph transmitter 1
100021	21			C	9	10	21	E_RV_pHT_R_02_ALM	CL1011_E_RV_pHT_02_ALM	Alarm Ph transmitter 2
100022	22			C	11	12	22	LS_V_01	LSH_1004_01	Gives an alarm when the level in influent tank (R-V-01) becomes too high
100023	23			C	13	14	23	LS_R_01	LSH_1010_01	Gives an alarm/action when the level in bioreactor (R-R-01) becomes too high
100024	24			C	15	16	24	LS_R_03	LSL_1008_01	

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			VR CABINET	Compartment I electrical devices tags		Comments
	X1 (D0)						X6	EPAS VARIABLE NAME	MPP VARIABLE NAME	
100025	25	H4		D	1	2	25	V_GetCakeButton	CL1001_GetCakeButton	Button for filling feeder
100026	26			D	3	4	NC			
100027	27			D	5	6	27	V_V_03_FB	S3CV_1001_01_FB	Valve state feedback
100028	28			D	7	8	28	V_V_04_FB	S3CV_1001_02_FB	Valve state feedback
~~100029~~	~~29~~			~~D~~	~~9~~	~~10~~	~~29~~	~~V_V_07_FB~~	~~SV_1003_01_FB~~	~~Valve state feedback~~
~~100030~~	~~30~~			~~D~~	~~11~~	~~12~~	~~30~~	~~V_R_19_FB~~	~~SV_1009_01_FB~~	~~Valve state feedback~~
100031	31			D	13	14	31	ERR_R_pH_PMP_powersupply	CL1011_ERR_pH_PP_pwrsupply	Control Circuit-breaker F43
100032	32			D	15	16	32	Emergency_Button_Pressed		emergency button pressed

4.5.4 Filtration Unit Digital Inputs Table (FUDIT)

PLC ADDRESS	PLC CABINET X1 (DI)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET X5	Compartment I electrical devices tags EPAS VARIABLE NAME	MPP VARIABLE NAME	Comments
100033	33			I	1	2	1	Control_Tens230VAC_steerFiltrate		
100034	34			I	3	4	2	Control_Tens24VDC_steerFiltrate		
100035	35			I	5	6	3	Control_Tens230VAC_powerFiltrate		
100036	36	I1		I	7	8	4	Control_Emergency		
100037	37			I	9	10	5	HX_G_01_ALM		
~~100038~~	~~38~~			~~I~~	~~11~~	~~12~~	~~6~~	~~HX_G_02_ALM~~	-	-
100039	39			I	13	14	7	FS_F_01_ALM	FT_1201_01_ALM	AlarmContact Flow Meter
100040	40		I	I	15	16	8	A_G_01_ALM		
100041	41			J	1	2	9	A_G_02_ALM		
100042	42			J	3	4	10	E_FG_U1_ALM_F34	CL1201_E_FG_U1_ALM_F34	Alarm Contact Frequency regulator
100043	43	I2		J	5	6	11	E_FG_F35_F36	CL1201_E_FG_F35_F36	Tension Control Pump F35
~~100044~~	~~44~~			~~J~~	~~7~~	~~8~~	~~12~~	-	-	-
~~100045~~	~~45~~			~~J~~	~~9~~	~~10~~	~~13~~	-	-	-
~~100046~~	~~46~~			~~J~~	~~11~~	~~12~~	~~14~~	-	-	-

PLC ADDRESS	PLC CABINET X1 (DI)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET X5	Compartment I electrical devices tags EPAS VARIABLE NAME	Compartment I electrical devices tags MPP VARIABLE NAME	Comments
100047	47			J	13	14	15	LS_G_01	LSH_1102_01	Gives an alarm/action when the condensate level in buffer vessel R-G-01 becomes too high (=> problem with condensate evacuation system)
100048	48			J	15	16	16	LS_F_01	LSH_1206_01	Measures upper volume in gas phase for volume measurement in filtrate tank (R-F-01)
100049	49	I3		K	1	2	17	LS_C_04	LSL_1209_02	Detects low level in cleaning buffer tank (R-C-02)
100050	50			K	3	4	18	LS_C_03	LSH_1209_02	Detects high level in cleaning buffer tank (R-C-02)

PLC ADDRESS	PLC CABINET X1 (DI)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET X5	Compartment I electrical devices tags EPAS VARIABLE NAME	MPP VARIABLE NAME	Comments
100051	51			K	5	6	19	LS_C_02	LSL_1209_01	Detects low level in cleaning agent tank (R-C-01)
100052	52			K	7	8	20	LS_C_01	LSH_1209_01	Detects high level in cleaning agent tank (R-C-01)
100053	53			K	9	10	21	LS_F_02	LSH_1206_02	Measures pressure in liquid phase for volume measurement in filtrate tank (R-F-01)
100054	54			K	11	12	22	V_S_08_FB	S3CV_1210_06_FB	Valve state feedback
100055	55			K	13	14	23	V_S_07_FB	S3CV_1210_07_FB	Valve state feedback
100056	56			K	15	16	24	V_S_06_FB	S3CV_1210_05_FB	Valve state feedback
100057	57	I4		L	1	2	25	V_S_05_FB	S3CV_1210_04_FB	Valve state feedback
100058	58			L	3	4	26	V_S_04_FB	S3CV_1210_03_FB	Valve state feedback
100059	59			L	5	6	27	V_S_03_FB	S3CV_1210_02_FB	Valve state feedback

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X1 (DI)						X5	EPAS VARIABLE NAME	MPP VARIABLE NAME	
100060	60			L	7	8	28	V_S_02_FB	S3CV_1210_01_FB	Valve state feedback
100061	61			L	9	10	29	V_G_28_FB	SV_1101_01_FB	Valve state feedback
100062	62			L	11	12	30	V_G_25_FB	SV_1100_05_FB	Valve state feedback
100063	63			L	13	14	31	V_G_21_FB	SV_1103_02_FB	Valve state feedback
100064	64			L	15	16	32	V_G_20_FB	SV_1103_01_FB	Valve state feedback
~~100065~~	~~65~~	J1	J	~~M~~	~~1~~	~~2~~	~~33~~	-		
100066	66			M	3	4	34	V_G_16_FB	S3CV_1102_01_FB	Valve state feedback
100067	67			M	5	6	35	V_G_10_FB	SV_1102_01_FB	Valve state feedback
100068	68			M	7	8	36	V_G_08_FB	SV_1100_03_FB	Valve state feedback
100069	69			M	9	10	37	V_G_05_FB	SV_1100_01_FB	Valve state feedback
100070	70			M	11	12	38	V_G_03_FB	S3CV_1100_02_FB	Valve state feedback
100071	71			M	13	14	39	V_G_02_FB	S3CV_1100_01_FB	Valve state feedback
100072	72			M	15	16	40	V_G_01_FB	S3CV_1103_01_FB	Valve state feedback
100073	73	J2		N	1	2	41	V_F_18_FB	S3CV_1201_09_FB	Valve state feedback
100074	74			N	3	4	42	V_F_17_FB	S3CV_1201_08_FB	Valve state feedback

PLC ADDRESS	PLC CABINET X1 (DI)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET X5	Compartment I electrical devices tags EPAS VARIABLE NAME	MPP VARIABLE NAME	Comments
100075	75			N	5	6	43	V_F_16_FB	S3CV_1201_07_FB	Valve state feedback
100076	76			N	7	8	44	V_F_15_FB	S3CV_1201_06_FB	Valve state feedback
100077	77			N	9	10	45	V_F_14_FB	S3CV_1201_05_FB	Valve state feedback
100078	78			N	11	12	46	V_F_13_FB	SV_1203_01_FB	Valve state feedback
100079	79			N	13	14	47	V_F_12_FB	SV_1204_02_FB	Valve state feedback
~~100080~~	~~80~~			~~N~~	~~15~~	~~16~~	~~48~~	~~V_F_11_FB (the same comment)~~	-	~~Valve state feedback~~
100081	81	J3		O	1	2	49	V_F_10_FB	SV_1204_01_FB	Valve state feedback
100082	82			O	3	4	50	V_F_08_FB	S3CV_1202_02_FB	Valve state feedback
100083	83			O	5	6	51	V_F_07_FB	S3CV_1202_01_FB	Valve state feedback
100084	84			O	7	8	52	V_F_06_FB	SV_1201_02_FB	Valve state feedback
100085	85			O	9	10	53	V_F_05_FB	S3CV_1201_04_FB	Valve state feedback
100086	86			O	11	12	54	V_F_04_FB	S3CV_1201_03_FB	Valve state feedback
100087	87			O	13	14	55	V_F_03_FB	S3CV_1201_02_FB	Valve state feedback
100088	88			O	15	16	56	V_F_02_FB	S3CV_1201_01_FB	Valve state feedback
100089	89	J4		P	1	2	57	V_F_01_FB	SV_1201_01_FB	Valve state feedback

PLC ADDRESS	PLC CABINET X1 (DI)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET X5	Compartment I electrical devices tags EPAS VARIABLE NAME	Compartment I electrical devices tags MPP VARIABLE NAME	Comments
100090	90			P	3	4	58	V_C_21_FB	SV_1207_05_FB	Valve state feedback
100091	91			P	5	6	59	V_C_19_FB	S3CV_1207_08_FB	Valve state feedback
100092	92			P	7	8	60	V_C_18_FB	S3CV_1207_07_FB	Valve state feedback
100093	93			P	9	10	61	V_C_17_FB	S3CV_1207_06_FB	Valve state feedback
100094	94			P	11	12	62	V_C_16_FB	S3CV_1207_05_FB	Valve state feedback
100095	95			P	13	14	63	V_C_15_FB	S3CV_1207_04_FB	Valve state feedback
100096	96			P	15	16	64	V_C_14_FB	S3CV_1207_03_FB	Valve state feedback
100097	97	K1	K	Q	1	2	65	V_C_13_FB	S3CV_1207_02_FB	Valve state feedback
100098	98			Q	3	4	66	V_C_12_FB	S3CV_1207_01_FB	Valve state feedback
100099	99			Q	5	6	67	V_C_11_FB	SV_1209_05_FB	Valve state feedback
100100	100			Q	7	8	68	V_C_10_FB	SV_1209_04_FB	Valve state feedback
100101	101			Q	9	10	69	V_C_09_FB	SV_1209_03_FB	Valve state feedback
100102	102			Q	11	12	70	V_C_07_FB	SV_1209_02_FB	Valve state feedback
100103	103			Q	13	14	71	V_C_06_FB	SV_1209_01_FB	Valve state feedback
100104	104			Q	15	16	72	V_C_05_FB	SV_1207_04_FB	Valve state feedback

PLC ADDRESS	PLC CABINET X1 (DI)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET X5	Compartment I electrical devices tags EPAS VARIABLE NAME	Compartment I electrical devices tags MPP VARIABLE NAME	Comments
100105	105	K2		R	1	2	73	V_S_12_FB	SV_1210_02_FB	Valve state feedback
100106	106			R	3	4	74	V_S_11_FB	SV_1210_01_FB	Valve state feedback
100107	107			R	5	6	75	V_G_07_FB	SV_1100_02_FB	Valve state feedback
100108	108			R	7	8	76	V_S_13_FB	SV_1210_03_FB	Valve state feedback
100109	109			R	9	10	77	V_G_24_FB	?	Valve state feedback
100110	110			R	11	12	78	V_C_01_FB	SV_1207_01_FB	Valve state feedback
100111	111			R	13	14	79	V_C_02_FB	SV_1207_02_FB	Valve state feedback
100112	112			R	15	16	80	V_C_04_FB	SV_1207_03_FB	Valve state feedback
100113	NC	K3					NC	-	-	-
100114	NC						NC	-	-	-
100115	NC						NC	-	-	-
100116	NC						NC	-	-	-
100117	NC						NC	-	-	-
100118	NC						NC	-	-	-
100119	NC						NC	-	-	-
100120	NC						NC	-	-	-
100121	NC	K4					NC	-	-	-
100122	NC						NC	-	-	-
100123	NC						NC	-	-	-

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X1 (DI)						X5	EPAS VARIABLE NAME	MPP VARIABLE NAME	
100124	NC						NC	-	-	-
100125	NC						NC	-	-	-
100126	NC						NC	-	-	-
100127	NC						NC	-	-	-
100128	NC						NC	-	-	-

4.5.5 Bioreactor Analog Input Table (BAIT)

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			VR CABINET	Compartment I electrical devices tags		Comments
	X3(AI)						X3	EPAS VARIABLE NAME	MPP VARIABLE NAME	
300001	1,2	D	D	G	1	2	1	pHs_R_01	AT_1011_01	Measures pH in bioreactor (R-R-01)
300002	3,4			G	3	4	2	T_pH_R_01	CL1011_T_pH_01	Temperature Output transmitter 1
300003	5,6			G	5	6	3	pHs_R_02	AT_1011_02	Measures pH in bioreactor (R-R-01)
300004	7,8			G	7	8	4	T_pH_R_02	CL1011_T_pH_02	Temperature Output transmitter 2
300005	11,12			G	9	10	5	LS_V_02	LT_1004_01	Measures pressure in liquid phase for volume measurement in influent tank (R-V-01)
300006	13,14			G	11	12	6	PS_V_01	PT_1003_01	Measures pressure in gas phase for gas and volume measurement in influent tank (R-V-01)
300007	15,16			G	13	14	7	PS_V_03	PT_1001_01	Measures pressure immediately after pump PMP-V-01 and gives an alarm if pressure increases above the pump's limit
300008	17,18			G	15	16	NC			
300009	21,22			H	1	2	NC			
300010	23,24			H	3	4	10	PS_R_01	PT_1009_01	Measures pressure in gas phase for gas and volume measurement in bioreactor (R-R-01)

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			VR CABINET	Compartment I electrical devices tags		Comments
	X3(AI)						X3	EPAS VARIABLE NAME	MPP VARIABLE NAME	
300011	25,26			H	5	6	11	PS_R_02	PT_1009_02	Measures pressure in liquid phase for volume measurement in bioreactor (R-R-01)
300012	27,28			H	7	8	NC			
300013	31,32			H	9	10	13	LS_R_02	LT_1010_01	Measures pressure in liquid phase for volume measurement in bioreactor (R-R-01)
300014	33,34			H	11	12	14	TS_V_01	TT_1002_01	Measures temperature in influent tank (R-V-01)
300015	35,36			H	13	14	15	TS_R_01	TT_1008_01	Measures temperature in bioreactor (R-R-01)
300016	37,38			H	15	16	16	TS_R_02	TT_1008_02	Measures temperature in warm water bath HX-R-01

4.5.6 Filtration Unit Analog Input Table (FUAIT)

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X3 (AI)						X3	EPAS VARIABLE NAME	MPP VARIABLE NAME	
300018	17	E	E	2B	1	2	1	FS_F_01	FT_1201_01	Measures the retentate flow
~~300019~~	~~18~~			~~2B~~	~~3~~	~~4~~	~~2~~	~~A_G_01_H2~~	~~AT_1101_02_H2~~	~~Analyses bioreactor gas phase composition for H2~~
300020	19			2B	5	6	3	A_G_02_CO2	AT_1101_01_MV1	Analyses bioreactor gas phase composition for CO2 and CH4
300021	20			2B	7	8	4	TS_F_02	TT_1200_01	Measures temperature in retentate
300022	21			2B	9	10	5	TS_F_01	TT_1205_01	Measures temperature in filtrate tank R-F-01
300023	22			2B	11	12	6	TS_C_01	TT_1208_01	Measures temperature in cleaning buffer vessel (R-C-02). Is Measureed. Value for temperature control in (R-C-02)
~~300024~~	~~23~~			~~2B~~	~~13~~	~~14~~	~~7~~	~~PS_G_03~~	~~PT_1104_01~~	~~Measures pressure of gas after R-G-02~~
300025	24			2B	15	16	8	PS_G_02	PT_1101_01	Measures pressure of gas after gas analyser
300026	25			2C	1	2	9	PS_G_01	PT_1100_01	Measures pressure in buffer vessel R-G- 01
300027	26			2C	3	4	10	PS_F_07	PT_1203_07	Measures pressure of retentate after pump PMP-F-01 (safety pump)
300028	27			2C	5	6	11	PS_F_06	PT_1203_06	Measures pressure of filtrate at outlet of membrane Fi-F-02
300029	28			2C	7	8	12	PS_F_05	PT_1203_05	Measures pressure of retentate at outlet of membrane Fi-F-02
300030	29			2C	9	10	13	PS_F_04	PT_1203_04	Measures pressure of retentate at inlet of membrane Fi-F-02

PLC ADDRESS	PLC CABINET X3 (AI)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET X3	Compartment I electrical devices tags: EPAS VARIABLE NAME	Compartment I electrical devices tags: MPP VARIABLE NAME	Comments
300031	30			2C	11	12	14	PS_F_03	PT_1203_03	Measures pressure of filtrate at outlet of membrane Fi-F-01
300032	31			2C	13	14	15	PS_F_02	PT_1203_02	Measures pressure of retentate at outlet of membrane Fi-F-01
300033	32			2C	15	16	16	PS_F_01	PT_1203_01	Measures pressure of retentate at inlet of membrane Fi-F-01
300035	33			2D	1	2	17	SS_F_01	AT_1201_01	Measures turbidity of retentate
300036	34			2D	3	4	18	FS_G_01	FT_1101_01	Measures the gas flow entering in the gas analyser Measures the gas flow entering in the
300037	35			2D	5	6	19	FS_G_04	FT_1103_01	Measures the N2 gas flow entering the bioreactor R-R-01 (passive gas loop configuration)
300038	36			2D	7	8	20	LS_F_03	LT_1206_01	Measures pressure in gas phase for volume measurement in filtrate tank (R-F-01)
300039	37			2D	9	10	21	A_G_02_CH4	AT_1101_01_MV2	Analyses bioreactor gas phase composition for CO2 and CH4
300040	38			2D	11	12	22	PS_G_04	PT_1100_02	Measures pressure of gas produced by bioreactor (R-R-01) and accumulated in R-G-02 for flow measurement
300041	39			2D	13	14	23	TS_G_01	TT_1104_01	Measures temperature in R-G-02 for determination of produced gas flow
300042	40			2D	15	16	24	PS_F_09	PT_1203_08	Measures pressure at inlet of dead end filter Fi-F-03 (to follow clogging)
300043	41			2E	1	2	25	TS_F_03_Av	TT_1200_02_Av	Temperature measured on Mbne 1

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X3 (AI)						X3	EPAS VARIABLE NAME	MPP VARIABLE NAME	
300044	42			2E	3	4	26	TS_F_04_Av	TT_1200_03_Av	Temperature measured on Mbne 2
300045	43			2E	5	6	NC	-	-	-
300046	44			2E	7	8	NC	-	-	-
300047	45			2E	9	10	NC	-	-	-
300048	46			2E	11	12	NC	-	-	-
300049	47			2E	13	14	NC	-	-	-
300050	48			2E	15	16	NC	-	-	-

4.5.7 Filtration Unit Analog Output Table (FUAOT)

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X4 (A0)						X4	EPAS VARIABLE NAME	MPP VARIABLE NAME	
400001	1	G	G	2F	1	2	1	PMP_F_02_Speed	PP_1202_01_MV2	Speed control of the filtratie pump By freq.reg.
400002	2			2F	3	4	2	PMP_F_01_Speed	GP_1201_01_MV2	Speed control of the filtratie pump By freq.reg.
400003	3			2F	5	6	3	V_G_09_SETPOINT	SV_1100_04_MV	Valve control setpoint. Used to adapt the gas flow coming from buffer vessel R-G-01 and going to bioreactor R-R-01 in order to keep the pressure constant in the

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X4 (A0)						X4	EPAS VARIABLE NAME	MPP VARIABLE NAME	
400004	4			2F	7	8	4	V_G_29_SETPOINT	SV_1100_06_MV	to keep bioreactor pressure constant (passive gas loop configuration) Regulates N2 inlet in bioreactor R-R-01 Valve control setpoint

ELECTRICAL CABINET REWIRING CHECK-OUT PROCEDURE

FOR THE

MELISSA CI

APPROVAL LIST		
NAME	SIGNATURE	DATE
Prepared by: E. Creus		
Revised by: M. Bassas		
Approved by: T. López		
Authorised by: T. López		

DISTRIBUTION LIST		
NAME	POSITION	COMPANY
Melissa Pilot plant	Pilot plant responsible	UAB

CHANGE RECORD			
AUTHOR	ISSUE	DATE	CHANGE
E. Creus	1.0	23/04/08	First issue

CONTENTS

1. Scope

This document describes the electrical cabinet rewiring check-out procedure to be completed as part of the verification. This procedure is a continuity test to ensure the correct wiring connections between the different subsystems.

This test procedure applies to system composed by the filter unit, bioreactor and electrical cabinet of CS Melissa-CI.

The purpose of the test is to check the correct rewiring of MELISSA CI electrical cabinets.

Tests will be performed at the MELISSA pilot plant in UAB facilities.

2. REFERENCE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

Ref.	Title	Reference	Issue	Date
AD1	Procedimiento de Control de No conformidades	NTE-PG-007	3.0	05/12/06

2.2 REFERENCE DOCUMENTS

Ref.	Title	Reference	Issue	Date
RD1	Engineering of the waste compartment (by EPAS)	TN 71.8.3	1	12/06/2007

General instructions

2.3 Personnel

At least the following personnel is required for the execution of the tests:

- 2 electronical engineers

2.4 Test Conditions

The test will be performed at 24/04/08.

The following environmental requirements are applicable to all tests undertaken.

- Temperature: 22 ºC +/- 10 ºC
- The areas in which materials and equipment preparation for test is to be carried out shall be maintained in a neat orderly fashion, with no loose material (dirt, dust, oils, etc) that can cause contamination of the parts.
- Other environmental conditions are the normal in laboratory.

2.5 Requirements for measurement equipment

When indicated in the test procedure, measurements and test instruments shall be subjected to approved calibration procedures and shall be within the normal calibration periods at the time of test. Instrumentation that will run out of calibration during the planned test time shall be not used.

2.6 Non Conformances

Non Conformances will be issued in case of test deviations or test failures and will be handled as indicated in AD1.

2.7 Safety considerations

PLC CABINET, FILTRATION UNIT CABINET and BIOREACTOR CABINET, should disconected of electrical net.

2.8 Test Report

A report shall be prepared for the tests containing for each test executed:

- Device Under Test data, identification and configuration
- Test set-up
- Test Facility and Environmental Data
- Instrumentation used with reference to the corresponding calibration reports and calibration date when required
- As-run test procedures including deviations, NCRs raised and recommendations of corrective actions.

- The test sign-off sheet detailed in Annex #1 including:
    - Test Procedures deviations
    - NCRs raised
    - Test conductor name and signature
    - QA name and signature
    - Summary of tests results and conclusion

2.9 Pass / Fail Criteria

During the continuity test multimeter result should be lower than 50Ω.

3. Test sequence

Tests shall be executed in the order provided below:

4. Tests procedures

Test			
Requirements tested			
Unit identification			
Ambient Temperature			
Start of Execution Date		End of Execution Date	
Test equipment	*Model*	*S/N*	*Calibration certificate*
Multimeter	VICTOR VC9802A+	01	04/12/07
Remarks			
Sign-off signatures			
Test executor: Date / Signature			

PLC CABINET	CABLE			VR CABINET	OK/NOK
X1 (DI)				X5	
1	A	1	2	1	
2	A	3	4	2	
3	A	5	6	3	
4	A	7	8	NC	
5	A	9	10	NC	
6	A	11	12	NC	
7	A	13	14	7	
8	A	15	16	8	
9	B	1	2	9	
10	B	3	4	10	
11	B	5	6	11	
12	B	7	8	12	
13	B	9	10	13	
14	B	11	12	14	
15	B	13	14	15	
16	B	15	16	16	
17	C	1	2	17	
18	C	3	4	18	
19	C	5	6	19	
20	C	7	8	20	
21	C	9	10	21	
22	C	11	12	22	
23	C	13	14	23	
24	C	15	16	24	
25	D	1	2	25	
26	D	3	4	NC	
27	D	5	6	27	
28	D	7	8	28	
29	D	9	10	29	

PLC CABINET	CABLE			VR CABINET	OK/NOK
X1 (DI)				X5	
30	D	11	12	30	
31	D	13	14	31	
32	D	15	16	32	

PLC CABINET	CABLE			VR CABINET	OK/NOK
X2 (D0)				X6	
1	E	1	2	1	
2	E	3	4	2	
3	E	5	6	3	
4	E	7	8	4	
5	E	9	10	5	
6	E	11	12	6	
7	E	13	14	7	
8	E	15	16	8	
9	F	1	2	9	
10	F	3	4	10	
11	F	5	6	11	
12	F	7	8	12	
13	F	9	10	13	
14	F	11	12	NC	
15	F	13	14	NC	
16	F	15	16	NC	

PLC CABINET	CABLE			VR CABINET	OK/NOK
X3(AI)				X3	
PHOENIX E					
1,2	G	1	2	1	
3,4	G	3	4	2	
5,6	G	5	6	3	
7,8	G	7	8	4	
11,12	G	9	10	5	
13,14	G	11	12	6	
15,16	G	13	14	7	
17,18	G	15	16	NC	
21,22	H	1	2	NC	
23,24	H	3	4	10	
25,26	H	5	6	11	
27,28	H	7	8	NC	
31,32	H	9	10	13	
33,34	H	11	12	14	
35,36	H	13	14	15	
37,38	H	15	16	16	

LC CABINET	CABLE			FG CABINET	OK/NOK
X1 (DI)				X5	
33	I	1	2	1	
34	I	3	4	2	
35	I	5	6	3	
36	I	7	8	4	
37	I	9	10	5	
38	I	11	12	6	
39	I	13	14	7	
40	I	15	16	8	
41	J	1	2	9	
42	J	3	4	10	
43	J	5	6	11	
44	J	7	8	12	
45	J	9	10	13	
46	J	11	12	14	
47	J	13	14	15	
48	J	15	16	16	
49	K	1	2	17	
50	K	3	4	18	
51	K	5	6	19	
52	K	7	8	20	
53	K	9	10	21	
54	K	11	12	22	
55	K	13	14	23	
56	K	15	16	24	
57	L	1	2	25	
58	L	3	4	26	
59	L	5	6	27	
60	L	7	8	28	
61	L	9	10	29	
62	L	11	12	30	
63	L	13	14	31	
64	L	15	16	32	
65	M	1	2	33	
66	M	3	4	34	
67	M	5	6	35	
68	M	7	8	36	
69	M	9	10	37	
70	M	11	12	38	
71	M	13	14	39	
72	M	15	16	40	
73	N	1	2	41	
74	N	3	4	42	
75	N	5	6	43	
76	N	7	8	44	
77	N	9	10	45	

LC CABINET X1 (DI)	CABLE			FG CABINET X5	OK/NOK
78	N	11	12	46	
79	N	13	14	47	
80	N	15	16	48	
81	O	1	2	49	
82	O	3	4	50	
83	O	5	6	51	
84	O	7	8	52	
85	O	9	10	53	
86	O	11	12	54	
87	O	13	14	55	
88	O	15	16	56	
89	P	1	2	57	
90	P	3	4	58	
91	P	5	6	59	
92	P	7	8	60	
93	P	9	10	61	
94	P	11	12	62	
95	P	13	14	63	
96	P	15	16	64	
97	Q	1	2	65	
98	Q	3	4	66	
99	Q	5	6	67	
100	Q	7	8	68	
101	Q	9	10	69	
102	Q	11	12	70	
103	Q	13	14	71	
104	Q	15	16	72	
105	R	1	2	73	
106	R	3	4	74	
107	R	5	6	75	
108	R	7	8	76	
109	R	9	10	77	
110	R	11	12	78	
111	R	13	14	79	
112	R	15	16	80	

LC CABINET X2 (DO)	CABLE			FG CABINET X6	OK/NOK
17	S	1	2	1	
18	S	3	4	2	
19	S	5	6	3	
20	S	7	8	4	
21	S	9	10	5	
22	S	11	12	6	
23	S	13	14	7	
24	S	15	16	8	
25	T	1	2	9	
26	T	3	4	10	
27	T	5	6	11	
28	T	7	8	12	
29	T	9	10	13	
30	T	11	12	14	
31	T	13	14	15	
32	T	15	16	16	
33	U	1	2	17	
34	U	3	4	18	
35	U	5	6	19	
36	U	7	8	20	
37	U	9	10	21	
38	U	11	12	22	
39	U	13	14	23	
40	U	15	16	24	
41	V	1	2	25	
42	V	3	4	26	
43	V	5	6	27	
44	V	7	8	28	
45	V	9	10	29	
46	V	11	12	30	
47	V	13	14	31	
48	V	15	16	32	
49	W	1	2	33	
50	W	3	4	34	
51	W	5	6	35	
52	W	7	8	36	
53	W	9	10	37	
54	W	11	12	38	
55	W	13	14	39	
56	W	15	16	40	
57	X	1	2	41	
58	X	3	4	42	
59	X	5	6	43	
60	X	7	8	44	
61	X	9	10	45	

LC CABINET	CABLE			FG CABINET	OK/NOK
X2 (DO)				X6	
62	X	11	12	46	
63	X	13	14	47	
64	X	15	16	48	
65	Y	1	2	49	
66	Y	3	4	50	
67	Y	5	6	51	
68	Y	7	8	52	
69	Y	9	10	53	
70	Y	11	12	54	
71	Y	13	14	55	
72	Y	15	16	56	
73	Z	1	2	57	
74	Z	3	4	58	
75	Z	5	6	59	
76	Z	7	8	60	
77	Z	9	10	61	
78	Z	11	12	62	
79	Z	13	14	63	
80	Z	15	16	64	
81	2A	1	2	65	
82	2A	3	4	66	
83	2A	5	6	67	
84	2A	7	8	68	
85	2A	9	10	69	
86	2A	11	12	NC	
87	2A	13	14	NC	
88	2A	15	16	NC	

PLC CABINET	CABLE			FG CABINET	OK/NOK
X3 (AI)				X3	
PHOENIX F					
1,2	2B	1	2	1	
3,4	2B	3	4	2	
5,6	2B	5	6	3	
7,8	2B	7	8	4	
11,12	2B	9	10	5	
13,14	2B	11	12	6	
15,16	2B	13	14	7	
17,18	2B	15	16	8	
21,22	2C	1	2	9	
23,24	2C	3	4	10	
25,26	2C	5	6	11	
27,28	2C	7	8	12	
31,32	2C	9	10	13	
33,34	2C	11	12	14	
35,36	2C	13	14	15	
37,38	2C	15	16	16	
PHOENIX G					
1,2	2D	1	2	17	
3,4	2D	3	4	18	
5,6	2D	5	6	19	
7,8	2D	7	8	20	
11,12	2D	9	10	21	
13,14	2D	11	12	22	
15,16	2D	13	14	23	
17,18	2D	15	16	24	
21,22	2E	1	2	NC	
23,24	2E	3	4	NC	
25,26	2E	5	6	NC	
27,28	2E	7	8	NC	
31,32	2E	9	10	NC	
33,34	2E	11	12	NC	
35,36	2E	13	14	NC	
37,38	2E	15	16	NC	

PLC CABINET	CABLE			FG CABINET	OK/NOK
X4 (A0)				X4	
1	2F	1	2	1	
2	2F	3	4	2	
3	2F	5	6	3	
4	2F	7	8	4	
NA	2F	9	10	NC	
NA	2F	11	12	NC	
NA	2F	13	14	NC	
NA	2F	15	16	NC	
NA	2F	17	18	NC	

ANNEX 1: Procedure sign-off sheet

<table>
<tr><th colspan="4">PROCEDURE SIGN-OFF SHEET</th></tr>
<tr><td>Test reference:</td><td></td><td>Issue:</td><td>Date:</td></tr>
<tr><td colspan="4">Remarks :</td></tr>
<tr><td colspan="4">Procedure deviations:</td></tr>
<tr><td colspan="4">NCRs :</td></tr>
<tr><td colspan="2">Test conductor</td><td colspan="2">QA Representative</td></tr>
<tr><td>Name:</td><td></td><td>Name:</td><td></td></tr>
<tr><td>Date:</td><td></td><td>Date:</td><td></td></tr>
<tr><td>Visa:</td><td></td><td>Visa:</td><td></td></tr>
</table>

ELECTRICAL CABINET REWIRING CHECK-OUT PROCEDURE THROUGH SCHNEIDER PLC

FOR THE

MELISSA CI

APPROVAL LIST		
NAME	SIGNATURE	DATE
Prepared by: T.López		
Revised by: J.Carbonell		
Approved by: E.Creus		
Authorised by: J.Duatis		

DISTRIBUTION LIST		
NAME	POSITION	COMPANY
Melissa Pilot Plant	Pilot plant responsible	UAB

CHANGE RECORD			
AUTHOR	ISSUE	DATE	CHANGE
T.López	1.0	23/04/08	First issue

CONTENTS

1. Scope

This document describes the electrical cabinet rewiring check-out procedure to be completed as part of the verification. This procedure is a continuity test through plc commands to ensure the correct wiring connections between the different subsystems.

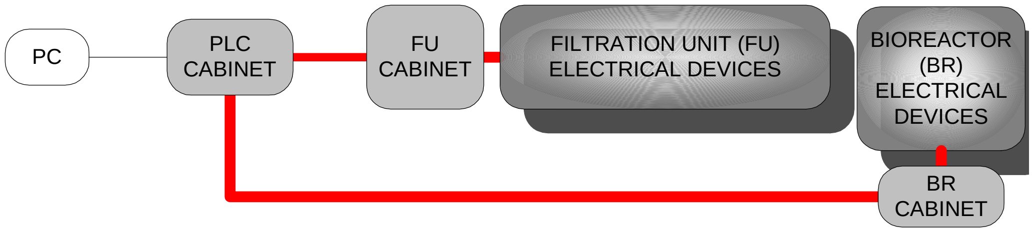


Figure 1 MELISSA CI

This test procedure applies to system composed by the Melissa CI filtration unit, and bioreactor electrical cabinet, Melissa CI plc cabinet and each of 231 electrical devices of Melissa CI as show in Figure 1.

The purpose of the test is to check the correct rewiring of MELISSA CI electrical cabinets and electrical devices (actuators and sensor).

Tests will be performed at the MELISSA pilot plant in UAB facilities.

2. REFERENCE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

Ref.	Title	Reference	Issue	Date
AD1	Procedimiento de Control de No conformidades	NTE-PG-007	3.0	05/12/06

2.2 REFERENCE DOCUMENTS

Ref.	Title	Reference	Issue	Date
RD1	Engineering of the waste compartment (by EPAS)	TN 71.8.3	1	12/06/2007
RD2	CI_procedures_20080505_OG.xls (by SHERPA)		1	27/04/08
RD3	CI_List_Equipments_IO_Tag_20080415.xls (by SHERPA)		1	15/04/08

3. General instructions

3.1 Personnel

At least the following personnel is required for the execution of the tests:

- 1 electronically engineer
- 1 Melissa pilot plant electrical technician

3.2 Test Conditions

The following environmental requirements are applicable to all tests undertaken.

- The areas in which materials and equipment preparation for test is to be carried out shall be maintained in a neat orderly fashion, with no loose material (dirt, dust, oils, etc) that can cause contamination of the parts.

3.3 Non Conformances

Non-Conformances will be issued in case of test deviations or test failures and will be handled as indicated in AD1.

3.4 Safety considerations

Standard low voltage safety rules specified in Reglamento Baja tension and UAB safety rules have to be in consideration.

3.5 Test Report

A report shall be prepared for the tests containing for each test executed:

- Device Under Test data, identification and configuration
- Test set-up
- Test Facility and Environmental Data
- As-run test procedures including deviations, NCRs raised and recommendations of corrective actions.
- The test sign-off sheet detailed in Annex #1 including:
  - Test Procedures deviations
  - NCRs raised
  - Test conductor name and signature
  - QA name and signature
  - Summary of tests results and conclusion

4. Tests procedures

Test	ELECTRICAL CONNECTIVITY TROUGH SCHNEIDER PLC		
Requirements tested	NA		
Unit identification	*MELISSA CI*		
Ambient Temperature	*NA*		
Start of Execution Date		End of Execution Date	
Test equipment	*Model*	*S/N*	*Calibration certificate*
Laptop pc	Standard is enough		NA
Concept software		3.5	NA
Multimeter	Standard is enough		
Sign-off signatures			
Test executor: Date / Signature			

4.1 Digital output test procedure

1. From device disconnected go to connect state (bit=1) through plc, if the device change position and/or state, electrical connection is right.

PLC ADDRESS	*EPAS Tag*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
000001	PMP-R-01		Bioreactor	Peristaltic pump	Pumps acid in the bioreactor (R-R-01) to correct pH	
000002	PMP-R-02		Bioreactor	Peristaltic pump	Pumps base in the bioreactor (R-R-01) to correct pH	
000003	BL-V-01		Influent Tank	Blender	Homogenize influent tank content (R-V-01)	
000004	BL-R-01		Bioreactor	Blender	Homogenize bioreactor content (R-R-01)	

PLC ADDRESS	*EPAS Tag*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
000005	HX-V-01		Influent Tank	Cooler	Cool down influent tank (R-V-01) to prevent pre-degradation	
000006	HX-R-01		Bioreactor	Heat exchanger	Heat bioreactor (R-R-01)	
000007	PMP-V-01		Influent Tank	Recirculation pump	Circulates continuously the influent in a loop	
000008	PMP-V-01		Influent Tank	Recirculation pump	Circulates continuously the influent in a loop	
000012	SIREN		Bioreactor		siren + flashing light	
000013	V-R-19		Bioreactor	Powered 2-way valve	Releases gas from bioreactor (R-R-01) when the pressure increases over the set point	
000014	V-V-07		Influent Tank	Powered 2-way valve	Releases gas from the influent tank (R-V-01) when the pressure increases to the point Pressure sensors PS-V-01 and LS-V-02 are about to go out of their ranges Powered 2-way valve(safety). During feeding of the influent tank it switches to release gas faster than PR-G-02 when pressure becomes so high that volume measurement is impossible due to overranging LS-V-02.	
000015	V-V-04		Influent Tank	Powered 3-way valve	Used to fill in the influent tank R-V-01 with fresh influent or to circulate the influent in a loop	
000016	V-V-03		Influent Tank	Powered 3-way valve	Used to feed the bioreactor R-R-01 with influent at regular intervals of time	

PLC ADDRESS	*EPAS Tag*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
000017	HX-C-01		CIP	Heat exchanger	Heats cleaning buffer R-C-02	
000018	PMP-C-01		CIP	Pump	Pumps cleaning agent or water to the tanks	
000019	PMP-C-02		CIP	Peristaltic pump	Pumps pure detergent (R-C-03) to cleaning agent tank (R-C-01)	
000020	PMP-C-03		CIP	Pump	Pumps cleaning agent from cleaning buffer R-C-02 to FU retentate line	
000021	PMP_F_05		Effluent Tank	Harvesting pump	Pumps the filtrate out of the system for drain	
000022	PMP-G-01		Gas Loop	Gas compressor	Pumps gas from the bioreactor through the buffer vessel R-G-01 (active gas loop)	
000023	PMP-G-02		Gas Loop	Gas pump	Pumps gas from the bioreactor through gas analyser	
000024	PMP-F-02		Filtration Unit	Filtrate pump	Pumps filtrate out of membranes Fi-F-01 and Fi-F-02 to filtrate tank R-F-01 and keeps the flux constant	

PLC ADDRESS	*EPAS Tag*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
000025	V-S-02		SIP	Powered 3-way valve	Allows flow of steam and condens at the retentate side of membrane Fi-F-01 to steam trap V-S-09 and condensate vessel R-S-01 when activated	
000026	V-S-03		SIP	Powered 3-way valve	Allows flow of steam and condens at the retentate side of membrane Fi-F-02 to steam trap V-S-09 and condensate vessel R-S-01 when activated	
000027	V-S-04		SIP	Powered 3-way valve	Allows steam in retentate side of membrane Fi-F-01 when activated	
000028	V-S-05		SIP	Powered 3-way valve	Allows steam in retentate side of membrane Fi-F-02 when activated	
000029	V-S-06		SIP	Powered 3-way valve	Allows flow of steam and condens at the filtration side of membrane Fi-F-01 to steam trap V-S-10 and condensate vessel R-S-02 when activated	
000030	V-S-07		SIP	Powered 3-way valve	Allows flow of steam and condens at the filtration side of membrane Fi-F-02 to steam trap V-S-10 and condensate vessel R-S-02 when activated	
000031	V-S-08		SIP	Powered 3-way valve	Allows flow of steam and condens in effluent vessel VR-F-01 to steam trap V-S-14 and condensate vessel R-S-03 when activated	
000032	PMP-F-01		Filtration Unit	Pump	Pumps reactor content through membranes Fi-F-01 and Fi-F-02 in retentate loop. Is also used during cleaning of the retentate loop	
000033	V-G-08		Gas Loop	Powered 2-way valve	Opens / closes outlet of gas from R-G-02 for produced biogas flow determination	
000034	V-G-10		Gas Loop	Powered 2-way valve	Opens/ closes condensate flow from buffer vessel R-G-01 to bioreactor R-R-01	

PLC ADDRESS	*EPAS Tag*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
000035	V-G-16		Gas Loop	Powered 3-way valve	Used to evacuate N2 gas from the gas analysis loop in case of gas analyser calibration	
000037	V-G-20		Gas Loop	Powered 2-way valve	Used to flush N2 in the retentate loop of the FU in order to prevent under pressure in the loop	
000038	V-G-21		Gas Loop	Powered 2-way valve	Used to flush N2 in the filtrate tank	
000039	V-G-25		Gas Loop	Powered 2-way valve	Opens/ closes gas flow from buffer vessel R-G-01 to bioreactor R-R-01	
000040	V-G-28		Gas Loop	Powered 2-way valve	Opens/ closes the second gas analysis loop	
000041	V-F-15		Filtration Unit	Powered 3-way valve	Used to drain the retentate side of membrane Fi-F-01	
000042	V-F-16		Filtration Unit	Powered 3-way valve	Used to pump back retentate from R-C- 04 to retentate line in FU	
000043	V-F-17		Filtration Unit	Powered 3-way valve	Used to drain retentate from FU retentate line in R-C-04 or in a vessel	
000044	V-F-18		Filtration Unit	Powered 3-way valve	Used to drain retentate from FU retentate line in R-C-04 or in a vessel	
000045	V-G-01		Gas Loop	Powered 3-way valve	Used to connect N2 gas inlet to gas analysis loop for gas analyser calibration	
000046	V-G-02		Gas Loop	Powered 3-way valve	Used to by-pass the gas compressor PMP-G-01	
000047	V-G-03		Gas Loop	Powered 3-way valve	Used to by-pass the gas compressor PMP-G-01	
000048	V-G-05		Gas Loop	Powered 2-way valve	Opens/closes inlet of biogas in buffer vessel R-G-01	
000049	V-F-06		Filtration Unit	Powered 2-way valve	Opens/ closes retentate flow from FU to bioreactor R-R-01	

PLC ADDRESS	*EPAS Tag*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
000050	V-F-07		Filtration Unit	Powered 3-way valve	Used to select outlet filtrate from membrane Fi-F-01 or Fi-F02	
000051	V-F-08		Filtration Unit	Powered 3-way valve	Used to send back filtrate to bioreactor or to collect filtrate in filtrate tank R-F-01	
000052	V-F-10		Effluent Tank	Powered 2-way valve	Used to drain the filtrate tank R-F-01	
000054	V-F-12		Effluent Tank	Powered 2-way valve	Is closed during SIP of effluent vessel R-F-01 to allow pressure and temperature to rise	
000055	V-F-13		Filtration Unit	Powered 2-way valve	Used to keep atmospheric pressure in the retentate line by letting enter/escape air when draining/ filling the tubes	
000056	V-F-14		Filtration Unit	Powered 3-way valve	Used to drain the retentate side of membrane Fi-F-02	
000057	V-C-18		CIP	Powered 3-way valve	Activated during backwashing and cleaning of retentate side of membrane Fi-F-02	
000058	V-C-19		CIP	Powered 3-way valve	Activated during backwashing and cleaning of retentate side of membrane Fi-F-01	
000059	V-C-21		CIP	Powered 2-way valve	When activated, allows cleaning agent to filtratte side of membranes Fi-F-01 and -02 during backwashing	
000060	V-F-01		Filtration Unit	Powered 2-way valve	Opens/ closes retentate flow from bioreactor R-R-01 to Filtration Unit	
000061	V-F-02		Filtration Unit	Powered 3-way valve	Used to bypass the FU	
000062	V-F-03		Filtration Unit	Powered 3-way valve	Used to select inlet retentate of membrane Fi-F-01 or Fi-F02	
000063	V-F-04		Filtration Unit	Powered 3-way valve	Used to select outlet retentate from membrane Fi-F-01 or Fi-F-02	
000064	V-F-05		Filtration Unit	Powered 3-way valve	Used to bypass the FU	

PLC ADDRESS	EPAS Tag	OK/NOK	Location	Description	Function	Comments
000065	V-C-10		CIP	Powered 2-way valve	Used to drain and during rincing of cleaning agent vessel (R-C-01)	
000066	V-C-11		CIP	Powered 2-way valve	Allows outside air to enter during draining and rincing of cleaning agent vessel (R-C-01) and allows air to leave the vessel when it is being filled	
000067	V-C-12		CIP	Powered 3-way valve	Activated for backwashing membrane Fi-F-02	
000068	V-C-13		CIP	Powered 3-way valve	Activated for backwashiong mbne membrane Fi-F-01	
000069	V-C-14		CIP	Powered 3-way valve	Activated during cleaning of retentate loop	
000070	V-C-15		CIP	Powered 3-way valve	Activated during cleaning of retentate loop	
000071	V-C-16		CIP	Powered 3-way valve	Activated for cleaning of retentate side of membrane Fi-F-01	
000072	V-C-17		CIP	Powered 3-way valve	Activated for cleaning of retentate side of membrane Fi-F-02	
000074	V-C-01		CIP	Powered 2-way valve	Allows water to No-C-01 for rincing of Feeding Vessel (R-V-01)	
000075	V-C-02		CIP	Powered 2-way valve	Allows water to No-C-02 for rincing of bioreactor (R-R-01)	
000076	V-C-04		CIP	Powered 2-way valve	Allows water to No-C-03 for rincing of effluent vessel (R-F-01)	
000077	V-C-05		CIP	Powered 2-way valve	Allows water to No-C-04 for rincing and filling cleaning buffer vessel (R-C-02)	
000078	V-C-06		CIP	powered 2-way valve	Drains cleaning buffer vessel (R-C-02) when open	
000079	V-C-07		CIP	Powered 2-way valve	Allows outside air to enter cleaning buffer vesel (R-C-02) while it is drained and allows air to leave the vessel when it is being filled	

PLC ADDRESS	EPAS Tag	OK/NOK	Location	Description	Function	Comments
000080	V-C-09		CIP	Powered 2-way valve	Used to fill R-C-01 with water	
000084	St-S-01		SIP	Electrical steam generator	Generates steam of 3.8bara or 140°C when activated	
000085	V-S-12		SIP	Powered 2-way valve	Allows steam in filtrate side of membrane Fi-F-01 when activated	
000086	V-S-11		SIP	Powered 2-way valve	Allows steam in filtrate side of membrane Fi-F-02 when activated	
000087	V-G-07		Gas Loop	Powered 2-way valve	Opens/ closes inlet of gas in R-G-02 for produced biogas flow determination	
000088	V-S-13		SIP	Powered 2-way valve	Allows steam in efflluent vessel R-F-01 and the filtrate side of Fi-F-03 when activated	

4.2 Digital input test procedure

1- Read sensor in stable state

2- Change physical parameter/position (depends of the sensor). If there are a proportional change in the variable, the electrical connection is right.

3- Come back to stable state, this state will be more or less same value that stable state.

PLC ADDRESS	*ELECTRICAL DEVICE*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
100001	E_RV_F4_F5		Bioreactor		Tension control Steering circuit 230VAC	
100002	E_RV_F6_F8		Bioreactor		Tension control Steering circuit 24VDC	
100003	E_RV_F9_F10		Bioreactor		Tension control Power circuit 230VAC	
100004	E_RV_F1_NC		Bioreactor			
100005	E_RV_F3_NC		Bioreactor			
100006	E_RV_F9_NC		Bioreactor			
100007	E_RV_F14_F15		Bioreactor		Circuit Breaker 14 of PMP_R_03	
100008	E_RV_F16_F17		Bioreactor		Circuit Breaker 16 of PMP_V_02	
100009	E_RV_Q2_F19		Bioreactor		Motor Switch Q2	
100010	E_RV_K2_F21 => E_RV_K1_F21		Bioreactor		Control Contactor K1 Counter clockwise	
100011	E_RV_K1_F20 => E_RV_K2_F20		Bioreactor		Control Contactor K2 Clockwise	
100012	E_RV_Q4_F23		Bioreactor		Control Circuit-breaker Q4	
100013	E_RV_K4_F22		Bioreactor		Control Contactor K4	

PLC ADDRESS	ELECTRICAL DEVICE	OK/NOK	Location	Description	Function	Comments
100014	E_RV_Q3_F26		Bioreactor		Control Circuit-breaker Q3	
100015	E_RV_K3_F27		Bioreactor		Control Contactor K3	
100016	E_RV_U1_ALM		Bioreactor	CONTROL BL-V-01	Alarm Frequency regulator U1	
100017	E_RV_F29_F31		Bioreactor		Control Circuit-breaker F29	
100018	E_RV_U2_ALM		Bioreactor	CONTROL BL-R-01	Alarm Frequency regulator U2	
100019	E_RV_F33_F35		Bioreactor		Control Circuit-breaker F33	
100020	E_RV_pHT_R_01_ALM		Bioreactor		Alarm Ph transmitter 1	
100021	E_RV_pHT_R_02_ALM		Bioreactor		Alarm Ph transmitter 2	
100022	LS_V_01		Influent Tank	Level switch	Gives an alarm when the level in influent tank (R-V-01) becomes too high	

PLC ADDRESS	ELECTRICAL DEVICE	OK/NOK	Location	Description	Function	Comments
100023	LS_R_01		Bioreactor	Level Switch	Gives an alarm/action when the level in bioreactor (R-R-01) becomes too high	
100024	LS_R_03		Bioreactor	Level Switch	Gives an alarm/action when the level in the warm water bath (HX-R-01) becomes too low	
100025	V_GetCakeButton		Gas Loop	Level switch	Button for filling feeder	
100027	V_V_03_FB		Effluent Tank	Level switch	Valve state feedback	
100028	V_V_04_FB		Effluent Tank	Level switch	Valve state feedback	
100029	V_V_07_FB		Effluent Tank	Level switch	Valve state feedback	
100030	V_R_19_FB		Bioreactor	Level switch	Valve state feedback	
100031	ERR_R_pH_PMP_powersupply			Level switch	Control Circuit-breaker F43	
100032	Emergency_Button_Pressed			Level switch	emergency button pressed	

PLC ADDRESS	*ELECTRICAL DEVICE*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
100033	Control_Tens230VAC_steerFiltrate			fuse test	E-FG-F4	
100034	Control_Tens24VDC_steerFiltrate			fuse test	E-FG-F6	
100035	Control_Tens230VAC_powerFiltrate			fuse test	E-FG-F9	
100036	Control_Emergency					
100037	HX_G_01_ALM		gas loop			
100038	HX_G_02_ALM		gas loop			
100039	FS_F_01_ALM		Filtration Unit		AlarmContact Flow Meter	
100040	A_G_01_ALM		gas loop			
100041	A_G_02_ALM		gas loop			
100042	E_FG_U1_ALM_F34				Alarm Contact Frequency regulator	
100043	E_FG_F35_F36				Tension Control Pump F35	
100047	LS_G_01		gas loop		Gives an alarm/action when the condensate level in buffer vessel R-G-01 becomes too high (=> problem with condensate evacuation system)	

PLC ADDRESS	ELECTRICAL DEVICE	OK/NOK	Location	Description	Function	Comments
100048	LS_F_01		Filtration Unit		Measures upper volume in gas phase for volume measurement in filtrate tank (R-F-01)	
100049	LS_C_04		CIP		Detects low level in cleaning buffer tank (R-C-02)	
100050	LS_C_03		CIP		Detects high level in cleaning buffer tank (R-C-02)	
100051	LS_C_02		CIP		Detects low level in cleaning agent tank (R-C-01)	
100052	LS_C_01		CIP		Detects high level in cleaning agent tank (R-C-01)	
100053	LS_F_02		Filtration Unit		Measures pressure in liquid phase for volume measurement in filtrate tank (R-F-01)	
100054	V_S_07_FB		SIP		Valve state feedback	
100055	V_S_08_FB		SIP		Valve state feedback	
100056	V_S_06_FB		SIP		Valve state feedback	
100057	V_S_05_FB		SIP		Valve state feedback	
100058	V_S_04_FB		SIP		Valve state feedback	
100059	V_S_03_FB		SIP		Valve state feedback	

PLC ADDRESS	ELECTRICAL DEVICE	OK/NOK	Location	Description	Function	Comments
100060	V_S_02_FB		SIP		Valve state feedback	
100061	V_G_28_FB		gas loop		Valve state feedback	
100062	V_G_25_FB		gas loop		Valve state feedback	
100063	V_G_21_FB		gas loop		Valve state feedback	
100064	V_G_20_FB		gas loop		Valve state feedback	
100066	V_G_16_FB		gas loop		Valve state feedback	
100067	V_G_10_FB		gas loop		Valve state feedback	
100068	V_G_08_FB		gas loop		Valve state feedback	
100069	V_G_05_FB		gas loop		Valve state feedback	
100070	V_G_03_FB		gas loop		Valve state feedback	
100071	V_G_02_FB		gas loop		Valve state feedback	
100072	V_G_01_FB		gas loop		Valve state feedback	
100073	V_F_18_FB		Filtration Unit		Valve state feedback	
100074	V_F_17_FB		Filtration Unit		Valve state feedback	
100075	V_F_16_FB		Filtration Unit		Valve state feedback	
100076	V_F_15_FB		Filtration Unit		Valve state feedback	
100077	V_F_14_FB		Filtration Unit		Valve state feedback	
100078	V_F_13_FB		Filtration Unit		Valve state feedback	
100079	V_F_12_FB		Filtration Unit		Valve state feedback	
100080	V_F_11_FB		Filtration Unit		Valve state feedback	
100081	V_F_10_FB		Filtration Unit		Valve state feedback	
100082	V_F_08_FB		Filtration Unit		Valve state feedback	
100083	V_F_07_FB		Filtration Unit		Valve state feedback	
100084	V_F_06_FB		Filtration Unit		Valve state feedback	
100085	V_F_05_FB		Filtration Unit		Valve state feedback	
100086	V_F_04_FB		Filtration Unit		Valve state feedback	
100087	V_F_03_FB		Filtration Unit		Valve state feedback	
100088	V_F_02_FB		Filtration Unit		Valve state feedback	
100089	V_F_01_FB		Filtration Unit		Valve state feedback	

PLC ADDRESS	ELECTRICAL DEVICE	OK/NOK	Location	Description	Function	Comments
100090	V_C_21_FB		CIP		Valve state feedback	
100091	V_C_19_FB		CIP		Valve state feedback	
100092	V_C_18_FB		CIP		Valve state feedback	
100093	V_C_17_FB		CIP		Valve state feedback	
100094	V_C_16_FB		CIP		Valve state feedback	
100095	V_C_15_FB		CIP		Valve state feedback	
100096	V_C_14_FB		CIP		Valve state feedback	
100097	V_C_13_FB		CIP		Valve state feedback	
100098	V_C_12_FB		CIP		Valve state feedback	
100099	V_C_11_FB		CIP		Valve state feedback	
100100	V_C_10_FB		CIP		Valve state feedback	
100101	V_C_09_FB		CIP		Valve state feedback	
100102	V_C_07_FB		CIP		Valve state feedback	
100103	V_C_06_FB		CIP		Valve state feedback	
100104	V_C_05_FB		CIP		Valve state feedback	
100105	V_S_12_FB		SIP		Valve state feedback	
100106	V_S_11_FB		SIP		Valve state feedback	
100107	V_G_07_FB		gas loop		Valve state feedback	
100108	V_S_13_FB		SIP		Valve state feedback	
100110	V_C_01_FB		CIP		Valve state feedback	
100111	V_C_02_FB		CIP		Valve state feedback	
100112	V_C_04_FB		CIP		Valve state feedback	

4.3 Analog input test procedure

1-Read sensor in stable state

2- Change physical parameter/position (depends of the sensor). If there are proportional change in the variable, the electrical connection is right.

3- Come back to stable state, this state will be more or less same value of first point.

PLC ADDRESS	*ELECTRICAL DEVICE*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
300001	pHS-R-01		Bioreactor	pH sensor	Measures pH in bioreactor (R-R-01)	
300002			Bioreactor	pH sensor	(Epas T-pH-R-01) Measures temp. of the Electrod (same sensor as pH ?)	
300003	pHS-R-02		Bioreactor	pH sensor	Measures pH in bioreactor (R-R-01)	
300004			Bioreactor	pH sensor	(Epas T-pH-R-02) Measures temp. of the Electrod (same sensor as pH ?)	
300005	LS-V-02		Influent Tank	Level sensor	Measures pressure in liquid phase for volume measurement in influent tank (R-V-01)	
300006	PS-V-01		Influent Tank	Pressure transducer	Measures pressure in gas phase for gas and volume measurement in influent tank (R-V-01)	

PLC ADDRESS	ELECTRICAL DEVICE	OK/NOK	Location	Description	Function	Comments
300007	PS-V-03		Influent Tank	Pressure transducer	Measures pressure immediately after pump PMP-V-01 and gives an alarm if pressure increases above the pump's limit	
300009	TS-V-02		Influent Tank	Temperature sensor	Measures temperature in influent tank (R-V-01)	
300010	PS-R-01		Bioreactor	Pressure transducer	Measures pressure in gas phase for gas and volume measurement in bioreactor (R-R-01)	
300011	PS-R-02		Bioreactor	Pressure transducer	Measures pressure in liquid phase for volume measurement in bioreactor (R-R-01)	
300013	LS-R-02		Bioreactor	Level sensor	Measures pressure in liquid phase for volume measurement in bioreactor (R-R-01)	
300014	TS-V-01		Influent Tank	Temperature sensor	Measures temperature in influent tank (R-V-01)	
300015	TS-R-01		Bioreactor	Temperature sensor	Measures temperature in bioreactor (R-R-01)	
300016	TS-R-02		Bioreactor	Temperature sensor	Measures temperature in warm water bath HX-R-01	
300018	FS-F-01		Filtration Unit	Flow meter	Measures the retentate flow	
300019	A-G-01		Gas Loop	Gas analyser	Analyses bioreactor gas phase composition for	

PLC ADDRESS	*ELECTRICAL DEVICE*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
					H2	
300021	TS-F-02		Filtration Unit	Temperature sensor	Measures temperature in retentate	
300022	TS-F-01		Effluent Tank	Temperature sensor	Measures temperature in filtrate tank R-F-01	
300023	TS-C-01		CIP	Temperature sensor	Measures temperature in cleaning buffer vessel (R-C-02). Is Measureed. Value for temperature control in (R-C-02)	
300024	PS-G-03		Gas Loop		Measures the gas pressure on the gas line before the columns.	
300025	PS-G-02		Gas Loop	Pressure transducer	Measures pressure of gas after gas analyser	
300026	PS-G-01		Gas Loop	Pressure transducer	Measures pressure in buffer vessel R-G- 01	
300027	PS-F-07		Filtration Unit	Pressure transducer	Measures pressure of retentate after pump PMP-F-01 (safety pump)	
300028	PS-F-06		Filtration Unit	Pressure transducer	Measures pressure of filtrate at outlet of membrane Fi-F-02	
300029	PS-F-05		Filtration Unit	Pressure transducer	Measures pressure of retentate at outlet of membrane Fi-F-02	
300030	PS-F-04		Filtration Unit	Pressure transducer	Measures pressure of retentate at inlet of membrane Fi-F-02	
300031	PS-F-03		Filtration Unit	Pressure transducer	Measures pressure of filtrate at outlet of membrane Fi-F-01	
300032	PS-F-02		Filtration Unit	Pressure transducer	Measures pressure of retentate at outlet of membrane Fi-F-01	
300033	PS-F-01		Filtration Unit	Pressure transducer	Measures pressure of retentate at inlet of membrane Fi-F-01	
300035	SS-F-01		Filtration Unit	Turbidity sensor	Measures turbidity of retentate	

PLC ADDRESS	*ELECTRICAL DEVICE*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
300036	FS-G-01		Gas Loop	Mass Flow meter	Measures the gas flow entering in the gas analyser Measures the gas flow entering in the	
300037	FS-G-04		Gas Loop	N2 Mass Flow meter	Measures the N2 gas flow entering the bioreactor R-R-01 (passive gas loop configuration)	
300038	LS-F-03		Effluent Tank	Level sensor	Measures pressure in gas phase for volume measurement in filtrate tank (R-F-01)	
300040	PS-G-04		Gas Loop	Pressure transducer	Measures pressure of gas produced by bioreactor (R-R-01) and accumulated in R-G-02 for flow measurement	
300041	TS-G-01		Gas Loop	Temperature sensor	Measures temperature in R-G-02 for determination of produced gas flow	
300042	PS-F-09		Filtration Unit	Pressure transducer	Measures pressure at inlet of dead end filter Fi-F-03 (to follow clogging)	
300043	TS-F-03		Filtration Unit	Temperature sensor	Measures temperature Membrane1	
300044	TS-F-04		Filtration Unit	Temperature sensor	Measures temperature Membrane2	
300049 => 300020	A-G-02		Gas Loop	Gas analyser	Analyses bioreactor gas phase composition for CO2 and CH4. One sensor, 2 measurements	
300050 => 300039	A-G-02		Gas Loop	Gas analyser	Analyses bioreactor gas phase composition for CO2 and CH4. One sensor. 2 measurement	

4.4 Analog output test procedure

1- From a medium value go to upper or lower value (30%)

2- Check device, if it change in proportion to set point, the electrical connection is right.

PLC ADDRESS	*EPAS Tag*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
400001			Filtration Unit	control PMP-F-02	2 variables for the pump	
400002			Filtration Unit	control PMP-F-03	2 variables for the pump	
400003	V-G-09		Gas Loop	Powered proportional valve	Used to adapt the gas flow coming from buffer vessel R-G-01 and going to bioreactor R-R-01 in order to keep the pressure constant in the bioreactor	
400004	V-G-29		Gas Loop	Powered proportional valve	to keep bioreactor pressure constant (passive gas loop configuration) Regulates N2 inlet in bioreactor R-R-01	

DATA PACKAGE 94.1 Issue 1

ELECTRICAL CABINET REWIRING CHECK-OUT REPORT

FOR THE

MELISSA CI

APPROVAL LIST		
NAME	SIGNATURE	DATE
Prepared by: T. López		
Revised by: M. Bassas		
Approved by: E. Creus		
Authorised by: J. Duatis		

DISTRIBUTION LIST		
NAME	POSITION	COMPANY
Melissa Pilot plant	Pilot plant responsible	UAB

CHANGE RECORD			
AUTHOR	ISSUE	DATE	CHANGE
T. López	1.0	24/04/08	First issue

CONTENTS

1. Scope

This document describes the electrical cabinet rewiring check-out report of the verification performed at the MELISSA pilot plant in UAB facilities to check the correct connection of the sensors and actuators to the PLC cabinet provided by NTE according to RD1.

2. REFERENCE DOCUMENTS

2.1. APPLICABLE DOCUMENTS

Ref.	Title	Reference	Issue	Date
AD1	Procedimiento de Control de No conformidades	NTE-PG-007	3.0	05/12/06

2.2. REFERENCE DOCUMENTS

Ref.	Title	Reference	Issue	Date
RD1	Electrical Cabinet Rewiring Check-out Procedure	NTE-MCI-PR-001	1	23/04/2008

3. Summary of results

All tests resulted successfully and no deviations were found. See in ANNEX 1 detailed test results in the as-run procedure.

4. ANNEX 1

(see attached the as-run procedure)

PROCEDURE SIGN-OFF SHEET

Test reference:	conectivity test	Issue: 1	Date: 24/04/08

Remarks :

Procedure deviations:

(None)

NCRs :

(None)

Test conductor		QA Representative	
Name:	Toni López	Name:	
Date:	24/04/08	Date:	
Visa:		Visa:	

4. TESTS PROCEDURES

Test	conectivity test		
Requirements tested	Continuity specyfied conection		
Unit identification			
Ambient Temperature			
Start of Execution Date	24/04/08	End of Execution Date	
Test equipment	*Model*	*S/N*	*Calibration certificate*
Multimeter	VICTOR VC9802A+	01	04/12/07
Remarks			
Sign-off signatures			
Test executor: Date / Signature		[redacted]	

PLC CABINET X1 (DI)	CABLE			VR CABINET X5	OK/NOK	
1	A	1	2	1	OK	9:15
2	A	3	4	2	OK	
3	A	5	6	3	OK	
4	A	7	8	NC	OK	
5	A	9	10	NC	OK	
6	A	11	12	NC	OK	
7	A	13	14	7	OK	
8	A	15	16	8	OK	
9	B	1	2	9	OK	
10	B	3	4	10	OK	
11	B	5	6	11	OK	
12	B	7	8	12	OK	
13	B	9	10	13	OK	
14	B	11	12	14	OK	
15	B	13	14	15	OK	
16	B	15	16	16	OK	
17	C	1	2	17	OK	
18	C	3	4	18	OK	
19	C	5	6	19	OK	
20	C	7	8	20	OK	
21	C	9	10	21	OK	
22	C	11	12	22		NO RELAY !
23	C	13	14	23	OK	
24	C	15	16	24	OK	
25	D	1	2	25	OK	
26	D	3	4	NC	OK	
27	D	5	6	27	OK	
28	D	7	8	28	OK	
29	D	9	10	29	OK	
30	D	11	12	30	OK	
31	D	13	14	31	OK	
32	D	15	16	32	OK	

PLC CABINET	CABLE			VR CABINET	OK/NOK
X3(AI)				X3	
PHOENIX D					
1,2	G	1	2	1	OK
3,4	G	3	4	2	OK
5,6	G	5	6	3	OK
7,8	G	7	8	4	OK
11,12	G	9	10	5	OK
13,14	G	11	12	6	OK
15,16	G	13	14	7	OK
17,18	G	15	16	NC	OK
21,22	H	1	2	NC	OK
23,24	H	3	4	10	OK
25,26	H	5	6	11	OK
27,28	H	7	8	NC	OK
31,32	H	9	10	13	OK
33,34	H	11	12	14	OK
35,36	H	13	14	15	OK
37,38	H	15	16	16	OK

PLC CABINET	CABLE			VR CABINET	OK/NOK
X2 (D0)				X6	
1	E	1	2	1	OK
2	E	3	4	2	OK
3	E	5	6	3	OK
4	E	7	8	4	OK
5	E	9	10	5	OK
6	E	11	12	6	OK
7	E	13	14	7	OK
8	E	15	16	8	OK
9	F	1	2	9	OK
10	F	3	4	10	OK
11	F	5	6	11	OK
12	F	7	8	12	OK
13	F	9	10	13	OK
14	F	11	12	NC	-
15	F	13	14	NC	-
16	F	15	16	NC	-

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superior regleta

PLC CABINET X1 (DI)	CABLE			FG CABINET X5	OK/NOK
33	I	1	2	1	OK
34	I	3	4	2	OK
35	I	5	6	3	OK
36	I	7	8	4	OK
37	I	9	10	5	OK
38	I	11	12	6	OK
39	I	13	14	7	OK
40	I	15	16	8	OK
41	J	1	2	9	OK
42	J	3	4	10	OK
43	J	5	6	11	OK
44	J	7	8	12	OK
45	J	9	10	13	OK
46	J	11	12	14	OK
47	J	13	14	15	OK
48	J	15	16	16	OK
49	K	1	2	17	OK
50	K	3	4	18	OK
51	K	5	6	19	OK
52	K	7	8	20	OK
53	K	9	10	21	OK
54	K	11	12	22	OK
55	K	13	14	23	OK
56	K	15	16	24	OK
57	L	1	2	25	OK
58	L	3	4	26	OK
59	L	5	6	27	OK
60	L	7	8	28	OK
61	L	9	10	29	OK
62	L	11	12	30	OK
63	L	13	14	31	OK
64	L	15	16	32	OK
65	M	1	2	33	OK
66	M	3	4	34	OK
67	M	5	6	35	OK
68	M	7	8	36	OK
69	M	9	10	37	OK
70	M	11	12	38	OK
71	M	13	14	39	OK
72	M	15	16	40	OK
73	N	1	2	41	OK
74	N	3	4	42	OK
75	N	5	6	43	OK
76	N	7	8	44	OK
77	N	9	10	45	OK
78	N	11	12	46	OK
79	N	13	14	47	OK

10.30

80	N	15	16	48	OK
81	O	1	2	49	OK
82	O	3	4	50	OK
83	O	5	6	51	OK
84	O	7	8	52	OK
85	O	9	10	53	OK
86	O	11	12	54	OK
87	O	13	14	55	OK
88	O	15	16	56	OK
89	P	1	2	57	OK
90	P	3	4	58	OK
91	P	5	6	59	OK
92	P	7	8	60	OK
93	P	9	10	61	OK
94	P	11	12	62	OK
95	P	13	14	63	OK
96	P	15	16	64	OK
97	Q	1	2	65	OK
98	Q	3	4	66	OK
99	Q	5	6	67	OK
100	Q	7	8	68	OK
101	Q	9	10	69	OK
102	Q	11	12	70	OK
103	Q	13	14	71	OK
104	Q	15	16	72	OK
105	R	1	2	73	OK
106	R	3	4	74	OK
107	R	5	6	75	OK
108	R	7	8	76	OK
109	R	9	10	77	OK
110	R	11	12	78	OK
111	R	13	14	79	OK
112	R	15	16	80	OK

PLC CABINET	CABLE			FG CABINET	OK/NOK
X2 (DO)				X6	
17	S	1	2	1	OK
18	S	3	4	2	OK
19	S	5	6	3	OK
20	S	7	8	4	OK
21	S	9	10	5	OK
22	S	11	12	6	OK
23	S	13	14	7	OK
24	S	15	16	8	OK
25	T	1	2	9	OK
26	T	3	4	10	OK
27	T	5	6	11	OK
28	T	7	8	12	OK
29	T	9	10	13	OK
30	T	11	12	14	OK
31	T	13	14	15	OK
32	T	15	16	16	OK
33	U	1	2	17	OK
34	U	3	4	18	OK
35	U	5	6	19	OK
36	U	7	8	20	OK
37	U	9	10	21	OK
38	U	11	12	22	OK
39	U	13	14	23	OK
40	U	15	16	24	OK
41	V	1	2	25	OK
42	V	3	4	26	OK
43	V	5	6	27	OK
44	V	7	8	28	OK
45	V	9	10	29	OK
46	V	11	12	30	OK
47	V	13	14	31	OK
48	V	15	16	32	OK
49	W	1	2	33	OK
50	W	3	4	34	OK
51	W	5	6	35	OK
52	W	7	8	36	OK
53	W	9	10	37	OK
54	W	11	12	38	OK
55	W	13	14	39	OK
56	W	15	16	40	OK
57	X	1	2	41	OK
58	X	3	4	42	OK
59	X	5	6	43	OK
60	X	7	8	44	OK
61	X	9	10	45	OK
62	X	11	12	46	OK
63	X	13	14	47	OK
64	X	15	16	48	OK
65	Y	1	2	49	OK

66	Y	3	4	50	ok
67	Y	5	6	51	ok
68	Y	7	8	52	ok
69	Y	9	10	53	ok
70	Y	11	12	54	ok
71	Y	13	14	55	ok
72	Y	15	16	56	ok
73	Z	1	2	57	ok
74	Z	3	4	58	ok
75	Z	5	6	59	ok
76	Z	7	8	60	ok
77	Z	9	10	61	ok
78	Z	11	12	62	ok
79	Z	13	14	63	ok
80	Z	15	16	64	ok
81	2A	1	2	65	ok
82	2A	3	4	66	ok
83	2A	5	6	67	ok
84	2A	7	8	68	ok
85	2A	9	10	69	ok
86	2A	11	12	NC	—
87	2A	13	14	NC	—
88	2A	15	16	NC	—

PLC CABINET X3 (AI)	CABLE			FG CABINET X3	OK/NOK
PHOENIX E					
1,2	2B	1	2	1	OK
3,4	2B	3	4	2	OK
5,6	2B	5	6	3	OK
7,8	2B	7	8	4	OK
11,12	2B	9	10	5	OK
13,14	2B	11	12	6	OK
15,16	2B	13	14	7	OK
17,18	2B	15	16	8	OK
21,22	2C	1	2	9	OK
23,24	2C	3	4	10	OK
25,26	2C	5	6	11	OK
27,28	2C	7	8	12	OK
31,32	2C	9	10	13	OK
33,34	2C	11	12	14	OK
35,36	2C	13	14	15	OK
37,38	2C	15	16	16	OK.
PHOENIX F					
1,2	2D	1	2	17	OK
3,4	2D	3	4	18	OK
5,6	2D	5	6	19	OK
7,8	2D	7	8	20	OK
11,12	2D	9	10	21	OK
13,14	2D	11	12	22	OK
15,16	2D	13	14	23	OK
17,18	2D	15	16	24	OK
21,22	2E	1	2	NC	—
23,24	2E	3	4	NC	—
25,26	2E	5	6	NC	—
27,28	2E	7	8	NC	—
31,32	2E	9	10	NC	—
33,34	2E	11	12	NC	—
35,36	2E	13	14	NC	—
37,38	2E	15	16	NC	—

PLC CABINET	CABLE			FG CABINET	OK/NOK
X4 (A0)				X4	
1	2F	1	2	1	OK
2	2F	3	4	2	OK
3	2F	5	6	3	OK
4	2F	7	8	4	OK
NA	2F	9	10	NC	-
NA	2F	11	12	NC	-
NA	2F	13	14	NC	-
NA	2F	15	16	NC	-
NA	2F	17	18	NC	-

ELECTRICAL CABINET REWIRING CHECK-OUT REPORT THROUGH SCHNEIDER PLC

FOR THE

MELISSA CI

APPROVAL LIST		
NAME	SIGNATURE	DATE
Prepared by: T.López		
Revised by: J.Carbonell		
Approved by: E.Creus		
Authorised by: J.Duatis		

DISTRIBUTION LIST		
NAME	POSITION	COMPANY
Melissa Pilot plant	Pilot plant responsible	UAB

CHANGE RECORD			
AUTHOR	ISSUE	DATE	CHANGE
T.López	1.0	23/04/08	First issue

CONTENTS

1. Scope

This document describes the electrical cabinet rewiring check-out procedure to be completed as part of the verification. This procedure is a continuity test through plc commands to ensure the correct wiring connections between the different subsystems.

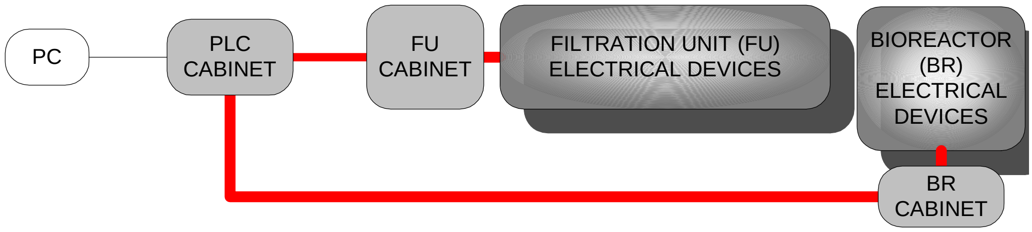

Figure 1 MELISSA CI

This test procedure applies to system composed by the Melissa CI filtration unit, and bioreactor electrical cabinet, Melissa CI plc cabinet and each of 231 electrical devices of Melissa CI as show in **¡Error! No se encuentra el origen de la referencia.**.

The purpose of the test is to check the correct rewiring of MELISSA CI electrical cabinets and electrical devices (actuators and sensor).

Tests will be performed at the MELISSA pilot plant in UAB facilities.

2. REFERENCE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

Ref.	Title	Reference	Issue	Date
AD1	Procedimiento de Control de No conformidades	NTE-PG-007	3.0	05/12/06

2.2 REFERENCE DOCUMENTS

Ref.	Title	Reference	Issue	Date
RD1	Engineering of the waste compartment (by EPAS)	TN 71.8.3	1	12/06/2007
RD2	CI_procedures_20080505_OG.xls (by SHERPA)		1	27/04/08
RD3	CI_List_Equipments_IO_Tag_20080415.xls (by SHERPA)		1	15/04/08

3. General instructions

3.1 Personnel

At least the following personnel is required for the execution of the tests:

- 1 electronically engineer
- 1 Melissa pilot plant electrical technician

3.2 Test Conditions

The test was performed on 13/05/08.

The following environmental requirements are applicable to all tests undertaken.

- The areas in which materials and equipment preparation for test is to be carried out shall be maintained in a neat orderly fashion, with no loose material (dirt, dust, oils, etc) that can cause contamination of the parts.

3.3 Non Conformances

Non-Conformances will be issued in case of test deviations or test failures and will be handled as indicated in AD1.

3.4 Safety considerations

Standard low voltage safety rules specified in Reglamento Baja tension and UAB safety rules have to be in consideration.

3.5 Test Report

A report shall be prepared for the tests containing for each test executed:

- Device Under Test data, identification and configuration
- Test set-up
- Test Facility and Environmental Data
- As-run test procedures including deviations, NCRs raised and recommendations of corrective actions.
- The test sign-off sheet detailed in Annex #1 including:
    - Test Procedures deviations
    - NCRs raised
    - Test conductor name and signature
    - QA name and signature
    - Summary of tests results and conclusion

4. Tests procedures

Test	ELECTRICAL CONNECTIVITY TROUGH SCHNEIDER PLC			
Requirements tested	NA			
Unit identification	*MELISSA CI*			
Ambient Temperature	*NA*			
Start of Execution Date	*13/05/08*	End of Execution Date		*16/05/08*
Test equipment	*Model*		*S/N*	*Calibration certificate*
Laptop pc	Standard is enough			NA
Concept software			3.5	NA
Multimeter	Standard is enough			
Sign-off signatures				
Test executor: Date / Signature				

4.1 Digital output test procedure

1. From device disconnected go to connect state (bit=1) through plc, if the device change position and/or state, electrical connection is right.

PLC ADDRESS	*EPAS Tag*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
000001	PMP-R-01	OK	Bioreactor	Peristaltic pump	Pumps acid in the bioreactor (R-R-01) to correct pH	
000002	PMP-R-02	OK	Bioreactor	Peristaltic pump	Pumps base in the bioreactor (R-R-01) to correct pH	
000003	BL-V-01	OK	Influent Tank	Blender	Homogenize influent tank content (R-V-01)	
000004	BL-R-01	OK	Bioreactor	Blender	Homogenize bioreactor content (R-R-01)	
000005	HX-V-01	OK	Influent Tank	Cooler	Cool down influent tank (R-V-01) to prevent pre-degradation	

PLC ADDRESS	*EPAS Tag*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
000006	HX-R-01	OK	Bioreactor	Heat exchanger	Heat bioreactor (R-R-01)	
000007	PMP-V-01	OK	Influent Tank	Recirculation pump	Circulates continuously the influent in a loop	Direction isn't clear, seems that pump run always in the same direction.
000008	PMP-V-01	OK	Influent Tank	Recirculation pump	Circulates continuously the influent in a loop	
000012	SIREN	OK	Bioreactor		siren + flashing light	
000013	V-R-19	OK	Bioreactor	Powered 2-way valve	Releases gas from bioreactor (R-R-01) when the pressure increases over the set point	
000014	V-V-07	OK	Influent Tank	Powered 2-way valve	Releases gas from the influent tank (R-V-01) when the pressure increases to the point Pressure sensors PS-V-01 and LS-V-02 are about to go out of their ranges Powered 2-way valve(safety). During feeding of the influent tank it switches to release gas faster than PR-G-02 when pressure becomes so high that volume measurement is impossible due to overranging LS-V-02.	
000015	V-V-04	OK	Influent Tank	Powered 3-way valve	Used to fill in the influent tank R-V-01 with fresh influent or to circulate the influent in a loop	It´s blocked
000016	V-V-03	OK	Influent Tank	Powered 3-way valve	Used to feed the bioreactor R-R-01 with influent at regular intervals of time	It doesn't have fuse. We use other to test it. It´s blocked
000017	HX-C-01	OK	CIP	Heat exchanger	Heats cleaning buffer R-C-02	Safety module doesn't work. We disconnect safety module to do test.

PLC ADDRESS	*EPAS Tag*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
000018	PMP-C-01	OK	CIP	Pump	Pumps cleaning agent or water to the tanks	Safety module doesn't work. We disconnect safety module to do test.
000019	PMP-C-02	OK	CIP	Peristaltic pump	Pumps pure detergent (R-C-03) to cleaning agent tank (R-C-01)	Safety module doesn't work. We disconnect safety module to do test.
000020	PMP-C-03	OK	CIP	Pump	Pumps cleaning agent from cleaning buffer R-C-02 to FU retentate line	Safety module doesn't work. We disconnect safety module to do test.
~~000021~~	~~PMP_F_05~~	OK	~~Effluent Tank~~	~~Harvesting pump~~	~~Pumps the filtrate out of the system for drain~~	It doesn't exist. Safety module doesn't work. We disconnect safety module to do test.
000022	PMP-G-01	OK	Gas Loop	Gas compressor	Pumps gas from the bioreactor through the buffer vessel R-G-01 (active gas loop)	Safety module doesn't work. We disconnect safety module to do test.
000023	PMP-G-02	OK	Gas Loop	Gas pump	Pumps gas from the bioreactor through gas analyser	Safety module doesn't work. We disconnect safety module to do test.
000024	PMP-F-02	NOK	Filtration Unit	Filtrate pump	Pumps filtrate out of membranes Fi-F-01 and Fi-F-02 to filtrate tank R-F-01 and keeps the flux constant	Electrical connection between cabinets is right. But, connection between FU cabinet and device is not test it.

PLC ADDRESS	EPAS Tag	OK/NOK	Location	Description	Function	Comments
000025	V-S-02	OK	SIP	Powered 3-way valve	Allows flow of steam and condens at the retentate side of membrane Fi-F-01 to steam trap V-S-09 and condensate vessel R-S-01 when activated	
000026	V-S-03	OK	SIP	Powered 3-way valve	Allows flow of steam and condens at the retentate side of membrane Fi-F-02 to steam trap V-S-09 and condensate vessel R-S-01 when activated	It´s blocked
000027	V-S-04	OK	SIP	Powered 3-way valve	Allows steam in retentate side of membrane Fi-F-01 when activated	
000028	V-S-05	OK	SIP	Powered 3-way valve	Allows steam in retentate side of membrane Fi-F-02 when activated	
000029	V-S-06	OK	SIP	Powered 3-way valve	Allows flow of steam and condens at the filtration side of membrane Fi-F-01 to steam trap V-S-10 and condensate vessel R-S-02 when activated	
000030	V-S-07	OK	SIP	Powered 3-way valve	Allows flow of steam and condens at the filtration side of membrane Fi-F-02 to steam trap V-S-10 and condensate vessel R-S-02 when activated	
000031	V-S-08	OK	SIP	Powered 3-way valve	Allows flow of steam and condens in effluent vessel VR-F-01 to steam trap V-S-14 and condensate vessel R-S-03 when activated	Not in PID, not use
000032	PMP-F-01	OK	Filtration Unit	Pump	Pumps reactor content through membranes Fi-F-01 and Fi-F-02 in retentate loop. Is also used during cleaning of the retentate loop	
000033	V-G-08	OK	Gas Loop	Powered 2-way valve	Opens / closes outlet of gas from R-G-02 for produced biogas flow determination	
000034	V-G-10	OK	Gas Loop	Powered 2-way valve	Opens/ closes condensate flow from buffer vessel R-G-01 to bioreactor R-R-01	
000035	V-G-16	OK	Gas Loop	Powered 3-way valve	Used to evacuate N2 gas from the gas analysis loop in case of gas analyser calibration	

PLC ADDRESS	EPAS Tag	OK/NOK	Location	Description	Function	Comments
000037	V-G-20	OK	Gas Loop	Powered 2-way valve	Used to flush N2 in the retentate loop of the FU in order to prevent under pressure in the loop	
000038	V-G-21	OK	Gas Loop	Powered 2-way valve	Used to flush N2 in the filtrate tank	
000039	V-G-25	OK	Gas Loop	Powered 2-way valve	Opens/ closes gas flow from buffer vessel R-G-01 to bioreactor R-R-01	
000040	V-G-28	OK	Gas Loop	Powered 2-way valve	Opens/ closes the second gas analysis loop	
000041	V-F-15	OK	Filtration Unit	Powered 3-way valve	Used to drain the retentate side of membrane Fi-F-01	IDC PHOENIX WIRES WERE CROSS BETWEEN THESE PHOENIX MODULES
000042	V-F-16	OK	Filtration Unit	Powered 3-way valve	Used to pump back retentate from R-C- 04 to retentate line in FU	
000043	V-F-17	OK	Filtration Unit	Powered 3-way valve	Used to drain retentate from FU retentate line in R-C-04 or in a vessel	
000044	V-F-18	OK	Filtration Unit	Powered 3-way valve	Used to drain retentate from FU retentate line in R-C-04 or in a vessel	It´s blocked
000045	V-G-01	OK	Gas Loop	Powered 3-way valve	Used to connect N2 gas inlet to gas analysis loop for gas analyser calibration	
000046	V-G-02	OK	Gas Loop	Powered 3-way valve	Used to by-pass the gas compressor PMP-G-01	
000047	V-G-03	OK	Gas Loop	Powered 3-way valve	Used to by-pass the gas compressor PMP-G-01	
000048	V-G-05	OK	Gas Loop	Powered 2-way valve	Opens/closes inlet of biogas in buffer vessel R-G-01	
000049	V-F-06	OK	Filtration Unit	Powered 2-way valve	Opens/ closes retentate flow from FU to bioreactor R-R-01	
000050	V-F-07	OK	Filtration Unit	Powered 3-way valve	Used to select outlet filtrate from membrane Fi-F-01 or Fi-F02	

PLC ADDRESS	*EPAS Tag*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
000051	V-F-08	OK	Filtration Unit	Powered 3-way valve	Used to send back filtrate to bioreactor or to collect filtrate in filtrate tank R-F-01	
000052	V-F-10	OK	Effluent Tank	Powered 2-way valve	Used to drain the filtrate tank R-F-01	It´s blocked
000054	V-F-12	OK	Effluent Tank	Powered 2-way valve	Is closed during SIP of effluent vessel R-F-01 to allow pressure and temperature to rise	
000055	V-F-13	OK	Filtration Unit	Powered 2-way valve	Used to keep atmospheric pressure in the retentate line by letting enter/escape air when draining/ filling the tubes	
000056	V-F-14	OK	Filtration Unit	Powered 3-way valve	Used to drain the retentate side of membrane Fi-F-02	It´s blocked
000057	V-C-18	OK	CIP	Powered 3-way valve	Activated during backwashing and cleaning of retentate side of membrane Fi-F-02	It´s blocked
000058	V-C-19	OK	CIP	Powered 3-way valve	Activated during backwashing and cleaning of retentate side of membrane Fi-F-01	
000059	V-C-21	OK	CIP	Powered 2-way valve	When activated, allows cleaning agent to filtratte side of membranes Fi-F-01 and -02 during backwashing	
000060	V-F-01	OK	Filtration Unit	Powered 2-way valve	Opens/ closes retentate flow from bioreactor R-R-01 to Filtration Unit	
000061	V-F-02	OK	Filtration Unit	Powered 3-way valve	Used to bypass the FU	
000062	V-F-03	OK	Filtration Unit	Powered 3-way valve	Used to select inlet retentate of membrane Fi-F-01 or Fi-F02	It´s blocked
000063	V-F-04	OK	Filtration Unit	Powered 3-way valve	Used to select outlet retentate from membrane Fi-F-01 or Fi-F-02	
000064	V-F-05	OK	Filtration Unit	Powered 3-way valve	Used to bypass the FU	
000065	V-C-10	OK	CIP	Powered 2-way valve	Used to drain and during rincing of cleaning agent vessel (R-C-01)	

PLC ADDRESS	*EPAS Tag*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
000066	V-C-11	OK	CIP	Powered 2-way valve	Allows outside air to enter during draining and rincing of cleaning agent vessel (R-C-01) and allows air to leave the vessel when it is being filled	
000067	V-C-12	OK	CIP	Powered 3-way valve	Activated for backwashing membrane Fi-F-02	
000068	V-C-13	OK	CIP	Powered 3-way valve	Activated for backwashiong mbne membrane Fi-F-01	
000069	V-C-14	OK	CIP	Powered 3-way valve	Activated during cleaning of retentate loop	It´s blocked
000070	V-C-15	OK	CIP	Powered 3-way valve	Activated during cleaning of retentate loop	It´s blocked
000071	V-C-16	OK	CIP	Powered 3-way valve	Activated for cleaning of retentate side of membrane Fi-F-01	
000072	V-C-17	OK	CIP	Powered 3-way valve	Activated for cleaning of retentate side of membrane Fi-F-02	
000074	V-C-01	OK	CIP	Powered 2-way valve	Allows water to No-C-01 for rincing of Feeding Vessel (R-V-01)	It´s blocked
000075	V-C-02	OK	CIP	Powered 2-way valve	Allows water to No-C-02 for rincing of bioreactor (R-R-01)	
000076	V-C-04	OK	CIP	Powered 2-way valve	Allows water to No-C-03 for rincing of effluent vessel (R-F-01)	
000077	V-C-05	OK	CIP	Powered 2-way valve	Allows water to No-C-04 for rincing and filling cleaning buffer vessel (R-C-02)	
000078	V-C-06	OK	CIP	powered 2-way valve	Drains cleaning buffer vessel (R-C-02) when open	
000079	V-C-07	OK	CIP	Powered 2-way valve	Allows outside air to enter cleaning buffer vessel (R-C-02) while it is drained and allows air to leave the vessel when it is being filled	
000080	V-C-09	OK	CIP	Powered 2-way valve	Used to fill R-C-01 with water	

PLC ADDRESS	*EPAS Tag*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
000084	St-S-01	OK	SIP	Electrical steam generator	Generates steam of 3.8bara or 140°C when activated	This device doesn't exist or isn't connected
000085	V-S-12	OK	SIP	Powered 2-way valve	Allows steam in filtrate side of membrane Fi-F-01 when activated	
000086	V-S-11	OK	SIP	Powered 2-way valve	Allows steam in filtrate side of membrane Fi-F-02 when activated	
000087	V-G-07	OK	Gas Loop	Powered 2-way valve	Opens/ closes inlet of gas in R-G-02 for produced biogas flow determination	
000088	V-S-13	OK	SIP	Powered 2-way valve	Allows steam in efflluent vessel R-F-01 and the filtrate side of Fi-F-03 when activated	

4.2 Digital input test procedure

1- Read sensor in stable state

2- Change physical parameter/position (depends of the sensor). If there are a proportional change in the variable, the electrical connection is right.

3- Come back to stable state, this state will be more or less same value that stable state.

PLC ADDRESS	*ELECTRICAL DEVICE*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
100001	E_RV_F4_F5	OK	Bioreactor		Tension control Steering circuit 230VAC	
100002	E_RV_F6_F8	OK	Bioreactor		Tension control Steering circuit 24VDC	rele is have polariti. Odd wire in the upper part of connector.
100003	E_RV_F9_F10	OK	Bioreactor		Tension control Power circuit 230VAC	
~~100004~~	~~E_RV_F1_NC~~	OK	Bioreactor			not used and/or connected
~~100005~~	~~E_RV_F3_NC~~	OK	Bioreactor			not used and/or connected
~~100006~~	~~E_RV_F9_NC~~	OK	Bioreactor			not used and/or connected
100007	E_RV_F14_F15	OK	Bioreactor		Circuit Breaker 14 of PMP_R_03	
100008	E_RV_F16_F17	OK	Bioreactor		Circuit Breaker 16 of PMP_V_02	
100009	E_RV_Q2_F19	OK	Bioreactor		Motor Switch Q2	
100010	~~E_RV_K2_F21~~ => E_RV_K1_F21	OK	Bioreactor		Control Contactor K1 Counter clockwise	tag is wrong
100011	~~E_RV_K1_F20~~ => E_RV_K2_F20	OK	Bioreactor		Control Contactor K2 Clockwise	tag is wrong
100012	E_RV_Q4_F23	OK	Bioreactor		Control Circuit-breaker Q4	
100013	E_RV_K4_F22	OK	Bioreactor		Control Contactor K4	
100014	E_RV_Q3_F26	OK	Bioreactor		Control Circuit-breaker Q3	

PLC ADDRESS	ELECTRICAL DEVICE	OK/NOK	Location	Description	Function	Comments
100015	E_RV_K3_F27	OK	Bioreactor		Control Contactor K3	
100016	E_RV_U1_ALM	OK	Bioreactor	CONTROL BL-V-01	Alarm Frequency regulator U1	phisical tag was u2, now is changed to u1
100017	E_RV_F29_F31	OK	Bioreactor		Control Circuit-breaker F29	
100018	E_RV_U2_ALM	OK	Bioreactor	CONTROL BL-R-01	Alarm Frequency regulator U2	phisical tag was u1, now is changed to u2
100019	E_RV_F33_F35	OK	Bioreactor		Control Circuit-breaker F33	
100020	E_RV_pHT_R_01_ALM	OK	Bioreactor		Alarm Ph transmitter 1	This connection have polarity. Odd wire have to be connected in the upper part of connector.
100021	E_RV_pHT_R_02_ALM	OK	Bioreactor		Alarm Ph transmitter 2	This connection have polarity. Odd wire have to be connected in the upper part of connector.
100022	LS_V_01	OK	Influent Tank	Level switch	Gives an alarm when the level in influent tank (R-V-01) becomes too high	it don't have relay and don't have fuse in the cabinet. Electrical connection from Bioreactor cabinet to electrical device was wrong.This connection have polarity. Odd wire have to be

PLC ADDRESS	ELECTRICAL DEVICE	OK/NOK	Location	Description	Function	Comments
						connected in the upper part of connector.
100023	LS_R_01	OK	Bioreactor	Level Switch	Gives an alarm/action when the level in bioreactor (R-R-01) becomes too high	it don't have fuse. Electrical connection from bioreactor cabinet to electrical device was wrong.This connection have polarity. Odd wire have to be connected in the upper part of connector.
100024	LS_R_03	OK	Bioreactor	Level Switch	Gives an alarm/action when the level in the warm water bath (HX-R-01) becomes too low	This connection have polarity. Odd wire have to be connected in the upper part of connector.

PLC ADDRESS	ELECTRICAL DEVICE	OK/NOK	Location	Description	Function	Comments
100025	V_GetCakeButton	OK	Gas Loop	Level switch	Button for filling feeder	This connection have polarity. Odd wire have to be connected in the upper part of connector.
100027	V_V_03_FB	OK	Effluent Tank	Level switch	Valve state feedback	This electrical device was connected wrong, It couldn't work before.
100028	V_V_04_FB	OK	Effluent Tank	Level switch	Valve state feedback	This electrical device was connected wrong, couldn't work before.
~~100029~~	~~V_V_07_FB~~	OK	~~Effluent Tank~~	~~Level switch~~	~~Valve state feedback~~	-
~~100030~~	~~V_R_19_FB~~	OK	~~Bioreactor~~	~~Level switch~~	~~Valve state feedback~~	-
100031	ERR_R_pH_PMP_powersupply	OK		Level switch	Control Circuit-breaker F43	
100032	Emergency_Button_Pressed	OK		Level switch	emergency button pressed	
100033	Control_Tens230VAC_steerFiltrate	OK		fuse test	E-FG-F4	
100034	Control_Tens24VDC_steerFiltrate	OK		fuse test	E-FG-F6	
100035	Control_Tens230VAC_powerFiltrate	OK		fuse test	E-FG-F9	
100036	Control_Emergency	OK				
100037	HX_G_01_ALM	OK	gas loop			
~~100038~~	~~HX_G_02_ALM~~	OK	~~gas loop~~	-	-	

PLC ADDRESS	*ELECTRICAL DEVICE*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
100039	FS_F_01_ALM	OK	Filtration Unit		AlarmContact Flow Meter	It don't have fuse. Relay have polariti, odd wire have to be connected to upper of connector
~~100040~~	~~A_G_01_ALM~~	OK	~~gas loop~~	-	-	
100041	A_G_02_ALM	OK	gas loop			This relay have polariti, odd wire have to be connected to upper of connector
100042	E_FG_U1_ALM_F34	OK			Alarm Contact Frequency regulator	
100043	E_FG_F35_F36	OK			Tension Control Pump F35	
100047	LS_G_01	OK	gas loop		Gives an alarm/action when the condensate level in buffer vessel R-G-01 becomes too high (=> problem with condensate evacuation system)	This relay have polariti, odd wire have to be connected to upper of connector.Sensor is broken
100048	LS_F_01	OK	Filtration Unit		Measures upper volume in gas phase for volume measurement in filtrate tank (R-F-01)	This relay have polariti, odd wire have to be connected to upper of connector
100049	LS_C_04	OK	CIP		Detects low level in cleaning buffer tank (R-C-02)	This relay have polariti, odd wire have to be connected to

PLC ADDRESS	ELECTRICAL DEVICE	OK/NOK	Location	Description	Function	Comments
						upper of connector
100050	LS_C_03	OK	CIP		Detects high level in cleaning buffer tank (R-C-02)	This relay have polariti, odd wire have to be connected to upper of connector
100051	LS_C_02	OK	CIP		Detects low level in cleaning agent tank (R-C-01)	This relay have polariti, odd wire have to be connected to upper of connector
100052	LS_C_01	OK	CIP		Detects high level in cleaning agent tank (R-C-01)	This relay have polariti, odd wire have to be connected to upper of connector
100053	LS_F_02	OK	Filtration Unit		Measures pressure in liquid phase for volume measurement in filtrate tank (R-F-01)	This relay have polariti, odd wire have to be connected to upper of connector
100054	V_S_07_FB	OK	SIP		Valve state feedback	
100055	V_S_08_FB	OK	SIP		Valve state feedback	
100056	V_S_06_FB	OK	SIP		Valve state feedback	
100057	V_S_05_FB	OK	SIP		Valve state feedback	
100058	V_S_04_FB	OK	SIP		Valve state feedback	

PLC ADDRESS	ELECTRICAL DEVICE	OK/NOK	Location	Description	Function	Comments
100059	V_S_03_FB	OK	SIP		Valve state feedback	
100060	V_S_02_FB	OK	SIP		Valve state feedback	
100061	V_G_28_FB	OK	gas loop		Valve state feedback	
100062	V_G_25_FB	OK	gas loop		Valve state feedback	
100063	V_G_21_FB	OK	gas loop		Valve state feedback	
100064	V_G_20_FB	OK	gas loop		Valve state feedback	
100066	V_G_16_FB	OK	gas loop		Valve state feedback	
100067	V_G_10_FB	OK	gas loop		Valve state feedback	
100068	V_G_08_FB	OK	gas loop		Valve state feedback	
100069	V_G_05_FB	OK	gas loop		Valve state feedback	
100070	V_G_03_FB	OK	gas loop		Valve state feedback	
100071	V_G_02_FB	OK	gas loop		Valve state feedback	
100072	V_G_01_FB	OK	gas loop		Valve state feedback	
100073	V_F_18_FB	OK	Filtration Unit		Valve state feedback	
100074	V_F_17_FB	OK	Filtration Unit		Valve state feedback	
100075	V_F_16_FB	OK	Filtration Unit		Valve state feedback	
100076	V_F_15_FB	OK	Filtration Unit		Valve state feedback	
100077	V_F_14_FB	OK	Filtration Unit		Valve state feedback	
100078	V_F_13_FB	OK	Filtration Unit		Valve state feedback	
100079	V_F_12_FB	OK	Filtration Unit		Valve state feedback	
~~100080~~	~~V_F_11_FB~~	OK	~~Filtration Unit~~	-	~~Valve state feedback~~	it doesn't exist
100081	V_F_10_FB	OK	Filtration Unit		Valve state feedback	
100082	V_F_08_FB	OK	Filtration Unit		Valve state feedback	
100083	V_F_07_FB	OK	Filtration Unit		Valve state feedback	
100084	V_F_06_FB	OK	Filtration Unit		Valve state feedback	
100085	V_F_05_FB	OK	Filtration Unit		Valve state feedback	
100086	V_F_04_FB	OK	Filtration Unit		Valve state feedback	
100087	V_F_03_FB	OK	Filtration Unit		Valve state feedback	
100088	V_F_02_FB	OK	Filtration Unit		Valve state feedback	
100089	V_F_01_FB	OK	Filtration Unit		Valve state feedback	

PLC ADDRESS	*ELECTRICAL DEVICE*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
100090	V_C_21_FB	OK	CIP		Valve state feedback	
100091	V_C_19_FB	OK	CIP		Valve state feedback	
100092	V_C_18_FB	OK	CIP		Valve state feedback	
100093	V_C_17_FB	OK	CIP		Valve state feedback	
100094	V_C_16_FB	OK	CIP		Valve state feedback	
100095	V_C_15_FB	OK	CIP		Valve state feedback	
100096	V_C_14_FB	OK	CIP		Valve state feedback	
100097	V_C_13_FB	OK	CIP		Valve state feedback	
100098	V_C_12_FB	OK	CIP		Valve state feedback	
100099	V_C_11_FB	OK	CIP		Valve state feedback	
100100	V_C_10_FB	OK	CIP		Valve state feedback	
100101	V_C_09_FB	OK	CIP		Valve state feedback	
100102	V_C_07_FB	OK	CIP		Valve state feedback	
100103	V_C_06_FB	OK	CIP		Valve state feedback	
100104	V_C_05_FB	OK	CIP		Valve state feedback	
100105	V_S_12_FB	OK	SIP		Valve state feedback	
100106	V_S_11_FB	OK	SIP		Valve state feedback	
100107	V_G_07_FB	OK	gas loop		Valve state feedback	
100108	V_S_13_FB	OK	SIP		Valve state feedback	
100110	V_C_01_FB	OK	CIP		Valve state feedback	
100111	V_C_02_FB	OK	CIP		Valve state feedback	
100112	V_C_04_FB	OK	CIP		Valve state feedback	

4.3 Analog input test procedure

1-Read sensor in stable state

2- Change physical parameter/position (depends of the sensor). If there are proportional change in the variable, the electrical connection is right.

3- Come back to stable state, this state will be more or less same value of first point.

PLC ADDRESS	*ELECTRICAL DEVICE*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
300001	pHS-R-01	OK	Bioreactor	pH sensor	Measures pH in bioreactor (R-R-01)	This input have polarity. Odd wire in upper part of connector.
300002		OK	Bioreactor	pH sensor	(Epas T-pH-R-01) Measures temp. of the Electrod (same sensor as pH ?)	This input have polarity. Odd wire in upper part of connector.
300003	pHS-R-02	OK	Bioreactor	pH sensor	Measures pH in bioreactor (R-R-01)	This input have polarity. Odd wire in upper part of connector.
~~300004~~	-	~~OK~~	~~Bioreactor~~	~~pH sensor~~	~~(Epas T-pH-R-02) Measures temp. of the Electrod (same sensor as pH ?)~~	It isn't wired. This ph sensor doesn't have available temperature.
300005	LS-V-02	OK	Influent Tank	Level sensor	Measures pressure in liquid phase for volume measurement in influent tank (R-V-01)	This input have polarity. Odd wire in upper part of connector.
300006	PS-V-01	OK	Influent Tank	Pressure transducer	Measures pressure in gas phase for gas and volume measurement in influent tank (R-V-01)	This input have polarity. Odd wire in upper part of

PLC ADDRESS	*ELECTRICAL DEVICE*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
						connector.
300007	PS-V-03	OK	Influent Tank	Pressure transducer	Measures pressure immediately after pump PMP-V-01 and gives an alarm if pressure increases above the pump's limit	This input have polarity. Odd wire in upper part of connector. Sensor is broken
300009	TS-V-02	OK	Influent Tank	Temperature sensor	Measures temperature in influent tank (R-V-01)	This input have polarity. Odd wire in upper part of connector.
300010	PS-R-01	NOK	Bioreactor	Pressure transducer	Measures pressure in gas phase for gas and volume measurement in bioreactor (R-R-01)	It have some problem in tag declaration 32 bits instead of 16 bits (software problem).This input have polarity. Odd wire in upper part of connector.
300011	PS-R-02	OK	Bioreactor	Pressure transducer	Measures pressure in liquid phase for volume measurement in bioreactor (R-R-01)	This input have polarity. Odd wire in upper part of connector.
300013	LS-R-02	OK	Bioreactor	Level sensor	Measures pressure in liquid phase for volume measurement in bioreactor (R-R-01)	This input have polarity. Odd wire in upper part of connector.
300014	TS-V-01	OK	Influent Tank	Temperature sensor	Measures temperature in influent tank (R-V-01)	This input have polarity. Odd wire in upper part of connector.

PLC ADDRESS	ELECTRICAL DEVICE	OK/NOK	Location	Description	Function	Comments
300015	TS-R-01	OK	Bioreactor	Temperature sensor	Measures temperature in bioreactor (R-R-01)	This input have polarity. Odd wire in upper part of connector.
300016	TS-R-02	OK	Bioreactor	Temperature sensor	Measures temperature in warm water bath HX-R-01	This input have polarity. Odd wire in upper part of connector.
300018	FS-F-01	OK	Filtration Unit	Flow meter	Measures the retentate flow	
~~300019~~	~~A-G-01~~	~~OK~~	~~Gas Loop~~	~~Gas analyser~~	~~Analyses bioreactor gas phase composition for H2~~	It isn't used.
300021	TS-F-02	OK	Filtration Unit	Temperature sensor	Measures temperature in retentate	
300022	TS-F-01	OK	Effluent Tank	Temperature sensor	Measures temperature in filtrate tank R-F-01	
300023	TS-C-01	OK	CIP	Temperature sensor	Measures temperature in cleaning buffer vessel (R-C-02). Is Measureed. Value for temperature control in (R-C-02)	
~~300024~~	~~PS-G-03~~	~~OK~~	~~Gas Loop~~	-	~~Measures the gas pressure on the gas line before the columns.~~	It doesn't exist.
300025	PS-G-02	OK	Gas Loop	Pressure transducer	Measures pressure of gas after gas analyser	
300026	PS-G-01	OK	Gas Loop	Pressure transducer	Measures pressure in buffer vessel R-G- 01	
300027	PS-F-07	OK	Filtration Unit	Pressure transducer	Measures pressure of retentate after pump PMP-F-01 (safety pump)	
300028	PS-F-06	OK	Filtration Unit	Pressure transducer	Measures pressure of filtrate at outlet of membrane Fi-F-02	
300029	PS-F-05	OK	Filtration Unit	Pressure transducer	Measures pressure of retentate at outlet of membrane Fi-F-02	
300030	PS-F-04	OK	Filtration Unit	Pressure transducer	Measures pressure of retentate at inlet of membrane Fi-F-02	

PLC ADDRESS	ELECTRICAL DEVICE	OK/NOK	Location	Description	Function	Comments
300031	PS-F-03	OK	Filtration Unit	Pressure transducer	Measures pressure of filtrate at outlet of membrane Fi-F-01	
300032	PS-F-02	OK	Filtration Unit	Pressure transducer	Measures pressure of retentate at outlet of membrane Fi-F-01	
300033	PS-F-01	OK	Filtration Unit	Pressure transducer	Measures pressure of retentate at inlet of membrane Fi-F-01	
300035	SS-F-01	OK	Filtration Unit	Turbidity sensor	Measures turbidity of retentate	
300036	FS-G-01	OK	Gas Loop	Mass Flow meter	Measures the gas flow entering in the gas analyser Measures the gas flow entering in the	
300037	FS-G-04	OK	Gas Loop	N2 Mass Flow meter	Measures the N2 gas flow entering the bioreactor R-R-01 (passive gas loop configuration)	The connector of this device (DB-9) is short circuit. It should be repair.
300038	LS-F-03	OK	Effluent Tank	Level sensor	Measures pressure in gas phase for volume measurement in filtrate tank (R-F-01)	
300040	PS-G-04	OK	Gas Loop	Pressure transducer	Measures pressure of gas produced by bioreactor (R-R-01) and accumulated in R-G-02 for flow measurement	
300041	TS-G-01	OK	Gas Loop	Temperature sensor	Measures temperature in R-G-02 for determination of produced gas flow	
300042	PS-F-09	OK	Filtration Unit	Pressure transducer	Measures pressure at inlet of dead end filter Fi-F-03 (to follow clogging)	
300043	TS-F-03	OK	Filtration Unit	Temperature sensor	Measures temperature Membrane1	
300044	TS-F-04	OK	Filtration Unit	Temperature sensor	Measures temperature Membrane2	
~~300049~~ => 300020	A-G-02	OK	Gas Loop	Gas analyser	Analyses bioreactor gas phase composition for CO2 and CH4. One sensor, 2 measurements	It is a sensor of CO2
~~300050~~ => 300039	A-G-02	We can't test it.	Gas Loop	Gas analyser	Analyses bioreactor gas phase composition for CO2 and CH4. One sensor. 2 measurement	It is a sensor of CH4, We can't test it.

4.4 Analog output test procedure

1- From a medium value go to upper or lower value (30%)

2- Check device, if it change in proportion to set point, the electrical connection is right.

PLC ADDRESS	*EPAS Tag*	*OK/NOK*	*Location*	*Description*	*Function*	*Comments*
400001		OK	Filtration Unit	control PMP-F-02	2 variables for the pump	It isn't connected right. The connection between FU cabinet and device should be revised
~~400002~~	-	~~NOK~~	~~Filtration Unit~~	~~control PMP-F-03~~	~~2 variables for the pump~~	It isn't connected right. The connection between FU cabinet and device should be revised
400003	V-G-09	NOK	Gas Loop	Powered proportional valve	Used to adapt the gas flow coming from buffer vessel R-G-01 and going to bioreactor R-R-01 in order to keep the pressure constant in the bioreactor	EPAS Software don't allow change this value
400004	V-G-29	NOK	Gas Loop	Powered proportional valve	to keep bioreactor pressure constant (passive gas loop configuration) Regulates N2 inlet in bioreactor R-R-01	EPASSoftware don't allow change this value

MELISSA CI HMI SW USER MANUAL

PN15030

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RECORD OF CHANGES

Rev.	Date	Responsable of the modification	Section/Paragraph affected	Changes
1	2010/08/10	J.Carbonell	All Document	First Version
1.1	2011/11/18	J.Carbonell	Section 7	Added section 7 to describe CI Maintenance screens access locking mechanism.

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1 Summary

The intention is that this document will provide a comprehensive guide of the Human Machine Interface (HMI) of the Compartment CI at the MELiSSA Pilot Plant (MPP). The work developed herein describes the functionalities of each screen, the variables (pressure, temperature, pH, etc) -warnings and alarms- as well as the tools and the instrumentation in Compartment CI that will be monitored and/ or controlled through the computer as well as to know the entire system status.
This Operations Manual is intended to help the operation and maintenance of the Control System Demonstrator for compartment I in the MELISSA Plant installed at the UAB.

The detailed design description of this system is provided in the Hardware Design Document and Software Design Document, [R4] and [R3] respectively.

2 REFERENCES documents

2.1 APPLICABLE DOCUMENTS

[AD1]	Proposal for Lab Operations and Maintenance – phase 4. (MPP-OFR-09-0002 v4)	05/10/09

2.2 REFERENCE DOCUMENTS

[R1]	TNxx_CI_SHERPA_SWDescription_Draft2	Issue 1.0, March 2010
[R2]	CI_PLC_HMI_20100804.xls (Sherpa)	August 2010
[R3]	MELISSA CI HMI DESIGN (PN15030-RN-SP-001)	Draft, March 2010
[R4]	Melissa CI Control Cabinet Hardware Design Document (NTE-MCI-TN-008)	Issue 2.0, Feb. 2009
[R5]	Common HMI SW User Manual (NTE-CIVaP2-HB-011)	Issue 1.1, Oct. 2010
[R6]	Software User Manual for the VIAMASS sensor project (NTE-MCI-HB-007)	Issue 2.0, Oct. 2009

3 SYMBOLS AND ABBREVIATIONS

HMI	Human-Machine Interface
MELiSSA	Micro-Ecological Life Support System Alternative
UAB	Universitat Autonoma de Barcelona
MPP	MELiSSA Pilot Plant
CI	Compartment I
CII	Compartment II
CIII	Compartment III
CIVa	Compartment IVa
CIVb-HPC1	Compartment CIVb (Higher plant compartment)
CIP	Cleaning in place
SIP	Sterilization in place

4 INTRODUCTION

4.1 Intended Readership

This manual is intended for the personnel in charge of the operation of the MELISSA Control System for both maintenance and scientific purposes.

- Investigators responsible of performing in-plant experiments.
- Maintenance and troubleshooting personnel in charge of the installation and maintenance of the MELISSA Pilot Plant Software.

It is expected that users have some basic Microsoft® Windows knowledge and familiarity with the MELISSA Pilot Plant.

Note that no detailed explanation about the operation of third-party software(s) used to implement the Control System is given in this manual, but only reference to their corresponding user manuals when more detail is needed.

4.2 Purpose

The purpose of this document is to provide the user with an understanding of the functions available in the MELISSA CI HMI Software and a description of the common operations to be performed during its utilisation and maintenance. Following the instructions described in this manual will lead to a better understanding and to obtain a full profit of the MELISSA CI HMI software utilisation.

4.3 How to use this document

The Overview section is intended for all users. It summarises what this system is used for, into the process of using the MELISSA Pilot Plant.
The Table of Contents can be used to easily locate the detailed description of a specific function.

4.4 Problem reporting instructions

Problems found must be reported to NTE-SENER following the form included in

APPENDIX B. Problem Report Form.

NTE-SENER, S.A.
C\ Sabaters, nº 1
Parc Tecnològic del Vallès
08290 Cerdanyola del Vallès – Barcelona (Spain)
www.nte-sener.es
Tel.: 93 594 00 15
Fax: 93 594 90 09

5 Overview

Compartment I (CI) has the objective to degrade wastes (organic matter) through an anaerobic process carried out by a specific group of autochthonous bacteria. The result is a liquid stream rich in volatile fatty acid and ammonia and also containing mineral salts. Additionally, a gas stream rich in carbon dioxide is also obtained.
In addition to the anaerobic bioreactor where the biochemical reactions take place, CI is composed of other units to treat both the feed and the products. Firstly the waste pretreatment increases the degradation of the organic matter and avoids possible contamination in the products. Secondly, the products of the bacterial conversion of the wastes contained in the liquid output need to be separated from the non-biodegraded matter before entering the second compartment and, furthermore, they must fulfill certain requirements to avoid contamination. Moreover, the gas output needs to be processed as well as analyzed.
CI is, thus, differentiated in four units separated in racks:

- Waste Pre-treatment (WP)
- Bioreactor & Influent Tank (B&IT)
- Filtration Unit (FU)
- Gas Loop (GL)

6 HMI screens

6.1 Screens Hierarchy

Supervision displays navigation is implemented as follows:

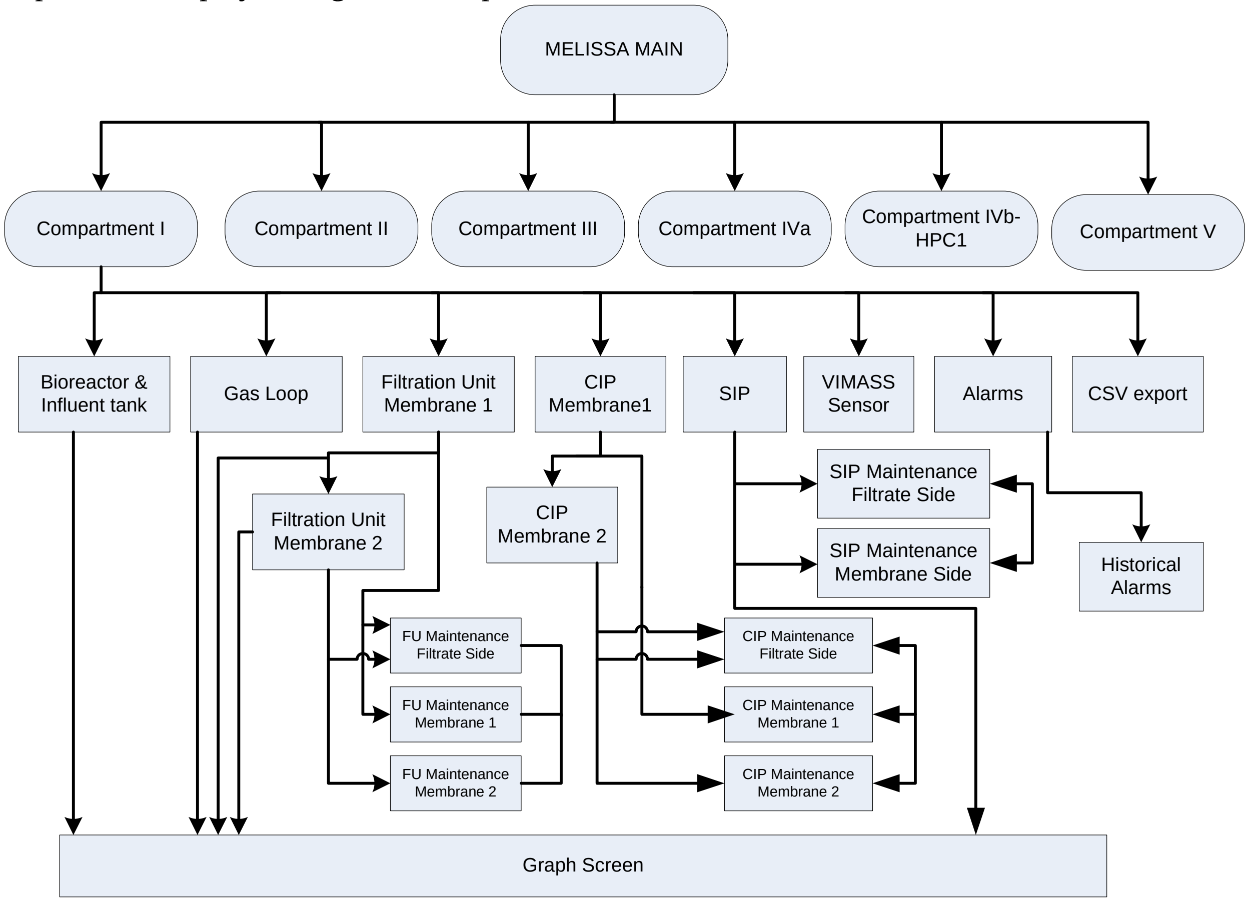


Figure 6-1: Melissa Screens Hierarchy

The HMI allow the user to interact with the PLC. Through the HMI the user can check and monitor the system operation, furthermore the user can operate the compartment from it. Figure 6-2 shows the general structure of the different screens. These can be manipulated by the user in order to interact with automation and control system. This map establishes the logical relations among the screens.

Therefore, following Figure 6-4, the main screen shows an overview of the complete system. From there, the user will be able to navigate through the screens of second level that represent the different subsytems in the CI: Bioreactor and Influent tank, Gas Loop, Filtration Unit, CIP, SIP and Viamass sensor. From these screens the user can open graphs showing the history values of the different variables (pH, Temperature, Pressure, level, biomass, gas production, etc). Furthermore, the user can open the alarms screen or CSV data export screen.

6.2 Melissa Main Screen

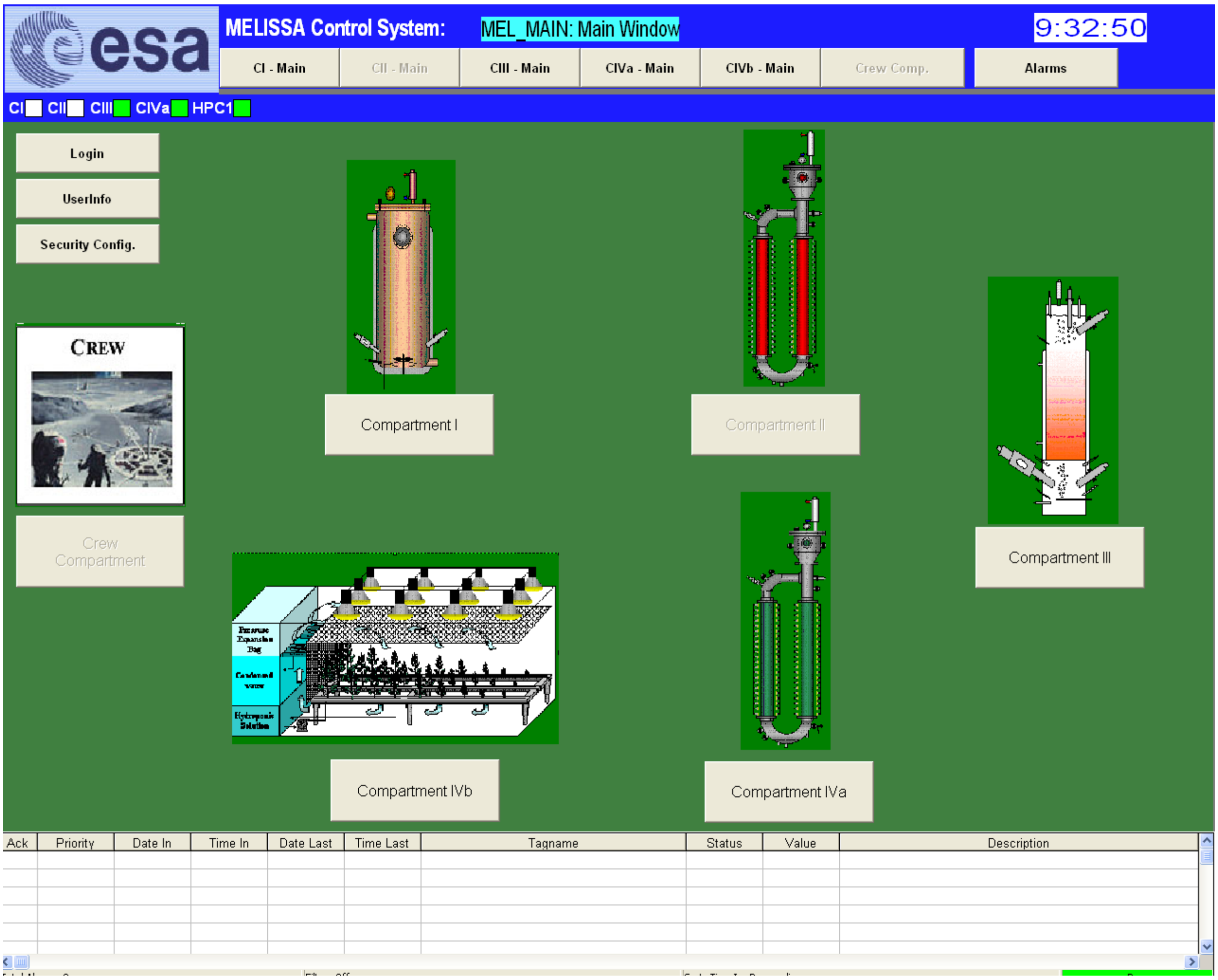


Figure 6-2: Melissa Main Window

In the Main Menu there are the general alarm indicators of each compartment, indicator background colour changes according to:

- Green: There are no alarms activated in the compartment.
- Yellow: some level 1 alarm is activated.
- Red: some level 2 alarm is activated.
- White: general alarms not implement in the compartment.

An example of the general alarm indicators is shown in the following picture, compartment CI and CII don't have general alarm indicator implemented (indicator in white), CIII has no alarm activated (indicator in green), in CIVa there is some level 1 alarm activated (indicator in yellow) and in the compartment CIVb HPC1 there is some level 2 alarm activated (indicator in red).

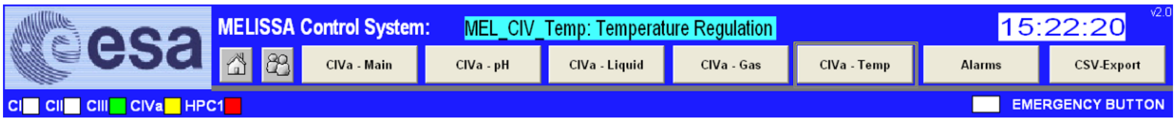


Figure 6-3: Global alarms

6.3 Compartment I Main Screen

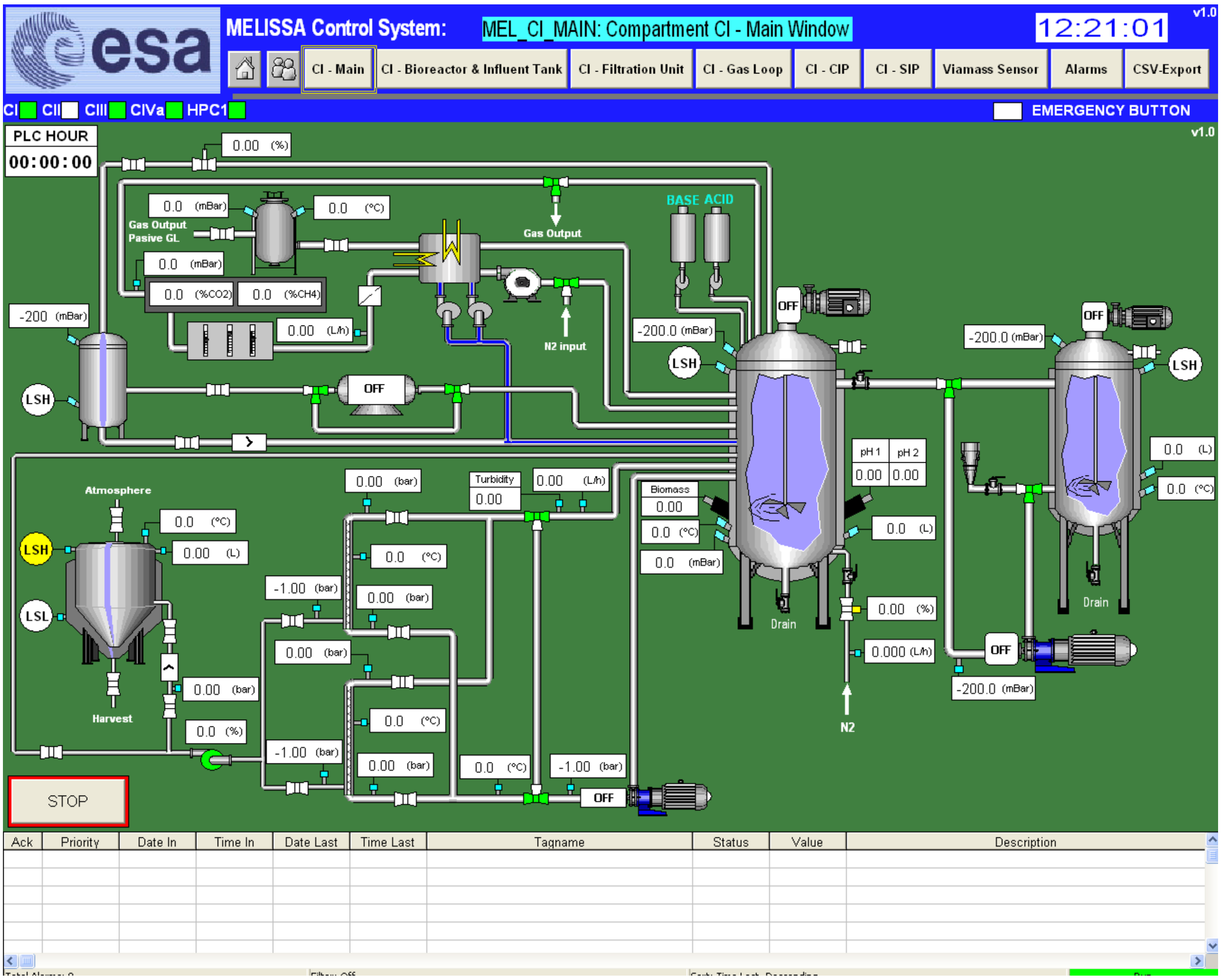


Figure 6-4: Compartment I Main Window

6.3.1 CI Main Menu

On the top of the window it is placed the Compartment CI Main Menu which is used to navigate for each subsystem of the CI, to visualize general alarms indicators, to check if any of the emergency buttons has been pressed and to configure the PLCs system clock.

6.3.2 System clock configuration

The system PLCs clock can be set from the HMI by double-clicking over digital clock placed in the CI Main Menu (Figure 6-5). Once clicked the configuration window (Figure 6-6) will be displayed.

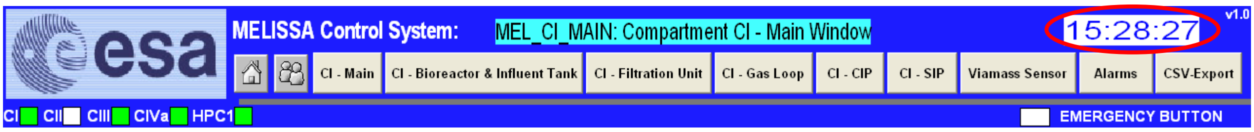


Figure 6-5: CIVa Main Menu Window

PLCs system clock configuration window is opened reading the following values from the PLC connected to the CI:

- Day of week
- Day
- Month
- Year
- Hour
- Minute
- Second

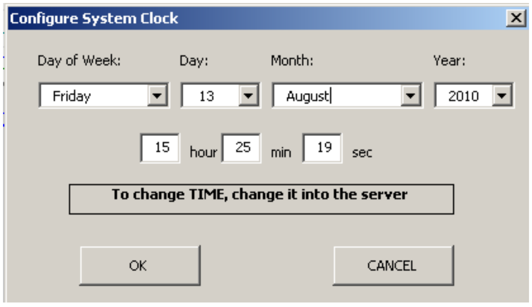


Figure 6-6: System clock configuration window

The user configures the system clock and press “Ok” command button to write updated values. Note that all PLCs in the network will be updated.
Pressing “CANCEL” command button, the window is closed without writing any values.

6.3.3 CI Main Window

From the compartment I Main Window users have a general view of the compartment I and allow the following actions:

- To have a general view of compartment I Bioreactor, gas loop and filtration unit. CIP and SIP is not implemented in this screen but the user will be able to go its specific screen.
- Analogue indicators of the most significant readings.
- Valves, pumps, level switch, pipes, tank levels animated.
- Device alarm animations.

- Emergency button pushing animation.
- CI PLC system clock indicator.
- Pushing the emergency command button, it stops all control loop of the CI:
    - Influent tank feeding mode (CL1001)
    - Influent tank temperature mode (CL1002)
    - Influent tank pressure mode (CL1003)
    - Influent tank blender mode (CL1005)
    - Bioreactor temperature mode (CL1008)
    - Bioreactor pressure mode (CL1009)
    - Bioreactor pH mode (CL1011)
    - Bioreactor Blender mode (CL1012)
    - Active Gas Loop mode (CL1100)
    - Gas Loop Analyzer mode (CL1101)
    - Gas Loop Condensate Flow Mode (CL1102)
    - Passive Gas Loop Mode (CL1103)
    - Filtration Unit Mode (CL1200)
    - CIP General Mode (CL1207)
    - SIP General Mode (CL1209)

6.3.4 Tags

The following tags are displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	Units	Range
CI_SYSCLOCK_HOUR	Compartment I PLC system clock (second)	Indicator	(hour)	0 to 23
CI_SYSCLOCK_MINUTE	Compartment I PLC system clock (minute)	Indicator	(minute)	0 to 59
CI_SYSCLOCK_SECOND	Comparment I PLC system clock (second)	Indicator	(second)	0 to 59
VSL2_1000_01_VOL_FILTERED	Volume filtered in VSL2_1000_01 tank	Analogue indicator	(L)	0 to 60
GP_1001_01_MV1	Start/Stop pump of the influent tank	Pump animated	--	--
PT_1001_01	Pressure after pump GP_1001_01	Analogue indicator	(mBar)	-200 to 200
S3V_1001_01_FB	Feeding bioreactor valve	3-way valve animated	--	--
S3V_1001_02_FB	Filling influent tank valve	3-way valve animated	--	--
TT_1002_01	Temperature in influent tank	Analogue indicator	(ºC)	0 to100
SV_1003_01_MV	Release gas from influent tank	2-way valve animated	--	--
PT_1003_01	Pressure in gas phase in influent tank	Analogue indicator	(mBar)	-200 to 200
LSH_1004_01	Level switch in VSL2_1006_01	Digital indicator	--	--
BLE_1005_01_MV	Influent tank blender	Blender an imated	--	--

Tag Name	Description	Type	Units	Range
TT_1008_01	Temperature in bioreactor	Analogue indicator	(ºC)	0 to 100
SV_1009_01_MV	Release gas from Bioreactor	2-way valve animated	--	--
PT_1009_01	Pressure in gas phase in bioreactor	Analogue indicator	(mBar)	-200 to 200
PT_1009_02	Pressure in liquid phase in bioreactor	Analogue indicator	(mBar)	0 to 400
CL1010_VSL2_1007_01_VOL_FILT	Volume filtered in VSL2_1007_01	Analogue indicator	(L)	0 to 120
LSH_1010_01	Bioreactor high level switch	Digital indicator	--	--
AT_1011_01	pH in bioreactor	Analogue indicator	(pH)	0 to 10
AT_1011_02	pH in bioreactor	Analogue indicator	(pH)	0 to 10
PP_1011_01_MV	Acid pump	Pump animated	--	--
PP_1011_02_MV	Base pump	Pump animated	--	--
BLE_1012_01_MV	Bioreactor blender	Blender animated	--	--
AT_1014_01	Biomass sensor	Analogue indicator	TBD	TBD
PT_1100_01	Pressure in buffer tank	Analogue indicator	(mBar)	0 to 10000
PT_1100_02	Pressure in buffer tank (Passive Gas Loop)	Analogue indicator	(mBar)	0 to 200
S3V_1100_01_FB	Active gas loop valve	3-way valve animated	--	--
S3V_1100_02_FB	Active gas loop valve	3-way valve animated	--	--
SV_1100_01_FB	Active gas loop valve	2-way valve animated	--	--
SV_1100_02_FB	Passive gas loop valve	2-way valve animated	--	--
SV_1100_03_FB	Passive gas loop valve	2-way valve animated	--	--
SV_1100_05_FB	Active gas loop valve	2-way valve animated	--	--
GCP_1100_01_MV	Gas compressor (Active gas loop)	Pump animated	--	--
SCV_1100_01_MV	Proportional valve (active gas loop)	Analogue indicator	(%)	0 to 100
PP_1101_01_MV	Analysis gas loop pump	Pump animated	--	--
FT_1101_01	Gas input flow in gas analysers	Analogue indicator	(L/h)	0 to 58
AT_1101_01_CH4	CH4 Analyser	Analogue indicator	(%)	0 to 100
AT_1101_01_CO2	CO2 Analyser	Analogue indicator	(%)	0 to 100
PT_1101_01_AV	Gas pressure after gas analyser	Analogue indicator	(mBar)	0 to 400
S3V_1101_01_FB	Analysis gas loop valve	3-way valve animated	--	--
LSH_1102_01	High level switch Buffer tank	Digital indicator	--	--
SV_1102_01_FB	Active Gas Loop condensate valve	2-way valve animation	--	--
FT_1103_01	N2 flow into bioreactor	Analogue indicator	(L/h)	0 to 2
SCV_1103_01_MV	Proportional valve, N2 input into bioreactor.	Analogue indicator	(%)	0 to 100
S3V_1103_01_FB	Analysis gas loop valve	3-way valve animated	--	--
TT_1104_01	Temperature in buffer tank (Passive gas loop)	Analogue indicator	(ºC)	0 to 100

Tag Name	Description	Type	Units	Range
TT_1200_01	Temperature in retentate line	Analogue indicator	(ºC)	0 to 100
TT_1200_02_AV	Temperature in Membrane 1	Analogue indicator	(ºC)	0 to 400
TT_1200_03_AV	Temperature in Membrane 2	Analogue indicator	(ºC)	0 to 400
GP_1201_01_MV1	Retentate pump	Pump animated	--	--
AT_1201_01	Turbidity in retentate side	Analogue indicator	TBD	0 to 100
FT_1201_01_IN_L_PER_H_FILTERED	Flow in retentate side	Analogue indicator	(L/h)	0 to 580
S3V_1201_01_FB	Bypass valve	3-way valve animated	--	--
S3V_1201_04_FB	Bypass valve	3-way valve animated	--	--
SV_1201_03_FB	Membrane 1 outlet retentate side valve	2-way valve animated	--	--
SV_1201_04_FB	Outlet retentate side Membrane 2 side	2-way valve animated	--	--
SV_1201_05_FB	Inlet valve retentate line Membrane 1	2-way valve animated	--	--
SV_1201_06_FB	Inlet retante side Membrane 2 valve	2-way valve animated	--	--
SV_1202_01_FB	Membrane 1 filtrate side valve	2-way valve animated	--	--
SV_1202_02_FB	Filtrate side Membrane 2 valve	2-way valve animated	--	--
SV_1202_03_FB	Recycle valve	2-way valve animated	--	--
SV_1202_04_FB	Filtrate flow to vessel valve (before filter)	2-way valve animated	--	--
PP_1202_01_MV1	Filtrate pump	Pump animated	--	--
PP_1202_01_MV2	Speed of filtrate pump	Analogue indicator	(%)	0 to 100
PT_1203_01	Pressure in Membrane 1 retentate side	Analogue indicator	(bar)	0 to 4
PT_1203_02	Pressure in outlet retentate side membrane 1	Analogue indicator	(bar)	0 to 4
PT_1203_03	Pressure in Membrane 1 filtrate side	Analogue indicator	(bar)	-1 to 4
PT_1203_04	Pressure in inlet retentate side Membrane 2	Analogue indicator	(bar)	0 to 4
PT_1203_05	Pressure in outlet retentate side Membrane 2	Analogue indicator	(bar)	0 to 4
PT_1203_06	Pressure in filtrate side Membrane 2	Analogue indicator	(bar)	-1 to 4
PT_1203_07	Pressure of retentate after GP_1201_01 pump	Analogue indicator	(bar)	-1 to 9
PT_1203_08	Pressure after filtrate pump	Analogue indicator	(bar)	0 to 4
SV_1204_01_FB	Harvesting valve	2-way valve animated	--	--
SV_1204_02_FB	Air inlet valve (harvesting tank)	2-way valve animated	--	--
SV_1204_03_FB	Filtrate flow to vessel valve (after filter)	2-way valve animated	--	--
TT_1205_01	Harvesting tank temperature	Analogue indicator	(ºC)	0 to 100
VSL2_1204_01_VOLUME	Harvesting tank level	Analogue indicator	(L)	0 to 100
LSL_1206_01	Low level switch harvesting tank	Digital indicator	--	--
LSH_1206_01	High level switch harvesting tank	Digital indicator	--	--

Table 6-1: Tags of the CI system main screen

6.3.5 Alarms

The following alarms are linked with the operation of the CI system main screen.

TAG NAME	Description	Colour
GP_1001_01_overpressure_A	Alarm fired when pressure goes over 300mBar	Pump in Red and "ERR" text
GP_1001_01_mightrundry_A	Alarm fired when bioreactor level is lower than 9 liters	Pump in Red and "ERR" text
GP_1001_01_fusemotorswitch_A	Motors switch fuse problem (Fuse F19)	Pump in red and "ERR" text
GP_1001_01_fuseclockwise_A	Clockwise fuse problem (Fuse F21)	Pump in red and "ERR" text
PT_1001_01_ERR	Pressure (after pump GP_1001_01) sensor link error	"ERR" text in RED
PT_1001_01_AHH	Pressure (after pump GP_1001_01) reaches high level 2 sensor	RED
PT_1001_01_AH	Pressure (after pump GP_1001_01) reaches high level 1 sensor	YELLOW
PT_1001_01_ALL	Pressure (after pump GP_1001_01) reaches low level 2 sensor	RED
PT_1001_01_AL	Pressure (after pump GP_1001_01) reaches low level 1 sensor	YELLOW
S3V_1001_01_A	Feeding Bioreactor valve in wrong position	RED and "ERR" text in RED
S3V_1001_02_A	Filling Influent valve in wrong position	RED and "ERR" text in RED
TT_1002_01_ERR	Influent tank temperature sensor link error	"ERR" text in RED
TT_1002_01_AHH	Influent tank temperature reaches high level 2 alarm	RED
TT_1002_01_AH	Influent tank temperature reaches high level 1 alarm	YELLOW
TT_1002_01_ALL	Influent tank temperature reaches low level 2 alarm	RED
TT_1002_01_AL	Influent tank temperature reaches low level 1 alarm	YELLOW
PT_1003_01_ERR	Influent tank pressure (gas phase) sensor link error	"ERR" text in RED
PT_1003_01_AHH	Influent tank pressure (gas phase) reaches high level 2 alarm	RED
PT_1003_01_AH	Influent tank pressure (gas phase) reaches high level 1 alarm	YELLOW
PT_1003_01_ALL	Influent tank pressure (gas phase) reaches low level 2 alarm	RED
PT_1003_01_AL	Influent tank pressure (gas phase) reaches low level 1 alarm	YELLOW
SV_1003_01_A	Influent tank release gas valve in wrong position	RED and "ERR" text in RED
LSH_1004_01_A	Influent tank high level switch alarm	RED
LT_1004_01_ERR	Influent tank level sensor link error	"ERR" text in RED
LT_1004_01_AHH	Influent tank level reaches high level 2 alarm	RED
LT_1004_01_AH	Influent tank level reaches high level 1 alarm	YELLOW
LT_1004_01_ALL	Influent tank level reaches low level 2 alarm	RED
LT_1004_01_AL	Influent tank level reaches low level 1 alarm	YELLOW
BLE_1005_01_Freqdrive_A	Blender frequency drive alarm	Blender in red and "ERR" text
BLE_1005_01_Powersupply_A	Blender fuse error Alarm.	Blender in red and "ERR" text
TT_1008_01_ERR	Bioreactor temperature sensor link error	"ERR" text in RED
TT_1008_01_AHH	Bioreactor temperature reaches high level 2 Alarm	RED
TT_1008_01_AH	Bioreactor temperature reaches high level 1 Alarm	YELLOW
TT_1008_01_ALL	Bioreactor temperature reaches low level 2 Alarm	RED
TT_1008_01_AL	Bioreactor temperature reaches low level 1 Alarm	YELLOW
PT_1009_01_ERR	Bioreactor pressure sensor link error (gas phase)	"ERR" text in RED
PT_1009_01_AHH	Bioreactor pressure reaches high level 2 Alarm (gas phase)	RED
PT_1009_01_AH	Bioreactor pressure reaches high level 1 Alarm (gas phase)	YELLOW
PT_1009_01_ALL	Bioreactor pressure reaches low level 2 Alarm (gas phase)	RED
PT_1009_01_AL	Bioreactor pressure reaches low level 1 Alarm (gas phase)	YELLOW
PT_1009_02_ERR	Bioreactor pressure sensor link error (liquid phase)	"ERR" text in RED
PT_1009_02_AHH	Bioreactor pressure reaches high level 2 Alarm (liquid phase)	RED
PT_1009_02_AH	Bioreactor pressure reaches high level 1 Alarm (liquid phase)	YELLOW
PT_1009_02_ALL	Bioreactor pressure reaches low level 2 Alarm (liquid phase)	RED

TAG NAME	Description	Colour
PT_1009_02_AL	Bioreactor pressure reaches low level 1 Alarm (liquid phase)	YELLOW
SV_1009_01_A	Bioreactor release gas valve in wrong position	RED and "ERR" text in RED
LT_1010_01_ERR	Bioreactor level sensor link error	"ERR" text in RED
LT_1010_01_AHH	Bioreactor level sensor reaches high level 2 Alarm	RED
LT_1010_01_AH	Bioreactor level sensor reaches high level 1 Alarm	YELLOW
LT_1010_01_ALL	Bioreactor level sensor reaches low level 2 Alarm	RED
LT_1010_01_AL	Bioreactor level sensor reaches low level 1 Alarm	YELLOW
LSH_1010_01_A	Bioreactor high level switch alarm	RED
AT_1011_01_ERR	pH sensor link error	"ERR" text in RED
AT_1011_02_ERR	pH sensor link error	"ERR" text in RED
CL1011_PH_AHH	Bioreactor pH reaches high level 2 Alarm	RED
CL1011_PH_AH	Bioreactor pH reaches high level 1 Alarm	YELLOW
CL1011_PH_ALL	Bioreactor pH reaches low level 2 Alarm	RED
CL1011_PH_AL	Bioreactor pH reaches low level 1 Alarm	YELLOW
CL1011_pH_PUMP_A	pH pumps power supply alarm	Pumps in red
CL1011_BLENDER_STOPPED_A	Blender is stopped	Bioreactor blender in Red
BLE_1012_01_Freqdrive_A	Blender frequency drive Alarm	Blender in red and "ERR" text
BLE_1012_01_Powersupply_A	Blender power supply Alarm	Blender in red and "ERR" text
PT_1100_01_ERR	Active Gas Loop Buffer tank pressure sensor link error	"ERR" text in RED
PT_1100_01_AHH	Active Gas Loop Buffer tank pressure reaches high level 2 Alarm	RED
PT_1100_01_AH	Active Gas Loop Buffer tank pressure reaches high level 1 Alarm	YELLOW
PT_1100_01_ALL	Active Gas Loop Buffer tank pressure reaches low level 2 Alarm	RED
PT_1100_01_AL	Active Gas Loop Buffer tank pressure reaches low level 1 Alarm	YELLOW
PT_1100_02_ERR	Passive gas loop buffer tank pressure sensor link error	"ERR" text in RED
PT_1100_02_AHH	Passive gas loop buffer tank pressure reaches high level 2 Alarm	RED
PT_1100_02_AH	Passive gas loop buffer tank pressure reaches high level 1 Alarm	YELLOW
PT_1100_02_ALL	Passive gas loop buffer tank pressure reaches low level 2 Alarm	RED
PT_1100_02_AL	Passive gas loop buffer tank pressure reaches low level 1 Alarm	YELLOW
SCV_1100_01_ERR	Active Gas Loop Proportional valve sensor link Error	"ERR" text in RED
S3V_1100_01_A	Active Gas Loop Bypass valve in wrong position	RED and "ERR" text in RED
S3V_1100_02_A	Active Gas Loop Bypass valve in wrong position	RED and "ERR" text in RED
SV_1100_01_A	Active Gas Loop Bypass valve in wrong position	RED and "ERR" text in RED
SV_1100_02_A	Passive Gas Loop valve in wrong position	RED and "ERR" text in RED
SV_1100_03_A	Passive Gas Loop valve in wrong position	RED and "ERR" text in RED
SV_1100_05_A	Active Gas Loop valve in wrong position	RED and "ERR" text in RED
FT_1101_01_ERR	Analysis gas loop flow sensor link error	"ERR" text in RED
FT_1101_01_AHH	Analysis gas loop flow reaches high level 2 Alarm	RED
FT_1101_01_AH	Analysis gas loop flow reaches high level 1 Alarm	YELLOW
FT_1101_01_ALL	Analysis gas loop flow reaches low level 2 Alarm	RED
FT_1101_01_AL	Analysis gas loop flow reaches low level 1 Alarm	YELLOW
AT_1101_01_CH4_ERR	Analysis gas loop, CH4 sensor link error	"ERR" text in RED
AT_1101_01_CH4_AHH	Analysis gas loop, CH4 reaches high level 2 Alarm	RED
AT_1101_01_CH4_AH	Analysis gas loop, CH4 reaches high level 1 Alarm	YELLOW
AT_1101_01_CH4_ALL	Analysis gas loop, CH4 reaches low level 2 Alarm	RED
AT_1101_01_CH4_AL	Analysis gas loop, CH4 reaches low level 1 Alarm	YELLOW
AT_1101_01_CO2_ERR	Analysis gas loop CO2 sensor link error	"ERR" text in RED
AT_1101_01_CO2_AHH	Analysis gas loop CO2 reaches high level 2 Alarm	RED
AT_1101_01_CO2_AH	Analysis gas loop CO2 reaches high level 1 Alarm	YELLOW

TAG NAME	Description	Colour
AT_1101_01_CO2_ALL	Analysis gas loop CO2 reaches low level 2 Alarm	RED
AT_1101_01_CO2_AL	Analysis gas loop CO2 reaches low level 1 Alarm	YELLOW
PT_1101_01_ERR	Pressure after gas analyzer sensor link error	“ERR” text in RED
PT_1101_01_AHH	Pressure after gas analyzer reaches high level 2 Alarm	RED
PT_1101_01_AH	Pressure after gas analyzer reaches high level 1 Alarm	YELLOW
PT_1101_01_ALL	Pressure after gas analyzer reaches low level 2 Alarm	RED
PT_1101_01_AL	Pressure after gas analyzer reaches low level 1 Alarm	YELLOW
S3V_1101_01_A	Analysis Gas Loop valve in wrong position	RED and “ERR” text in RED
SV_1102_01_A	Active Gas Loop Condensate valve in wrong position	RED and “ERR” text in RED
LSH_1102_01_A	Active Gas Loop Buffer tank low level switch Alarm	RED
FT_1103_01_ERR	N2 flow sensor link error	“ERR” text in RED
FT_1103_01_AHH	N2 flow reaches high level 2 Alarm	RED
FT_1103_01_AH	N2 flow reaches high level 1 Alarm	YELLOW
FT_1103_01_ALL	N2 flow reaches low level 2 Alarm	RED
FT_1103_01_AL	N2 flow reaches low level 1 Alarm	YELLOW
SCV_1103_01_ERR	Proportional valve of the N2 inlet Error	“ERR” text in RED
S3V_1103_01_A	Analysis Gas Loop valve in wrong position	RED and “ERR” text in RED
TT_1104_01_ERR	Passive gas loop buffer tank temperature sensor link error	“ERR” text in RED
TT_1104_01_AHH	Passive gas loop buffer tank temperature reaches high level 2 Alarm	RED
TT_1104_01_AH	Passive gas loop buffer tank temperature reaches high level 1 Alarm	YELLOW
TT_1104_01_ALL	Passive gas loop buffer tank temperature reaches low level 2 Alarm	RED
TT_1104_01_AL	Passive gas loop buffer tank temperature reaches low level 1 Alarm	YELLOW
TT_1200_01_ERR	Inlet retentate line temperature sensor link error	“ERR” text in RED
TT_1200_01_AHH	Inlet retentate line temperature reaches high level 2 Alarm	RED
TT_1200_01_AH	Inlet retentate line temperature reaches high level 1 Alarm	YELLOW
TT_1200_01_ALL	Inlet retentate line temperature reaches low level 2 Alarm	RED
TT_1200_01_AL	Inlet retentate line temperature reaches low level 1 Alarm	YELLOW
TT_1200_02_ERR	Membrane 1 temperature sensor link error	“ERR” text in RED
TT_1200_02_AHH	Membrane 1 temperature reaches high level 2 sensor	RED
TT_1200_02_AH	Membrane 1 temperature reaches high level 1 sensor	YELLOW
TT_1200_02_ALL	Membrane 1 temperature reaches low level 2 sensor	RED
TT_1200_02_AL	Membrane 1 temperature reaches low level 1 sensor	YELLOW
TT_1200_03_ERR	Membrane 2 temperature sensor link error	“ERR” text in RED
TT_1200_03_AHH	Membrane 2 temperature reaches high level 2 sensor	RED
TT_1200_03_AH	Membrane 2 temperature reaches high level 1 sensor	YELLOW
TT_1200_03_ALL	Membrane 2 temperature reaches low level 2 sensor	RED
TT_1200_03_AL	Membrane 2 temperature reaches low level 1 sensor	YELLOW
AT_1201_01_ERR	Turbidity in outlet retentate side sensor link error	“ERR” text in RED
AT_1201_01_AHH	Turbidity in outlet retentate side reaches high level 2 Alarm	RED
AT_1201_01_AH	Turbidity in outlet retentate side reaches high level 1 Alarm	YELLOW
AT_1201_01_ALL	Turbidity in outlet retentate side reaches low level 2 Alarm	RED
AT_1201_01_AL	Turbidity in outlet retentate side reaches low level 1 Alarm	YELLOW
FT_1201_01_ERR	Outlet retentate flow sensor link error	“ERR” text in RED
FT_1201_01_AHH	Outlet retentate flow reaches high level 2 Alarm	RED
FT_1201_01_AH	Outlet retentate flow reaches high level 1 Alarm	YELLOW
FT_1201_01_ALL	Outlet retentate flow reaches low level 2 Alarm	RED
FT_1201_01_AL	Outlet retentate flow reaches low level 1 Alarm	YELLOW
GP_1201_01_Freqdrive_A	Gear pump frequency drive Alarm	Pump in red and “ERR” text
GP_1201_01_Powersupply_A	Gear pump power supply Alarm	Pump in red and “ERR” text
GP_1201_01_FLOW_A	Flow of retentate line is below 50 L/H. GP_1201_01 might run dry. --> The Pump is stopped	Pump in red and “ERR” text
S3V_1201_01_A	Bypass valve in wrong position	RED and “ERR” text in RED
S3V_1201_04_A	Bypass valve in wrong position	RED and “ERR” text in wrong position
SV_1201_03_A	Outlet retentate side Membrane 1 valve in wrong position	RED and “ERR” text in

TAG NAME	Description	Colour
		RED
SV_1201_04_A	Outlet retentate side Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1201_05_A	Inlet retentate Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1201_06_A	Inlet retentate Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1202_01_A	Filtrate side Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1202_02_A	Filtrate side Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1202_03_A	Recirculation valve in wrong position	RED and “ERR” text in wrong position
SV_1202_04_A	Filtrate flow valve in wrong position	RED and “ERR” text in wrong position
PT_1203_01_ERR	Inlet retentate side Membrane 1 pressure sensor link error	“ERR” text in RED
PT_1203_01_AHH	Inlet retentate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_01_AH	Inlet retentate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_01_ALL	Inlet retentate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_01_AL	Inlet retentate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_02_ERR	Outlet retentate side Membrane 1 pressure sensor link error	“ERR” text in RED
PT_1203_02_AHH	Outlet retentate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_02_AH	Outlet retentate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_02_ALL	Outlet retentate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_02_AL	Outlet retentate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_03_ERR	Filtrate side Membrane 1 pressure sensor link error	“ERR” text in RED
PT_1203_03_AHH	Filtrate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_03_AH	Filtrate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_03_ALL	Filtrate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_03_AL	Filtrate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_04_ERR	Inlet retentate side Membrane 2 pressure sensor link error	“ERR” text in RED
PT_1203_04_AHH	Inlet retentate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_04_AH	Inlet retentate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_04_ALL	Inlet retentate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_04_AL	Inlet retentate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_05_ERR	Outlet retentate side Membrane 2 pressure sensor link error	“ERR” text in RED
PT_1203_05_AHH	Outlet retentate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_05_AH	Outlet retentate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_05_ALL	Outlet retentate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_05_AL	Outlet retentate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_06_ERR	Filtrate side Membrane 2 pressure sensor link error	“ERR” text in RED
PT_1203_06_AHH	Filtrate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_06_AH	Filtrate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_06_ALL	Filtrate side Membrane 2 pressure reaches low level 2	RED

TAG NAME	Description	Colour
	Alarm	
PT_1203_06_AL	Filtrate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_07_ERR	Pressure after circulation pump sensor link error	“ERR” text in RED
PT_1203_07_AHH	Pressure after circulation pump reaches high level 2 Alarm	RED
PT_1203_07_AH	Pressure after circulation pump reaches high level 1 Alarm	YELLOW
PT_1203_07_ALL	Pressure after circulation pump reaches low level 2 Alarm	RED
PT_1203_07_AL	Pressure after circulation pump reaches low level 1 Alarm	YELLOW
PT_1203_08_ERR	After filtrate pump pressure sensor link error	“ERR” text in RED
PT_1203_08_AHH	Pressure after filtrate pump reaches high level 2 Alarm	RED
PT_1203_08_AH	Pressure after filtrate pump reaches high level 1 Alarm	YELLOW
PT_1203_08_ALL	Pressure after filtrate pump reaches low level 2 Alarm	RED
PT_1203_08_AL	Pressure after filtrate pump reaches low level 1 Alarm	YELLOW
SV_1204_01_A	Drain valve of the harvesting tank in wrong position	RED and “ERR” text in wrong position
SV_1204_02_A	Air inlet valve of the harvesting tank in wrong position	RED and “ERR” text in wrong position
SV_1204_03_A	Filtrate flow valve in wrong position	RED and “ERR” text in wrong position
TT_1205_01_ERR	Harvesting tank temperature sensor link error	“ERR” text in RED
TT_1205_01_AHH	Harvesting tank temperature reaches high level 2 Alarm	RED
TT_1205_01_AH	Harvesting tank temperature reaches high level 1 Alarm	YELLOW
TT_1205_01_ALL	Harvesting tank temperature reaches low level 2 Alarm	RED
TT_1205_01_AL	Harvesting tank temperature reaches low level 1 Alarm	YELLOW
LT_1206_01_ERR	Harvesting tank level sensor link error	“ERR” text in RED
LT_1206_01_AHH	Harvesting tank level reaches high level 2 Alarm	RED
LT_1206_01_AH	Harvesting tank level reaches high level 1 Alarm	YELLOW
LT_1206_01_ALL	Harvesting tank level reaches low level 2 Alarm	RED
LT_1206_01_AL	Harvesting tank level reaches low level 1 Alarm	YELLOW
LSL_1206_01_A	Harvesting tank low level switch Alarm	RED
LSH_1206_01_A	Harvesting tank high level switch Alarm	RED

Table 6-2: Alarm tags of the Main Screen of CI system

6.4 Bioreactor and Influent tank screen

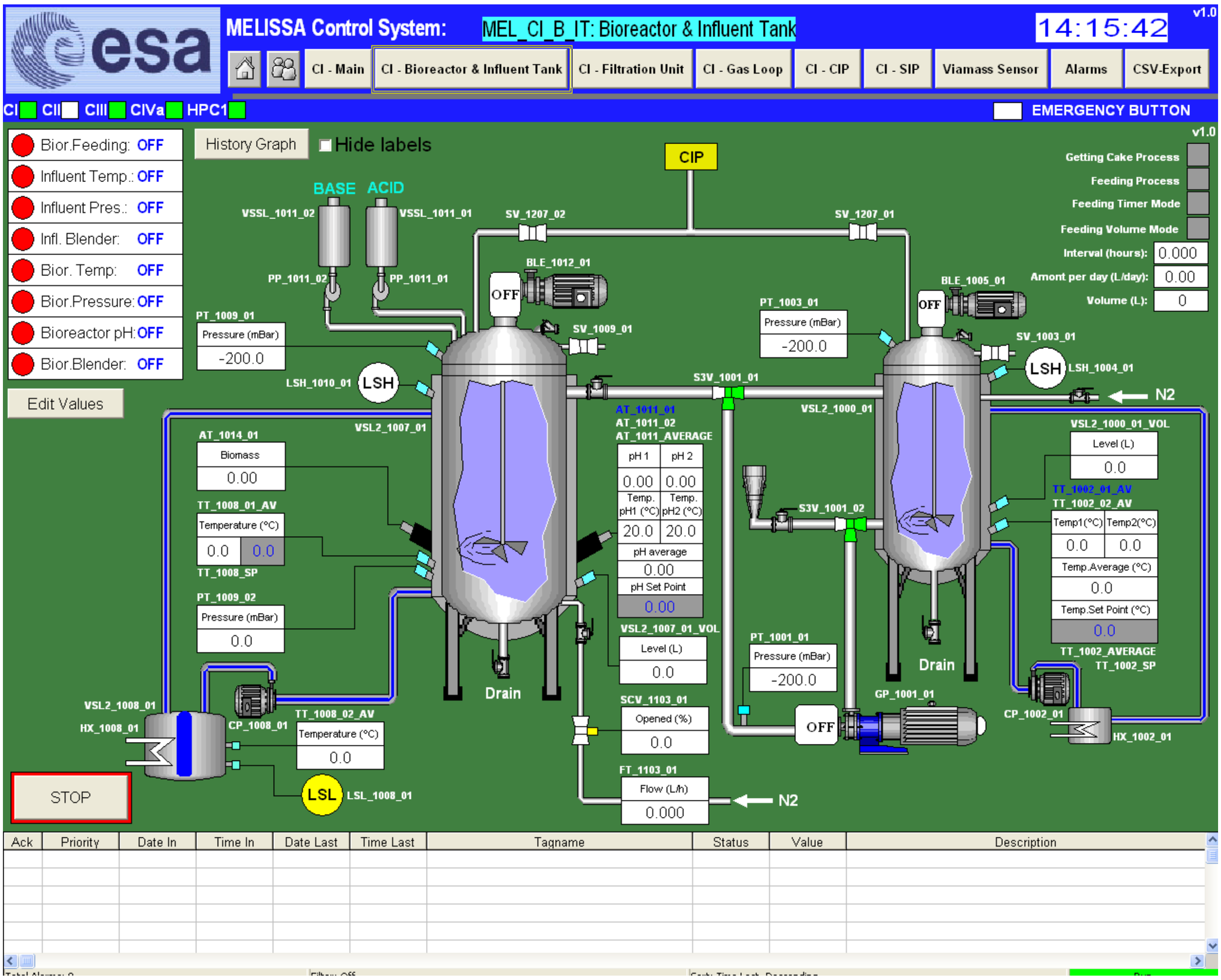


Figure 6-7: Main objects in CI Bioreactor and Influent tank screen

6.4.1 General actions

This display allows the user to:

- Monitor the influent tank indicators (level, temperature and pressure), pressure after recirculation pump GP_1001_01, bioreactor indicators (pH, level, pressure in liquid phase, pressure in gas phase, temperature and biomass concentration), N2 flow inlet to bioreactor, temperature in warm water bath and the indicators of the feeding procedure.
- Modify the set-points of Influent tank temperature, Bioreactor pH and Bioreactor temperature.
- Device alarm animations.
- Display the history graph clicking on the History graph command button.
- Hide labels selecting the “Hide labels” check box.
- Switch OFF the Bioreactor Feeding Mode, Influent tank temperature Mode, Influent tank pressure Mode, Influent tank blender Mode, Bioreactor

temperature Mode, Bioreactor pressure Mode, Bioreactor pH Mode and Bioreactor blender Mode clicking on the “Stop” command button.

- Select the pH probe for control clicking over the probe lecture:

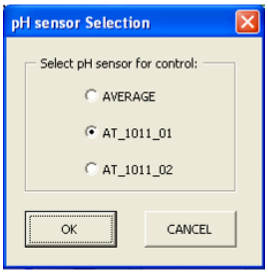


Figure 6-8: pH probe selection

- Select the Influent tank temperature probe for control clicking over the probe lecture:

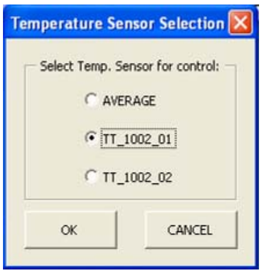
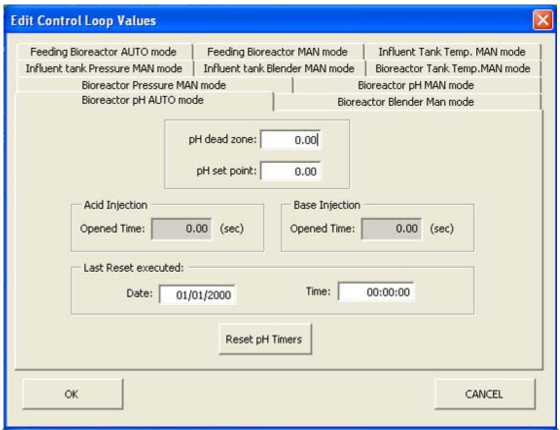
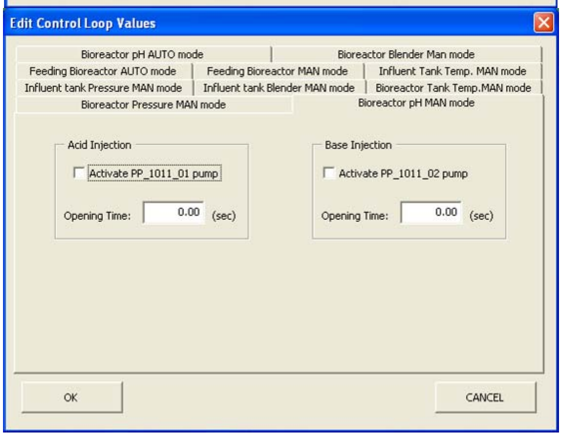


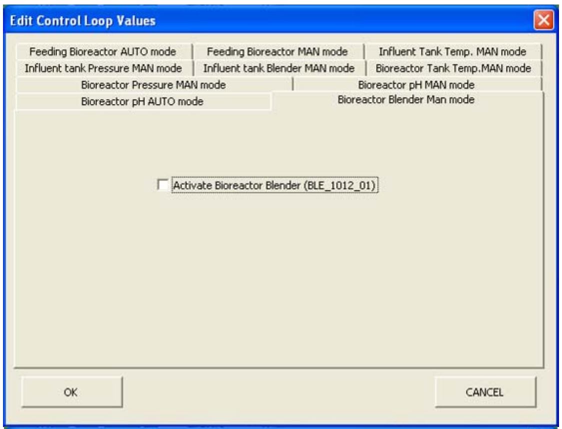
Figure 6-9: Influent tank temperature probe selection

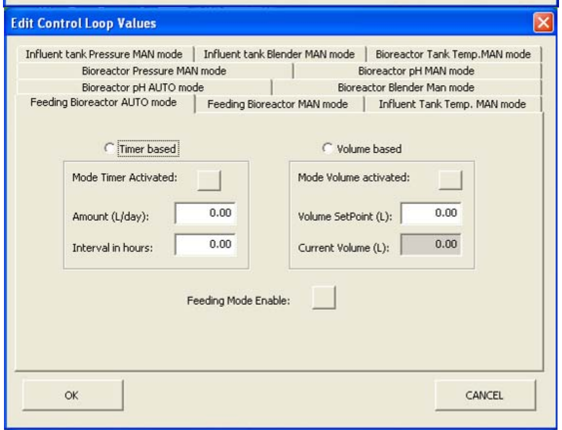
- Edit manual values clicking the “Edit Values” command button. In the Manual Values window user can switch between ten submenus:
    - Bioreactor pH AUTO Mode: Allows resetting the pH timers and selecting the pH Set-Point and the pH dead zone. Furthermore it is possible to read the date and time of the last timer reset and the opened time of the acid and the base injections.
    - Bioreactor pH MAN Mode: Allows activating the acid and base pumps (PP_1011_01 and PP_1011_02 respectively) and select the opening time.
    - Bioreactor Blender MAN mode: Allows activating bioreactor blender (BLE_1012_01).
    - Feeding Bioreactor AUTO mode: Allow activating bioreactor feeding procedure in timer based or volume based and selecting the parameters of each mode.
    - Feeding Bioreactor MAN mode: Allow activating of the recirculation pump (GP_1001_01), feeding bioreactor valve (S3V_1001_01) and feeding influent tank valve (S3V_1001_02).
    - Influent tank temperature MAN mode: Allow activating influent tank cooler (HX_1002_01).
    - Influent tank pressure MAN mode: Allow activating influent tank release gas valve (SV_1003_01).

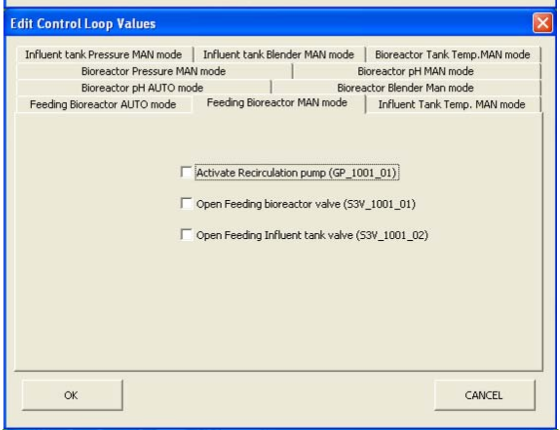
- o Influent tank blender in MAN mode: Allows activating influent tank blender (BLE_1005_01)
- o Bioreactor temperature MAN mode: Allow activating heat exchanger (HX_1008_01)
- o Bioreactor pressure MAN mode: Allow activating bioreactor release gas valve (SV_1009_01).

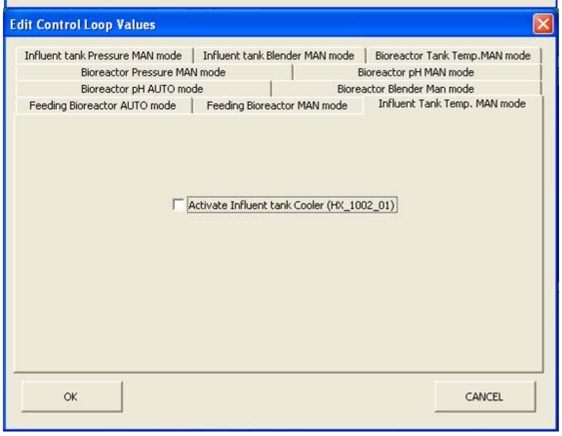





Edit Control Loop Values
Feeding Bioreactor AUTO mode
Feeding Bioreactor MAN mode
Influent Tank Temp. MAN mode
Influent tank Pressure MAN mode
Influent tank Blender MAN mode
Bioreactor Tank Temp.MAN mode
Bioreactor Pressure MAN mode
Bioreactor pH MAN mode
Bioreactor pH AUTO mode
Bioreactor Blender Man mode
Activate Bioreactor Blender (BLE_1012_01)
OK
CANCEL


Edit Control Loop Values
Influent tank Pressure MAN mode
Influent tank Blender MAN mode
Bioreactor Tank Temp.MAN mode
Bioreactor Pressure MAN mode
Bioreactor pH MAN mode
Bioreactor pH AUTO mode
Bioreactor Blender Man mode
Feeding Bioreactor AUTO mode
Feeding Bioreactor MAN mode
Influent Tank Temp. MAN mode
Timer based
Volume based
Mode Timer Activated:
Amount (L/day):
0.00
Interval in hours:
0.00
Mode Volume activated:
Volume SetPoint (L):
0.00
Current Volume (L):
0.00
Feeding Mode Enable:
OK
CANCEL


Edit Control Loop Values
Influent tank Pressure MAN mode
Influent tank Blender MAN mode
Bioreactor Tank Temp.MAN mode
Bioreactor Pressure MAN mode
Bioreactor pH MAN mode
Bioreactor pH AUTO mode
Bioreactor Blender Man mode
Feeding Bioreactor AUTO mode
Feeding Bioreactor MAN mode
Influent Tank Temp. MAN mode
Activate Recirculation pump (GP_1001_01)
Open Feeding bioreactor valve (S3V_1001_01)
Open Feeding Influent tank valve (S3V_1001_02)
OK
CANCEL


Edit Control Loop Values
Influent tank Pressure MAN mode
Influent tank Blender MAN mode
Bioreactor Tank Temp.MAN mode
Bioreactor Pressure MAN mode
Bioreactor pH MAN mode
Bioreactor pH AUTO mode
Bioreactor Blender Man mode
Feeding Bioreactor AUTO mode
Feeding Bioreactor MAN mode
Influent Tank Temp. MAN mode
Activate Influent tank Cooler (HX_1002_01)
OK
CANCEL

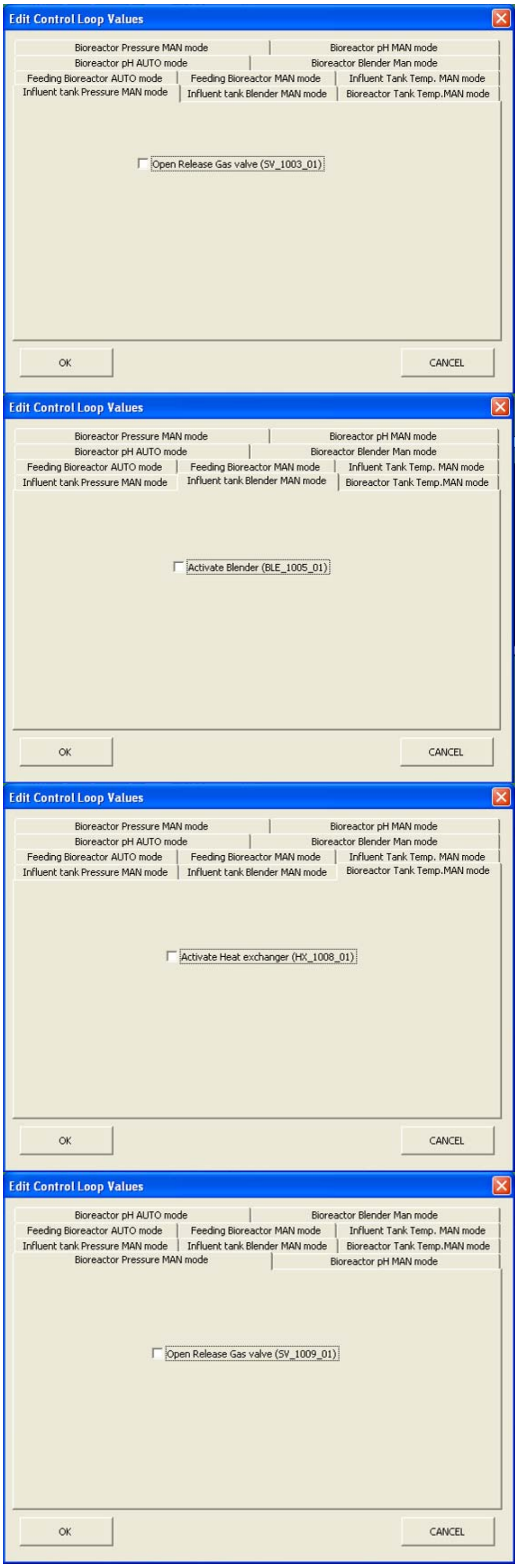


Figure 6-10: Edit Values dialog

6.4.2 Alarms

The following alarms are linked with the operation of the Bioreactor and Influent tank screen.

TAG NAME	Description	Colour
GP_1001_01_overpressure_A	Gear pump alarm	Pump in red and "ERR" text
GP_1001_01_mightrundry_A	Pump stopped if the volume filtered of the Influent tank is lower or equal to 9 litres.	Pump in red and "ERR" text
GP_1001_01_fusemotorswitch_A	Motor switch fuse problem (Fuse 19)	Pump in red and "ERR" text
GP_1001_01_fuseclockwise_A	Clockwise fuse problem (Fuse 21)	Pump in red and "ERR" text
PT_1001_01_ERR	Pressure (after pump GP_1001_01) sensor link error	"ERR" text in RED
PT_1001_01_AHH	Pressure (after pump GP_1001_01) reaches high level 2 sensor	RED
PT_1001_01_AH	Pressure (after pump GP_1001_01) reaches high level 1 sensor	YELLOW
PT_1001_01_ALL	Pressure (after pump GP_1001_01) reaches low level 2 sensor	RED
PT_1001_01_AL	Pressure (after pump GP_1001_01) reaches low level 1 sensor	YELLOW
S3V_1001_01_A	Feeding Bioreactor valve in wrong position	RED and "ERR" text in RED
S3V_1001_02_A	Filling Influent valve in wrong position	RED and "ERR" text in RED
TT_1002_01_ERR	Influent tank temperature sensor link error	"ERR" text in RED
TT_1002_01_AHH	Influent tank temperature reaches high level 2 alarm	RED
TT_1002_01_AH	Influent tank temperature reaches high level 1 alarm	YELLOW
TT_1002_01_ALL	Influent tank temperature reaches low level 2 alarm	RED
TT_1002_01_AL	Influent tank temperature reaches low level 1 alarm	YELLOW
TT_1002_02_ERR	Influent tank temperature sensor link error	"ERR" text in RED
TT_1002_02_AHH	Influent tank temperature reaches high level 2 alarm	RED
TT_1002_02_AH	Influent tank temperature reaches high level 1 alarm	YELLOW
TT_1002_02_ALL	Influent tank temperature reaches low level 2 alarm	RED
TT_1002_02_AL	Influent tank temperature reaches low level 1 alarm	YELLOW
HX_1002_01_A	Heat Exchanger Alarm	RED
PT_1003_01_ERR	Influent tank pressure (gas phase) sensor link error	"ERR" text in RED
PT_1003_01_AHH	Influent tank pressure (gas phase) reaches high level 2 alarm	RED
PT_1003_01_AH	Influent tank pressure (gas phase) reaches high level 1 alarm	YELLOW
PT_1003_01_ALL	Influent tank pressure (gas phase) reaches low level 2 alarm	RED
PT_1003_01_AL	Influent tank pressure (gas phase) reaches low level 1 alarm	YELLOW
SV_1003_01_A	Influent tank release gas valve in wrong position	RED and "ERR" text in RED
LSH_1004_01_A	Influent tank high level switch Alarm	RED
LT_1004_01_ERR	Influent tank level sensor link error	"ERR" text in RED
LT_1004_01_AHH	Influent tank level reaches high level 2 alarm	RED
LT_1004_01_AH	Influent tank level reaches high level 1 alarm	YELLOW
LT_1004_01_ALL	Influent tank level reaches low level 2 alarm	RED
LT_1004_01_AL	Influent tank level reaches low level 1 alarm	YELLOW
BLE_1005_01_Freqdrive_A	Blender frequency drive Alarm	Blender in red and "ERR" text
BLE_1005_01_PowerSupply_A	Blender power supply Alarm	Blender in red and "ERR" text
TT_1008_01_ERR	Bioreactor temperature sensor link error	"ERR" text in RED
TT_1008_01_AHH	Bioreactor temperature reaches high level 2 Alarm	RED
TT_1008_01_AH	Bioreactor temperature reaches high level 1 Alarm	YELLOW
TT_1008_01_ALL	Bioreactor temperature reaches low level 2 Alarm	RED
TT_1008_01_AL	Bioreactor temperature reaches low level 1 Alarm	YELLOW
TT_1008_02_ERR	Warm water bath temperature sensor link error	"ERR" text in RED
TT_1008_02_AHH	Warm water bath temperature reaches high level 2 Alarm	RED
TT_1008_02_AH	Warm water bath temperature reaches high level 1 Alarm	YELLOW
TT_1008_02_ALL	Warm water bath temperature reaches low level 2 Alarm	RED
TT_1008_02_AL	Warm water bath temperature reaches low level 1 Alarm	YELLOW
LSL_1008_01_A	Warm water bath low level switch Alarm	RED
PT_1009_01_ERR	Bioreactor pressure sensor link error (gas phase)	"ERR" text in RED
PT_1009_01_AHH	Bioreactor pressure reaches high level 2 Alarm (gas phase)	RED

TAG NAME	Description	Colour
PT_1009_01_AH	Bioreactor pressure reaches high level 1 Alarm (gas phase)	YELLOW
PT_1009_01_ALL	Bioreactor pressure reaches low level 2 Alarm (gas phase)	RED
PT_1009_01_AL	Bioreactor pressure reaches low level 1 Alarm (gas phase)	YELLOW
PT_1009_02_ERR	Bioreactor pressure sensor link error (liquid phase)	"ERR" text in RED
PT_1009_02_AHH	Bioreactor pressure reaches high level 2 Alarm (liquid phase)	RED
PT_1009_02_AH	Bioreactor pressure reaches high level 1 Alarm (liquid phase)	YELLOW
PT_1009_02_ALL	Bioreactor pressure reaches low level 2 Alarm (liquid phase)	RED
PT_1009_02_AL	Bioreactor pressure reaches low level 1 Alarm (liquid phase)	YELLOW
SV_1009_01_A	Bioreactor release gas valve in wrong position	RED and "ERR" text in RED
LT_1010_01_ERR	Bioreactor level sensor link error	"ERR" text in RED
LT_1010_01_AHH	Bioreactor level sensor reaches high level 2 Alarm	RED
LT_1010_01_AH	Bioreactor level sensor reaches high level 1 Alarm	YELLOW
LT_1010_01_ALL	Bioreactor level sensor reaches low level 2 Alarm	RED
LT_1010_01_AL	Bioreactor level sensor reaches low level 1 Alarm	YELLOW
LSH_1010_01_A	Bioreactor high level switch Alarm	RED
CL1011_PH_PUMP_A	pH pump power supply Alarm	
AT_1011_01_ERR	pH sensor link error	"ERR" text in RED
AT_1011_02_ERR	pH sensor link error	"ERR" text in RED
CL1011_PH_AHH	Bioreactor pH reaches high level 2 Alarm	RED
CL1011_PH_AH	Bioreactor pH reaches high level 1 Alarm	YELLOW
CL1011_PH_ALL	Bioreactor pH reaches low level 2 Alarm	RED
CL1011_PH_AL	Bioreactor pH reaches low level 1 Alarm	YELLOW
TT_1011_01_ERR	Temperature of the pH1 sensor link error	"ERR" text in RED
TT_1011_01_AHH	Temperature of the pH1 sensor reaches high level 2 Alarm	RED
TT_1011_01_AH	Temperature of the pH1 sensor reaches high level 1 Alarm	YELLOW
TT_1011_01_ALL	Temperature of the pH1 sensor reaches low level 2 Alarm	RED
TT_1011_01_AL	Temperature of the pH1 sensor reaches low level 1 Alarm	YELLOW
TT_1011_02_ERR	Temperature of the pH2 sensor link error	"ERR" text in RED
TT_1011_02_AHH	Temperature of the pH2 sensor reaches high level 2 Alarm	RED
TT_1011_02_AH	Temperature of the pH2 sensor reaches high level 1 Alarm	YELLOW
TT_1011_02_ALL	Temperature of the pH2 sensor reaches low level 2 Alarm	RED
TT_1011_02_AL	Temperature of the pH2 sensor reaches low level 1 Alarm	YELLOW
AT_1011_SENSOR_DEVIATION_A	Alarm fired when pH gap between two probes is more than 5%	TBD
CL1011_BLENDER_STOPPED_A	BLE_1012_01 stopped	TBD
BLE_1012_01_FreqDrive_A	Blender frequency driver Alarm	Blender in red and "ERR" text
BLE_1012_01_PowerSupply_A	Blender Power supply Alarm	Blender in red and "ERR" text
FT_1103_01_ERR	N2 flow sensor link error	"ERR" text in RED
FT_1103_01_AHH	N2 flow reaches high level 2 Alarm	RED
FT_1103_01_AH	N2 flow reaches high level 1 Alarm	YELLOW
FT_1103_01_ALL	N2 flow reaches low level 2 Alarm	RED
FT_1103_01_AL	N2 flow reaches low level 1 Alarm	YELLOW
SCV_1103_01_ERR	N2 inlet proportional valve Error	"ERR" text in RED
SV_1207_01_A	Influent tank cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_02_A	Bioreactor cleaning valve in wrong position	RED and "ERR" text in RED

Table 6-3: Alarm tags of the Bioreactor and Influent tank screen

6.4.3 Tags

The following tags are displayed in this screen (user inputs are highlighted in green):

Tag Name	Description	Type	Units	Range
VSL2_1000_01_VOL_FILTERED	Influent tank volume	Analogue indicator	(L)	0 to 60
CL1001_GETCAKE	Activate influent tank feeding mode	User input	--	--
CL1001_SCI_FEED	Bioreactor feeding indicator	Digital indicator	--	--
CL1001_SCI_FEED_MODE_TIMER_S	Activate feeding mode timer	User input	--	--
CL1001_SCI_FEED_MODE_VOLUME_S	Activate feeding mode volume	User input	--	--
CL1001_SCI_FEED_INTERV_IN_HO	Feeding bioreactor parameter	User input	(L/h)	0 to

Tag Name	Description	Type	Units	Range
UR				1000
CL1001_SCI_FEED_AMOUNT_PER_DAY	Amount per day to feed bioreactor	User Input	(L/day)	0 to 200
CL1001_SCI_FEED_VOLUME_SP	Bioreactor volume SP in volume mode	User input	(L)	0 to 120
GP_1001_01_OP	Start/Stop pump of the influent tank	Button	--	--
GP_1001_01_MV1	Start/Stop pump of the influent tank	Pump animation	--	--
PT_1001_01	Pressure after pump GP_1001_01	Analogue indicator	(mBar)	-200 to 200
S3V_1001_02_FB	Filling influent tank valve	3-way valve animated	--	--
S3V_1001_02_OP	Filling influent tank valve in manual mode	Button	--	--
S3V_1001_01_FB	Feeding bioreactor valve	3-way valve animated	--	--
S3V_1001_01_OP	Feeding bioreactor valve in manual mode	Button	--	--
HX_1002_01_MV	Influent tank cooler	Digital indicator	--	--
HX_1002_01_OP	Influent tank cooler in manual mode	Button	--	--
CL1002_Temp_Probe_selection	Influent tank probe selection for control	Button	--	0 to 2
TT_1002_SP	Influent tank temperature Set Point	SP User Input	(ºC)	0 to 100
TT_1002_01_AV	Temperature in influent tank	Analogue indicator	(ºC)	0 to100
TT_1002_02_AV	Temperature in influent tank	Analogue indicator	(ºC)	0 to 100
TT_1002_AVERAGE	Temperature average in influent tank	Analogue indicator	(ºC)	0 to 100
PT_1003_01	Pressure in gas phase in influent tank	Analogue indicator	(mBar)	-200 to 200
SV_1003_01_MV	Release gas from influent tank	2-way valve animated	--	--
SV_1003_01_OP	Release gas valve in manual mode	Button	--	--
LSH_1004_01	Influent tank high level switch	Digital indicator	--	--
BLE_1005_01_OP	Start/Stop influent tank blender	Button	--	--
BLE_1005_01_MV	Influent tank blender	Pump	--	--
TT_1008_01	Temperature in bioreactor	Analogue indicator	(ºC)	0 to 100
TT_1008_SP	Bioreactor temperature Set Point	SP User Input	(ºC)	0 to 100
TT_1008_02_AV	Temperature in VSL2_1008_01	Analogue indicator	(ºC)	0 to 100
LSL_1008_01	VSL2_1008_01 low level switch	Digital indicator	--	--
HX_1008_01_MV	Bioreactor heater	Digital indicator	--	--
HX_1008_01_OP	Bioreactor heater in manual mode	Button	--	--
SV_1009_01_MV	Release gas from Bioreactor	2-way valve animated	--	--
SV_1009_01_OP	Release gas from bioreactor in manual mode	Button	--	--
PT_1009_01	Pressure in gas phase in bioreactor	Analogue indicator	(mBar)	-200 to 200
PT_1009_02	Pressure in liquid phase in bioreactor	Analogue indicator	(mBar)	0 to 400
CL1010_VSL2_1007_01_VOL_FILTER	Bioreactor volume	Analogue indicator	(L)	0 to 120
LSH_1010_01	Bioreactor high level switch	Digital indicator	--	--
AT_1011_01	pH in bioreactor	Analogue indicator	(pH)	0 to 10
AT_1011_02	pH in bioreactor	Analogue indicator	(pH)	0 to 10
AT_1011_Average	pH average in bioreactor	Analogue indicator	(pH)	0 to 10
TT_1011_01	Temperature of the pH sensor (AT_1011_01)	Analogue indicator	(ºC)	TBD
TT_1011_02	Temperature of the pH sensor (AT_1011_02)	Analogue indicator	(ºC)	TBD
CL1011_PH_SP	Bioreactor pH Set Point	SP User Input	(pH)	0 to 10

Tag Name	Description	Type	Units	Rang e
CL1011_probe_selection	pH probe selection for control	Button	--	0 to 2
CL1011_pH_DeadZone	Absolute value which defines a Zone arround the Set point where the control is not active	User input	(pH)	TBD
CL1011_ACID_OP_Time	Acid injection time in manual mode	User Input	(sec)	TBD
CL1011_BASE_OP_Time	Base injection time in manual mode	User Input	(sec)	TBD
CL1011_BASE_Injection_Time	Base injection time indicator	Analogue indicator	(sec)	TBD
CL1011_ACID_Injection_Time	Acid injection time indicator	Analogue indicator	(sec)	TBD
CL1011_pH_Second	Second of the last pH reset timer fired	Analogue indicator	(sec)	0 to 59
CL1011_pH_Minute	Minute of the last pH reset timer fired	Analogue indicator	(min)	0 to 59
CL1011_pH_Hour	Hour of the last pH reset timer fired	Analogue indicator	(hour)	0 to 23
CL1011_pH_Day	Day of the last pH reset timer fired	Analogue indicator	(Day)	1 to 31
CL1011_pH_Month	Month of the last pH reset timer fired	Analogue indicator	(Mont h)	1 to12
CL1011_pH_Year	Year of the last pH reset timer fired	Analogue indicator	(Year)	0 to 99
CL1011_pH_Reset_timer	Reset button to reset the pH timer	Button	--	--
PP_1011_01_MV	Acid pump	Pump animated	--	--
PP_1011_01_OP	Acid pump in manual mode	Button	--	--
PP_1011_02_MV	Base pump	Pump animated	--	--
PP_1011_02_OP	Base pump in manual mode	Button	--	--
BLE_1012_01_OP	Start/Stop Bioreactor blender	Blender animated	--	--
BLE_1012_01_MV	Bioreactor blender	Blender animated	--	--
AT_1014_01	Biomass sensor	Analogue indicator	TBD	TBD
FT_1103_01	N2 flow into bioreactor	Analogue indicator	(L/h)	0 to 2
SCV_1103_01_MV	Proportional valve, N2 input into bioreactor.	Analogue indicator	(%)	0 to 100
SV_1207_01_FB	Influent tank cleaning valve	2-way valve animated	--	--
SV_1207_02_FB	Bioreactor tank cleaning valve	2-way valve animated	--	--

Table 6-4: Tags of the Bioreactor and Influent tank screen

6.4.4 Control Loops

The following control loops are implemented on the screen:

Control Logic	Description
CL1001	Influent tank feeding mode
CL1002	Influent tank temperature mode
CL1003	Influent tank pressure mode
CL1005	Influent tank blender mode
CL1008	Bioreactor temperature mode
CL1009	Bioreactor pressure mode
CL1011	Bioreactor pH mode
CL1012	Bioreactor blender mode

Table 6-5: Control loops of the Bioreactor and Influent tank system

6.5 Gas Loop screen

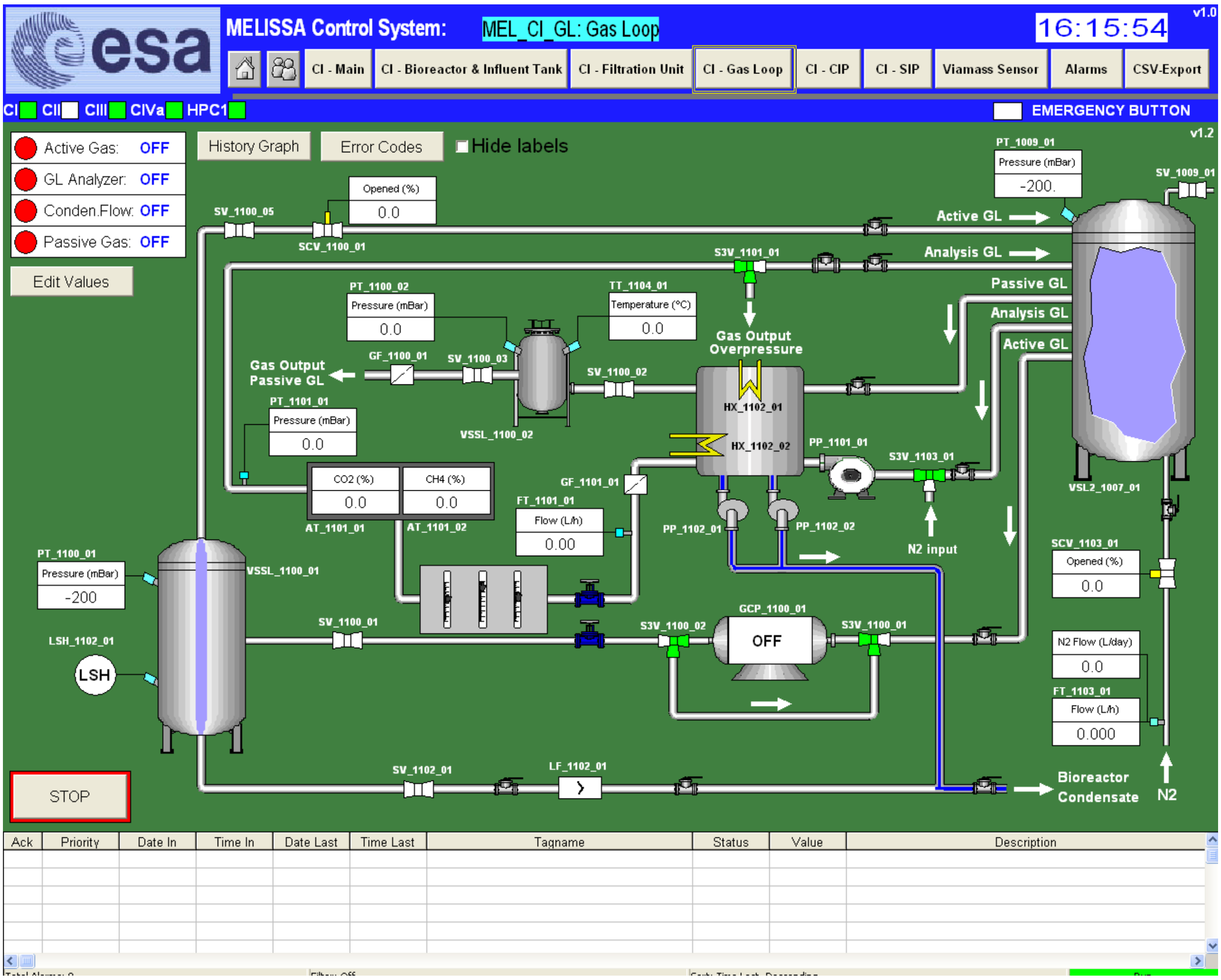


Figure 6-11: Main objects Gas Loop Screen

6.5.1 General actions

This display allows the user to:

- Monitor the bioreactor pressure in gas phase, the pressure and temperature of VSSL_1100_02 vessel, the pressure of the active gas loop buffer tank, flow through the analysis gas loop line, the CO2 and CH4 concentration and the state of the equipment (valves, pumps, gas compressor and level switch).
- Device alarm animations.
- Display the history graph clicking on the History graph command button.
- Hide labels selecting the “Hide labels” check box
- Switch OFF the Pressure Control Mode, Gas Loop Analyzer Mode, Condensate Flow Mode and N2 flow clicking on the “Stop” command button.
- Edit manual values clicking the “Edit Values” command button. In the Manual Values window user can switch between six submenus:
    - Active Gas Loop MAN mode: Allows activating gas compressor (GCP_1100_01), bypass valves (S3V_1100_01 and S3V_1100_02) and active gas loop valves (SV_1100_01 and SV_1100_05).

Furthermore is possible to write the proportional valve (SCV_1100_01) set point.

- Gas Loop Analyzer MAN Mode: Allows activating valves (S3V_1101_01, SV_1101_01 and S3V_1103_01) and pump PP_1101_01.
- Gas Loop Analyzer AUTO mode: Allows activating or deactivating calibration of the analyzers and read the state of the Analysis gas loop and calibration gas loop.
- Passive Gas Loop MAN mode: Allow to write the SCV_1103_01 proportional valve set point and open passive gas loop valves (SV_1100_02 and SV_1100_03).
- Outlet Gas Calculation: Indicates the total CO2 (mg), total CH4 (mg), total N2 (mg) from last reset executed, total N2 flow (L), total Mole gas escape (mol), date and hour of the last reset executed and command button to reset the gas timer.
- Condensate Flow Manual Mode: Allows activating valve SV_1102_01.
- Passive Gas Loop AUTO mode: Allow activating Biogas Flow calculus and the desired total biogas in L/day.

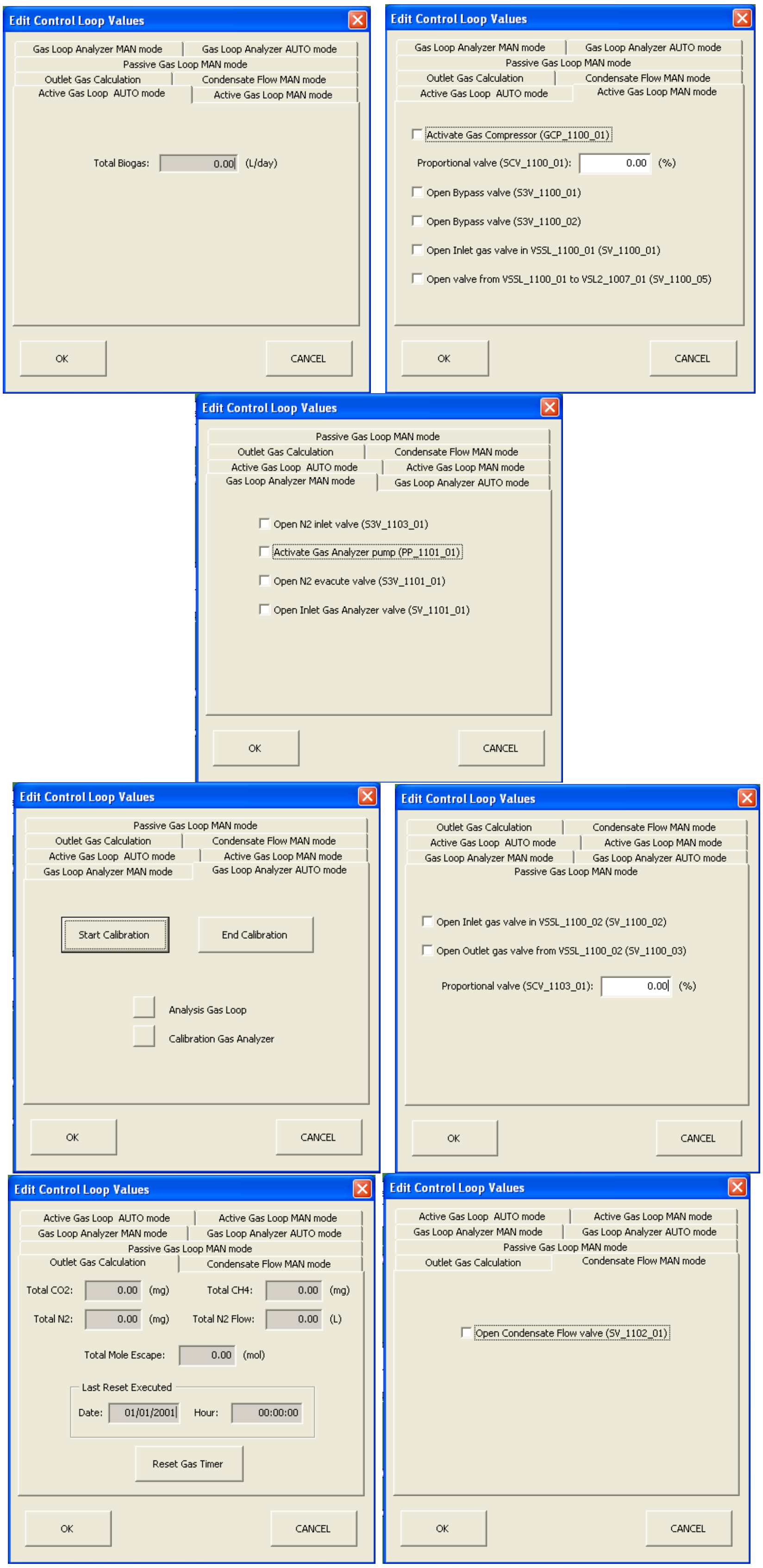


Figure 6-12: Edit Values dialog

- Error Codes command button allows to open a window showing the error code of the each gas loop procedure. Operator will be able identify error code of the step inside the procedure that has been wrong executed. For error code description, please refer to [R6].

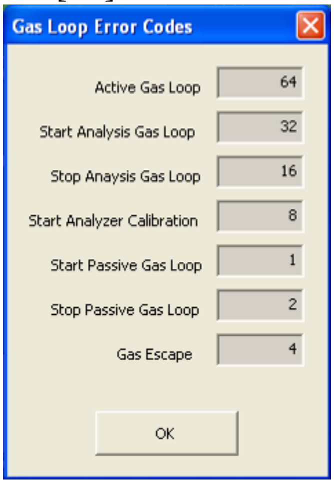


Figure 6-13: Error Codes of the Gas Loop Procedures

Name	Description	Address
CL1100_G_Active_Loop_Error	Error Code of the Active Gas Loop Procedure	400335
CL1101_G_Ana_Start_Error_	Error Code of the Start Analysis Gas Loop Procedure	400337
CL1101_G_Ana_Stop_Error	Error Code of the Stop Analysis Gas Loop Procedure	400339
CL1101_G_Ana_Cal_Start_Error	Error Code of the Start Calibration Gas Analyzer Procedure	400341
CL1103_G_PAS_Start_Error	Error Code of the Start Passive Gas Loop Procedure	400343
CL1103_G_PAS_Stop_Error	Error Code of the Stop Passive Gas Loop Procedure	400345
CL1103_G_PAS_Esc_Error	Error Code of the Gas Escape Procedure	400347

Table 6-6: Gas Loop Error Codes description

6.5.2 Alarms

The following alarms are linked with the operation of the Gas Loop screen.

TAG NAME	Description	Colour
SV_1009_01_A	Bioreactor release gas valve in wrong position	RED and "ERR" text in RED
PT_1009_01_ERR	Bioreactor pressure sensor link error (gas phase)	"ERR" text in RED
PT_1009_01_AHH	Bioreactor pressure reaches high level 2 Alarm (gas phase)	RED
PT_1009_01_AH	Bioreactor pressure reaches high level 1 Alarm (gas phase)	YELLOW
PT_1009_01_ALL	Bioreactor pressure reaches low level 2 Alarm (gas phase)	RED
PT_1009_01_AL	Bioreactor pressure reaches low level 1 Alarm (gas phase)	YELLOW
PT_1100_01_ERR	Active Gas Loop Buffer tank pressure sensor link error	"ERR" text in RED
PT_1100_01_AHH	Active Gas Loop Buffer tank pressure reaches high level 2 Alarm	RED

TAG NAME	Description	Colour
PT_1100_01_AH	Active Gas Loop Buffer tank pressure reaches high level 1 Alarm	YELLOW
PT_1100_01_ALL	Active Gas Loop Buffer tank pressure reaches low level 2 Alarm	RED
PT_1100_01_AL	Active Gas Loop Buffer tank pressure reaches low level 1 Alarm	YELLOW
PT_1100_02_ERR	Passive gas loop buffer tank pressure sensor link error	"ERR" text in RED
PT_1100_02_AHH	Passive gas loop buffer tank pressure reaches high level 2 Alarm	RED
PT_1100_02_AH	Passive gas loop buffer tank pressure reaches high level 1 Alarm	YELLOW
PT_1100_02_ALL	Passive gas loop buffer tank pressure reaches low level 2 Alarm	RED
PT_1100_02_AL	Passive gas loop buffer tank pressure reaches low level 1 Alarm	YELLOW
SCV_1100_01_ERR	Sensor link error	"ERR" text in RED
S3V_1100_01_A	Active Gas Loop Bypass valve in wrong position	RED and "ERR" text in RED
S3V_1100_02_A	Active Gas Loop Bypass valve in wrong position	RED and "ERR" text in RED
SV_1100_01_A	Analysis Gas loop valve in wrong position	RED and "ERR" text in RED
SV_1100_02_A	Passive Gas Loop valve in wrong position	RED and "ERR" text in RED
SV_1100_03_A	Passive Gas Loop valve in wrong position	RED and "ERR" text in RED
SV_1100_05_A	Active Gas Loop valve in wrong position	RED and "ERR" text in RED
S3V_1101_01_A	Analysis Gas Loop valve in wrong position	RED and "ERR" text in RED
FT_1101_01_ERR	Analysis gas loop flow sensor link error	"ERR" text in RED
FT_1101_01_AHH	Analysis gas loop flow reaches high level 2 Alarm	RED
FT_1101_01_AH	Analysis gas loop flow reaches high level 1 Alarm	YELLOW
FT_1101_01_ALL	Analysis gas loop flow reaches low level 2 Alarm	RED
FT_1101_01_AL	Analysis gas loop flow reaches low level 1 Alarm	YELLOW
AT_1101_01_CH4_ERR	Analysis gas loop, CH4 sensor link error	"ERR" text in RED
AT_1101_01_CH4_AHH	Analysis gas loop, CH4 reaches high level 2 Alarm	RED
AT_1101_01_CH4_AH	Analysis gas loop, CH4 reaches high level 1 Alarm	YELLOW
AT_1101_01_CH4_ALL	Analysis gas loop, CH4 reaches low level 2 Alarm	RED
AT_1101_01_CH4_AL	Analysis gas loop, CH4 reaches low level 1 Alarm	YELLOW
AT_1101_01_CO2_ERR	Analysis gas loop CO2 sensor link error	"ERR" text in RED
AT_1101_01_CO2_AHH	Analysis gas loop CO2 reaches high level 2 Alarm	RED
AT_1101_01_CO2_AH	Analysis gas loop CO2 reaches high level 1 Alarm	YELLOW
AT_1101_01_CO2_ALL	Analysis gas loop CO2 reaches low level 2 Alarm	RED
AT_1101_01_CO2_AL	Analysis gas loop CO2 reaches low level 1 Alarm	YELLOW
PT_1101_01_ERR	Pressure after gas analyzer sensor link error	"ERR" text in RED
PT_1101_01_AHH	Pressure after gas analyzer reaches high level 2 Alarm	RED
PT_1101_01_AH	Pressure after gas analyzer reaches high level 1 Alarm	YELLOW
PT_1101_01_ALL	Pressure after gas analyzer reaches low level 2 Alarm	RED
PT_1101_01_AL	Pressure after gas analyzer reaches low level 1 Alarm	YELLOW
LSH_1102_01_A	Active Gas Loop Buffer tank high level switch Alarm	RED
SV_1102_01_A	Active Gas Loop Condensate valve in wrong position	RED and "ERR" text in RED
FT_1103_01_ERR	N2 flow sensor link error	"ERR" text in RED
FT_1103_01_AHH	N2 flow reaches high level 2 Alarm	RED
FT_1103_01_AH	N2 flow reaches high level 1 Alarm	YELLOW
FT_1103_01_ALL	N2 flow reaches low level 2 Alarm	RED
FT_1103_01_AL	N2 flow reaches low level 1 Alarm	YELLOW
S3V_1103_01_A	Analysis Gas Loop valve in wrong position	RED and "ERR" text in RED
SCV_1103_01_ERR	N2 inlet proportional valve Error	RED and "ERR" text in RED
TT_1104_01_ERR	Passive gas loop buffer tank temperature sensor link error	"ERR" text in RED
TT_1104_01_AHH	Passive gas loop buffer tank temperature reaches high level 2 Alarm	RED
TT_1104_01_AH	Passive gas loop buffer tank temperature reaches high level 1 Alarm	YELLOW
TT_1104_01_ALL	Passive gas loop buffer tank temperature reaches low level 2 Alarm	RED
TT_1104_01_AL	Passive gas loop buffer tank temperature reaches low level 1 Alarm	YELLOW

Table 6-7: Alarm tags of the Gas Loop screen

6.5.3 Tags

The following tags are displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	Units	Range
SV_1009_01_MV	Release gas from Bioreactor	2-way valve animated	--	--
PT_1009_01	Pressure in gas phase in bioreactor	Analogue indicator	(mBar)	-200 to 200
PT_1100_01	Pressure in active gas loop buffer tank	Analogue indicator	(mBar)	0 to 10000
PT_1100_02	Pressure in passive gas loop buffer tank	Analogue indicator	(mBar)	0 to 200
SCV_1100_01_MV	Proportional valve (active gas loop)	Analogue indicator	(%)	0 to 100
SCV_1100_01_OP	Proportional valve (Active gas loop) in manual mode	User input	(%)	0 to 100
GCP_1100_01_MV	Gas compressor (Active gas loop)	Pump animated	--	--
GCP_1100_01_OP	Gas compressor in manual mode	Button	--	--
S3V_1100_01_FB	Active gas loop valve	3-way valve animated	--	--
S3V_1100_01_OP	Active gas loop valve in manual mode	Button	--	--
S3V_1100_02_FB	Active gas loop valve	3-way valve animated	--	--
S3V_1100_02_OP	Active gas loop valve in manual mode	Button	--	--
SV_1100_01_FB	Active gas loop valve	2-way valve animated	--	--
SV_1100_01_OP	Active gas loop valve in manual mode	Button	--	--
SV_1100_02_FB	Passive gas loop valve	2-way valve animated	--	--
SV_1100_02_OP	Passive gas loop valve in manual mode	Button	--	--
SV_1100_03_FB	Passive gas loop valve	2-way valve animated	--	--
SV_1100_03_OP	Passive gas loop valve in manual mode	Button	--	--
SV_1100_05_FB	Active gas loop valve	2-way valve animated	--	--
SV_1100_05_OP	Active gas loop valve in manual mode	Button	--	--
FT_1101_01	Gas input flow in gas analysers	Analogue indicator	(L/h)	0 to 58
AT_1101_01_CH4	CH4 Analyser	Analogue indicator	(%)	0 to 100
AT_1101_01_CO2	CO2 Analyser	Analogue indicator	(%)	0 to 100
PT_1101_01_AV	Gas pressure after gas analyser	Analogue indicator	(mBar)	0 to 400
PP_1101_01_MV	Analysis gas loop pump	Pump animated	--	--
PP_1101_01_OP	Start/Stop pump in manual mode	Button	--	--
S3V_1101_01_FB	Analysis gas loop valve	3-way valve animated	--	--
S3V_1101_01_OP	Analysis gas loop valve in manual mode	Button	--	--
SV_1101_01_OP	Second gas analysis valve in manual mode	Button	--	--
CL1101_TB_Ana	Analysis gas loop indicator	Digital indicator	--	--
CL1101_TB_Ana_Cal	Analyzer calibration indicator	Digital indicator	--	--
CL1101_SCI_ANA_CAL_START	Start calibration analyzers	Button	--	--
CL1101_SCI_END_CALIBRATION_GAS	Stop calibration analyzers	Button	--	--
SV_1102_01_FB	Active Gas Loop condensate valve	2-way valve animated	--	--
SV_1102_01_OP	Active Gas Loop condensate valve in manual mode	Button	--	--
LSH_1102_01	High level switch Active Gas Loop buffer tank	Digital indicator	--	--
FT_1103_01	N2 flow into bioreactor	Analogue indicator	(L/h)	0 to 2
SCV_1103_01_MV	Proportional valve, N2 input into bioreactor.	Analogue indicator	(%)	0 to 100
SCV_1103_01_OP	Proportional valve, N2 input into bioreactor in manual mode	User input	(%)	0 to 100
S3V_1103_01_FB	Analysis gas loop valve	3-way valve animated	--	--
S3V_1103_01_OP	Analysis gas loop valve in manual mode	Button	--	--
CL1103_Total_N2_Flow	Total N2 flow (Litre) since last reset executed	Analogue indicator	(L)	TBD
CL1103_N2_Flow_L_Per_Day	Inlet N2 flow to bioreactor	Analogue indicator	(L/day)	TBD

Tag Name	Description	Type	Units	Range
TT_1104_01	Temperature in passive gas loop buffer tank	Analogue indicator	(ºC)	0 to 100
CL1104_Start_Biogasflow_calcul	Start biogas flow calculus	User input	--	--
CL1104_Total_biogas_l_per_day	Total biogas L/day	Analogue indicator	(L/day)	TBD
CL1104_Gas_Second	Second of the time of the last gas timer reset executed.	Analogue indicator	(sec)	0 to 59
CL1104_Gas_Minute	Minute of the time of the last gas timer reset executed.	Analogue indicator	(min)	0 to 59
CL1104_Gas_Hour	Hour of the time of the last gas timer reset executed.	Analogue indicator	(hour)	0 to 23
CL1104_Gas_Day	Day of the date of the last gas timer reset executed.	Analogue indicator	(day)	1 to 31
CL1104_Gas_Month	Month of the date of the last gas timer reset executed.	Analogue indicator	(month)	1 to 12
CL1104_Gas_Year	Year of the date of the last gas timer reset executed	Analogue indicator	(year)	1 to 99
CL1104_Gas_Reset_Timer	Reset of the gas timer	Command button	--	--
CL1104_Total_CO2_mol	Total CO2 from last reset executed.	Analogue indicator	(mg)	TBD
CL1104_Total_CH4_mol	Total CH4 from last reset executed	Analogue indicator	(mg)	TBD
CL1104_total_N2_mol	Total N2 from last reset executed	Analogue indicator	(mg)	TBD
CL1104_Total_mole_escape	Total mole escapes from last reset executed.	Analogue indicator	(mole)	TBD

Table 6-8: Tags of the Gas Loop screen

6.5.4 Control loops

The following control loops are implemented on the screen:

Control Logic	Description
CL1100	Active Gas Loop Mode
CL1101	Gas Loop Analyzer mode
CL1102	Gas Loop Condensate Flow Mode
CL1103	Passive Gas Loop Mode

Table 6-9: Control loops of the Gas Loop system

6.6 Filtration Unit screen (Membrane 1)

The Filtration Unit is implemented in two screens, one for each membrane. When pressing CI-Filtration Unit command button from the navigation bar, the Filtration Unit screen opened corresponds to the membrane 1 and from this screen the user can navigate to the filtration unit membrane 2 screen by pressing the Membrane 2 button.

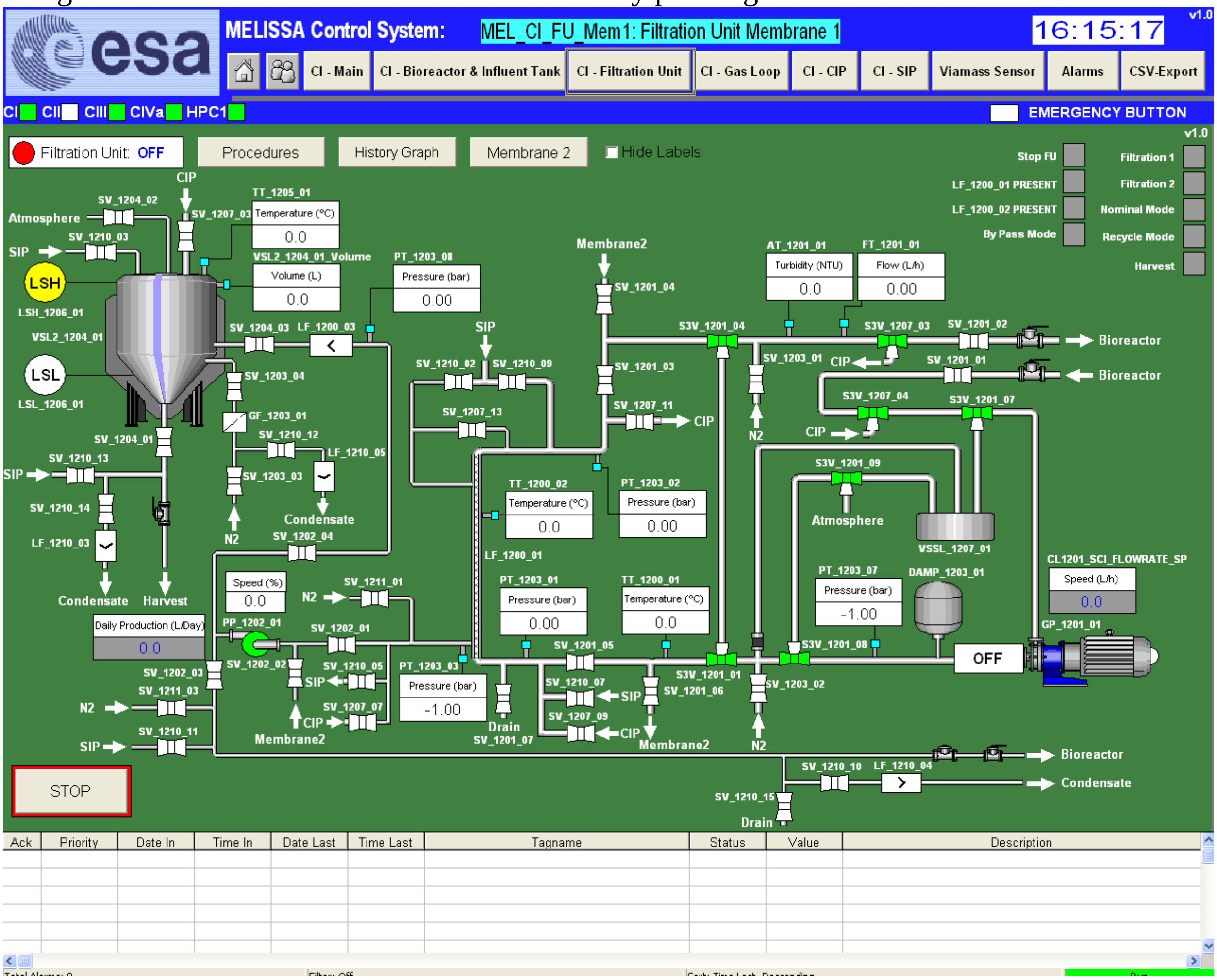


Figure 6-14: Main objects of the Membrane 1 Filtration Unit screen

6.6.1 General actions:

This display allows the user to:

- 2-way valves, 3-way valves, level switches, pumps animations.
- Analogue indicators.
- Devices alarm animations.
- Membrane background colour switch to green when ceramic membrane is present in its module.
- Modify the GP_1201_01 flow rate (L/h) and the daily production (L/day).
- Display the history graph clicking on the History graph command button.

- Display the filtration unit membrane 2 screen clicking “Membrane2” command button.
- Hide labels selecting the “Hide labels” check box.
- Display the Filtration unit procedures indicators, placed on right upper corner screen.
- Display the Filtration Unit Maintenance screens. Screens from filtration unit frame will be developed on specifics screens to maintenance. For Filtration Unit screens will be created three new screens for maintenance (one for each separate area), one for filtrate side and effluent vessel and one more for each membrane. The user will be able access to maintenance screen clicking over the area desired to maintenance.
- Selecting “Procedures” command button, the following window will be displayed and the user will be able activate one of the filtration unit procedure only if Filtration Unit mode is in AUTO mode.

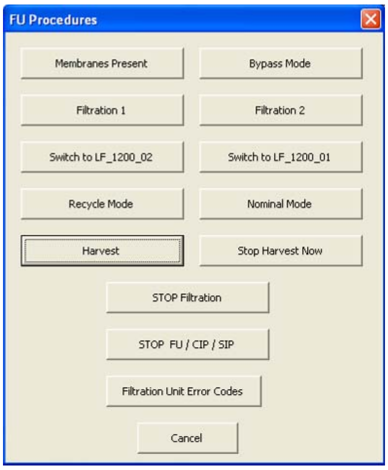


Figure 6-15: Filtration Unit procedures

- Error Codes command button allows to open a window showing the error code of the each gas loop procedure. Operator will be able identify error code of the step inside the procedure that has been wrong executed. For error code description, please refer to [R6].

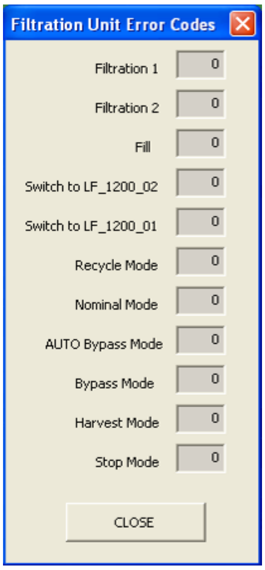


Figure 6-16: Error Codes of the Filtration Unit Procedures

Tag Name	Description	Address
CL1200_F_Cir1_Error	Error Code of the Membrane 1 filtration procedure	400253
CL1200_F_Cir2_Error	Error Code of the Membrane 2 filtration procedure	400255
CL1200_F_Fil_Error	Error Code of the filling procedure	400257
CL1200_F_S12_Error	Error Code of the change filtration from Membrane 1 to Membrane 2 procedure	400263
CL1200_F_S21_Error	Error Code of the change filtration from Membrane 2 to Membrane 1 procedure	400261
CL1200_F_Rec_Error	Error Code of the recycler procedure	400265
CL1200_F_Nom_Error	Error code of the filtration in nominal mode procedure	400259
CL1201_F_Auto_Bypass_Error	Error code of the Auto bypass procedure	400271
CL1201_F_Bypass_Error	Error code of the Bypass procedure	400269
CL1204_F_Harvest_Error	Error Code of the Harvest procedure	400271
CL1200_F_Stop_Error	Error Code of the Stop Filtration procedure	400251

Table 6-10: Error Codes description of the Filtration Unit

6.6.2 Alarms

The following alarms are linked with the operation of the Membrane 1 Filtration Unit screen.

TAG NAME	Description	Colour

TAG NAME	Description	Colour
TT_1200_01_ERR	Inlet retentate line temperature sensor link error	“ERR” text in RED
TT_1200_01_AHH	Inlet retentate line temperature reaches high level 2 Alarm	RED
TT_1200_01_AH	Inlet retentate line temperature reaches high level 1 Alarm	YELLOW
TT_1200_01_ALL	Inlet retentate line temperature reaches low level 2 Alarm	RED
TT_1200_01_AL	Inlet retentate line temperature reaches low level 1 Alarm	YELLOW
TT_1200_02_ERR	Membrane 1 temperature sensor link error	“ERR” text in RED
TT_1200_02_AHH	Membrane 1 temperature reaches high level 2 sensor	RED
TT_1200_02_AH	Membrane 1 temperature reaches high level 1 sensor	YELLOW
TT_1200_02_ALL	Membrane 1 temperature reaches low level 2 sensor	RED
TT_1200_02_AL	Membrane 1 temperature reaches low level 1 sensor	YELLOW
AT_1201_01_ERR	Turbidity in outlet retentate side sensor link error	“ERR” text in RED
AT_1201_01_AHH	Turbidity in outlet retentate side reaches high level 2 Alarm	RED
AT_1201_01_AH	Turbidity in outlet retentate side reaches high level 1 Alarm	YELLOW
AT_1201_01_ALL	Turbidity in outlet retentate side reaches low level 2 Alarm	RED
AT_1201_01_AL	Turbidity in outlet retentate side reaches low level 1 Alarm	YELLOW
FT_1201_01_ERR	Outlet retentate flow sensor link error	“ERR” text in RED
FT_1201_01_AHH	Outlet retentate flow reaches high level 2 Alarm	RED
FT_1201_01_AH	Outlet retentate flow reaches high level 1 Alarm	YELLOW
FT_1201_01_ALL	Outlet retentate flow reaches low level 2 Alarm	RED
FT_1201_01_AL	Outlet retentate flow reaches low level 1 Alarm	YELLOW
GP_1201_01_Freqdrive_A	Gear pump frequency drive Alarm	Pump in red and “ERR” text
GP_1201_01_Powersupply_A	Gear pump power supply Alarm	Pump in red and “ERR” text
GP_1201_01_FLOW_A	Flow of retentate line is below 50 L/H. GP_1201_01 might run drive. --> The Pump is stopped	Pump in red and “ERR” text
S3V_1201_01_A	Bypass valve in wrong position	RED and “ERR” text in RED
S3V_1201_04_A	Bypass valve in wrong position	RED and “ERR” text in RED
S3V_1201_07_A	Valve allows flow from VSSL_1207_01 tank to retentate line in wrong position	RED and “ERR” text in RED
S3V_1201_08_A	Retentate line drain valve in wrong position	RED and “ERR” text in RED
S3V_1201_09_A	Retentate line drain valve in wrong position	RED and “ERR” text in RED
SV_1201_01_A	Valve allows flow from bioreactor to filtration unit in wrong position	RED and “ERR” text in RED
SV_1201_02_A	Valve allows flow from filtration unit to bioreactor in wrong position	RED and “ERR” text in RED
SV_1201_03_A	Outlet retentate side Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1201_04_A	Outlet retentate side Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1201_05_A	Inlet retentate Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1201_06_A	Inlet retentate Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1201_07_A	Drain Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1202_01_A	Filtrate side Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1202_02_A	Filtrate side Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1202_03_A	Recirculation valve in wrong position	RED and “ERR” text in RED
SV_1202_04_A	Filtrate flow valve in wrong position	RED and “ERR” text in RED
PT_1203_01_ERR	Inlet retentate side Membrane 1 pressure sensor link error	“ERR” text in RED
PT_1203_01_AHH	Inlet retentate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_01_AH	Inlet retentate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_01_ALL	Inlet retentate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_01_AL	Inlet retentate side Membrane 1 pressure reaches low level 1	YELLOW

TAG NAME	Description	Colour
	Alarm	
PT_1203_02_ERR	Outlet retentate side Membrane 1 pressure sensor link error	"ERR" text in RED
PT_1203_02_AHH	Outlet retentate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_02_AH	Outlet retentate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_02_ALL	Outlet retentate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_02_AL	Outlet retentate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_03_ERR	Filtrate side Membrane 1 pressure sensor link error	"ERR" text in RED
PT_1203_03_AHH	Filtrate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_03_AH	Filtrate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_03_ALL	Filtrate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_03_AL	Filtrate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_07_ERR	Pressure after circulation pump sensor link error	"ERR" text in RED
PT_1203_07_AHH	Pressure after circulation pump reaches high level 2 Alarm	RED
PT_1203_07_AH	Pressure after circulation pump reaches high level 1 Alarm	YELLOW
PT_1203_07_ALL	Pressure after circulation pump reaches low level 2 Alarm	RED
PT_1203_07_AL	Pressure after circulation pump reaches low level 1 Alarm	YELLOW
PT_1203_08_ERR	After filtrate pump pressure sensor link error	"ERR" text in RED
PT_1203_08_AHH	Pressure after filtrate pump reaches high level 2 Alarm	RED
PT_1203_08_AH	Pressure after filtrate pump reaches high level 1 Alarm	YELLOW
PT_1203_08_ALL	Pressure after filtrate pump reaches low level 2 Alarm	RED
PT_1203_08_AL	Pressure after filtrate pump reaches low level 1 Alarm	YELLOW
SV_1203_01_A	N2 input valve to the retentate line in wrong position	RED and "ERR" text in RED
SV_1203_02_A	N2 input valve to the retentate line in wrong position	RED and "ERR" text in RED
SV_1203_03_A	N2 input valve to harvesting tank in wrong position	RED and "ERR" text in RED
SV_1203_04_A	N2 input valve to harvesting tank in wrong position	RED and "ERR" text in RED
SV_1204_01_A	Drain valve of the harvesting tank in wrong position	RED and "ERR" text in RED
SV_1204_02_A	Air inlet valve of the harvesting tank in wrong position	RED and "ERR" text in RED
SV_1204_03_A	Filtrate flow valve in wrong position	RED and "ERR" text in RED
TT_1205_01_ERR	Harvesting tank temperature sensor link error	"ERR" text in RED
TT_1205_01_AHH	Harvesting tank temperature reaches high level 2 Alarm	RED
TT_1205_01_AH	Harvesting tank temperature reaches high level 1 Alarm	YELLOW
TT_1205_01_ALL	Harvesting tank temperature reaches low level 2 Alarm	RED
TT_1205_01_AL	Harvesting tank temperature reaches low level 1 Alarm	YELLOW
LT_1206_01_ERR	Harvesting tank level sensor link error	"ERR" text in RED
LT_1206_01_AHH	Harvesting tank level reaches high level 2 Alarm	RED
LT_1206_01_AH	Harvesting tank level reaches high level 1 Alarm	YELLOW
LT_1206_01_ALL	Harvesting tank level reaches low level 2 Alarm	RED
LT_1206_01_AL	Harvesting tank level reaches low level 1 Alarm	YELLOW
LSL_1206_01_A	Harvesting tank low level switch Alarm	RED
LSH_1206_01_A	Harvesting tank high level switch Alarm	RED
S3V_1207_03_A	Retentate line cleaning valve in wrong position	RED and "ERR" text in RED
S3V_1207_04_A	Retentate line cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_03_A	Cleaning agent input valve of the harvest tank in wrong position	RED and "ERR" text in RED
SV_1207_07_A	Cleaning input valve to the filtrate side in wrong position.	RED and "ERR" text in RED
SV_1207_09_A	Cleaning input valve to Membrane 1 retentate side in wrong position	RED and "ERR" text in RED
SV_1207_11_A	Membrane 1 retentate side cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_13_A	Bypass valve between outlet retentate side and filtrate side in wrong position	RED and "ERR" text in RED
SV_1210_02_A	Steam input valve in Membrane 1 filtrate side in wrong position	RED and "ERR" text in RED

TAG NAME	Description	Colour
SV_1210_03_A	Steam input valve of the harvest tank in wrong position	RED and "ERR" text in RED
SV_1210_05_A	Steam input valve to the filtrate side in wrong position	RED and "ERR" text in RED
SV_1210_07_A	Steam input valve to Membrane 1 retentate side in wrong position	RED and "ERR" text in RED
SV_1210_09_A	Steam input valve in Membrane 1 outlet retentate side in wrong position	RED and "ERR" text in RED
SV_1210_11_A	Steam input valve of the recycling line in wrong position	RED and "ERR" text in RED
SV_1210_13_A	Steam input valve of the harvesting line in wrong position	RED and "ERR" text in RED
SV_1210_14_A	Steam outlet valve of the harvesting line in wrong position	RED and "ERR" text in RED
SV_1210_15_A	Drain valve of the recycling line in wrong position	RED and "ERR" text in RED
SV_1211_01_A	N2 input valve to the filtrate side in wrong position	RED and "ERR" text in RED
SV_1211_03_A	N2 input valve to recycling line in wrong position	RED and "ERR" text in RED

Table 6-11: Alarm tags of the Membrane 1 Filtration Unit screen

6.6.3 Tags

The following tags are displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	Units	Range
TT_1200_01	Temperature in retentate line	Analogue indicator	(ºC)	0 to 100
TT_1200_02_AV	Temperature in Membrane 1	Analogue indicator	(ºC)	0 to 400
CL1200_SCI_MEMBR1_PRESENT	Membrane 1 presence in its housing	Filter animated	--	--
CL1200_SCI_MEMBR2_PRESENT	Membrane 2 presence in its housing	Filter animated	--	--
CL1200_SCI_CIR1	Activate circulation mode over Membrane1	Button	--	--
CL1200_SCI_CIR2	Activate circulation mode over Membrane2	Button	--	--
CL1200_SCI_S12	Switch filtration from Membrane 1 to Membrane 2.	Button	--	--
CL1200_SCI_S21	Switch filtration from Membrane 2 to Membrane 1.	Button	--	--
CL1200_SCI_RECYCLE_MODE	Activate filtration in recycle mode	Button	--	--
CL1200_SCI_NOM	Activate filtration in nominal mode	Button	--	--
CL1200_SCI_STOP	Stop filtration	Button	--	--
CL1200_SCI_STOP_FCS	Stop all activities in filtration unit	Button	--	--
CL1200_TB_STOP	Filtration Unit, stop mode indicator	Digital indicator	--	--
CL1200_TB_CIR1	Filtration Unit, circulation 1 mode indicator	Digital indicator	--	--
CL1200_TB_CIR2	Filtration Unit, circulation 2 mode indicator	Digital indicator	--	--
CL1200_TB_NOM	Filtration Unit, nominal mode indicator	Digital indicator	--	--
CL1200_TB_REC	Filtration Unit, recycling mode indicator	Digital indicator	--	--
AT_1201_01	Turbidity in retentate side	Analogue indicator	(NTU)	0 to 100
FT_1201_01_IN_L_PER_H_FILTERED	Flow in retentate side	Analogue indicator	(L/h)	0 to 580
CL1201_SCI_FLOWRATE_SP	Retentate pump flowrate Set Point	User Input	(L/h)	0 to 450
CL1201_SCI_BYPASS	Filtration in bypass mode	Button	--	--
CL1201_TB_BYPASS	Filtration Unit, bypass mode indicator	Digital indicator	--	--
GP_1201_01_MV1	Retentate pump	Pump	--	--

Tag Name	Description	Type	Units	Range
		animated		
S3V_1201_01_FB	Filtration Unit bypass valve	3-way valve animated	--	--
S3V_1201_04_FB	Filtration Unit bypass valve	3-way valve animated	--	--
S3V_1201_07_FB	Valve allows flow from VSSL_1207_01 tank to retentate line.	3-way valve animated	--	--
S3V_1201_08_FB	Retentate line drain valve	3-way valve animated	--	--
S3V_1201_09_FB	Retentate line drain valve	3-way valve animated	--	--
SV_1201_01_FB	Valve allows flow from bioreactor to filtration unit	2-way valve animated	--	--
SV_1201_02_FB	Valve allows flow from filtration unit to bioreactor	2-way valve animated	--	--
SV_1201_03_FB	Membrane 1 outlet retentate side valve	2-way valve animated	--	--
SV_1201_04_FB	Outlet retentate side Membrane 2 side	2-way valve animation	--	--
SV_1201_05_FB	Inlet valve retentate line Membrane 1	2-way valve animation	--	--
SV_1201_06_FB	Inlet retentate side Membrane 2 valve	2-way valve animated	--	--
SV_1201_07_FB	Drain Membrane 1 valve	2-way valve animated	--	--
CL1202_SCI_FILTR_FLOWRATE	Desired daily production	SP User Input	(L/day)	0 to 100
PP_1202_01_MV1	Filtrate pump	Pump animated	--	--
PP_1202_01_MV2	Speed of filtrate pump	Analogue indicator	(%)	0 to 100
SV_1202_01_FB	Membrane 1 filtrate side valve	2-way valve animated	--	--
SV_1202_02_FB	Filtrate side Membrane 2 valve	2-way valve animated	--	--
SV_1202_03_FB	Recycle line valve	2-way valve animated	--	--
SV_1202_04_FB	Filtrate flow to vessel valve (before filter)	2-way valve animated	--	--
PT_1203_01	Pressure in Membrane 1 retentate side	Analogue indicator	(bar)	0 to 4
PT_1203_02	Pressure in outlet retentate side membrane 1	Analogue indicator	(bar)	0 to 4
PT_1203_03	Pressure in Membrane 1 filtrate side	Analogue indicator	(bar)	-1 to 4
PT_1203_07	Pressure of retentate after GP_1201_01 pump	Analogue indicator	(bar)	-1 to 9
PT_1203_08	Pressure after filtrate pump	Analogue indicator	(bar)	0 to 4
SV_1203_01_FB	N2 input valve of the retentate line	2-way valve animated	--	--
SV_1203_02_FB	N2 input valve to the retentate line	2-way valve animated	--	--
SV_1203_03_FB	N2 input valve to harvesting tank	2-way valve animated	--	--
SV_1203_04_FB	N2 input valve to harvesting tank	2-way valve animated	--	--
CL1204_SCI_HARVEST	Activate harvesting mode	Button	--	--
CL1204_STOPHARVESTNOW	Stop immediately harvesting	Button	--	--
CL1204_TB_HARVEST	Filtration Unit, harvesting mode indicator	Digital indicator	--	--
SV_1204_01_FB	Harvesting line valve	2-way valve animated	--	--
SV_1204_02_FB	Air inlet valve (harvesting tank)	2-way valve animated	--	--
SV_1204_03_FB	Filtrate flow to vessel valve (after filter)	2-way valve animated	--	--
TT_1205_01	Harvesting tank temperature	Analogue indicator	(ºC)	0 to 100

Tag Name	Description	Type	Units	Range
VSL2_1204_01_Volume	Harvesting tank level	Analogue indicator	(L)	0 to 100
LSL_1206_01	Low level switch harvesting tank	Digital indicator	--	--
LSH_1206_01	High level switch harvesting tank	Digital indicator	--	--
S3V_1207_03_FB	Retentate line cleaning valve	3-way valve animated	--	--
S3V_1207_04_FB	Retentate line cleaning valve	3-way valve animated	--	--
SV_1207_03_FB	Cleaning agent input valve of the harvest tank	2-way valve animated	--	--
SV_1207_07_FB	Cleaning input valve to the filtrate side	2-way valve animated	--	--
SV_1207_09_FB	Cleaning input valve to Membrane 1 retentate side	2-way valve animated	--	--
SV_1207_11_FB	Membrane 1 retentate side cleaning valve	2-way valve animated	--	--
SV_1207_13_FB	Bypass valve between outlet retentate side and filtrate side	2-way valve animated	--	--
SV_1210_02_FB	Steam input valve in Membrane 1 filtrate side	2-way valve animated	--	--
SV_1210_03_FB	Steam input valve of the harvest tank	2-way valve animated	--	--
SV_1210_05_FB	Steam input valve to the filtrate side	2-way valve animated	--	--
SV_1210_07_FB	Steam input valve to Membrane 1 retentate side	2-way valve animated	--	--
SV_1210_09_FB	Steam input valve in Membrane 1 outlet retentate side	2-way valve animated	--	--
SV_1210_10_MV	Steam outlet valve of the recycling line	2-way valve animated	--	--
SV_1210_11_FB	Steam input valve of the recycling line	2-way valve animated	--	--
SV_1210_12_MV	N2 outlet valve to harvesting tank	2-way valve animated	--	--
SV_1210_13_FB	Steam input valve of the harvesting line	2-way valve animated	--	--
SV_1210_14_FB	Steam outlet valve of the harvesting line	2-way valve animated	--	--
SV_1210_15_FB	Drain valve of the recycling line	2-way valve animated	--	--
SV_1211_01_FB	N2 input valve to the filtrate side	2-way valve animated	--	--
SV_1211_03_FB	N2 input valve to recycling line	2-way valve animated	--	--

Table 6-12: Tags of the Membrane 1Filtration Unit screen

6.6.4 Control loops

The following control loops will be implemented on the screen:

Control Logic	Description
CL1200	Filtration Unit mode

Table 6-13: Control loops of the Filtration Unit system

6.7 Filtration unit screen (Membrane 2)

Filtration unit membrane 2 screen is opened from the filtration unit membrane 1 screen command button, from this screen also is possible coming back to the filtration unit membrane 1 screen. This screen has the same functionalities than membrane 1.

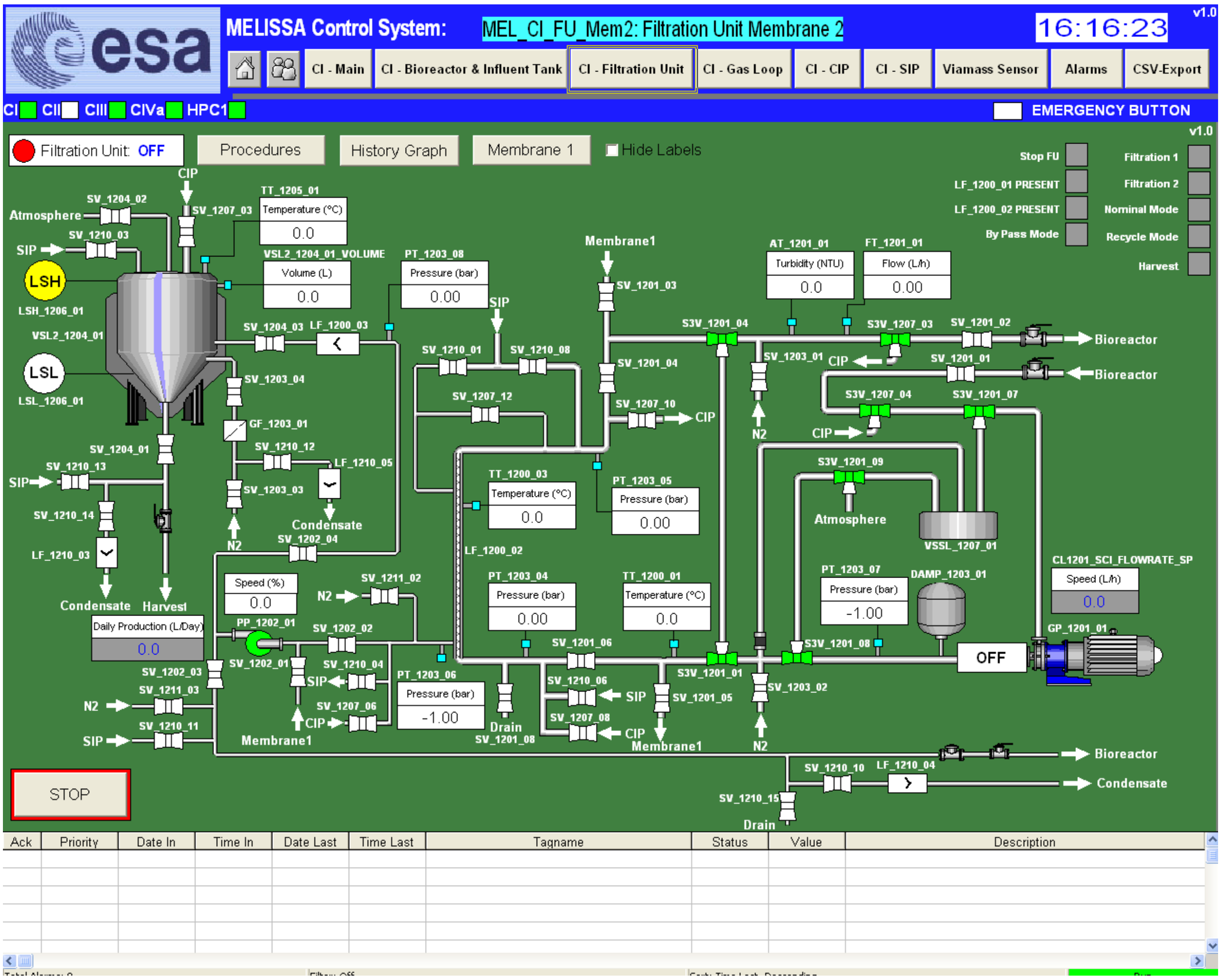


Figure 6-17: Main objects in Membrane 2 Filtration Unit screen

6.7.1 Alarms

The following alarms are linked with the operation of the Membrane 2 Filtration Unit screen.

TAG NAME	Description	Colour
TT_1200_01_ERR	Inlet retentate line temperature sensor link error	“ERR” text in RED
TT_1200_01_AHH	Inlet retentate line temperature reaches high level 2 Alarm	RED
TT_1200_01_AH	Inlet retentate line temperature reaches high level 1 Alarm	YELLOW
TT_1200_01_ALL	Inlet retentate line temperature reaches low level 2 Alarm	RED
TT_1200_01_AL	Inlet retentate line temperature reaches low level 1 Alarm	YELLOW
TT_1200_03_ERR	Membrane 2 temperature sensor link error	“ERR” text in RED
TT_1200_03_AHH	Membrane 2 temperature reaches high level 2 sensor	RED
TT_1200_03_AH	Membrane 2 temperature reaches high level 1 sensor	YELLOW
TT_1200_03_ALL	Membrane 2 temperature reaches low level 2 sensor	RED
TT_1200_03_AL	Membrane 2 temperature reaches low level 1 sensor	YELLOW
AT_1201_01_ERR	Turbidity in outlet retentate side sensor link error	“ERR” text in RED
AT_1201_01_AHH	Turbidity in outlet retentate side reaches high level 2 Alarm	RED

TAG NAME	Description	Colour
AT_1201_01_AH	Turbidity in outlet retentate side reaches high level 1 Alarm	YELLOW
AT_1201_01_ALL	Turbidity in outlet retentate side reaches low level 2 Alarm	RED
AT_1201_01_AL	Turbidity in outlet retentate side reaches low level 1 Alarm	YELLOW
FT_1201_01_ERR	Outlet retentate flow sensor link error	"ERR" text in RED
FT_1201_01_AHH	Outlet retentate flow reaches high level 2 Alarm	RED
FT_1201_01_AH	Outlet retentate flow reaches high level 1 Alarm	YELLOW
FT_1201_01_ALL	Outlet retentate flow reaches low level 2 Alarm	RED
FT_1201_01_AL	Outlet retentate flow reaches low level 1 Alarm	YELLOW
GP_1201_01_Freqdrive_A	Gear pump frequency drive Alarm	Pump in red and "ERR" text
GP_1201_01_Powersupply_A	Gear pump power supply Alarm	Pump in red and "ERR" text
GP_1201_01_FLOW_A	Flow of retentate line is below 50 L/H. GP_1201_01 might run drive. --> The Pump is stopped	Pump in red and "ERR" text
S3V_1201_01_A	Bypass valve in wrong position	RED and "ERR" text in RED
S3V_1201_04_A	Bypass valve in wrong position	RED and "ERR" text in RED
S3V_1201_07_A	Valve allows flow from VSSL_1207_01 tank to retentate line in wrong position	RED and "ERR" text in RED
S3V_1201_08_A	Retentate line drain valve in wrong position	RED and "ERR" text in RED
S3V_1201_09_A	Retentate line drain valve in wrong position	RED and "ERR" text in RED
SV_1201_01_A	Valve allows flow from bioreactor to filtration unit in wrong position	RED and "ERR" text in RED
SV_1201_02_A	Valve allows flow from filtration unit to bioreactor in wrong position	RED and "ERR" text in RED
SV_1201_03_A	Outlet retentate side Membrane 1 valve in wrong position	RED and "ERR" text in RED
SV_1201_04_A	Outlet retentate side Membrane 2 valve in wrong position	RED and "ERR" text in RED
SV_1201_05_A	Inlet retentate Membrane 1 valve in wrong position	RED and "ERR" text in RED
SV_1201_06_A	Inlet retentate Membrane 2 valve in wrong position	RED and "ERR" text in RED
SV_1201_08_A	Drain Membrane 2 valve in wrong position	RED and "ERR" text in RED
SV_1202_01_A	Filtrate side Membrane 1 valve in wrong position	RED and "ERR" text in RED
SV_1202_02_A	Filtrate side Membrane 2 valve in wrong position	RED and "ERR" text in RED
SV_1202_03_A	Recirculation valve in wrong position	RED and "ERR" text in RED
SV_1202_04_A	Filtrate flow valve in wrong position	RED and "ERR" text in RED
PT_1203_04_ERR	Inlet retentate side Membrane 2 pressure sensor link error	"ERR" text in RED
PT_1203_04_AHH	Inlet retentate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_04_AH	Inlet retentate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_04_ALL	Inlet retentate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_04_AL	Inlet retentate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_05_ERR	Outlet retentate side Membrane 2 pressure sensor link error	"ERR" text in RED
PT_1203_05_AHH	Outlet retentate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_05_AH	Outlet retentate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_05_ALL	Outlet retentate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_05_AL	Outlet retentate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_06_ERR	Filtrate side Membrane 2 pressure sensor link error	"ERR" text in RED
PT_1203_06_AHH	Filtrate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_06_AH	Filtrate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_06_ALL	Filtrate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_06_AL	Filtrate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_07_ERR	Pressure after circulation pump sensor link error	"ERR" text in RED
PT_1203_07_AHH	Pressure after circulation pump reaches high level 2 Alarm	RED
PT_1203_07_AH	Pressure after circulation pump reaches high level 1 Alarm	YELLOW
PT_1203_07_ALL	Pressure after circulation pump reaches low level 2 Alarm	RED
PT_1203_07_AL	Pressure after circulation pump reaches low level 1 Alarm	YELLOW
PT_1203_08_ERR	After filtrate pump pressure sensor link error	"ERR" text in RED
PT_1203_08_AHH	Pressure after filtrate pump reaches high level 2 Alarm	RED
PT_1203_08_AH	Pressure after filtrate pump reaches high level 1 Alarm	YELLOW
PT_1203_08_ALL	Pressure after filtrate pump reaches low level 2 Alarm	RED

TAG NAME	Description	Colour
PT_1203_08_AL	Pressure after filtrate pump reaches low level 1 Alarm	YELLOW
SV_1203_01_A	N2 input valve of the retentate line in wrong position	RED and “ERR” text in RED
SV_1203_02_A	N2 input valve to the retentate line in wrong position	RED and “ERR” text in RED
SV_1203_03_A	N2 input valve to harvesting tank in wrong position	RED and “ERR” text in RED
SV_1203_04_A	N2 input valve to harvesting tank in wrong position	RED and “ERR” text in RED
SV_1204_01_A	Drain valve of the harvesting tank in wrong position	RED and “ERR” text in RED
SV_1204_02_A	Air inlet valve of the harvesting tank in wrong position	RED and “ERR” text in RED
SV_1204_03_A	Filtrate flow valve in wrong position	RED and “ERR” text in RED
TT_1205_01_ERR	Harvesting tank temperature sensor link error	“ERR” text in RED
TT_1205_01_AHH	Harvesting tank temperature reaches high level 2 Alarm	RED
TT_1205_01_AH	Harvesting tank temperature reaches high level 1 Alarm	YELLOW
TT_1205_01_ALL	Harvesting tank temperature reaches low level 2 Alarm	RED
TT_1205_01_AL	Harvesting tank temperature reaches low level 1 Alarm	YELLOW
LT_1206_01_ERR	Harvesting tank level sensor link error	“ERR” text in RED
LT_1206_01_AHH	Harvesting tank level reaches high level 2 Alarm	RED
LT_1206_01_AH	Harvesting tank level reaches high level 1 Alarm	YELLOW
LT_1206_01_ALL	Harvesting tank level reaches low level 2 Alarm	RED
LT_1206_01_AL	Harvesting tank level reaches low level 1 Alarm	YELLOW
LSL_1206_01_A	Harvesting tank low level switch Alarm	RED
LSH_1206_01_A	Harvesting tank high level switch Alarm	RED
S3V_1207_03_A	Retentate line cleaning valve in wrong position	RED and “ERR” text in RED
S3V_1207_04_A	Retentate line cleaning valve in wrong position	RED and “ERR” text in RED
SV_1207_03_A	Cleaning agent input valve of the harvest tank in wrong position	RED and “ERR” text in RED
SV_1207_06_A	Cleaning input valve to the Membrane 2 filtrate side in wrong position.	RED and “ERR” text in RED
SV_1207_08_A	Cleaning input valve to Membrane 2 retentate side in wrong position	RED and “ERR” text in RED
SV_1207_10_A	Membrane 2 retentate side cleaning valve in wrong position	RED and “ERR” text in RED
SV_1207_12_A	Bypass valve between outlet retentate side and filtrate side Membrane 2 in wrong position	RED and “ERR” text in RED
SV_1210_01_A	Steam input valve in Membrane 2 filtrate side in wrong position	RED and “ERR” text in RED
SV_1210_03_A	Steam input valve of the harvest tank in wrong position	RED and “ERR” text in RED
SV_1210_04_A	Steam input valve to the Membrane 2 filtrate side in wrong position	RED and “ERR” text in RED
SV_1210_06_A	Steam input valve to Membrane 2 retentate side in wrong position	RED and “ERR” text in RED
SV_1210_08_A	Steam input valve in Membrane 2 outlet retentate side in wrong position	RED and “ERR” text in RED
SV_1210_11_A	Steam input valve of the recycling line in wrong position	RED and “ERR” text in RED
SV_1210_13_A	Steam input valve of the harvesting line in wrong position	RED and “ERR” text in RED
SV_1210_14_A	Steam outlet valve of the harvesting line in wrong position	RED and “ERR” text in RED
SV_1210_15_A	Drain valve of the recycling line in wrong position	RED and “ERR” text in RED
SV_1211_02_A	N2 input valve to the Membrane 2 filtrate side in wrong position	RED and “ERR” text in RED
SV_1211_03_A	N2 input valve to recycling line in wrong position	RED and “ERR” text in RED

Table 6-14: Alarm tags of the Membrane 2 Filtration Unit system

6.7.2 Tag name definition

The following tags will be displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	Units	Range
TT_1200_01	Temperature in retentate line	Analogue indicator	(ºC)	0 to 100
TT_1200_03_AV	Temperature in Membrane 2	Analogue indicator	(ºC)	0 to 400
CL1200_SCI_MEMBR1_PRESENT	Membrane 1 presence in its housing	Filter animated	--	--
CL1200_SCI_MEMBR2_PRESENT	Membrane 2 presence in its housing	Filter animated	--	--
CL1201_SCI_BYPASS	Filtration in bypass mode	Button	--	--
CL1200_SCI_CIR1	Activate circulation mode over	Button	--	--

Tag Name	Description	Type	Units	Range
	Membrane1			
CL1200_SCI_CIR2	Activate circulation mode over Membrane2	Button	--	--
CL1200_SCI_S12	Switch filtration from Membrane 1 to Membrane 2.	Button	--	--
CL1200_SCI_S21	Switch filtration from Membrane 2 to Membrane 1.	Button	--	--
CL1200_SCI_RECYCLE_MODE	Activate filtration in recycle mode	Button	--	--
CL1200_SCI_NOM	Activate filtration in nominal mode	Button	--	--
CL1204_SCI_HARVEST	Activate harvesting mode	Button	--	--
CL1204_STOPHARVESTNOW	Stop immediately harvesting	Button	--	--
CL1200_SCI_STOP	Stop filtration	Button	--	--
CL1200_SCI_STOP_FCS	Stop all activities in filtration unit	Button	--	--
CL1200_TB_STOP	Filtration Unit, stop mode indicator	Digital indicator	--	--
CL1201_TB_BYPASS	Filtration Unit, bypass mode indicator	Digital indicator	--	--
CL1200_TB_CIR1	Filtration Unit, circulation 1 mode indicator	Digital indicator	--	--
CL1200_TB_CIR2	Filtration Unit, circulation 2 mode indicator	Digital indicator	--	--
CL1200_TB_NOM	Filtration Unit, nominal mode indicator	Digital indicator	--	--
CL1200_TB_REC	Filtration Unit, recycling mode indicator	Digital indicator	--	--
CL1204_TB_HARVEST	Filtration Unit, harvesting mode indicator	Digital indicator	--	--
AT_1201_01	Turbidity in retentate side	Analogue indicator	(NTU)	0 to 100
FT_1201_01_IN_L_PER_H_FILTERED	Flow in retentate side	Analogue indicator	(L/h)	0 to 580
CL1201_SCI_FLOWRATE_SP	Retentate pump flow rate Set Point	User Input SP	(L/h)	0 to 450
GP_1201_01_MV1	Retentate pump	Pump animated	--	--
S3V_1201_01_FB	Filtration Unit bypass valve	3-way valve animated	--	--
S3V_1201_04_FB	Filtration Unit bypass valve	3-way valve animated	--	--
S3V_1201_07_FB	Valve allows flow from VSSL_1207_01 tank to retentate line.	3-way valve animated	--	--
S3V_1201_08_FB	Retentate line drain valve	3-way valve animated	--	--
S3V_1201_09_FB	Retentate line drain valve	3-way valve animated	--	--
SV_1201_01_FB	Valve allows flow from bioreactor to filtration unit	2-way valve animated	--	--
SV_1201_02_FB	Valve allows flow from filtration unit to bioreactor	2-way valve animated	--	--
SV_1201_03_FB	Membrane 1 outlet retentate side valve	2-way valve animated	--	--
SV_1201_04_FB	Outlet retentate side Membrane 2 side	2-way valve animated	--	--
SV_1201_05_FB	Inlet valve retentate line Membrane 1	2-way valve animated	--	--
SV_1201_06_FB	Inlet retentate side Membrane 2 valve	2-way valve animated	--	--
SV_1201_08_FB	Drain Membrane 2 valve	2-way valve animated	--	--
CL1202_SCI_FILTR_FLOWRATE	Desired daily production	SP User Input	(L/day)	0 to 100
PP_1202_01_MV1	Filtrate pump	Pump animated	--	--
PP_1202_01_MV2	Speed of filtrate pump	Analogue indicator	(%)	0 to 100
SV_1202_01_FB	Membrane 1 filtrate side valve	2-way valve animated	--	--
SV_1202_02_FB	Filtrate side Membrane 2 valve	2-way valve animated	--	--
SV_1202_03_FB	Recycle line valve	2-way valve	--	--

Tag Name	Description	Type	Units	Range
		animated		
SV_1202_04_FB	Filtrate flow to vessel valve (before filter)	2-way valve animated	--	--
PT_1203_04	Pressure in Membrane 2 retentate side	Analogue indicator	(bar)	0 to 4
PT_1203_05	Pressure in outlet retentate side membrane 2	Analogue indicator	(bar)	0 to 4
PT_1203_06	Pressure in Membrane 1 filtrate side	Analogue indicator	(bar)	-1 to 4
PT_1203_07	Pressure of retentate after GP_1201_01 pump	Analogue indicator	(bar)	-1 to 9
PT_1203_08	Pressure after filtrate pump	Analogue indicator	(bar)	0 to 4
SV_1203_01_FB	N2 input valve of the retentate line	2-way valve animated	--	--
SV_1203_02_FB	N2 input valve to the retentate line	2-way valve animated	--	--
SV_1203_03_FB	N2 input valve to harvesting tank	2-way valve animated	--	--
SV_1203_04_FB	N2 input valve to harvesting tank	2-way valve animated	--	--
SV_1204_01_FB	Harvesting line valve	2-way valve animated	--	--
SV_1204_02_FB	Air inlet valve (harvesting tank)	2-way valve animated	--	--
SV_1204_03_FB	Filtrate flow to vessel valve (after filter)	2-way valve animated	--	--
TT_1205_01	Harvesting tank temperature	Analogue indicator	(ºC)	0 to 100
VSL2_1204_01_VOLUME	Harvesting tank level	Analogue indicator	(L)	0 to 100
LSL_1206_01	Low level switch harvesting tank	Digital indicator	--	--
LSH_1206_01	High level switch harvesting tank	Digital indicator	--	--
S3V_1207_03_FB	Retentate line cleaning valve	3-way valve animated	--	--
S3V_1207_04_FB	Retentate line cleaning valve	3-way valve animated	--	--
SV_1207_03_FB	Cleaning agent input valve of the harvest tank	2-way valve animated	--	--
SV_1207_06_FB	Cleaning input valve to the filtrate side of Membrane 2	2-way valve animated	--	--
SV_1207_08_FB	Cleaning input valve to Membrane 2 retentate side	2-way valve animated	--	--
SV_1207_10_FB	Membrane 2 retentate side cleaning valve	2-way valve animated	--	--
SV_1207_12_FB	Bypass valve between outlet retentate side and filtrate side of Membrane2	2-way valve animated	--	--
SV_1210_01_FB	Steam input valve in Membrane 2 filtrate side	2-way valve animated	--	--
SV_1210_03_FB	Steam input valve of the harvest tank	2-way valve animated	--	--
SV_1210_04_FB	Steam input valve to the filtrate side of Membrane 2	2-way valve animated	--	--
SV_1210_06_FB	Steam input valve to Membrane 2 retentate side	2-way valve animated	--	--
SV_1210_08_FB	Steam input valve in Membrane 2 outlet retentate side	2-way valve animated	--	--
SV_1210_10_MV	Steam outlet valve of the recycling line	2-way valve animated	--	--
SV_1210_11_FB	Steam input valve of the recycling line	2-way valve animated	--	--
SV_1210_12_MV	N2 outlet valve to harvesting tank	2-way valve animated	--	--
SV_1210_13_FB	Steam input valve of the harvesting line	2-way valve animated	--	--
SV_1210_14_FB	Steam outlet valve of the harvesting line	2-way valve	--	--

Tag Name	Description	Type	Units	Range
		animated		
SV_1210_15_FB	Drain valve of the recycling line	2-way valve animated	--	--
SV_1211_02_FB	N2 input valve to the filtrate side of Membrane 2	2-way valve animated	--	--
SV_1211_03_FB	N2 input valve to recycling line	2-way valve animated	--	--

Table 6-15: Tags of the Membrane 2 Filtration Unit screen

6.7.3 Control loops

The following control loops are implemented on the screen:

Control Logic	Description
CL1200	Filtration Unit mode

Table 6-16: Control Loops of the Membrane 2 Filtration Unit Screen

6.8 Filtration Unit Maintenance screen (Filtrate Side)

Clicking over the filtration area of the Membrane1 Filtration Unit screen or Membrane2 Filtration Unit screen the following screen is opened. Filtration area groups filtrate line, recycle line, effluent tank and harvesting line.

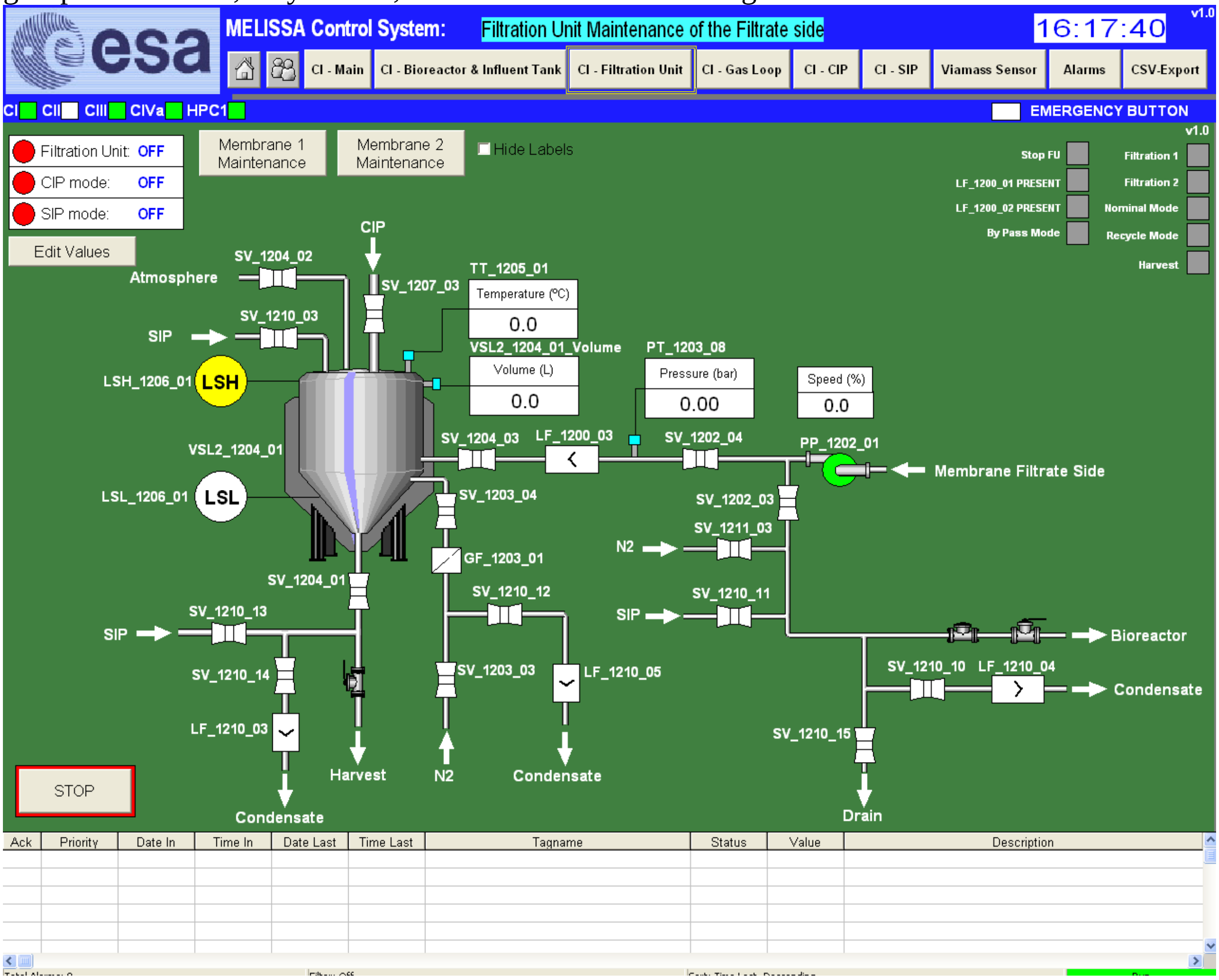


Figure 6-18: Main objects of the Filtration Unit Maintenance screen (Filtrate side)

6.8.1 General actions

This display allows the user to:

- 2-way valves, 3-way valves, level switches, pumps animations.
- Analogue indicators.
- Device alarm animations.
- Change the mode of the filtration unit control loop, cleaning control loop and sterilization control loop.
- Display the status of the filtration unit procedures through its indicators.

- Navigate to the different screens of the filtration Unit Maintenance through “Membrane 1 Maintenance” and “Membrane 2 Maintenance” command buttons.
- Hide labels selecting the “Hide labels” check box.
- Switch OFF the Filtration Unit Mode, Cleaning Mode and Sterilization Mode clicking on the “Stop” command button.
- Activate/deactivate valves and pumps in manual mode clicking over the equipment. The following window will be opened indicating to the user the name of the equipment, its actual state and the desired action to execute.

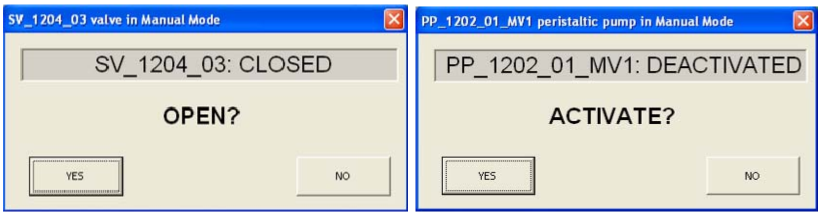


Figure 6-19: Equipment dialogs

- From Edit Values command button, it is possible to activate/deactivate more than one valve and pumps at the same time. Working only if Filtration Unit control mode is in manual mode.

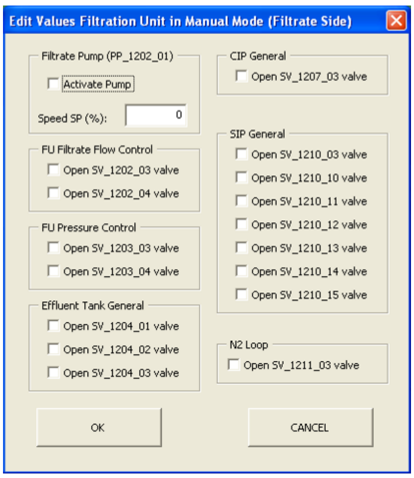


Figure 6-20: Edit Values Dialog

6.8.2 Alarms

The following alarms are linked with the operation of the Filtration Unit Maintenance screen (Filtrate side).

TAG NAME	Description	Colour
SV_1202_03_A	Recirculation valve in wrong position	RED and “ERR” text in RED
SV_1202_04_A	Filtrate flow valve in wrong position	RED and “ERR” text in RED
PT_1203_08_ERR	After filtrate pump pressure sensor link error	“ERR” text in RED
PT_1203_08_AHH	Pressure after filtrate pump reaches high level 2 Alarm	RED
PT_1203_08_AH	Pressure after filtrate pump reaches high level 1 Alarm	YELLOW
PT_1203_08_ALL	Pressure after filtrate pump reaches low level 2 Alarm	RED
PT_1203_08_AL	Pressure after filtrate pump reaches low level 1 Alarm	YELLOW
SV_1203_03_A	N2 input valve to harvesting tank in wrong position	RED and “ERR” text in RED

TAG NAME	Description	Colour
SV_1203_04_A	N2 input valve to harvesting tank in wrong position	RED and “ERR” text in RED
SV_1204_01_A	Drain valve of the harvesting tank in wrong position	RED and “ERR” text in RED
SV_1204_02_A	Air inlet valve of the harvesting tank in wrong position	RED and “ERR” text in RED
SV_1204_03_A	Filtrate flow valve in wrong position	RED and “ERR” text in RED
TT_1205_01_ERR	Harvesting tank temperature sensor link error	“ERR” text in RED
TT_1205_01_AHH	Harvesting tank temperature reaches high level 2 Alarm	RED
TT_1205_01_AH	Harvesting tank temperature reaches high level 1 Alarm	YELLOW
TT_1205_01_ALL	Harvesting tank temperature reaches low level 2 Alarm	RED
TT_1205_01_AL	Harvesting tank temperature reaches low level 1 Alarm	YELLOW
LT_1206_01_ERR	Harvesting tank level sensor link error	“ERR” text in RED
LT_1206_01_AHH	Harvesting tank level reaches high level 2 Alarm	RED
LT_1206_01_AH	Harvesting tank level reaches high level 1 Alarm	YELLOW
LT_1206_01_ALL	Harvesting tank level reaches low level 2 Alarm	RED
LT_1206_01_AL	Harvesting tank level reaches low level 1 Alarm	YELLOW
LSL_1206_01_A	Harvesting tank low level switch Alarm	RED
LSH_1206_01_A	Harvesting tank high level switch Alarm	RED
SV_1207_03_A	Cleaning agent input valve of the harvest tank in wrong position	RED and “ERR” text in RED
SV_1210_03_A	Steam input valve of the harvest tank in wrong position	RED and “ERR” text in RED
SV_1210_11_A	Steam input valve of the recycling line in wrong position	RED and “ERR” text in RED
SV_1210_13_A	Steam input valve of the harvesting line in wrong position	RED and “ERR” text in RED
SV_1210_14_A	Steam outlet valve of the harvesting line in wrong position	RED and “ERR” text in RED
SV_1210_15_A	Drain valve of the recycling line in wrong position	RED and “ERR” text in RED
SV_1211_03_A	N2 input valve to recycling line in wrong position	RED and “ERR” text in RED

Table 6-17: Alarm tags of the Filtration Unit Maintenance screen (Filtrate Side)

6.8.3 Tags

The following tags are displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	Units	Range
CL1200_SCI_MEMBR1_PRESENT	Membrane 1 presence in its housing	Filter animated	--	--
CL1200_SCI_MEMBR2_PRESENT	Membrane 2 presence in its housing	Filter animated	--	--
CL1200_TB_STOP	Filtration Unit, stop mode indicator	Digital indicator	--	--
CL1200_TB_CIR1	Filtration Unit, circulation 1 mode indicator	Digital indicator	--	--
CL1200_TB_CIR2	Filtration Unit, circulation 2 mode indicator	Digital indicator	--	--
CL1200_TB_NOM	Filtration Unit, nominal mode indicator	Digital indicator	--	--
CL1200_TB_REC	Filtration Unit, recycling mode indicator	Digital indicator	--	--
CL1201_TB_BYPASS	Filtration Unit, bypass mode indicator	Digital indicator	--	--
PP_1202_01_MV1	Filtrate pump	Pump animated	--	--
PP_1202_01_MV1_OP	Filtrate pump in manual mode	User Input		
PP_1202_01_MV2	Speed of filtrate pump	Analogue indicator	(%)	0 to 100
PP_1202_01_MV2_OP	Speed of filtrate pump in manual mode	User Input	(%)	0 to 100
SV_1202_03_FB	Recycle line valve	2-way valve animated	--	--
SV_1202_03_OP	Valve in manual mode	User Input	--	--
SV_1202_04_FB	Filtrate flow to vessel valve (before filter)	2-way valve animated	--	--
SV_1202_04_OP	Valve in manual mode	User Input	--	--
PT_1203_08	Pressure after filtrate pump	Analogue indicator	(bar)	0 to 4
SV_1203_03_FB	N2 input valve to harvesting tank	2-way valve animated	--	--
SV_1203_03_OP	N2 input valve to harvesting tank in manual mode	User Input	--	--
SV_1203_04_FB	N2 input valve to harvesting tank	2-way valve animated	--	--

Tag Name	Description	Type	Units	Range
SV_1203_04_OP	N2 input valve to harvesting tank in manual mode	User Input	--	--
CL1204_TB_HARVEST	Filtration Unit, harvesting mode indicator	Digital indicator	--	--
SV_1204_01_FB	Harvesting line valve	2-way valve animated	--	--
SV_1204_01_OP	Valve in manual mode	User Input	--	--
SV_1204_02_FB	Air inlet valve (harvesting tank)	2-way valve animated	--	--
SV_1204_02_OP	Valve in manual mode	User Input	--	--
SV_1204_03_FB	Filtrate flow to vessel valve (after filter)	2-way valve animated	--	--
SV_1204_03_OP	Filtrate flow to vessel valve (after filter) in manual mode	User Input	--	--
TT_1205_01	Harvesting tank temperature	Analogue indicator	(ºC)	0 to 100
VSL2_1204_01_VOLUME	Harvesting tank level	Analogue indicator	(L)	0 to 100
LSL_1206_01	Low level switch harvesting tank	Digital indicator	--	--
LSH_1206_01	High level switch harvesting tank	Digital indicator	--	--
SV_1207_03_FB	Cleaning agent input valve of the harvest tank	2-way valve animated	--	--
SV_1207_03_OP	Valve in manual mode	User Input	--	--
SV_1210_03_FB	Steam input valve of the harvest tank	2-way valve animated	--	--
SV_1210_03_OP	Valve in manual mode	User Input	--	--
SV_1210_10_MV	Steam outlet valve of the recycling line	2-way valve animated	--	--
SV_1210_10_OP	Valve in manual mode	User Input	--	--
SV_1210_11_FB	Steam input valve of the recycling line	2-way valve animated	--	--
SV_1210_11_OP	Valve in manual mode	User Input	--	--
SV_1210_12_MV	N2 outlet valve to harvesting tank	2-way valve animated	--	--
SV_1210_12_OP	Valve in manual mode	User Input	--	--
SV_1210_13_FB	Steam input valve of the harvesting line	2-way valve animated	--	--
SV_1210_13_OP	Valve in manual mode	User Input	--	--
SV_1210_14_FB	Steam outlet valve of the harvesting line	2-way valve animated	--	--
SV_1210_14_OP	Valve in manual mode	User Input	--	--
SV_1210_15_FB	Drain valve of the recycling line	2-way valve animated	--	--
SV_1210_15_OP	Valve in manual mode	User Input	--	--
SV_1211_03_FB	N2 input valve to recycling line	2-way valve animated	--	--
SV_1211_03_OP	Valve in manual mode	User Input	--	--

Table 6-18: Tags of the Filtration Unit Maintenance (Filtrate side)

6.8.4 Control Loops

The following control loops are implemented on the screen:

Control Logic	Description
CL1200	Filtration Unit mode
CL1207	Cleaning in Place mode
CL1210	Sterilization in Place mode

Table 6-19: Control Loops of the Filtration Unit Maintenance (Filtrate Side)

6.9 Filtration Unit Maintenance screen (Membrane 1)

Clicking over Membrane 1 area of the Filtration Unit Membrane 1 screen the following screen is opened. Membrane 1 area groups the filtration bypass line, retentate inlet line, membrane 1, retentate outlet line and filtrate outlet line of the Membrane 1.

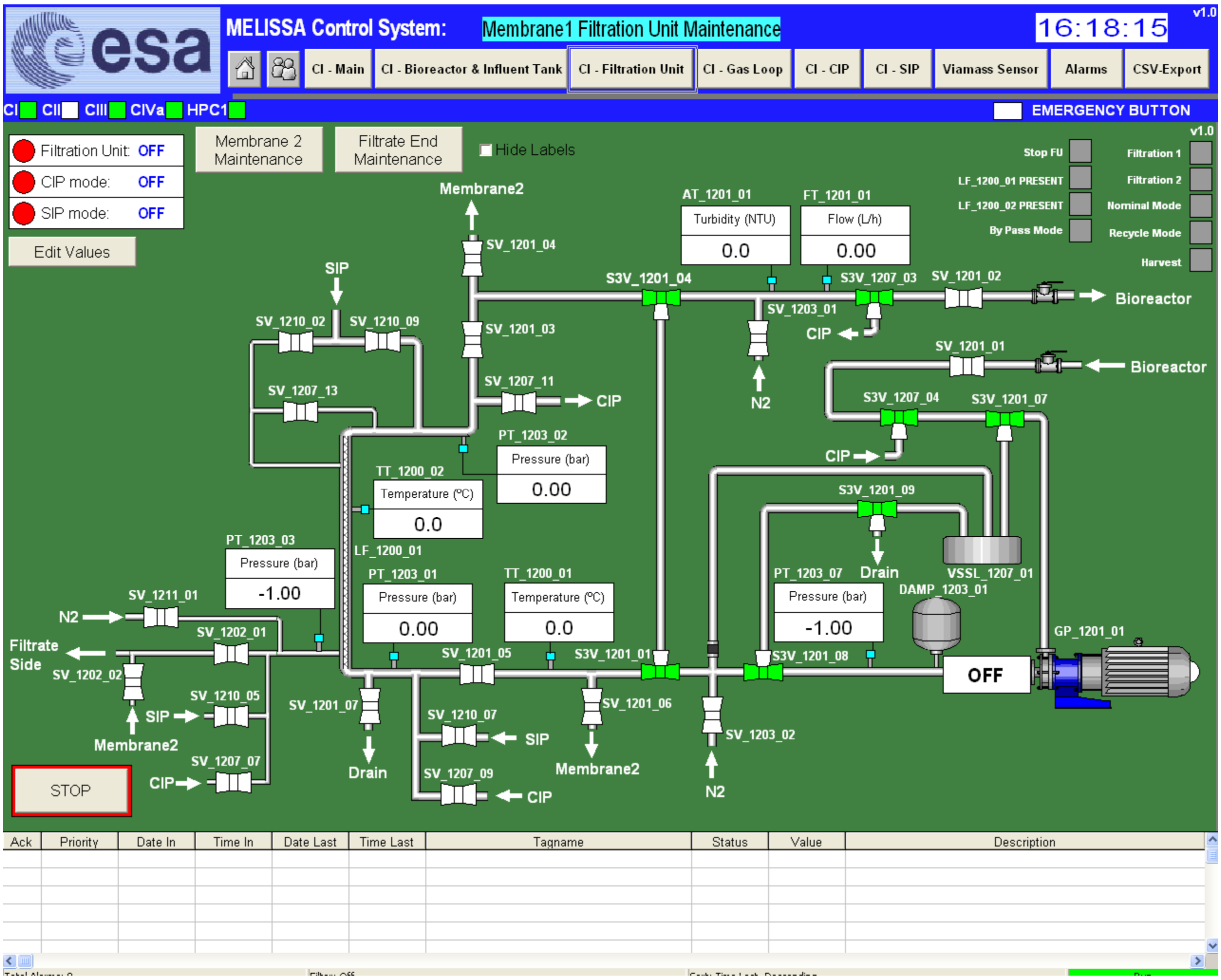


Figure 6-21: Main objects of the Filtration Unit Maintenance screen (Membrane 1 side)

6.9.1 General actions

This display allows the user to:

- 2-way valves, 3-way valves, level switches, pumps animations.
- Analogue indicators.
- Device alarm animations.
- Change the mode of the filtration unit control loop, cleaning control loop and sterilization control loop.
- Display the status of the filtration unit procedures through its indicators.

- Navigate to the different screens of the filtration Unit Maintenance through “Membrane 2 Maintenance” and “Filtrate End Maintenance” command buttons.
- Hide labels selecting the “Hide labels” check box.
- Switch OFF the Filtration Unit Mode, Cleaning Mode and Sterilization Mode clicking on the “Stop” command button.
- Activate/deactivate valves and pumps in manual mode clicking over the equipment. The following window will be opened indicating to the user the name of the equipment, its actual state and the desired action to execute.

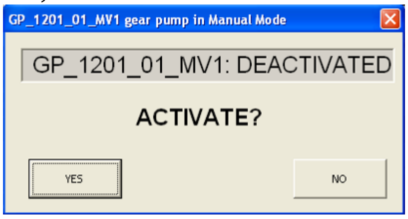


Figure 6-22: Equipment in manual mode

- Edit values allows to activate different equipment at the same time in manual mode.

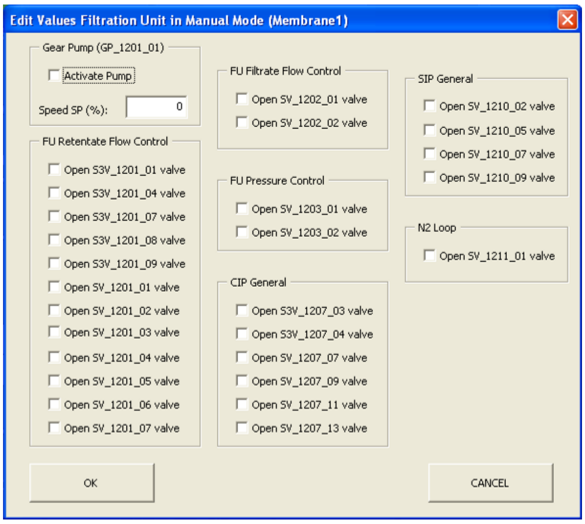


Figure 6-23: Edit Values Dialog

6.9.2 Alarms

The following alarms are linked with the operation of the Filtration Unit Maintenance screen (Membrane 1 side)

TAG NAME	Description	Colour
TT_1200_01_ERR	Inlet retentate line temperature sensor link error	“ERR” text in RED
TT_1200_01_AHH	Inlet retentate line temperature reaches high level 2 Alarm	RED
TT_1200_01_AH	Inlet retentate line temperature reaches high level 1 Alarm	YELLOW
TT_1200_01_ALL	Inlet retentate line temperature reaches low level 2 Alarm	RED
TT_1200_01_AL	Inlet retentate line temperature reaches low level 1 Alarm	YELLOW
TT_1200_02_ERR	Membrane 1 temperature sensor link error	“ERR” text in RED
TT_1200_02_AHH	Membrane 1 temperature reaches high level 2 sensor	RED
TT_1200_02_AH	Membrane 1 temperature reaches high level 1 sensor	YELLOW
TT_1200_02_ALL	Membrane 1 temperature reaches low level 2 sensor	RED

TAG NAME	Description	Colour
TT_1200_02_AL	Membrane 1 temperature reaches low level 1 sensor	YELLOW
AT_1201_01_ERR	Turbidity in outlet retentate side sensor link error	“ERR” text in RED
AT_1201_01_AHH	Turbidity in outlet retentate side reaches high level 2 Alarm	RED
AT_1201_01_AH	Turbidity in outlet retentate side reaches high level 1 Alarm	YELLOW
AT_1201_01_ALL	Turbidity in outlet retentate side reaches low level 2 Alarm	RED
AT_1201_01_AL	Turbidity in outlet retentate side reaches low level 1 Alarm	YELLOW
FT_1201_01_ERR	Outlet retentate flow sensor link error	“ERR” text in RED
FT_1201_01_AHH	Outlet retentate flow reaches high level 2 Alarm	RED
FT_1201_01_AH	Outlet retentate flow reaches high level 1 Alarm	YELLOW
FT_1201_01_ALL	Outlet retentate flow reaches low level 2 Alarm	RED
FT_1201_01_AL	Outlet retentate flow reaches low level 1 Alarm	YELLOW
GP_1201_01_Freqdrive_A	Gear pump frequency drive Alarm	Pump in red and “ERR” text
GP_1201_01_Powersupply_A	Gear pump power supply Alarm	Pump in red and “ERR” text
GP_1201_01_FLOW_A	Flow of retentate line is below 50 L/H. GP_1201_01 might run drive. --> The Pump is stopped	Pump in red and “ERR” text
S3V_1201_01_A	Bypass valve in wrong position	RED and “ERR” text in RED
S3V_1201_04_A	Bypass valve in wrong position	RED and “ERR” text in RED
S3V_1201_07_A	Valve allows flow from VSSL_1207_01 tank to retentate line in wrong position	RED and “ERR” text in RED
S3V_1201_08_A	Retentate line drain valve in wrong position	RED and “ERR” text in RED
S3V_1201_09_A	Retentate line drain valve in wrong position	RED and “ERR” text in RED
SV_1201_01_A	Valve allows flow from bioreactor to filtration unit in wrong position	RED and “ERR” text in RED
SV_1201_02_A	Valve allows flow from filtration unit to bioreactor in wrong position	RED and “ERR” text in RED
SV_1201_03_A	Outlet retentate side Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1201_04_A	Outlet retentate side Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1201_05_A	Inlet retentate Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1201_06_A	Inlet retentate Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1201_07_A	Drain Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1202_01_A	Filtrate side Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1202_02_A	Filtrate side Membrane 2 valve in wrong position	RED and “ERR” text in RED
PT_1203_01_ERR	Inlet retentate side Membrane 1 pressure sensor link error	“ERR” text in RED
PT_1203_01_AHH	Inlet retentate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_01_AH	Inlet retentate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_01_ALL	Inlet retentate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_01_AL	Inlet retentate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_02_ERR	Outlet retentate side Membrane 1 pressure sensor link error	“ERR” text in RED
PT_1203_02_AHH	Outlet retentate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_02_AH	Outlet retentate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_02_ALL	Outlet retentate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_02_AL	Outlet retentate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_03_ERR	Filtrate side Membrane 1 pressure sensor link error	“ERR” text in RED
PT_1203_03_AHH	Filtrate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_03_AH	Filtrate side Membrane 1 pressure reaches high level 1	YELLOW

TAG NAME	Description	Colour
	Alarm	
PT_1203_03_ALL	Filtrate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_03_AL	Filtrate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_07_ERR	Pressure after circulation pump sensor link error	"ERR" text in RED
PT_1203_07_AHH	Pressure after circulation pump reaches high level 2 Alarm	RED
PT_1203_07_AH	Pressure after circulation pump reaches high level 1 Alarm	YELLOW
PT_1203_07_ALL	Pressure after circulation pump reaches low level 2 Alarm	RED
PT_1203_07_AL	Pressure after circulation pump reaches low level 1 Alarm	YELLOW
SV_1203_01_A	N2 input valve of the retentate line in wrong position	RED and "ERR" text in RED
SV_1203_02_A	N2 input valve to the retentate line in wrong position	RED and "ERR" text in RED
S3V_1207_03_A	Retentate line cleaning valve in wrong position	RED and "ERR" text in RED
S3V_1207_04_A	Retentate line cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_07_A	Cleaning input valve to the filtrate side in wrong position.	RED and "ERR" text in RED
SV_1207_09_A	Cleaning input valve to Membrane 1 retentate side in wrong position	RED and "ERR" text in RED
SV_1207_11_A	Membrane 1 retentate side cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_13_A	Bypass valve between outlet retentate side and filtrate side in wrong position	RED and "ERR" text in RED
SV_1210_02_A	Steam input valve in Membrane 1 filtrate side in wrong position	RED and "ERR" text in RED
SV_1210_05_A	Steam input valve to the filtrate side in wrong position	RED and "ERR" text in RED
SV_1210_07_A	Steam input valve to Membrane 1 retentate side in wrong position	RED and "ERR" text in RED
SV_1210_09_A	Steam input valve in Membrane 1 outlet retentate side in wrong position	RED and "ERR" text in RED
SV_1211_01_A	N2 input valve to the filtrate side in wrong position	RED and "ERR" text in RED

Table 6-20: Alarm tags of the Filtration Unit Maintenance screen (Membrane 1 side)

6.9.3 Tags

The following tags are displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	Units	Range
TT_1200_01	Temperature in retentate line	Analogue indicator	(ºC)	0 to 100
TT_1200_02_AV	Temperature in Membrane 1	Analogue indicator	(ºC)	0 to 400
CL1200_SCI_MEMBR1_PRESENT	Membrane 1 presence in its housing	Filter animated	--	--
CL1200_SCI_MEMBR2_PRESENT	Membrane 2 presence in its housing	Filter animated	--	--
CL1200_TB_STOP	Filtration Unit, stop mode indicator	Digital indicator	--	--
CL1200_TB_CIR1	Filtration Unit, circulation 1 mode indicator	Digital indicator	--	--
CL1200_TB_CIR2	Filtration Unit, circulation 2 mode indicator	Digital indicator	--	--
CL1200_TB_NOM	Filtration Unit, nominal mode indicator	Digital indicator	--	--
CL1200_TB_REC	Filtration Unit, recycling mode indicator	Digital indicator	--	--
AT_1201_01	Turbidity in retentate side	Analogue indicator	TBD	0 to 100
FT_1201_01_IN_L_PER_H_FILTERED	Flow in retentate side	Analogue indicator	(L/h)	0 to 580

Tag Name	Description	Type	Units	Range
GP_1201_01_MV1	Retentate pump	Pump animated	--	--
GP_1201_01_MV1_OP	Retentate pump in manual mode	User Input	--	--
CL1201_TB_BYPASS	Filtration Unit, bypass mode indicator	Digital indicator	--	--
GP_1201_01_MV2_OP	Speed of retentate pump in manual mode	User Input	(%)	0 to 100
S3V_1201_01_FB	Filtration Unit bypass valve	3-way valve animated	--	--
S3V_1201_01_OP	Valve in manual mode	User input	--	--
S3V_1201_04_FB	Filtration Unit bypass valve	3-way valve animated	--	--
S3V_1201_04_OP	Valve in manual mode	User input	--	--
S3V_1201_07_FB	Valve allows flow from VSSL_1207_01 tank to retentate line.	3-way valve animated	--	--
S3V_1201_07_OP	Valve in manual mode	User input	--	--
S3V_1201_08_FB	Retentate line drain valve	3-way valve animated	--	--
S3V_1201_08_OP	Valve in manual mode	User input	--	--
S3V_1201_09_FB	Retentate line drain valve	3-way valve animated	--	--
S3V_1201_09_OP	Valve in manual mode	User input	--	--
SV_1201_01_FB	Valve allows flow from bioreactor to filtration unit	2-way valve animated	--	--
SV_1201_01_OP	Valve in manual mode	User input	--	--
SV_1201_02_FB	Valve allows flow from filtration unit to bioreactor	2-way valve animated	--	--
SV_1201_02_OP				
SV_1201_03_FB	Membrane 1 outlet retentate side valve	2-way valve animated	--	--
SV_1201_03_OP	Valve in manual mode	User input	--	--
SV_1201_04_FB	Outlet retentate side Membrane 2 side	2-way valve animation	--	--
SV_1201_04_OP	Valve in manual mode	User input	--	--
SV_1201_05_FB	Inlet valve retentate line Membrane 1	2-way valve animation	--	--
SV_1201_05_OP	Valve in manual mode	User input	--	--
SV_1201_06_FB	Inlet retentate side Membrane 2 valve	2-way valve animated	--	--
SV_1201_06_OP	Valve in manual mode	User input	--	--
SV_1201_07_FB	Drain Membrane 1 valve	2-way valve animated	--	--
SV_1201_07_OP	Valve in manual mode	User input	--	--
SV_1202_01_FB	Membrane 1 filtrate side valve	2-way valve animated	--	--
SV_1202_01_OP	Valve in manual mode	User input	--	--
SV_1202_02_FB	Filtrate side Membrane 2 valve	2-way valve animated	--	--
SV_1202_02_OP	Valve in manual mode	User input	--	--
PT_1203_01	Pressure in Membrane 1 retentate side	Analogue indicator	(bar)	0 to 4
PT_1203_02	Pressure in outlet retentate side membrane 1	Analogue indicator	(bar)	0 to 4
PT_1203_03	Pressure in Membrane 1 filtrate side	Analogue indicator	(bar)	-1 to 4
PT_1203_07	Pressure of retentate after GP_1201_01 pump	Analogue indicator	(bar)	-1 to 9
SV_1203_01_FB	N2 input valve of the retentate line	2-way valve animated	--	--
SV_1203_01_OP	Valve in manual mode	User input	--	--
SV_1203_02_FB	N2 input valve to the retentate line	2-way valve animated	--	--
SV_1203_02_OP	Valve in manual mode	User input	--	--
CL1204_TB_HARVEST	Filtration Unit, harvesting mode indicator	Digital indicator	--	--
S3V_1207_03_FB	Retentate line cleaning valve	3-way valve animated	--	--
S3V_1207_03_OP	Valve in manual mode	User input	--	--

Tag Name	Description	Type	Units	Range
S3V_1207_04_FB	Retentate line cleaning valve	3-way valve animated	--	--
S3V_1207_04_OP	Valve in manual mode	User input	--	--
SV_1207_07_FB	Cleaning input valve to the filtrate side	2-way valve animated	--	--
SV_1207_07_OP	Valve in manual mode	User input	--	--
SV_1207_09_FB	Cleaning input valve to Membrane 1 retentate side	2-way valve animated	--	--
SV_1207_09_OP	Valve in manual mode	User input	--	--
SV_1207_11_FB	Membrane 1 retentate side cleaning valve	2-way valve animated	--	--
SV_1207_11_OP	Valve in manual mode	User input	--	--
SV_1207_13_FB	Bypass valve between outlet retentate side and filtrate side	2-way valve animated	--	--
SV_1207_13_OP	Valve in manual mode	User input	--	--
SV_1210_02_FB	Steam input valve in Membrane 1 filtrate side	2-way valve animated	--	--
SV_1210_02_OP	Valve in manual mode	User input	--	--
SV_1210_05_FB	Steam input valve to the filtrate side	2-way valve animated	--	--
SV_1210_05_OP	Valve in manual mode	User input	--	--
SV_1210_07_FB	Steam input valve to Membrane 1 retentate side	2-way valve animated	--	--
SV_1210_07_OP	Valve in manual mode	User input	--	--
SV_1210_09_FB	Steam input valve in Membrane 1 outlet retentate side	2-way valve animated	--	--
SV_1210_09_OP	Valve in manual mode	User input	--	--
SV_1211_01_FB	N2 input valve to the filtrate side	2-way valve animated	--	--
SV_1211_01_OP	Valve in manual mode	User input	--	--

Table 6-21: Tags of the Filtration Unit Maintenance (Membrane 1 side)

6.9.4 Control Loops

The following control loops are implemented on the screen:

Control Logic	Description
CL1200	Filtration Unit mode
CL1207	Cleaning in Place Mode
CL1210	Sterilization in Place Mode

Table 6-22: Control Loops of the Filtration Unit Maintenance (Membrane 1 side)

6.10 Filtration Unit Maintenance screen (Membrane 2)

Clicking over Membrane 2 area of the Filtration Unit Membrane 1 screen the following screen will be opened.

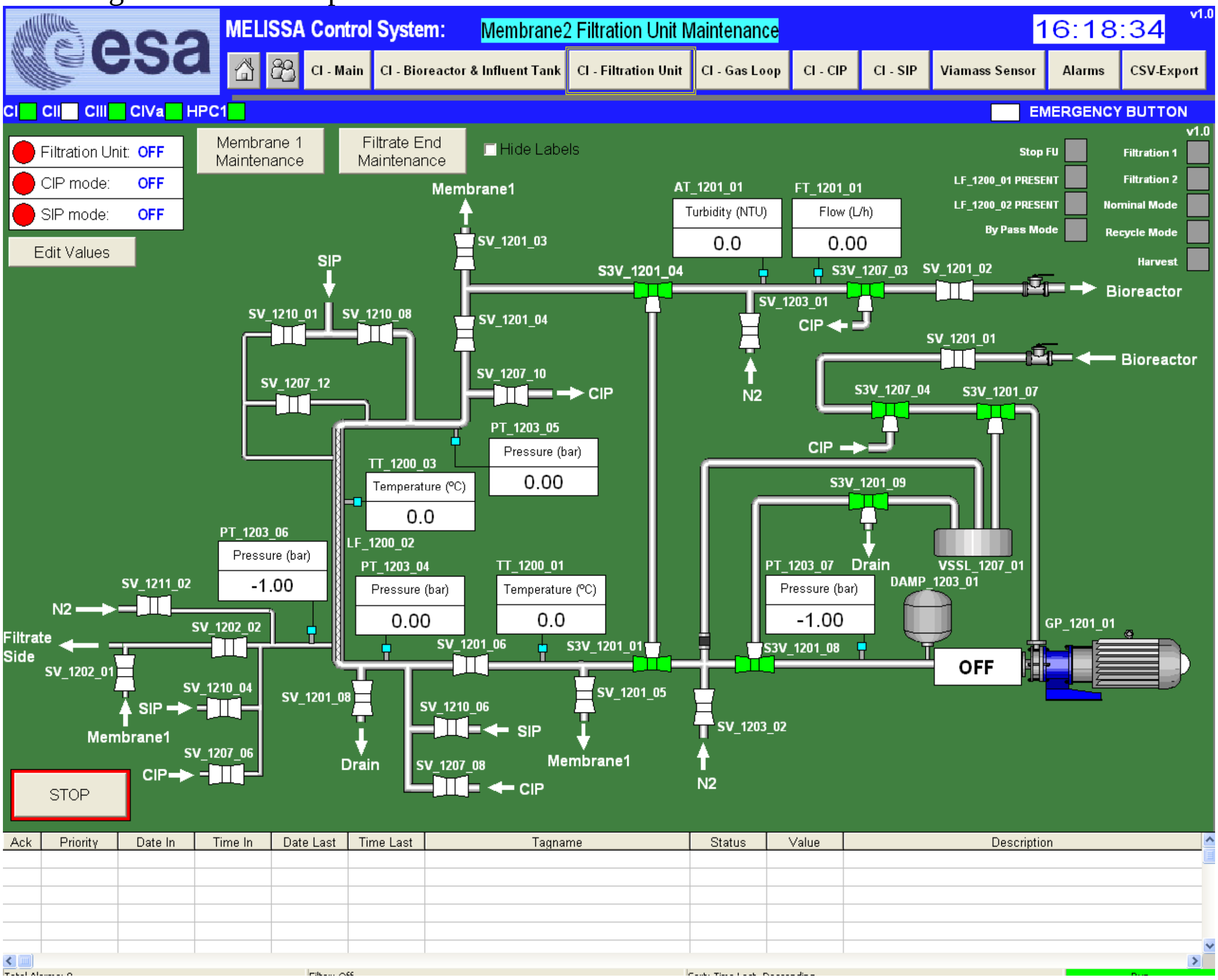


Figure 6-24: Main objects of the Filtration Unit Maintenance screen (Membrane 2 side)

This screen has the same features described in Filtration Unit Maintenance screen (Membrane 1 side).

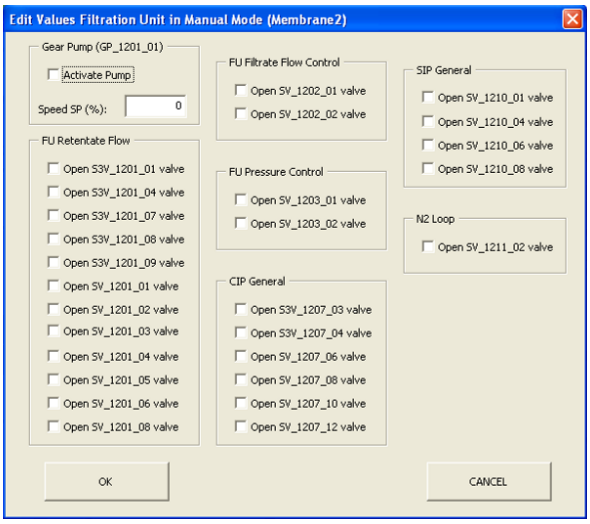


Figure 6-25: Edit Values Dialog

6.10.1 Alarms

The following alarms are linked with the operation of the Filtration Unit Maintenance screen (Membrane2)

TAG NAME	Description	Colour
TT_1200_01_ERR	Inlet retentate line temperature sensor link error	“ERR” text in RED
TT_1200_01_AHH	Inlet retentate line temperature reaches high level 2 Alarm	RED
TT_1200_01_AH	Inlet retentate line temperature reaches high level 1 Alarm	YELLOW
TT_1200_01_ALL	Inlet retentate line temperature reaches low level 2 Alarm	RED
TT_1200_01_AL	Inlet retentate line temperature reaches low level 1 Alarm	YELLOW
TT_1200_03_ERR	Membrane 2 temperature sensor link error	“ERR” text in RED
TT_1200_03_AHH	Membrane 2 temperature reaches high level 2 sensor	RED
TT_1200_03_AH	Membrane 2 temperature reaches high level 1 sensor	YELLOW
TT_1200_03_ALL	Membrane 2 temperature reaches low level 2 sensor	RED
TT_1200_03_AL	Membrane 2 temperature reaches low level 1 sensor	YELLOW
AT_1201_01_ERR	Turbidity in outlet retentate side sensor link error	“ERR” text in RED
AT_1201_01_AHH	Turbidity in outlet retentate side reaches high level 2 Alarm	RED
AT_1201_01_AH	Turbidity in outlet retentate side reaches high level 1 Alarm	YELLOW
AT_1201_01_ALL	Turbidity in outlet retentate side reaches low level 2 Alarm	RED
AT_1201_01_AL	Turbidity in outlet retentate side reaches low level 1 Alarm	YELLOW
FT_1201_01_ERR	Outlet retentate flow sensor link error	“ERR” text in RED
FT_1201_01_AHH	Outlet retentate flow reaches high level 2 Alarm	RED
FT_1201_01_AH	Outlet retentate flow reaches high level 1 Alarm	YELLOW
FT_1201_01_ALL	Outlet retentate flow reaches low level 2 Alarm	RED
FT_1201_01_AL	Outlet retentate flow reaches low level 1 Alarm	YELLOW
GP_1201_01_Freqdrive_A	Gear pump frequency drive Alarm	Pump in red and “ERR” text
GP_1201_01_Powersupply_A	Gear pump power supply Alarm	Pump in red and “ERR” text
GP_1201_01_FLOW_A	Flow of retentate line is below 50 L/H. GP_1201_01 might run drive. --> The Pump is stopped	Pump in red and “ERR” text
S3V_1201_01_A	Bypass valve in wrong position	RED and “ERR” text in RED
S3V_1201_04_A	Bypass valve in wrong position	RED and “ERR” text in RED
S3V_1201_07_A	Valve allows flow from VSSL_1207_01 tank to retentate line in wrong position	RED and “ERR” text in RED
S3V_1201_08_A	Retentate line drain valve in wrong position	RED and “ERR” text in RED
S3V_1201_09_A	Retentate line drain valve in wrong position	RED and “ERR” text in RED
SV_1201_01_A	Valve allows flow from bioreactor to filtration unit in wrong position	RED and “ERR” text in RED
SV_1201_02_A	Valve allows flow from filtration unit to bioreactor in wrong	RED and “ERR” text in

TAG NAME	Description	Colour
	position	RED
SV_1201_03_A	Outlet retentate side Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1201_04_A	Outlet retentate side Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1201_05_A	Inlet retentate Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1201_06_A	Inlet retentate Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1201_08_A	Drain Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1202_01_A	Filtrate side Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1202_02_A	Filtrate side Membrane 2 valve in wrong position	RED and “ERR” text in RED
PT_1203_04_ERR	Inlet retentate side Membrane 2 pressure sensor link error	“ERR” text in RED
PT_1203_04_AHH	Inlet retentate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_04_AH	Inlet retentate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_04_ALL	Inlet retentate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_04_AL	Inlet retentate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_05_ERR	Outlet retentate side Membrane 2 pressure sensor link error	“ERR” text in RED
PT_1203_05_AHH	Outlet retentate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_05_AH	Outlet retentate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_05_ALL	Outlet retentate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_05_AL	Outlet retentate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_06_ERR	Filtrate side Membrane 2 pressure sensor link error	“ERR” text in RED
PT_1203_06_AHH	Filtrate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_06_AH	Filtrate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_06_ALL	Filtrate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_06_AL	Filtrate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_07_ERR	Pressure after circulation pump sensor link error	“ERR” text in RED
PT_1203_07_AHH	Pressure after circulation pump reaches high level 2 Alarm	RED
PT_1203_07_AH	Pressure after circulation pump reaches high level 1 Alarm	YELLOW
PT_1203_07_ALL	Pressure after circulation pump reaches low level 2 Alarm	RED
PT_1203_07_AL	Pressure after circulation pump reaches low level 1 Alarm	YELLOW
SV_1203_01_A	N2 input valve of the retentate line in wrong position	RED and “ERR” text in RED
SV_1203_02_A	N2 input valve to the retentate line in wrong position	RED and “ERR” text in RED
S3V_1207_03_A	Retentate line cleaning valve in wrong position	RED and “ERR” text in RED
S3V_1207_04_A	Retentate line cleaning valve in wrong position	RED and “ERR” text in RED
SV_1207_06_A	Cleaning input valve to the Membrane 2 filtrate side in wrong position.	RED and “ERR” text in RED
SV_1207_08_A	Cleaning input valve to Membrane 2 retentate side in wrong position	RED and “ERR” text in RED
SV_1207_10_A	Membrane 2 retentate side cleaning valve in wrong position	RED and “ERR” text in RED
SV_1207_12_A	Bypass valve between outlet retentate side and filtrate side Membrane 2 in wrong position	RED and “ERR” text in RED
SV_1210_01_A	Steam input valve in Membrane 2 filtrate side in wrong position	RED and “ERR” text in RED
SV_1210_04_A	Steam input valve to the Membrane 2 filtrate side in wrong position	RED and “ERR” text in RED
SV_1210_06_A	Steam input valve to Membrane 2 retentate side in wrong position	RED and “ERR” text in RED
SV_1210_08_A	Steam input valve in Membrane 2 outlet retentate side in wrong position	RED and “ERR” text in RED

TAG NAME	Description	Colour
SV_1211_02_A	N2 input valve to the Membrane 2 filtrate side in wrong position	RED and "ERR" text in RED

Table 6-23: Alarm tags of the Filtration Unit Maintenance screen (Memabrane 2)

6.10.2 Tags

The following tags are displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	Units	Range
TT_1200_01	Temperature in retentate line	Analogue indicator	(ºC)	0 to 100
TT_1200_03_AV	Temperature in Membrane 2	Analogue indicator	(ºC)	0 to 400
CL1200_SCI_MEMBR1_PRESENT	Membrane 1 presence in its housing	Filter animated	--	--
CL1200_SCI_MEMBR2_PRESENT	Membrane 2 presence in its housing	Filter animated	--	--
CL1200_TB_STOP	Filtration Unit, stop mode indicator	Digital indicator	--	--
CL1200_TB_CIR1	Filtration Unit, circulation 1 mode indicator	Digital indicator	--	--
CL1200_TB_CIR2	Filtration Unit, circulation 2 mode indicator	Digital indicator	--	--
CL1200_TB_NOM	Filtration Unit, nominal mode indicator	Digital indicator	--	--
CL1200_TB_REC	Filtration Unit, recycling mode indicator	Digital indicator	--	--
AT_1201_01	Turbidity in retentate side	Analogue indicator	TBD	0 to 100
FT_1201_01_IN_L_PER_H_FILTERED	Flow in retentate side	Analogue indicator	(L/h)	0 to 580
GP_1201_01_MV1	Retentate pump	Pump animated	--	--
GP_1201_01_MV1_OP	Retentate pump in manual mode	User Input	--	--
GP_1201_01_MV2_OP	Speed of retentate pump in manual mode	User Input	(%)	0 to 100
CL1201_TB_BYPASS	Filtration Unit, bypass mode indicator	Digital indicator	--	--
S3V_1201_01_FB	Filtration Unit bypass valve	3-way valve animated	--	--
S3V_1201_01_OP	Valve in manual mode	User Input	--	--
S3V_1201_04_FB	Filtration Unit bypass valve	3-way valve animated	--	--
S3V_1201_04_OP	Valve in manual mode	User Input	--	--
S3V_1201_07_FB	Valve allows flow from VSSL_1207_01 tank to retentate line.	3-way valve animated	--	--
S3V_1201_07_OP	Valve in manual mode	User Input	--	--
S3V_1201_08_FB	Retentate line drain valve	3-way valve animated	--	--
S3V_1201_08_OP	Valve in manual mode	User Input	--	--
S3V_1201_09_FB	Retentate line drain valve	3-way valve animated	--	--
S3V_1201_09_OP	Valve in manual mode	User Input	--	--
SV_1201_01_FB	Valve allows flow from bioreactor to filtration unit	2-way valve animated	--	--
SV_1201_01_OP	Valve in manual mode	User Input	--	--
SV_1201_02_FB	Valve allows flow from filtration unit to bioreactor	2-way valve animated	--	--
SV_1201_02_OP	Valve in manual mode	User Input	--	--
SV_1201_03_FB	Membrane 1 outlet retentate side valve	2-way valve animated	--	--
SV_1201_03_OP	Valve in manual mode	User Input	--	--
SV_1201_04_FB	Outlet retentate side Membrane 2 side	2-way valve animated	--	--
SV_1201_04_OP	Valve in manual mode	User Input	--	--

Tag Name	Description	Type	Units	Range
SV_1201_05_FB	Inlet valve retentate line Membrane 1	2-way valve animated	--	--
SV_1201_05_OP	Valve in manual mode	User Input	--	--
SV_1201_06_FB	Inlet retentate side Membrane 2 valve	2-way valve animated	--	--
SV_1201_06_OP	Valve in manual mode	User Input	--	--
SV_1201_08_FB	Drain Membrane 2 valve	2-way valve animated	--	--
SV_1201_08_OP	Valve in manual mode	User Input	--	--
CL1202_SCI_FILTR_FLOWRATE	Desired daily production	SP User Input	(L/day)	0 to 100
SV_1202_01_FB	Membrane 1 filtrate side valve	2-way valve animated	--	--
SV_1202_01_OP	Valve in manual mode	User Input	--	--
SV_1202_02_FB	Filtrate side Membrane 2 valve	2-way valve animated	--	--
SV_1202_02_OP	Valve in manual mode	User Input	--	--
PT_1203_04	Pressure in Membrane 2 retentate side	Analogue indicator	(bar)	0 to 4
PT_1203_05	Pressure in outlet retentate side membrane 2	Analogue indicator	(bar)	0 to 4
PT_1203_06	Pressure in Membrane 1 filtrate side	Analogue indicator	(bar)	-1 to 4
PT_1203_07	Pressure of retentate after GP_1201_01 pump	Analogue indicator	(bar)	-1 to 9
SV_1203_01_FB	N2 input valve of the retentate line	2-way valve animated	--	--
SV_1203_01_OP	Valve in manual mode	User Input	--	--
SV_1203_02_FB	N2 input valve to the retentate line	2-way valve animated	--	--
SV_1203_02_OP	Valve in manual mode	User Input	--	--
CL1204_TB_HARVEST	Filtration Unit, harvesting mode indicator	Digital indicator	--	--
S3V_1207_03_FB	Retentate line cleaning valve	3-way valve animated	--	--
S3V_1207_03_OP	Valve in manual mode	User Input	--	--
S3V_1207_04_FB	Retentate line cleaning valve	3-way valve animated	--	--
S3V_1207_04_OP	Valve in manual mode	User Input	--	--
SV_1207_06_FB	Cleaning input valve to the filtrate side of Membrane 2	2-way valve animated	--	--
SV_1207_06_OP	Valve in manual mode	User Input	--	--
SV_1207_08_FB	Cleaning input valve to Membrane 2 retentate side	2-way valve animated	--	--
SV_1207_08_OP	Valve in manual mode	User Input	--	--
SV_1207_10_FB	Membrane 2 retentate side cleaning valve	2-way valve animated	--	--
SV_1207_10_OP	Valve in manual mode	User Input	--	--
SV_1207_12_FB	Bypass valve between outlet retentate side and filtrate side of Membrane2	2-way valve animated	--	--
SV_1207_12_OP	Valve in manual mode	User Input	--	--
SV_1210_01_FB	Steam input valve in Membrane 2 filtrate side	2-way valve animated	--	--
SV_1210_01_OP	Valve in manual mode	User Input	--	--
SV_1210_04_FB	Steam input valve to the filtrate side of Membrane 2	2-way valve animated	--	--
SV_1210_04_OP	Valve in manual mode	User Input	--	--
SV_1210_06_FB	Steam input valve to Membrane 2 retentate side	2-way valve animated	--	--
SV_1210_06_OP	Valve in manual mode	User Input	--	--
SV_1210_08_FB	Steam input valve in Membrane 2 outlet retentate side	2-way valve animated	--	--
SV_1210_08_OP	Valve in manual mode	User Input	--	--
SV_1211_02_FB	N2 input valve to the filtrate side of Membrane 2	2-way valve animated	--	--
SV_1211_02_OP	Valve in manual mode	User Input	--	--

Table 6-24: Tags of the Filtration Unit Maintenance screen (Membrane 2)

6.10.3 Control Loops

The following control loops are implemented on the screen:

Control Logic	Description
CL1200	Filtration Unit mode
CL1207	Cleaning in Place Mode
CL1210	Sterilization in Place Mode

Table 6-25: Control Loops of the Filtration Unit Maintenance (Membrane 2 side)

6.11 Cleaning in Place screen (Membrane 1)

Cleaning in Place screens are implemented in the same way than in the Filtration Unit, one screen for each membrane.

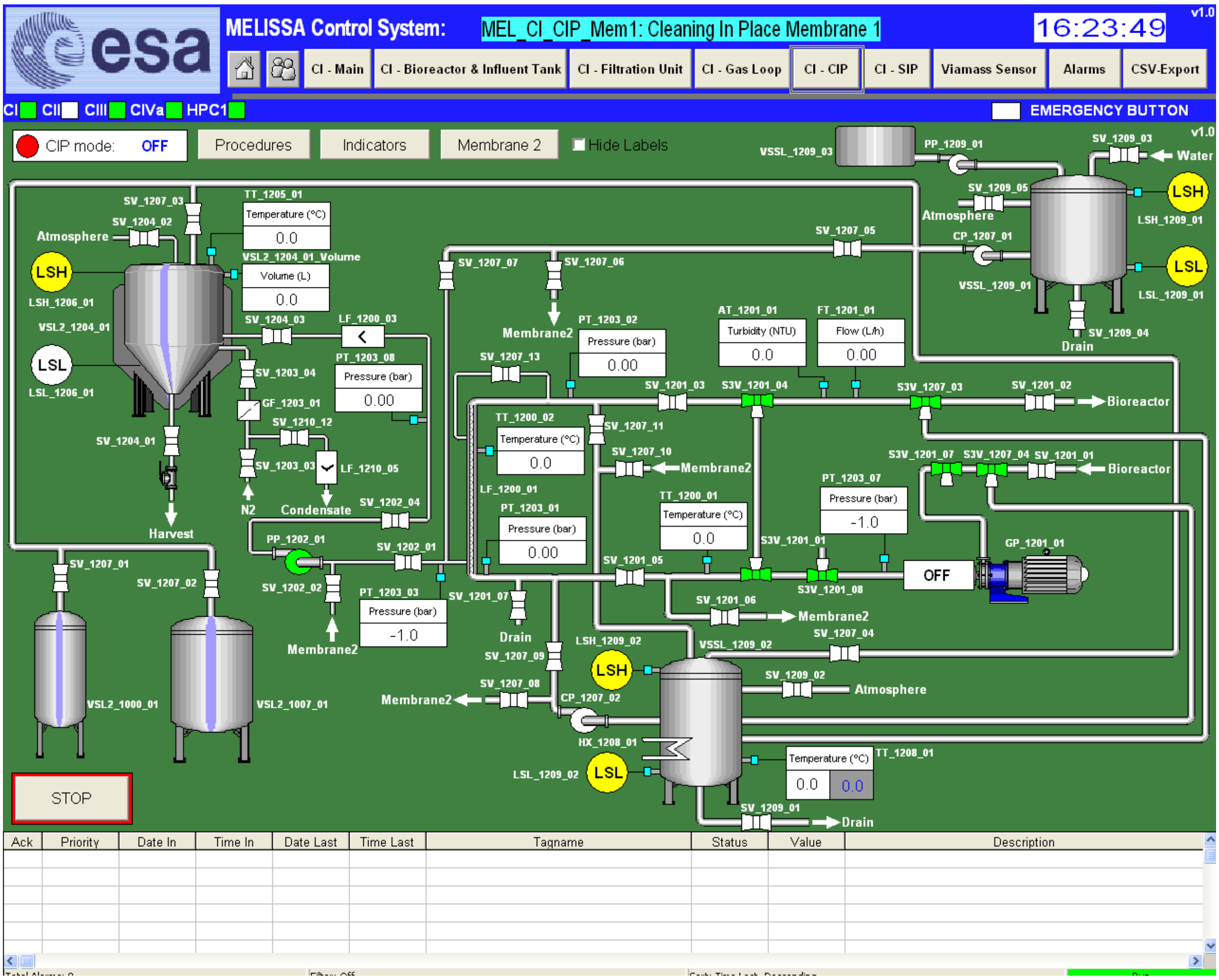


Figure 6-26: Main objects in Membrane 1 CIP screen

6.11.1 General actions

This display allows the user to:

- 2-way valves, 3-way valves, level switches, pumps animations.
- Analogue indicators.
- Device alarm animations.
- Membrane background colour switch to green when ceramic membrane is present in its module.
- Display the CIP membrane 2 screen clicking “Membrane2” command button.
- Hide labels selecting the “Hide labels” check box.

- Display the CIP procedures clicking "Procedures" command button. The following windows will be opened and the user will be able active some of the CIP procedures.

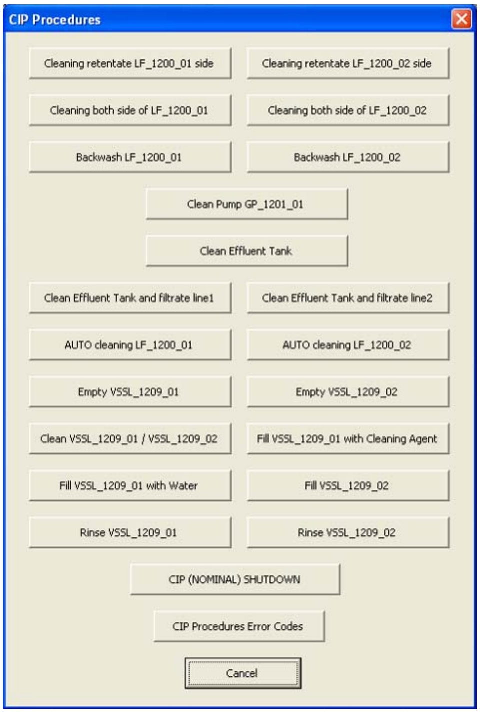


Figure 6-27: CIP procedures

- Error Codes command button allows to open a window showing the error code of the each gas loop procedure. Operator will be able identify error code of the step inside the procedure that has been wrong executed.

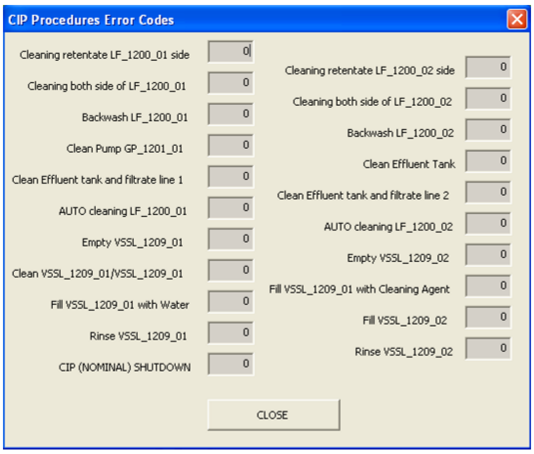


Figure 6-28: Error Codes of the Cleaning Procedures

Tag Name	Description	Address
CL1207_C_Cl1_Error	Error Code of the Cleaning retentate Membrane 1 procedure.	400281
CL1207_C_Cl2_Error	Error Code of the Cleaning retentate Membrane 2 procedure.	400283
CL1207_C_BCl1_Error	Error Code of the cleaning both sides of Membrane 1 procedure	400285
CL1207_C_BCl2_Error	Error Code of the cleaning both sides of Membrane 2 procedure	400287
CL1207_C_BW1_Error	Error code of the backwashing Membrane 1 procedure	400289
CL1207_C_BW2_Error	Error code of the backwashing Membrane 2 procedure	400291
CL1207_C_ET1_Error	Error code of the Cleaning Effluent tank and membrane 1 filtrate line procedure	400293
CL1207_C_ET2_Error	Error code of the Cleaning Effluent tank and membrane 2 filtrate line procedure	400295
CL1207_C_Rinse_CA_Error	Error code of the Rinse VSSL_1209_01 procedure	400275
CL1207_C_Rinse_CB_Error	Error code of the rinse VSSL_1209_02 procedure	400277
CL1207_C_R_F_01_Error	Error code of the cleaning Effluent tank procedure	400299
CL1207_C_CLPMP_Error	Error code of the cleaning pump GP_1201_01 procedure	400299
CL1207_C_Stop_Error	Error code of the stop cleaning procedure.	400279
CL1207_C_Clean_CAB_Error	Error code of the cleaning VSSL_1209_01 and VSSL_1209_02 procedure.	400273
CL1207_C_P_Cl1_Error	Error code of the AUTO cleaning membrane 1 procedure	400301
CL1207_C_P_Cl2_Error	Error code of the AUTO cleaning membrane 2 procedure	400303
CL1209_C_Empty_CA_Error	Error code of the Empty VSSL_1209_01 procedure	400305
CL1209_C_Empty_CB_Error	Error code of the Empty VSSL_1209_02 procedure	400307
CL1209_C_Fill_CA_Error	Error code of the filling VSSL_1209_01 procedure	400309
CL1209_C_Fill_CB_Error	Error code of the filling VSSL_1209_02 procedure	400311
CL1209_C_Fill_WA_Error	Error code of the filling VSSL_1209_01 with water procedure	400213

Table 6-26: Error Codes description of the Cleaning procedures

- Display the CIP procedures indicators clicking “Indicators” command button. The following window will be opened.

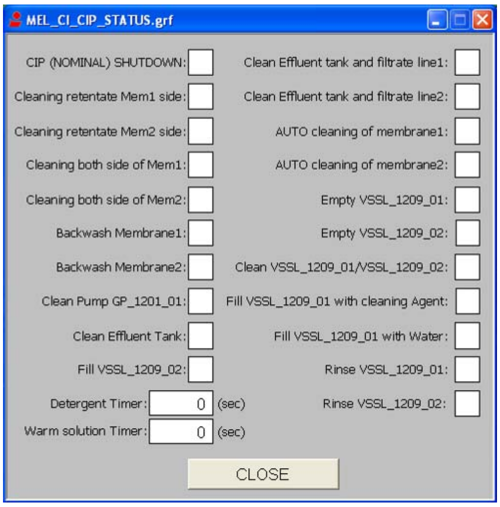


Figure 6-29: Indicators of the CIP procedures

- Display the CIP Maintenance screens. Screens from filtration unit frame will be developed on specifics screens to maintenance. For CIP screens will be created three new screens for maintenance (one for each separate area), one for filtrate side and effluent vessel and one more for each membrane. The user will be able access to maintenance screen clicking over the area desired to maintenance.

6.11.2 Alarms

The following alarms are linked with the operation of the Membrane 1 CIP screen.

TAG NAME	Description	Colour
TT_1200_01_ERR	Inlet retentate line temperature sensor link error	“ERR” text in RED
TT_1200_01_AHH	Inlet retentate line temperature reaches high level 2 Alarm	RED
TT_1200_01_AH	Inlet retentate line temperature reaches high level 1 Alarm	YELLOW
TT_1200_01_ALL	Inlet retentate line temperature reaches low level 2 Alarm	RED
TT_1200_01_AL	Inlet retentate line temperature reaches low level 1 Alarm	YELLOW
TT_1200_02_ERR	Membrane 1 temperature sensor link error	“ERR” text in RED
TT_1200_02_AHH	Membrane 1 temperature reaches high level 2 sensor	RED
TT_1200_02_AH	Membrane 1 temperature reaches high level 1 sensor	YELLOW
TT_1200_02_ALL	Membrane 1 temperature reaches low level 2 sensor	RED
TT_1200_02_AL	Membrane 1 temperature reaches low level 1 sensor	YELLOW
AT_1201_01_ERR	Turbidity in outlet retentate side sensor link error	“ERR” text in RED
AT_1201_01_AHH	Turbidity in outlet retentate side reaches high level 2 Alarm	RED
AT_1201_01_AH	Turbidity in outlet retentate side reaches high level 1 Alarm	YELLOW
AT_1201_01_ALL	Turbidity in outlet retentate side reaches low level 2 Alarm	RED
AT_1201_01_AL	Turbidity in outlet retentate side reaches low level 1 Alarm	YELLOW
FT_1201_01_ERR	Outlet retentate flow sensor link error	“ERR” text in RED
FT_1201_01_AHH	Outlet retentate flow reaches high level 2 Alarm	RED
FT_1201_01_AH	Outlet retentate flow reaches high level 1 Alarm	YELLOW
FT_1201_01_ALL	Outlet retentate flow reaches low level 2 Alarm	RED
FT_1201_01_AL	Outlet retentate flow reaches low level 1 Alarm	YELLOW
GP_1201_01_FreqDrive_A	Gear pump alarm	RED
GP_1201_01_PowerSupply_A	Gear pump alarm	RED

TAG NAME	Description	Colour
GP_1201_01_FLOW_A	Flow of retentate line is below 50L/h. GP_1201_01_might_run_dry, the pump is stopped	RED
S3V_1201_01_A	Bypass valve in wrong position	RED and “ERR” text in RED
S3V_1201_04_A	Bypass valve in wrong position	RED and “ERR” text in RED
S3V_1201_07_A	Valve allows flow from VSSL_1207_01 tank to retentate line in wrong position	RED and “ERR” text in RED
S3V_1201_08_A	Retentate line drain valve in wrong position	RED and “ERR” text in RED
SV_1201_01_A	Valve allows flow from bioreactor to filtration unit in wrong position	RED and “ERR” text in RED
SV_1201_02_A	Valve allows flow from filtration unit to bioreactor in wrong position	RED and “ERR” text in RED
SV_1201_03_A	Outlet retentate side Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1201_05_A	Inlet retentate Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1201_06_A	Inlet retentate Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1201_07_A	Drain Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1202_01_A	Filtrate side Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1202_02_A	Filtrate side Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1202_04_A	Filtrate flow valve in wrong position	RED and “ERR” text in RED
PT_1203_01_ERR	Inlet retentate side Membrane 1 pressure sensor link error	“ERR” text in RED
PT_1203_01_AHH	Inlet retentate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_01_AH	Inlet retentate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_01_ALL	Inlet retentate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_01_AL	Inlet retentate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_02_ERR	Outlet retentate side Membrane 1 pressure sensor link error	“ERR” text in RED
PT_1203_02_AHH	Outlet retentate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_02_AH	Outlet retentate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_02_ALL	Outlet retentate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_02_AL	Outlet retentate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_03_ERR	Filtrate side Membrane 1 pressure sensor link error	“ERR” text in RED
PT_1203_03_AHH	Filtrate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_03_AH	Filtrate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_03_ALL	Filtrate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_03_AL	Filtrate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_07_ERR	Pressure after circulation pump sensor link error	“ERR” text in RED
PT_1203_07_AHH	Pressure after circulation pump reaches high level 2 Alarm	RED
PT_1203_07_AH	Pressure after circulation pump reaches high level 1 Alarm	YELLOW
PT_1203_07_ALL	Pressure after circulation pump reaches low level 2 Alarm	RED
PT_1203_07_AL	Pressure after circulation pump reaches low level 1 Alarm	YELLOW
PT_1203_08_ERR	After filtrate pump pressure sensor link error	“ERR” text in RED
PT_1203_08_AHH	Pressure after filtrate pump reaches high level 2 Alarm	RED
PT_1203_08_AH	Pressure after filtrate pump reaches high level 1 Alarm	YELLOW
PT_1203_08_ALL	Pressure after filtrate pump reaches low level 2 Alarm	RED
PT_1203_08_AL	Pressure after filtrate pump reaches low level 1 Alarm	YELLOW
SV_1203_03_A	N2 input valve to harvesting tank in wrong position	RED and “ERR” text in RED
SV_1203_04_A	N2 input valve to harvesting tank in wrong position	RED and “ERR” text in RED
SV_1204_01_A	Drain valve of the harvesting tank in wrong position	RED and “ERR” text in RED

TAG NAME	Description	Colour
SV_1204_02_A	Air inlet valve of the harvesting tank in wrong position	RED and "ERR" text in RED
SV_1204_03_A	Filtrate flow valve in wrong position	RED and "ERR" text in RED
TT_1205_01_ERR	Harvesting tank temperature sensor link error	"ERR" text in RED
TT_1205_01_AHH	Harvesting tank temperature reaches high level 2 Alarm	RED
TT_1205_01_AH	Harvesting tank temperature reaches high level 1 Alarm	YELLOW
TT_1205_01_ALL	Harvesting tank temperature reaches low level 2 Alarm	RED
TT_1205_01_AL	Harvesting tank temperature reaches low level 1 Alarm	YELLOW
LT_1206_01_ERR	Harvesting tank level sensor link error	"ERR" text in RED
LT_1206_01_AHH	Harvesting tank level reaches high level 2 Alarm	RED
LT_1206_01_AH	Harvesting tank level reaches high level 1 Alarm	YELLOW
LT_1206_01_ALL	Harvesting tank level reaches low level 2 Alarm	RED
LT_1206_01_AL	Harvesting tank level reaches low level 1 Alarm	YELLOW
LSL_1206_01_A	Harvesting tank low level switch Alarm	RED
LSH_1206_01_A	Harvesting tank high level switch Alarm	RED
CP_1207_01_RunDry_A	Cleaning pump alarm	RED
CP_1207_02_RunDry_A	Cleaning pump alarm	RED
S3V_1207_03_A	Retentate line cleaning valve in wrong position	RED and "ERR" text in RED
S3V_1207_04_A	Retentate line cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_01_A	Influent tank cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_02_A	Bioreactor cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_03_A	Cleaning agent input valve of the harvest tank in wrong position	RED and "ERR" text in RED
SV_1207_04_A	VSSL_1209_02 cleaning agent inlet valve in wrong position	RED and "ERR" text in RED
SV_1207_05_A	Filtrate side cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_06_A	Cleaning input valve to the Membrane 2 filtrate side in wrong position	RED and "ERR" text in RED
SV_1207_07_A	Cleaning input valve to the Membrane 1 filtrate side in wrong position.	RED and "ERR" text in RED
SV_1207_08_A	Cleaning input valve to Membrane 2 retentate side in wrong position	
SV_1207_09_A	Cleaning input valve to Membrane 1 retentate side in wrong position	RED and "ERR" text in RED
SV_1207_10_A	Membrane 2 retentate side cleaning valve in wrong position	
SV_1207_11_A	Membrane 1 retentate side cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_13_A	Bypass valve between outlet retentate side and filtrate side in wrong position	RED and "ERR" text in RED
TT_1208_01_ERR	VSSL_1209_02 temperature sensor link error	"ERR" text in RED
TT_1208_01_AHH	VSSL_1209_02 temperature reaches high level 2 Alarm	RED
TT_1208_01_AH	VSSL_1209_02 temperature reaches high level 1 Alarm	YELLOW
TT_1208_01_ALL	VSSL_1209_02 temperature reaches low level 2 Alarm	RED
TT_1208_01_AL	VSSL_1209_02 temperature reaches low level 1 Alarm	YELLOW
LSH_1209_01_A	VSSL_1209_01 high level switch Alarm	RED
LSL_1209_01_A	VSSL_1209_01 low level switch Alarm	RED
LSH_1209_02_A	VSSL_1209_02 high level switch Alarm	RED
LSL_1209_02_A	VSSL_1209_02 low level switch Alarm	RED
SV_1209_01_A	VSSL_1209_02 drain valve in wrong position	RED and "ERR" text in RED
SV_1209_02_A	VSSL_1209_02 air outlet valve in wrong position	RED and "ERR" text in RED
SV_1209_03_A	VSSL_1209_01 water inlet valve in wrong position	RED and "ERR" text in RED
SV_1209_04_A	VSSL_1209_01 drain valve in wrong position	RED and "ERR" text in RED
SV_1209_05_A	VSSL_1209_01 air outlet valve in wrong position	RED and "ERR" text in RED

Table 6-27: Alarm tags of the Membrane 1 CIP system

6.11.3 Tags

The following tags are displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	Units	Range
TT_1200_01	Temperature in retentate line	Analogue indicator	(ºC)	0 to 100
TT_1200_02_AV	Temperature in Membrane 1	Analogue indicator	(ºC)	0 to 400
CL1200_SCI_MEMBR1_PRESENT	Membrane 1 presence in its housing	Filter animated	--	--
AT_1201_01	Turbidity in retentate side	Analogue indicator	TBD	0 to 100
FT_1201_01_IN_L_PER_H_FILTERED	Flow in retentate side	Analogue indicator	(L/h)	0 to 580
GP_1201_01_MV1	Retentate pump	Pump animated	--	--
S3V_1201_01_FB	Filtration Unit bypass valve	3-way valve animated	--	--
S3V_1201_04_FB	Filtration Unit bypass valve	3-way valve animated	--	--
S3V_1201_07_FB	Valve allows flow from VSSL_1207_01 tank to retentate line.	3-way valve animated	--	--
S3V_1201_08_FB	Retentate line drain valve	3-way valve animated	--	--
SV_1201_01_FB	Valve allows flow from bioreactor to filtration unit	2-way valve animated	--	--
SV_1201_02_FB	Valve allows flow from filtration unit to bioreactor	2-way valve animated	--	--
SV_1201_03_FB	Membrane 1 outlet retentate side valve	2-way valve animated	--	--
SV_1201_05_FB	Inlet valve retentate line Membrane 1	2-way valve animated	--	--
SV_1201_06_FB	Inlet retentate side Membrane 2 valve	2-way valve animated	--	--
SV_1201_07_FB	Drain Membrane 1 valve	2-way valve animated	--	--
PP_1202_01_MV1	Filtrate pump	Pump animated	--	--
SV_1202_01_FB	Membrane 1 filtrate side valve	2-way valve animated	--	--
SV_1202_02_FB	Filtrate side Membrane 2 valve	2-way valve animated	--	--
SV_1202_04_FB	Filtrate flow to vessel valve (before filter)	2-way valve animated	--	--
PT_1203_01	Pressure in Membrane 1 retentate side	Analogue indicator	(bar)	0 to 4
PT_1203_02	Pressure in outlet retentate side membrane 1	Analogue indicator	(bar)	0 to 4
PT_1203_03	Pressure in Membrane 1 filtrate side	Analogue indicator	(bar)	-1 to 4
PT_1203_07	Pressure of retentate after GP_1201_01 pump	Analogue indicator	(bar)	-1 to 9
PT_1203_08	Pressure after filtrate pump	Analogue indicator	(bar)	0 to 4
SV_1203_03_FB	N2 input valve to harvesting tank	2-way valve animated	--	--
SV_1203_04_FB	N2 input valve to harvesting tank	2-way valve animated	--	--
SV_1204_01_FB	Harvesting line valve	2-way valve animated	--	--
SV_1204_02_FB	Air inlet valve (harvesting tank)	2-way valve animated	--	--
SV_1204_03_FB	Filtrate flow to vessel valve (after filter)	2-way valve animated	--	--
TT_1205_01	Harvesting tank temperature	Analogue	(ºC)	0 to

Tag Name	Description	Type	Units	Range
		indicator		100
LSL_1206_01	Low level switch harvesting tank	Digital indicator	--	--
LSH_1206_01	High level switch harvesting tank	Digital indicator	--	--
VSL2_1204_01_VOLUME	Harvesting tank level	Analogue indicator	(L)	0 to 100
CP_1207_01_MV	Circulated cleaning pump	Pump animated	--	--
CP_1207_02_MV	Retentate side circulated cleaning pump	Pump animated	--	--
S3V_1207_03_FB	Retentate line cleaning valve	3-way valve animated	--	--
S3V_1207_04_FB	Retentate line cleaning valve	3-way valve animated	--	--
SV_1207_01_FB	Influent tank cleaning valve	2-way valve animated	--	--
SV_1207_02_FB	Bioreactor cleaning valve	2-way valve animated	--	--
SV_1207_03_FB	Cleaning agent input valve of the harvest tank	2-way valve animated	--	--
SV_1207_04_FB	VSSL_1209_02 cleaning agent inlet valve	2-way valve animated	--	--
SV_1207_05_FB	Membranes filtrate side cleaning valve	2-way valve animated	--	--
SV_1207_06_FB	Cleaning input valve to the Membrane 2 filtrate side	2-way valve animated	--	--
SV_1207_07_FB	Cleaning input valve to the Membrane 1 filtrate side	2-way valve animated	--	--
SV_1207_08_FB	Cleaning input valve to Membrane 2 retentate side	2-way valve animated	--	--
SV_1207_09_FB	Cleaning input valve to Membrane 1 retentate side	2-way valve animated	--	--
SV_1207_10_FB	Membrane 2 retentate side cleaning valve	2-way valve animated	--	--
SV_1207_11_FB	Membrane 1 retentate side cleaning valve	2-way valve animated	--	--
SV_1207_13_FB	Bypass valve between outlet retentate side and filtrate side	2-way valve animated	--	--
HX_1208_01_MV	Cleaning buffer tank heat exchanger	Heat Exchanger animated	--	--
TT_1208_01	VSSL_1209_02 temperature	Analogue indicator	0	100
CL1208_SCI_CB_TEMP_SP	Cleaning buffer tank temperature set-point	User Input	0	100
PP_1209_01_MV	Pumps cleaning agent from VSSL_1209_03 to VSSL_1209_01	Pump animated	--	--
LSH_1209_01	VSSL_1209_01 high level switch	Digital indicator	--	--
LSL_1209_01	VSSL_1209_01 low level switch	Digital indicator	--	--
LSH_1209_02	VSSL_1209_02 high level switch	Digital indicator	--	--
LSL_1209_02	VSSL_1209_02 low level switch	Digital indicator	--	--
SV_1209_01_FB	VSSL_1209_02 drain valve	2-way valve animated	--	--
SV_1209_02_FB	VSSL_1209_02 air outlet valve	2-way valve animated	--	--
SV_1209_03_FB	Fill VSSL_1209_01 with water	2-way valve animated	--	--
SV_1209_04_FB	VSSL_1209_01 drain valve	2-way valve animated	--	--
SV_1209_05_FB	VSSL_1209_01 air outlet valve	2-way valve animated	--	--
SV_1210_12_MV	N2 outlet valve to harvesting tank	2-way valve animated	--	--

Table 6-28: Tags of the Membrane 1 CIP screen

6.11.4 Control loops

The following control loops are implemented on the screen:

Control Logic	Description
CL1207	Cleaning in place mode

Table 6-29: Control Loop of the CIP (Membrane 1) screen

6.12 Cleaning in Place screen (Membrane 2)

CIP membrane 2 screen is opened from the CIP membrane 1 screen command button, from this screen also is possible coming back to the CIP membrane 1 screen. This screen has the same functionalities than membrane 1.

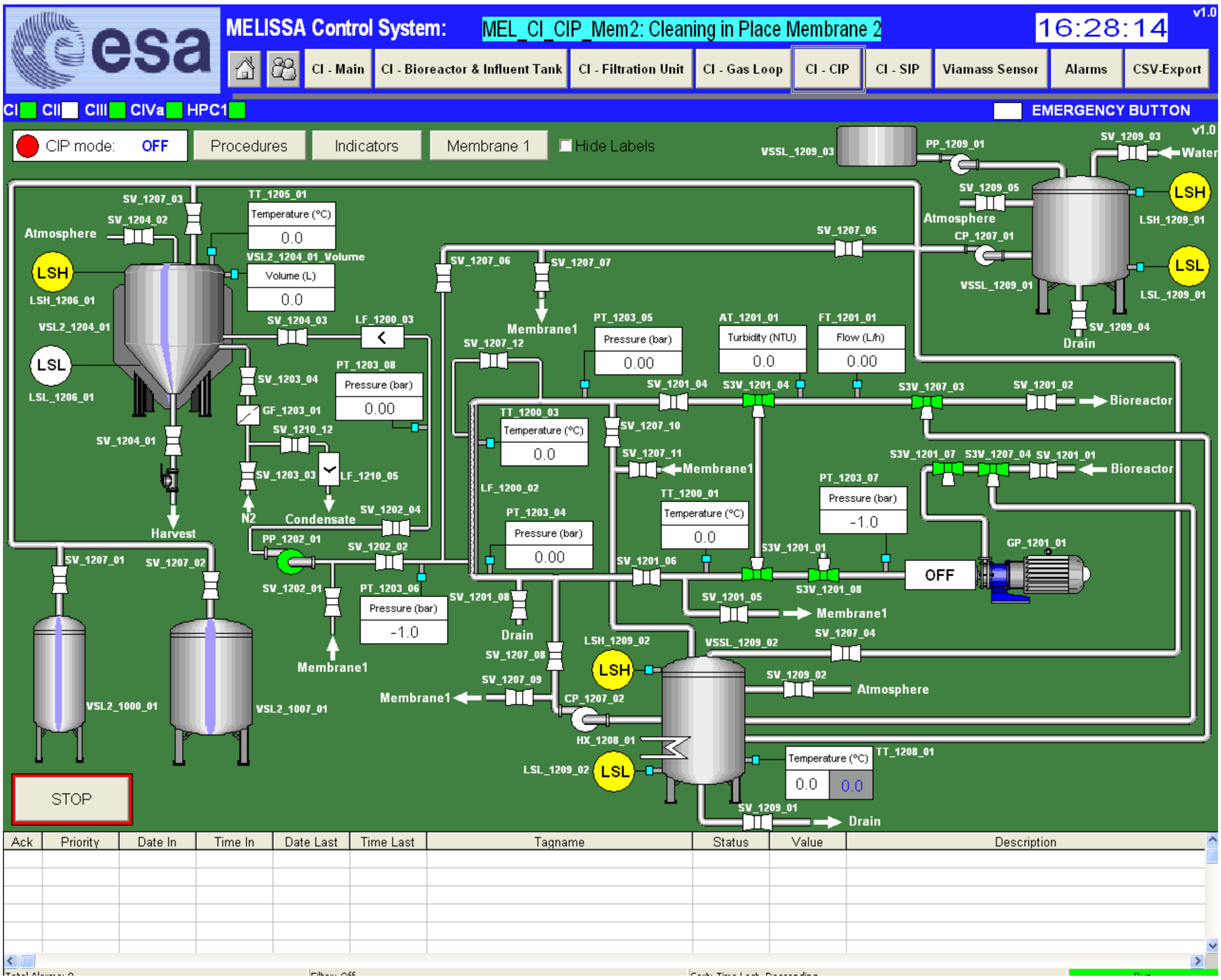


Figure 6-30: Main objects in Membrane 2 CIP screen

6.12.1 Alarms

The following alarms are linked with the operation of the Membrane 2 CIP screen.

TAG NAME	Description	Colour
TT_1200_01_ERR	Inlet retentate line temperature sensor link error	“ERR” text in RED
TT_1200_01_AHH	Inlet retentate line temperature reaches high level 2 Alarm	RED
TT_1200_01_AH	Inlet retentate line temperature reaches high level 1 Alarm	YELLOW
TT_1200_01_ALL	Inlet retentate line temperature reaches low level 2 Alarm	RED
TT_1200_01_AL	Inlet retentate line temperature reaches low level 1 Alarm	YELLOW
TT_1200_03_ERR	Membrane 2 temperature sensor link error	“ERR” text in RED
TT_1200_03_AHH	Membrane 2 temperature reaches high level 2 sensor	RED
TT_1200_03_AH	Membrane 2 temperature reaches high level 1 sensor	YELLOW
TT_1200_03_ALL	Membrane 2 temperature reaches low level 2 sensor	RED
TT_1200_03_AL	Membrane 2 temperature reaches low level 1 sensor	YELLOW
AT_1201_01_ERR	Turbidity in outlet retentate side sensor link error	“ERR” text in RED
AT_1201_01_AHH	Turbidity in outlet retentate side reaches high level 2 Alarm	RED

TAG NAME	Description	Colour
AT_1201_01_AH	Turbidity in outlet retentate side reaches high level 1 Alarm	YELLOW
AT_1201_01_ALL	Turbidity in outlet retentate side reaches low level 2 Alarm	RED
AT_1201_01_AL	Turbidity in outlet retentate side reaches low level 1 Alarm	YELLOW
FT_1201_01_ERR	Outlet retentate flow sensor link error	“ERR” text in RED
FT_1201_01_AHH	Outlet retentate flow reaches high level 2 Alarm	RED
FT_1201_01_AH	Outlet retentate flow reaches high level 1 Alarm	YELLOW
FT_1201_01_ALL	Outlet retentate flow reaches low level 2 Alarm	RED
FT_1201_01_AL	Outlet retentate flow reaches low level 1 Alarm	YELLOW
GP_1201_01_FreqDrive_A	Gear pump alarm	RED
GP_1201_01_PowerSupply_A	Gear pump alarm	RED
GP_1201_01_FLOW_A	Flow of retentate line is below 50L/h. GP_1201_01_might_run_dry, the pump is stopped	RED
S3V_1201_01_A	Bypass valve in wrong position	RED and “ERR” text in RED
S3V_1201_04_A	Bypass valve in wrong position	RED and “ERR” text in RED
S3V_1201_07_A	Valve allows flow from VSSL_1207_01 tank to retentate line in wrong position	RED and “ERR” text in RED
S3V_1201_08_A	Retentate line drain valve in wrong position	RED and “ERR” text in RED
SV_1201_01_A	Valve allows flow from bioreactor to filtration unit in wrong position	RED and “ERR” text in RED
SV_1201_02_A	Valve allows flow from filtration unit to bioreactor in wrong position	RED and “ERR” text in RED
SV_1201_04_A	Outlet retentate side Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1201_05_A	Inlet retentate Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1201_06_A	Inlet retentate Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1201_08_A	Drain Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1202_01_A	Filtrate side Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1202_02_A	Filtrate side Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1202_04_A	Filtrate flow valve in wrong position	RED and “ERR” text in RED
PT_1203_04_ERR	Inlet retentate side Membrane 2 pressure sensor link error	“ERR” text in RED
PT_1203_04_AHH	Inlet retentate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_04_AH	Inlet retentate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_04_ALL	Inlet retentate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_04_AL	Inlet retentate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_05_ERR	Outlet retentate side Membrane 2 pressure sensor link error	“ERR” text in RED
PT_1203_05_AHH	Outlet retentate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_05_AH	Outlet retentate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_05_ALL	Outlet retentate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_05_AL	Outlet retentate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_06_ERR	Filtrate side Membrane 2 pressure sensor link error	“ERR” text in RED
PT_1203_06_AHH	Filtrate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_06_AH	Filtrate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_06_ALL	Filtrate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_06_AL	Filtrate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_07_ERR	Pressure after circulation pump sensor link error	“ERR” text in RED
PT_1203_07_AHH	Pressure after circulation pump reaches high level 2 Alarm	RED
PT_1203_07_AH	Pressure after circulation pump reaches high level 1 Alarm	YELLOW
PT_1203_07_ALL	Pressure after circulation pump reaches low level 2 Alarm	RED
PT_1203_07_AL	Pressure after circulation pump reaches low level 1 Alarm	YELLOW
PT_1203_08_ERR	After filtrate pump pressure sensor link error	“ERR” text in RED
PT_1203_08_AHH	Pressure after filtrate pump reaches high level 2 Alarm	RED
PT_1203_08_AH	Pressure after filtrate pump reaches high level 1 Alarm	YELLOW
PT_1203_08_ALL	Pressure after filtrate pump reaches low level 2 Alarm	RED
PT_1203_08_AL	Pressure after filtrate pump reaches low level 1 Alarm	YELLOW
SV_1203_03_A	N2 input valve to harvesting tank in wrong position	RED and “ERR” text in RED
SV_1203_04_A	N2 input valve to harvesting tank in wrong position	RED and “ERR” text in RED

TAG NAME	Description	Colour
SV_1204_01_A	Drain valve of the harvesting tank in wrong position	RED and "ERR" text in RED
SV_1204_02_A	Air inlet valve of the harvesting tank in wrong position	RED and "ERR" text in RED
SV_1204_03_A	Filtrate flow valve in wrong position	RED and "ERR" text in RED
TT_1205_01_ERR	Harvesting tank temperature sensor link error	"ERR" text in RED
TT_1205_01_AHH	Harvesting tank temperature reaches high level 2 Alarm	RED
TT_1205_01_AH	Harvesting tank temperature reaches high level 1 Alarm	YELLOW
TT_1205_01_ALL	Harvesting tank temperature reaches low level 2 Alarm	RED
TT_1205_01_AL	Harvesting tank temperature reaches low level 1 Alarm	YELLOW
LT_1206_01_ERR	Harvesting tank level sensor link error	"ERR" text in RED
LT_1206_01_AHH	Harvesting tank level reaches high level 2 Alarm	RED
LT_1206_01_AH	Harvesting tank level reaches high level 1 Alarm	YELLOW
LT_1206_01_ALL	Harvesting tank level reaches low level 2 Alarm	RED
LT_1206_01_AL	Harvesting tank level reaches low level 1 Alarm	YELLOW
LSL_1206_01_A	Harvesting tank low level switch Alarm	RED
LSH_1206_01_A	Harvesting tank high level switch Alarm	RED
CP_1207_01_RunDry_A	Cleaning pump alarm	RED
CP_1207_02_RunDry_A	Cleaning pump alarm	RED
S3V_1207_03_A	Retentate line cleaning valve in wrong position	RED and "ERR" text in RED
S3V_1207_04_A	Retentate line cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_01_A	Influent tank cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_02_A	Bioreactor cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_03_A	Cleaning agent input valve of the harvest tank in wrong position	RED and "ERR" text in RED
SV_1207_04_A	VSSL_1209_02 cleaning agent inlet valve in wrong position	RED and "ERR" text in RED
SV_1207_05_A	Filtrate side cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_06_A	Cleaning input valve to the Membrane 2 filtrate side in wrong position	
SV_1207_07_A	Cleaning input valve to the Membrane 1 filtrate side in wrong position.	RED and "ERR" text in RED
SV_1207_08_A	Cleaning input valve to Membrane 2 retentate side in wrong position	
SV_1207_09_A	Cleaning input valve to Membrane 1 retentate side in wrong position	RED and "ERR" text in RED
SV_1207_10_A	Membrane 2 retentate side cleaning valve in wrong position	
SV_1207_11_A	Membrane 1 retentate side cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_12_A	Bypass valve between Membrane 2 outlet retentate side and filtrate side in wrong position	RED and "ERR" text in RED
TT_1208_01_ERR	VSSL_1209_02 temperature sensor link error	"ERR" text in RED
TT_1208_01_AHH	VSSL_1209_02 temperature reaches high level 2 Alarm	RED
TT_1208_01_AH	VSSL_1209_02 temperature reaches high level 1 Alarm	YELLOW
TT_1208_01_ALL	VSSL_1209_02 temperature reaches low level 2 Alarm	RED
TT_1208_01_AL	VSSL_1209_02 temperature reaches low level 1 Alarm	YELLOW
LSH_1209_01_A	VSSL_1209_01 high level switch Alarm	RED
LSL_1209_01_A	VSSL_1209_01 low level switch Alarm	RED
LSH_1209_02_A	VSSL_1209_02 high level switch Alarm	RED
LSL_1209_02_A	VSSL_1209_02 low level switch Alarm	RED
SV_1209_01_A	VSSL_1209_02 drain valve in wrong position	RED and "ERR" text in RED
SV_1209_02_A	VSSL_1209_02 air outlet valve in wrong position	RED and "ERR" text in RED
SV_1209_03_A	VSSL_1209_01 water inlet valve in wrong position	RED and "ERR" text in RED
SV_1209_04_A	VSSL_1209_01 drain valve in wrong position	RED and "ERR" text in RED
SV_1209_05_A	VSSL_1209_01 air outlet valve in wrong position	RED and "ERR" text in RED
SV_1210_12_A	N2 outlet valve to harvesting tank in wrong position	RED and "ERR" text in RED

Table 6-30: Alarm tags of the Membrane 2 CIP system

6.12.2 Tags

The following tags are displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	Units	Range
TT_1200_01	Temperature in retentate line	Analogue indicator	(ºC)	0 to 100
TT_1200_03_AV	Temperature in Membrane 2	Analogue indicator	(ºC)	0 to 400
CL1200_SCI_MEMBR2_PRESENT	Membrane 2 presence in its housing	Filter animated	--	--
AT_1201_01	Turbidity in retentate side	Analogue indicator	TBD	0 to 100
FT_1201_01_IN_L_PER_H_FILTERED	Flow in retentate side	Analogue indicator	(L/h)	0 to 580
GP_1201_01_MV1	Retentate pump	Pump animated	--	--
S3V_1201_01_FB	Filtration Unit bypass valve	3-way valve animated	--	--
S3V_1201_04_FB	Filtration Unit bypass valve	3-way valve animated	--	--
S3V_1201_07_FB	Valve allows flow from VSSL_1207_01 tank to retentate line.	3-way valve animated	--	--
S3V_1201_08_FB	Retentate line drain valve	3-way valve animated	--	--
SV_1201_01_FB	Valve allows flow from bioreactor to filtration unit	2-way valve animated	--	--
SV_1201_02_FB	Valve allows flow from filtration unit to bioreactor	2-way valve animated	--	--
SV_1201_04_FB	Membrane 2 outlet retentate side valve	2-way valve animated	--	--
SV_1201_05_FB	Inlet valve retentate line Membrane 1	2-way valve animated	--	--
SV_1201_06_FB	Inlet retentate side Membrane 2 valve	2-way valve animated	--	--
SV_1201_08_FB	Drain Membrane 2 valve	2-way valve animated	--	--
PP_1202_01_MV1	Filtrate pump	Pump animated	--	--
SV_1202_01_FB	Membrane 1 filtrate side valve	2-way valve animated	--	--
SV_1202_02_FB	Filtrate side Membrane 2 valve	2-way valve animated	--	--
SV_1202_04_FB	Filtrate flow to vessel valve (before filter)	2-way valve animated	--	--
PT_1203_04	Pressure in Membrane 2 retentate side	Analogue indicator	(bar)	0 to 4
PT_1203_05	Pressure in outlet retentate side membrane 2	Analogue indicator	(bar)	0 to 4
PT_1203_06	Pressure in Membrane 2 filtrate side	Analogue indicator	(bar)	-1 to 4
PT_1203_07	Pressure of retentate after GP_1201_01	Analogue	(bar)	-1 to 9

Tag Name	Description	Type	Units	Range
	pump	indicator		
PT_1203_08	Pressure after filtrate pump	Analogue indicator	(bar)	0 to 4
SV_1203_03_FB	N2 input valve to harvesting tank	2-way valve animated	--	--
SV_1203_04_FB	N2 input valve to harvesting tank	2-way valve animated	--	--
SV_1204_01_FB	Harvesting line valve	2-way valve animated	--	--
SV_1204_02_FB	Air inlet valve (harvesting tank)	2-way valve animated	--	--
SV_1204_03_FB	Filtrate flow to vessel valve (after filter)	2-way valve animated	--	--
TT_1205_01	Harvesting tank temperature	Analogue indicator	(ºC)	0 to 100
VSL2_1204_01_VOLUME	Harvesting tank level	Analogue indicator	(L)	0 to 100
LSL_1206_01	Low level switch harvesting tank	Digital indicator	--	--
LSH_1206_01	High level switch harvesting tank	Digital indicator	--	--
CP_1207_01_MV	Circulated cleaning pump	Pump animated	--	--
CP_1207_02_MV	Retentate side circulated cleaning pump	Pump animated	--	--
CL1207_SCI_CL1	Cleaning retentate Membrane 1 side	Button	--	--
CL1207_SCI_CL2	Cleaning retentate Membrane 2 side	Button	--	--
CL1207_SCI_BCL1	Cleaning both side of Membrane 1	Button	--	--
CL1207_SCI_BCL2	Cleaning both side of Membrane 2	Button	--	--
CL1207_SCI_BW1	Backwashing Membrane 1	Button	--	--
CL1207_SCI_BW2	Backwashing Membrane 2	Button	--	--
CL1207_SCI_CLPMP	Clean pump GP_1201_01	Button	--	--
CL1207_SCI_VSL2_1204_01	Clean effluent vessel	Button	--	--
CL1207_SCI_ET1	Clean effluent tank and Membrane 1 filtrate line	Button	--	--
CL1207_SCI_ET2	Clean effluent tank and Membrane 2 filtrate line	Button	--	--
CL1207_SCI_P_CL1	AUTO cleaning Membrane 1	Button	--	--
CL1207_SCI_P_CL2	AUTO cleaning Membrane 2	Button	--	--
CL1207_P_CL_CNTR_TIMES_1	Counter:Retentate side of FU with clear water	User input	(Number of time)	0 to 1000
CL1207_P_CL_CNTR_TIMES_2	Counter:Retentate side of FU with cleaning agent	User input	(Number of time)	0 to 1000
CL1207_P_CL_CNTR_TIMES_3	Counter:Filtrate side of FU with cleaning agent	User input	(Number of time)	0 to 1000
CL1207_P_CL_CNTR_TIMES_4	Counter:Retentate side of FU with clear water	User input	(Number of time)	0 to 1000
CL1207_P_CL_CNTR_TIMES_5	Counter:Filtrate side of FU with clear water	User input	(Number of time)	0 to 1000
CL1207_SCI_RINSE_CA	Rinse VSSL_1209_01 tank	Button	--	--
CL1207_SCI_FILL_CA	Fill VSSL_1209_01 with cleaning agent	Button	--	--
CL1207_SCI_RINSE_CB	Rinse VSSL_1209_02 tank	Button	--	--
CL1207_SCI_STOP	Stop any cleaning activity	Button	--	--
CL1207_TB_STOP	Status of the stop cleaning activity	Digital indicator	--	--
CL1207_TB_CL1	Status of the cleaning membrane 1	Digital indicator	--	--
CL1207_TB_CL2	Status of the cleaning membrane 2	Digital indicator	--	--
CL1207_TB_BCL1	Status of the cleaning both side of membrane 1	Digital indicator	--	--
CL1207_TB_BCL2	Status of the cleaning both side of membrane 2	Digital indicator	--	--

Tag Name	Description	Type	Units	Range
CL1207_TB_BW1	Status of the backwashing membrane 1	Digital indicator	--	--
CL1207_TB_BW2	Status of the backwashing membrane 2	Digital indicator	--	--
CL1207_TB_CLPMP	Status of the cleaning pump GP_1201_01	Digital indicator	--	--
CL1207_TB_VSL2_1204_01	Status of the cleaning effluent vessel	Digital indicator	--	--
CL1207_TB_ET1	Status of the cleaning effluent tank and Membrane 1 filtrate line	Digital indicator	--	--
CL1207_TB_ET2	Status of the cleaning effluent tank and Membrane 2 filtrate line	Digital indicator	--	--
CL1207_TB_P_CL1	Status of the AUTO cleaning Membrane 1	Digital indicator	--	--
CL1207_TB_P_CL2	Status of the AUTO cleaning Membrane 2	Digital indicator	--	--
CL1207_TB_CLEAN_CAB	Status of the cleaning vessels VSSL_1209_01 and VSSL_1209_02.	Digital indicator	--	--
CL1207_TB_RINSE_CA	Status of the rinsing of VSSL_1209_01	Digital indicator	--	--
CL1207_TB_RINSE_CB	Status of the rinsing of VSSL_1209_01	Digital indicator	--	--
S3V_1207_03_FB	Retentate line cleaning valve	3-way valve animated	--	--
S3V_1207_04_FB	Retentate line cleaning valve	3-way valve animated	--	--
SV_1207_01_FB	Influent tank cleaning valve	2-way valve animated	--	--
SV_1207_02_FB	Bioreactor cleaning valve	2-way valve animated	--	--
SV_1207_03_FB	Cleaning agent input valve of the harvest tank	2-way valve animated	--	--
SV_1207_04_FB	VSSL_1209_02 cleaning agent inlet valve	2-way valve animated	--	--
SV_1207_05_FB	Membranes filtrate side cleaning valve	2-way valve animated	--	--
SV_1207_06_FB	Cleaning input valve to the Membrane 2 filtrate side	2-way valve animated	--	--
SV_1207_07_FB	Cleaning input valve to the Membrane 1 filtrate side	2-way valve animated	--	--
SV_1207_08_FB	Cleaning input valve to Membrane 2 retentate side	2-way valve animated	--	--
SV_1207_09_FB	Cleaning input valve to Membrane 1 retentate side	2-way valve animated	--	--
SV_1207_10_FB	Membrane 2 retentate side cleaning valve	2-way valve animated	--	--
SV_1207_11_FB	Membrane 1 retentate side cleaning valve	2-way valve animated	--	--
SV_1207_12_FB	Bypass valve between Membrane 2 outlet retentate side and filtrate side	2-way valve animated	--	--
HX_1208_01_MV	Cleaning buffer tank heat exchanger	Heat exchanger	--	--
TT_1208_01	VSSL_1209_02 temperature	Analogue indicator	0	100

Tag Name	Description	Type	Units	Range
CL1208_SCI_CB_TEMP_SP	Cleaning buffer tank temperature set-point	User Input	0	100
PP_1209_01_MV	Pumps cleaning agent from VSSL_1209_03 to VSSL_1209_01	Pump animated	--	--
LSH_1209_01	VSSL_1209_01 high level switch	Digital indicator	--	--
LSL_1209_01	VSSL_1209_01 low level switch	Digital indicator	--	--
LSH_1209_02	VSSL_1209_02 high level switch	Digital indicator	--	--
LSL_1209_02	VSSL_1209_02 low level switch	Digital indicator	--	--
CL1209_CLEANING_AGENT_S	Select cleaning agent to fill tank	Button	--	--
CL1209_SCI_FILL_CA_DETERGTIME	Time to fill tank with cleaning agent	User input	(seconds)	0 to 9.999.999
CL1209_CLEANING_AGENT_R	Select water to fill tank	Button	--	--
CL1209_SCI_EMPTY_CA	Empty VSSL_1209_01	Button	--	--
CL1209_SCI_EMPTY_CB	Empty VSSL_1209_02	Button	--	--
CL1209_SCI_FILL_WA	Fill VSSL_1209_01 with water	Button	--	--
CL1209_SCI_FILL_CB	Fill VSSL_1209_02 with content of VSSL_1209_01	Button	--	--
CL1209_TB_FILL_CB	Status of the VSSL_1209_02 filling.	Digital indicator	--	--
CL1209_TB_EMPTY_CA	Status of the empty VSSL_1209_01	Digital indicator	--	--
CL1209_TB_EMPTY_CB	Status of the empty VSSL_1209_02	Digital indicator	--	--
CL1209_TB_FILL_CA	Status of the VSSL_1209_01 filling with cleaning agent	Digital indicator	--	--
CL1209_TB_FILL_WA	Status of the VSSL_1209_01 filling with water	Digital indicator	--	--
SV_1209_01_FB	VSSL_1209_02 drain valve	2-way valve animated	--	--
SV_1209_02_FB	VSSL_1209_02 air outlet valve	2-way valve animated	--	--
SV_1209_03_FB	Fill VSSL_1209_01 with water	2-way valve animated	--	--
SV_1209_04_FB	VSSL_1209_01 drain valve	2-way valve animated	--	--
SV_1209_05_FB	VSSL_1209_01 air outlet valve	2-way valve animated	--	--
SV_1210_12_MV	N2 outlet valve to harvesting tank	2-way valve animated	--	--

Table 6-31: Tags of the Membrane 2 CIP screen

6.12.3 Control loops

The following control loops are implemented on the screen:

Control Logic	Description
CL1207	Cleaning in place mode

Table 6-32: Control Loop of the CIP (Membrane 2) screen

6.13 Cleaning in Place Maintenance screen (Filtrate side)

Clicking over the filtration area of the Membrane1 CIP screen or Membrane2 CIP screen the following screen is opened. It is displayed the filtrate side, effluent tank, influent tank, bioreactor tank and cleaning equipment.

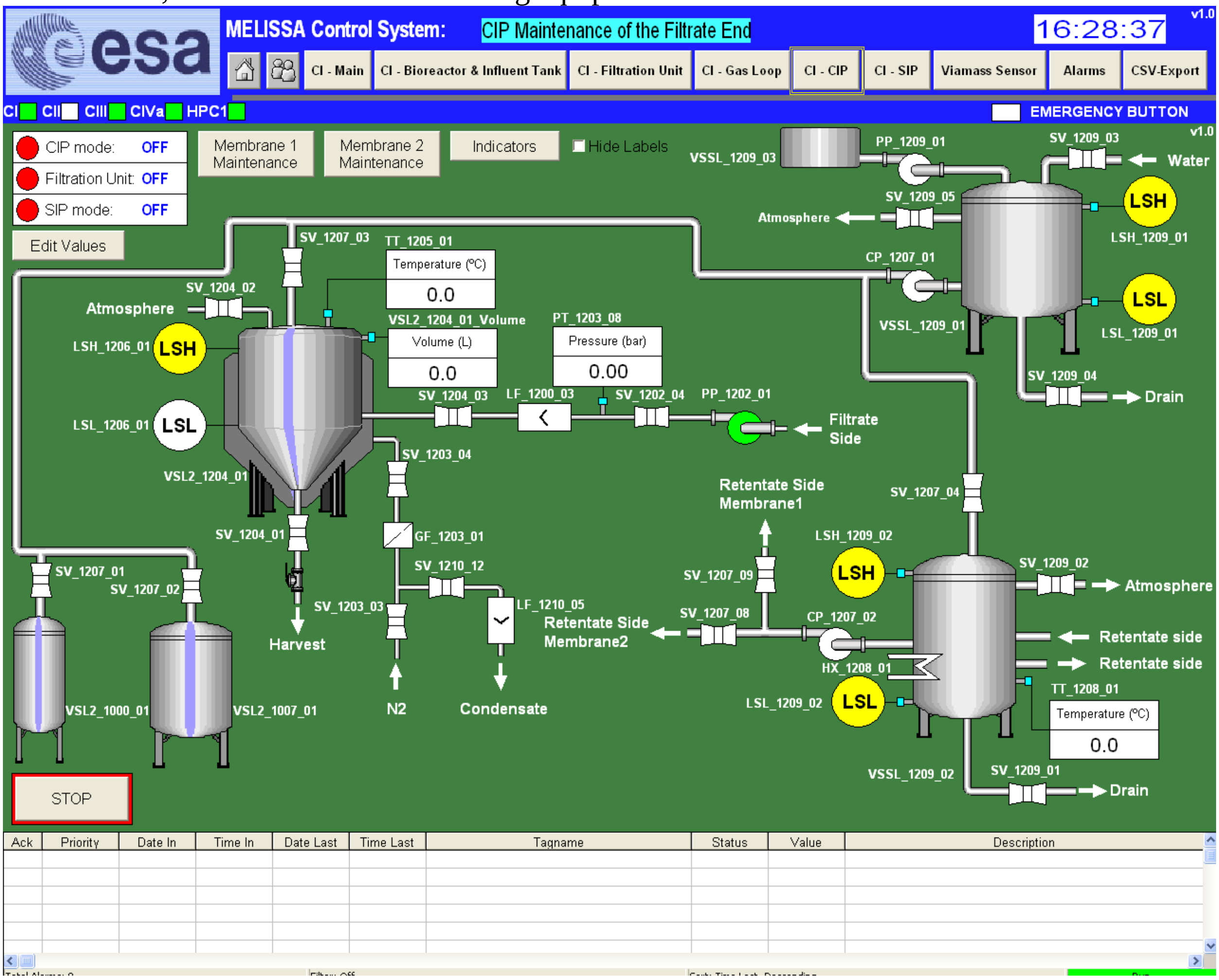


Figure 6-31: Main objects of the CIP Maintenance screen (Filtrate side)

6.13.1 General actions

This display allows the user to:

- 2-way valves, 3-way valves, level switch, pumps animations.
- Analogue indicators.
- Device alarm animations.
- Change Filtration Unit, CIP and SIP control loop mode state.
- Display the status of the CIP procedures clicking “Indicators” command button.

- Navigate to the different screens of the CIP Maintenance through “Membrane 1 Maintenance” and “Membrane 2 Maintenance” command buttons.
- Hide labels selecting the “Hide labels” check box.
- Switch OFF the CIP, Filtration Unit and SIP mode clicking on the “Stop” command button.
- Activate/deactivate valves and pumps in manual mode clicking over the equipment.

- From Edit Values command button, it will be possible to activate/deactivate more than one valve and pumps at the same time.

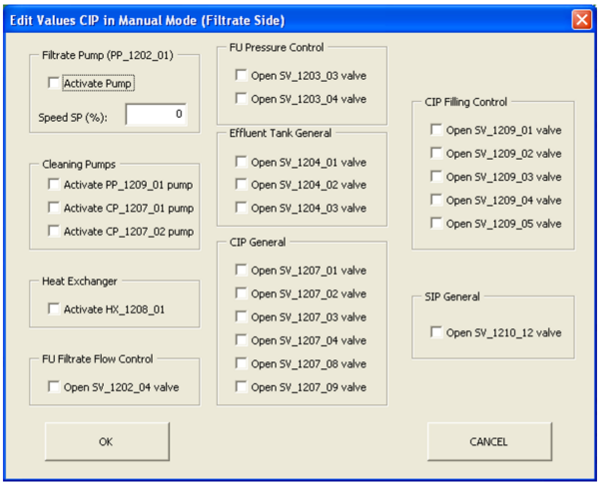


Figure 6-32: Edit Values dialog

6.13.2 Alarms

The following alarms are linked with the operation of the CIP Maintenance screen (Filtrate side).

TAG NAME	Description	Colour
SV_1202_04_A	Filtrate flow valve in wrong position	RED and “ERR” text in RED
PT_1203_08_ERR	After filtrate pump pressure sensor link error	“ERR” text in RED
PT_1203_08_AHH	Pressure after filtrate pump reaches high level 2 Alarm	RED
PT_1203_08_AH	Pressure after filtrate pump reaches high level 1 Alarm	YELLOW
PT_1203_08_ALL	Pressure after filtrate pump reaches low level 2 Alarm	RED
PT_1203_08_AL	Pressure after filtrate pump reaches low level 1 Alarm	YELLOW
SV_1203_03_A	N2 input valve to harvesting tank in wrong position	RED and “ERR” text in RED
SV_1203_04_A	N2 input valve to harvesting tank in wrong position	RED and “ERR” text in RED
SV_1204_01_A	Drain valve of the harvesting tank in wrong position	RED and “ERR” text in RED
SV_1204_02_A	Air inlet valve of the harvesting tank in wrong position	RED and “ERR” text in RED
SV_1204_03_A	Filtrate flow valve in wrong position	RED and “ERR” text in RED
TT_1205_01_ERR	Harvesting tank temperature sensor link error	“ERR” text in RED
TT_1205_01_AHH	Harvesting tank temperature reaches high level 2 Alarm	RED
TT_1205_01_AH	Harvesting tank temperature reaches high level 1 Alarm	YELLOW
TT_1205_01_ALL	Harvesting tank temperature reaches low level 2 Alarm	RED
TT_1205_01_AL	Harvesting tank temperature reaches low level 1 Alarm	YELLOW

TAG NAME	Description	Colour
LT_1206_01_ERR	Harvesting tank level sensor link error	"ERR" text in RED
LT_1206_01_AHH	Harvesting tank level reaches high level 2 Alarm	RED
LT_1206_01_AH	Harvesting tank level reaches high level 1 Alarm	YELLOW
LT_1206_01_ALL	Harvesting tank level reaches low level 2 Alarm	RED
LT_1206_01_AL	Harvesting tank level reaches low level 1 Alarm	YELLOW
LSL_1206_01_A	Harvesting tank low level switch Alarm	RED
LSH_1206_01_A	Harvesting tank high level switch Alarm	RED
CP_1207_01_RunDry_A	Cleaning pump alarm	RED
CP_1207_02_RunDry_A	Cleaning pump alarm	RED
SV_1207_01_A	Influent tank cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_02_A	Bioreactor cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_03_A	Cleaning agent input valve of the harvest tank in wrong position	RED and "ERR" text in RED
SV_1207_04_A	VSSL_1209_02 cleaning agent inlet valve in wrong position	RED and "ERR" text in RED
SV_1207_08_A	Cleaning input valve to Membrane 2 retentate side in wrong position	
SV_1207_09_A	Cleaning input valve to Membrane 1 retentate side in wrong position	RED and "ERR" text in RED
TT_1208_01_ERR	VSSL_1209_02 temperature sensor link error	"ERR" text in RED
TT_1208_01_AHH	VSSL_1209_02 temperature reaches high level 2 Alarm	RED
TT_1208_01_AH	VSSL_1209_02 temperature reaches high level 1 Alarm	YELLOW
TT_1208_01_ALL	VSSL_1209_02 temperature reaches low level 2 Alarm	RED
TT_1208_01_AL	VSSL_1209_02 temperature reaches low level 1 Alarm	YELLOW
LSH_1209_01_A	VSSL_1209_01 high level switch Alarm	RED
LSL_1209_01_A	VSSL_1209_01 low level switch Alarm	RED
LSH_1209_02_A	VSSL_1209_02 high level switch Alarm	RED
LSL_1209_02_A	VSSL_1209_02 low level switch Alarm	RED
SV_1209_01_A	VSSL_1209_02 drain valve in wrong position	RED and "ERR" text in RED
SV_1209_02_A	VSSL_1209_02 air outlet valve in wrong position	RED and "ERR" text in RED
SV_1209_03_A	VSSL_1209_01 water inlet valve in wrong position	RED and "ERR" text in RED
SV_1209_04_A	VSSL_1209_01 drain valve in wrong position	RED and "ERR" text in RED
SV_1209_05_A	VSSL_1209_01 air outlet valve in wrong position	RED and "ERR" text in RED

Table 6-33: Alarm tags of the CIP Maintenance screen (Filtrate side)

6.13.3 Tags

The following tags are displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	Units	Range
PP_1202_01_MV1	Filtrate pump	Pump animated	--	--
PP_1202_01_MV1_OP	Filtrate pump in manual mode	User Input		
PP_1202_01_MV2_OP	Speed of filtrate pump in manual mode	User Input	(%)	0 to 100
SV_1202_04_FB	Filtrate flow to vessel valve (before filter)	2-way valve animated	--	--
SV_1202_04_OP	Valve in manual mode	User input	--	--
PT_1203_08	Pressure after filtrate pump	Analogue indicator	(bar)	0 to 4
SV_1203_03_FB	N2 input valve to harvesting tank	2-way valve animated	--	--
SV_1203_03_OP	Valve in manual mode	User input	--	--
SV_1203_04_FB	N2 input valve to harvesting tank	2-way valve animated	--	--
SV_1203_04_OP	Valve in manual mode	User input	--	--
SV_1204_01_FB	Harvesting line valve	2-way valve animated	--	--
SV_1204_01_OP	Valve in manual mode	User input	--	--
SV_1204_02_FB	Air inlet valve (harvesting tank)	2-way valve animated	--	--
SV_1204_02_OP	Valve in manual mode	User input	--	--
SV_1204_03_FB	Filtrate flow to vessel valve (after filter)	2-way valve animated	--	--
SV_1204_03_OP	Valve in manual mode	User input	--	--
TT_1205_01	Harvesting tank temperature	Analogue indicator	(ºC)	0 to 100

Tag Name	Description	Type	Units	Range
VSL2_1204_01_VOLUME	Harvesting tank level	Analogue indicator	(L)	0 to 100
LSL_1206_01	Low level switch harvesting tank	Digital indicator	--	--
LSH_1206_01	High level switch harvesting tank	Digital indicator	--	--
CP_1207_01_MV	Circulated cleaning pump	Pump animated	--	--
CP_1207_01_OP	Circulated cleaning pump in manual mode	User Input		
CP_1207_02_MV	Retentate side circulated cleaning pump	Pump animated	--	--
CP_1207_02_OP	Retentate side circulated cleaning pump in manual mode	User Input	--	--
SV_1207_01_FB	Influent tank cleaning valve	2-way valve animated	--	--
SV_1207_01_OP	Valve in manual mode	User input	--	--
SV_1207_02_FB	Bioreactor cleaning valve	2-way valve animated	--	--
SV_1207_02_OP	Valve in manual mode	User input	--	--
SV_1207_03_FB	Cleaning agent input valve of the harvest tank	2-way valve animated	--	--
SV_1207_03_OP	Valve in manual mode	User input	--	--
SV_1207_04_FB	VSSL_1209_02 cleaning agent inlet valve	2-way valve animated	--	--
SV_1207_04_OP	Valve in manual mode	User input	--	--
SV_1207_08_FB	Cleaning input valve to Membrane 2 retentate side	2-way valve animated	--	--
SV_1207_08_OP	Valve in manual mode	User input	--	--
SV_1207_09_FB	Cleaning input valve to Membrane 1 retentate side	2-way valve animated	--	--
SV_1207_09_OP	Valve in manual mode	User input	--	--
HX_1208_01_MV	Cleaning buffer heat exchanger	Heat exchanger animated	--	--
HX_1208_01_OP	Cleaning buffer heat exchanger in manual mode	User Input	--	--
TT_1208_01	VSSL_1209_02 temperature	Analogue indicator	--	--
PP_1209_01_MV	Pumps cleaning agent from VSSL_1209_03 to VSSL_1209_01	Pump animated	--	--
PP_1209_01_OP	Pumps cleaning agent from VSSL_1209_03 to VSSL_1209_01 in manual mode	User Input	--	--
LSH_1209_01	VSSL_1209_01 high level switch	Digital indicator	--	--
LSL_1209_01	VSSL_1209_01 low level switch	Digital indicator	--	--
LSH_1209_02	VSSL_1209_02 high level switch	Digital indicator	--	--
LSL_1209_02	VSSL_1209_02 low level switch	Digital indicator	--	--
SV_1209_01_FB	VSSL_1209_02 drain valve	2-way valve animated	--	--
SV_1209_01_OP	Valve in manual mode	User input	--	--
SV_1209_02_FB	VSSL_1209_02 air outlet valve	2-way valve animated	--	--
SV_1209_02_OP	Valve in manual mode	User input	--	--
SV_1209_03_FB	Fill VSSL_1209_01 with water	2-way valve animated	--	--
SV_1209_03_OP	Valve in manual mode	User input	--	--
SV_1209_04_FB	VSSL_1209_01 drain valve	2-way valve animated	--	--
SV_1209_04_OP	Valve in manual mode	User input	--	--
SV_1209_05_FB	VSSL_1209_01 air outlet valve	2-way valve animated	--	--
SV_1209_05_OP	Valve in manual mode	User input	--	--
SV_1210_12_MV	N2 outlet valve to harvesting tank	2-way valve animated	--	--
SV_1210_12_OP	Valve in manual mode	User input	--	--

Table 6-34: Tags of the CIP Maintenance screen (Filtrate side)

6.13.4 Control loops

The following control loops are implemented on the screen:

Control Logic	Description
CL1200	Filtration Unit mode
CL1207	Cleaning in place mode
CL1210	Sterilization in place mode

Table 6-35: Control Loop of the CIP Maintenance screen (Filtrate side)

6.14 Cleaning in Place Maintenance screen (Membrane 1)

Clicking over Membrane 1 area of the CIP Membrane 1 screen the following screen is opened. Membrane 1 area groups the filtration bypass line, retentate inlet line, membrane 1, retentate outlet line, filtrate outlet line of the Membrane 1 and cleaning equipment.

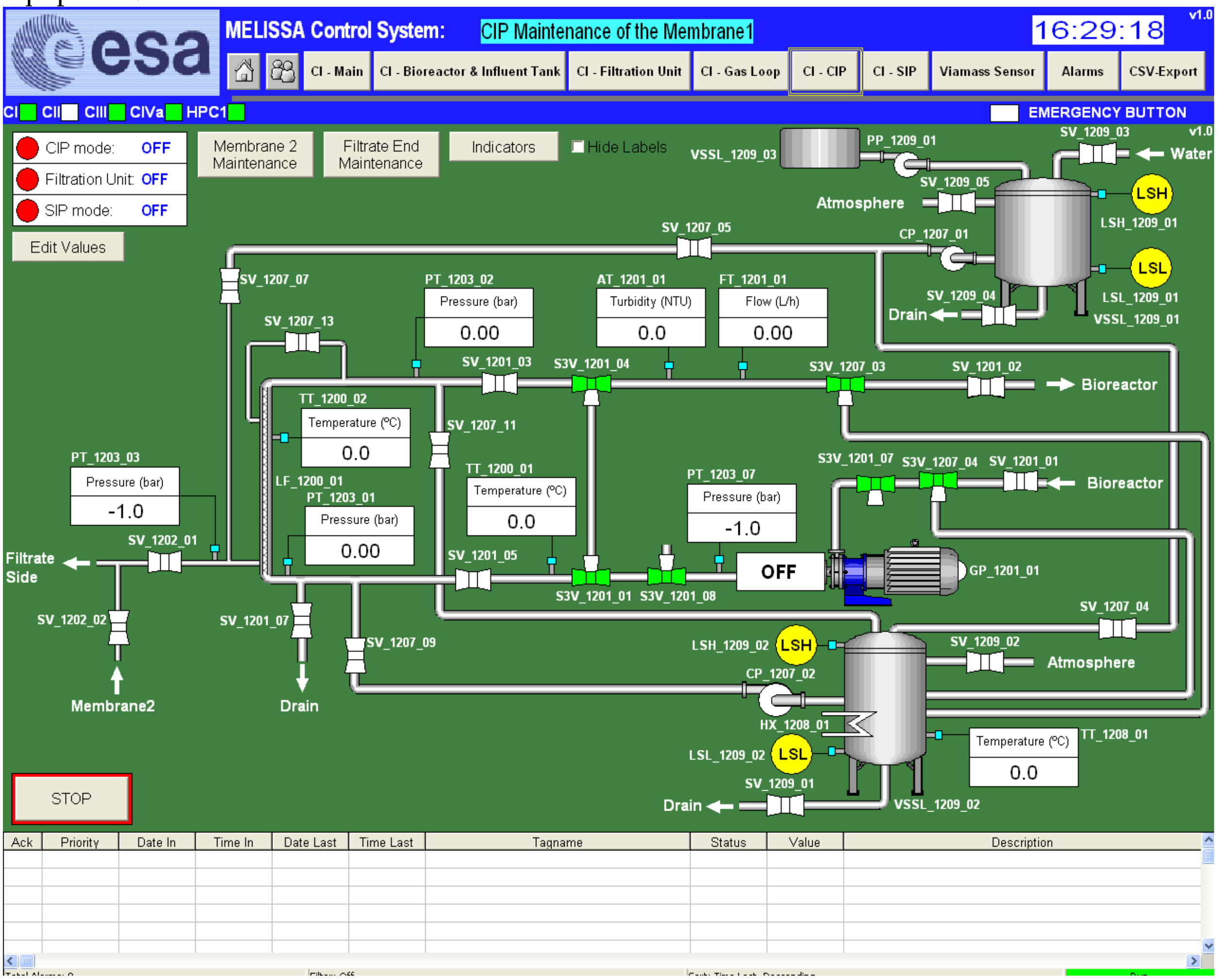


Figure 6-33: Main objects of the CIP Maintenance screen (Membrane1)

This display allows the user to:

- 2-way valves, 3-way valves, level switches, pumps animations.
- Analogue indicators.
- Device alarm animations.
- Change Filtration Unit, CIP and SIP control loop mode state.
- Display the status of the CIP procedures clicking “Indicators” command button.

- Navigate to the different screens of the filtration Unit Maintenance through “Membrane 2 Maintenance” and “Filtrate End Maintenance” command buttons.
- Hide labels selecting the “Hide labels” check box.
- Switch OFF the CIP, Filtration Unit and SIP mode clicking on the “Stop” command button.
- Activate/deactivate valves and pumps in manual mode clicking over the equipment.
- Edit values allows to activate different equipment at the same time in manual mode.

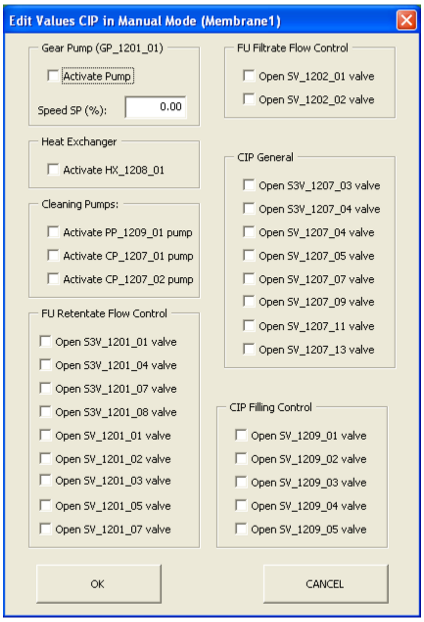


Figure 6-34: Edit Values dialog

6.14.1 Alarms

The following alarms are linked with the operation of the CIP Maintenance screen (Membrane 1)

TAG NAME	Description	Colour
TT_1200_01_ERR	Inlet retentate line temperature sensor link error	“ERR” text in RED
TT_1200_01_AHH	Inlet retentate line temperature reaches high level 2 Alarm	RED
TT_1200_01_AH	Inlet retentate line temperature reaches high level 1 Alarm	YELLOW
TT_1200_01_ALL	Inlet retentate line temperature reaches low level 2 Alarm	RED
TT_1200_01_AL	Inlet retentate line temperature reaches low level 1 Alarm	YELLOW
TT_1200_02_ERR	Membrane 1 temperature sensor link error	“ERR” text in RED
TT_1200_02_AHH	Membrane 1 temperature reaches high level 2 sensor	RED
TT_1200_02_AH	Membrane 1 temperature reaches high level 1 sensor	YELLOW
TT_1200_02_ALL	Membrane 1 temperature reaches low level 2 sensor	RED
TT_1200_02_AL	Membrane 1 temperature reaches low level 1 sensor	YELLOW
AT_1201_01_ERR	Turbidity in outlet retentate side sensor link error	“ERR” text in RED
AT_1201_01_AHH	Turbidity in outlet retentate side reaches high level 2 Alarm	RED
AT_1201_01_AH	Turbidity in outlet retentate side reaches high level 1 Alarm	YELLOW
AT_1201_01_ALL	Turbidity in outlet retentate side reaches low level 2 Alarm	RED
AT_1201_01_AL	Turbidity in outlet retentate side reaches low level 1 Alarm	YELLOW

TAG NAME	Description	Colour
FT_1201_01_ERR	Outlet retentate flow sensor link error	"ERR" text in RED
FT_1201_01_AHH	Outlet retentate flow reaches high level 2 Alarm	RED
FT_1201_01_AH	Outlet retentate flow reaches high level 1 Alarm	YELLOW
FT_1201_01_ALL	Outlet retentate flow reaches low level 2 Alarm	RED
FT_1201_01_AL	Outlet retentate flow reaches low level 1 Alarm	YELLOW
GP_1201_01_FreqDrive_A	Gear pump alarm	RED
GP_1201_01_PowerSupply_A	Gear pump alarm	RED
GP_1201_01_FLOW_A	Flow of retentate line is below 50L/h, GP_1201_01 might run dry, the pump is stopped	RED
S3V_1201_01_A	Bypass valve in wrong position	RED and "ERR" text in RED
S3V_1201_04_A	Bypass valve in wrong position	RED and "ERR" text in RED
S3V_1201_07_A	Valve allows flow from VSSL_1207_01 tank to retentate line in wrong position	RED and "ERR" text in RED
S3V_1201_08_A	Retentate line drain valve in wrong position	RED and "ERR" text in RED
SV_1201_01_A	Valve allows flow from bioreactor to filtration unit in wrong position	RED and "ERR" text in RED
SV_1201_02_A	Valve allows flow from filtration unit to bioreactor in wrong position	RED and "ERR" text in RED
SV_1201_03_A	Outlet retentate side Membrane 1 valve in wrong position	RED and "ERR" text in RED
SV_1201_05_A	Inlet retentate Membrane 1 valve in wrong position	RED and "ERR" text in RED
SV_1201_07_A	Drain Membrane 1 valve in wrong position	RED and "ERR" text in RED
SV_1202_01_A	Filtrate side Membrane 1 valve in wrong position	RED and "ERR" text in RED
SV_1202_02_A	Filtrate side Membrane 2 valve in wrong position	RED and "ERR" text in RED
PT_1203_01_ERR	Inlet retentate side Membrane 1 pressure sensor link error	"ERR" text in RED
PT_1203_01_AHH	Inlet retentate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_01_AH	Inlet retentate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_01_ALL	Inlet retentate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_01_AL	Inlet retentate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_02_ERR	Outlet retentate side Membrane 1 pressure sensor link error	"ERR" text in RED
PT_1203_02_AHH	Outlet retentate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_02_AH	Outlet retentate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_02_ALL	Outlet retentate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_02_AL	Outlet retentate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_03_ERR	Filtrate side Membrane 1 pressure sensor link error	"ERR" text in RED
PT_1203_03_AHH	Filtrate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_03_AH	Filtrate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_03_ALL	Filtrate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_03_AL	Filtrate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_07_ERR	Pressure after circulation pump sensor link error	"ERR" text in RED
PT_1203_07_AHH	Pressure after circulation pump reaches high level 2 Alarm	RED
PT_1203_07_AH	Pressure after circulation pump reaches high level 1 Alarm	YELLOW
PT_1203_07_ALL	Pressure after circulation pump reaches low level 2 Alarm	RED
PT_1203_07_AL	Pressure after circulation pump reaches low level 1 Alarm	YELLOW
CP_1207_01_RunDry_A	Cleaning pump alarm	RED
CP_1207_02_RunDry_A	Cleaning pump alarm	RED
S3V_1207_03_A	Retentate line cleaning valve in wrong position	RED and "ERR" text in RED
S3V_1207_04_A	Retentate line cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_04_A	VSSL_1209_02 cleaning agent inlet valve in wrong position	RED and "ERR" text in RED

TAG NAME	Description	Colour
SV_1207_05_A	Filtrate side cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_07_A	Cleaning input valve to the Membrane 1 filtrate side in wrong position.	RED and "ERR" text in RED
SV_1207_09_A	Cleaning input valve to Membrane 1 retentate side in wrong position	RED and "ERR" text in RED
SV_1207_11_A	Membrane 1 retentate side cleaning valve in wrong position	RED and "ERR" text in RED
SV_1207_13_A	Bypass valve between outlet retentate side and filtrate side in wrong position	RED and "ERR" text in RED
TT_1208_01_ERR	VSSL_1209_02 temperature sensor link error	"ERR" text in RED
TT_1208_01_AHH	VSSL_1209_02 temperature reaches high level 2 Alarm	RED
TT_1208_01_AH	VSSL_1209_02 temperature reaches high level 1 Alarm	YELLOW
TT_1208_01_ALL	VSSL_1209_02 temperature reaches low level 2 Alarm	RED
TT_1208_01_AL	VSSL_1209_02 temperature reaches low level 1 Alarm	YELLOW
LSH_1209_01_A	VSSL_1209_01 high level switch Alarm	RED
LSL_1209_01_A	VSSL_1209_01 low level switch Alarm	RED
LSH_1209_02_A	VSSL_1209_02 high level switch Alarm	RED
LSL_1209_02_A	VSSL_1209_02 low level switch Alarm	RED
SV_1209_01_A	VSSL_1209_02 drain valve in wrong position	RED and "ERR" text in RED
SV_1209_02_A	VSSL_1209_02 air outlet valve in wrong position	RED and "ERR" text in RED
SV_1209_03_A	VSSL_1209_01 water inlet valve in wrong position	RED and "ERR" text in RED
SV_1209_04_A	VSSL_1209_01 drain valve in wrong position	RED and "ERR" text in RED
SV_1209_05_A	VSSL_1209_01 air outlet valve in wrong position	RED and "ERR" text in RED

Table 6-36: Alarm tags of the CIP Maintenance system (Membrane 1)

6.14.2 Tag name definition

The following tags are displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	Units	Range
TT_1200_01	Temperature in retentate line	Analogue indicator	(ºC)	0 to 100
TT_1200_02_AV	Temperature in Membrane 1	Analogue indicator	(ºC)	0 to 400
CL1200_SCI_MEMBR1_PRESENT	Membrane 1 presence in its housing	Filter animated	--	--
AT_1201_01	Turbidity in retentate side	Analogue indicator	TBD	0 to 100
FT_1201_01_IN_L_PER_H_FILTERED	Flow in retentate side	Analogue indicator	(L/h)	0 to 580
GP_1201_01_MV1	Retentate pump	Pump animated	--	--
GP_1201_01_MV1_OP	Retentate pump in manual mode	User Input	--	--
GP_1201_01_MV2_OP	Speed of retentate pump in manual mode	User Input	(%)	0 to 100
S3V_1201_01_FB	Filtration Unit bypass valve	3-way valve animated	--	--
S3V_1201_01_OP	Valve in manual mode	User input	--	--
S3V_1201_04_FB	Filtration Unit bypass valve	3-way valve animated	--	--
S3V_1201_04_OP	Valve in manual mode	User input	--	--
S3V_1201_07_FB	Valve allows flow from VSSL_1207_01 tank to retentate line.	3-way valve animated	--	--
S3V_1201_07_OP	Valve in manual mode	User input	--	--
S3V_1201_08_FB	Retentate line drain valve	3-way valve animated	--	--
S3V_1201_08_OP	Valve in manual mode	User input	--	--
SV_1201_01_FB	Valve allows flow from bioreactor to filtration unit	2-way valve animated	--	--

Tag Name	Description	Type	Units	Range
SV_1201_01_OP	Valve in manual mode	User input	--	--
SV_1201_02_FB	Valve allows flow from filtration unit to bioreactor	2-way valve animated	--	--
SV_1201_02_OP	Valve in manual mode	User input	--	--
SV_1201_03_FB	Membrane 1 outlet retentate side valve	2-way valve animated	--	--
SV_1201_03_OP	Valve in manual mode	User input	--	--
SV_1201_05_FB	Inlet valve retentate line Membrane 1	2-way valve animated	--	--
SV_1201_05_OP	Valve in manual mode	User input	--	--
SV_1201_07_FB	Drain Membrane 1 valve	2-way valve animated	--	--
SV_1201_07_OP	Valve in manual mode	User input	--	--
SV_1202_01_FB	Membrane 1 filtrate side valve	2-way valve animated	--	--
SV_1202_01_OP	Valve in manual mode	User input	--	--
SV_1202_02_FB	Filtrate side Membrane 2 valve	2-way valve animated	--	--
SV_1202_02_OP	Valve in manual mode	User input	--	--
PT_1203_01	Pressure in Membrane 1 retentate side	Analogue indicator	(bar)	0 to 4
PT_1203_02	Pressure in outlet retentate side membrane 1	Analogue indicator	(bar)	0 to 4
PT_1203_03	Pressure in Membrane 1 filtrate side	Analogue indicator	(bar)	-1 to 4
PT_1203_07	Pressure of retentate after GP_1201_01 pump	Analogue indicator	(bar)	-1 to 9
CP_1207_01_MV	Circulated cleaning pump	Pump animated	--	--
CP_1207_01_OP	Circulated cleaning pump in manual mode	User Input	--	--
CP_1207_02_MV	Retentate side circulated cleaning pump	Pump animated	--	--
CP_1207_02_OP	Retentate side circulated cleaning pump in manual mode	User Input		
CL1207_TB_STOP	Status of the stop cleaning activity	Digital indicator	--	--
CL1207_TB_CL1	Status of the cleaning membrane 1	Digital indicator	--	--
CL1207_TB_CL2	Status of the cleaning membrane 2	Digital indicator	--	--
CL1207_TB_BCL1	Status of the cleaning both side of membrane 1	Digital indicator	--	--
CL1207_TB_BCL2	Status of the cleaning both side of membrane 2	Digital indicator	--	--
CL1207_TB_BW1	Status of the backwashing membrane 1	Digital indicator	--	--
CL1207_TB_BW2	Status of the backwashing membrane 2	Digital indicator	--	--
CL1207_TB_CLPMP	Status of the cleaning pump GP_1201_01	Digital indicator	--	--
CL1207_TB_VSL2_1204_01	Status of the cleaning effluent vessel	Digital indicator	--	--
CL1207_TB_ET1	Status of the cleaning effluent tank and Membrane 1 filtrate line	Digital indicator	--	--
CL1207_TB_ET2	Status of the cleaning effluent tank and Membrane 2 filtrate line	Digital indicator	--	--
CL1207_TB_P_CL1	Status of the AUTO cleaning Membrane 1	Digital indicator	--	--
CL1207_TB_P_CL2	Status of the AUTO cleaning Membrane 2	Digital indicator	--	--
CL1207_TB_CLEAN_CAB	Status of the cleaning vessels VSSL_1209_01 and VSSL_1209_02.	Digital indicator	--	--
CL1207_TB_RINSE_CA	Status of the rinsing of VSSL_1209_01	Digital indicator	--	--
CL1207_TB_RINSE_CB	Status of the rinsing of VSSL_1209_01	Digital indicator	--	--
S3V_1207_03_FB	Retentate line cleaning valve	3-way valve	--	--

Tag Name	Description	Type	Units	Range
		animated		
S3V_1207_03_OP	Valve in manual mode	User input	--	--
S3V_1207_04_FB	Retentate line cleaning valve	3-way valve animated	--	--
S3V_1207_04_OP	Valve in manual mode	User input	--	--
SV_1207_04_FB	VSSL_1209_02 cleaning agent inlet valve	2-way valve animated	--	--
SV_1207_04_OP	Valve in manual mode	User input	--	--
SV_1207_05_FB	Membranes filtrate side cleaning valve	2-way valve animated	--	--
SV_1207_05_OP	Valve in manual mode	User input	--	--
SV_1207_07_FB	Cleaning input valve to the Membrane 1 filtrate side	2-way valve animated	--	--
SV_1207_07_OP	Valve in manual mode	User input	--	--
SV_1207_09_FB	Cleaning input valve to Membrane 1 retentate side	2-way valve animated	--	--
SV_1207_09_OP	Valve in manual mode	User input	--	--
SV_1207_11_FB	Membrane 1 retentate side cleaning valve	2-way valve animated	--	--
SV_1207_11_OP	Valve in manual mode	User input	--	--
SV_1207_13_FB	Bypass valve between outlet retentate side and filtrate side	2-way valve animated	--	--
SV_1207_13_OP	Valve in manual mode	User input	--	--
TT_1208_01	VSSL_1209_02 temperature	Analogue indicator	--	--
HX_1208_01_MV	Cleaning buffer heat exchanger	Heat exchanger animated	--	--
HX_1208_01_OP	Cleaning buffer heat exchanger in manual mode	User Input	--	--
PP_1209_01_MV	Pumps cleaning agent from VSSL_1209_03 to VSSL_1209_01	Pump animated	--	--
PP_1209_01_OP	Pump in manual mode	User Input	--	--
LSH_1209_01	VSSL_1209_01 high level switch	Digital indicator	--	--
LSL_1209_01	VSSL_1209_01 low level switch	Digital indicator	--	--
LSH_1209_02	VSSL_1209_02 high level switch	Digital indicator	--	--
LSL_1209_02	VSSL_1209_02 low level switch	Digital indicator	--	--
CL1209_TB_FILL_CB	Status of the VSSL_1209_02 filling.	Digital indicator	--	--
CL1209_TB_EMPTY_CA	Status of the empty VSSL_1209_01	Digital indicator	--	--
CL1209_TB_EMPTY_CB	Status of the empty VSSL_1209_02	Digital indicator	--	--
CL1209_TB_FILL_CA	Status of the VSSL_1209_01 filling with cleaning agent	Digital indicator	--	--
CL1209_TB_FILL_WA	Status of the VSSL_1209_01 filling with water	Digital indicator	--	--
SV_1209_01_FB	VSSL_1209_02 drain valve	2-way valve animated	--	--
SV_1209_01_OP	Valve in manual mode	User input	--	--
SV_1209_02_FB	VSSL_1209_02 air outlet valve	2-way valve animated	--	--
SV_1209_02_OP	Valve in manual mode	User input	--	--
SV_1209_03_FB	Fill VSSL_1209_01 with water	2-way valve animated	--	--
SV_1209_03_OP	Valve in manual mode	User input	--	--
SV_1209_04_FB	VSSL_1209_01 drain valve	2-way valve animated	--	--
SV_1209_04_OP	Valve in manual mode	User input	--	--
SV_1209_05_FB	VSSL_1209_01 air outlet valve	2-way valve animated	--	--
SV_1209_05_OP	Valve in manual mode	User input	--	--

Table 6-37: Tags of the CIP Maintenance screen (Membrane 1)

6.14.3 Control loops

The following control loops are implemented on the screen:

Control Logic	Description
CL1200	Filtration Unit mode
CL1207	Cleaning in Place mode
CL1210	Sterilization in Place mode

Table 6-38: Control Loop of the CIP Maintenance screen (Membrane 1)

6.15 Cleaning in Place Maintenance screen (Membrane 2)

Clicking over Membrane 2 area of the CIP Membrane 2 screen the following screen is opened.

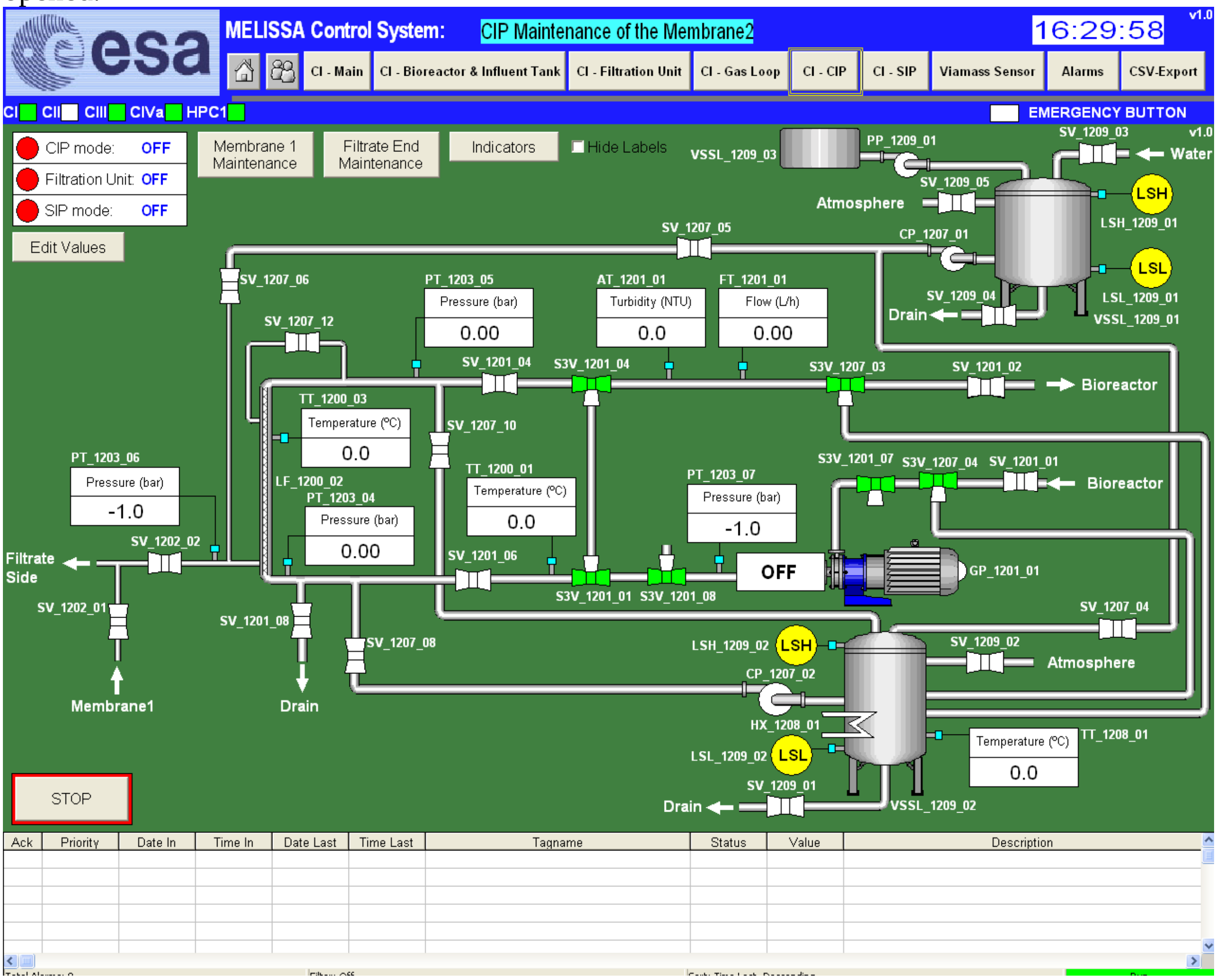


Figure 6-35: Main objects of the CIP Maintenance screen (Membrane2)

This display allows the user to:

- 2-way valves, 3-way valves, level switches, pumps animations.
- Analogue indicators.
- Device alarm animations.
- Change Filtration Unit, CIP and SIP control loop mode state.
- Display the status of the CIP procedures clicking “Indicators” command button.

- Navigate to the different screens of the filtration Unit Maintenance through “Membrane 1 Maintenance” and “Filtrate End Maintenance” command buttons.
- Hide labels selecting the “Hide labels” check box.
- Switch OFF the CIP, Filtration Unit and SIP mode clicking on the “Stop” command button.
- Activate/deactivate valves and pumps in manual mode clicking over the equipment.
- Edit values allows to activate different equipment at the same time in manual mode.

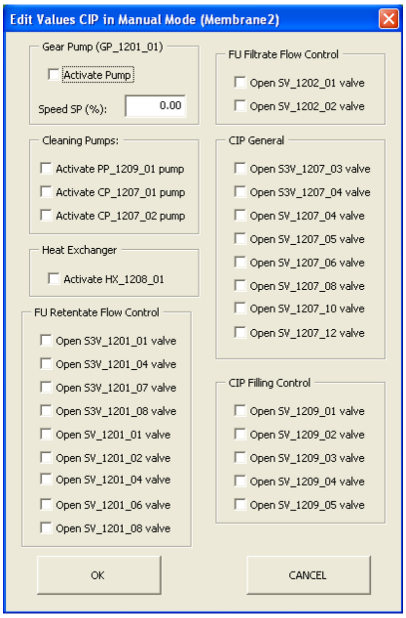


Figure 6-36: Edit Values dialog

6.15.1 Alarms

The following alarms are linked with the operation of the CIP Maintenance screen (Membrane 2)

TAG NAME	Description	Colour
TT_1200_01_ERR	Inlet retentate line temperature sensor link error	“ERR” text in RED
TT_1200_01_AHH	Inlet retentate line temperature reaches high level 2 Alarm	RED
TT_1200_01_AH	Inlet retentate line temperature reaches high level 1 Alarm	YELLOW
TT_1200_01_ALL	Inlet retentate line temperature reaches low level 2 Alarm	RED
TT_1200_01_AL	Inlet retentate line temperature reaches low level 1 Alarm	YELLOW
TT_1200_03_ERR	Membrane 2 temperature sensor link error	“ERR” text in RED
TT_1200_03_AHH	Membrane 2 temperature reaches high level 2 sensor	RED
TT_1200_03_AH	Membrane 2 temperature reaches high level 1 sensor	YELLOW
TT_1200_03_ALL	Membrane 2 temperature reaches low level 2 sensor	RED
TT_1200_03_AL	Membrane 2 temperature reaches low level 1 sensor	YELLOW
AT_1201_01_ERR	Turbidity in outlet retentate side sensor link error	“ERR” text in RED
AT_1201_01_AHH	Turbidity in outlet retentate side reaches high level 2 Alarm	RED
AT_1201_01_AH	Turbidity in outlet retentate side reaches high level 1 Alarm	YELLOW
AT_1201_01_ALL	Turbidity in outlet retentate side reaches low level 2 Alarm	RED
AT_1201_01_AL	Turbidity in outlet retentate side reaches low level 1 Alarm	YELLOW

TAG NAME	Description	Colour
FT_1201_01_ERR	Outlet retentate flow sensor link error	“ERR” text in RED
FT_1201_01_AHH	Outlet retentate flow reaches high level 2 Alarm	RED
FT_1201_01_AH	Outlet retentate flow reaches high level 1 Alarm	YELLOW
FT_1201_01_ALL	Outlet retentate flow reaches low level 2 Alarm	RED
FT_1201_01_AL	Outlet retentate flow reaches low level 1 Alarm	YELLOW
GP_1201_01_FreqDrive_A	Gear pump alarm	RED
GP_1201_01_PowerSupply_A	Gear pump alarm	RED
GP_1201_01_FLOW_A	Flow of retentate line is below 50L/h, GP_1201_01 might run dry, the pump is stopped.	RED
S3V_1201_01_A	Bypass valve in wrong position	RED and “ERR” text in RED
S3V_1201_04_A	Bypass valve in wrong position	RED and “ERR” text in RED
S3V_1201_07_A	Valve allows flow from VSSL_1207_01 tank to retentate line in wrong position	RED and “ERR” text in RED
S3V_1201_08_A	Retentate line drain valve in wrong position	RED and “ERR” text in RED
SV_1201_01_A	Valve allows flow from bioreactor to filtration unit in wrong position	RED and “ERR” text in RED
SV_1201_02_A	Valve allows flow from filtration unit to bioreactor in wrong position	RED and “ERR” text in RED
SV_1201_04_A	Outlet retentate side Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1201_06_A	Inlet retentate Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1201_08_A	Drain Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1202_01_A	Filtrate side Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1202_02_A	Filtrate side Membrane 2 valve in wrong position	RED and “ERR” text in RED
PT_1203_04_ERR	Inlet retentate side Membrane 2 pressure sensor link error	“ERR” text in RED
PT_1203_04_AHH	Inlet retentate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_04_AH	Inlet retentate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_04_ALL	Inlet retentate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_04_AL	Inlet retentate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_05_ERR	Outlet retentate side Membrane 2 pressure sensor link error	“ERR” text in RED
PT_1203_05_AHH	Outlet retentate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_05_AH	Outlet retentate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_05_ALL	Outlet retentate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_05_AL	Outlet retentate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_06_ERR	Filtrate side Membrane 2 pressure sensor link error	“ERR” text in RED
PT_1203_06_AHH	Filtrate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_06_AH	Filtrate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_06_ALL	Filtrate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_06_AL	Filtrate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_07_ERR	Pressure after circulation pump sensor link error	“ERR” text in RED
PT_1203_07_AHH	Pressure after circulation pump reaches high level 2 Alarm	RED
PT_1203_07_AH	Pressure after circulation pump reaches high level 1 Alarm	YELLOW
PT_1203_07_ALL	Pressure after circulation pump reaches low level 2 Alarm	RED
PT_1203_07_AL	Pressure after circulation pump reaches low level 1 Alarm	YELLOW
CP_1207_01_RunDry_A	Cleaning pump alarm	RED
CP_1207_02_RunDry_A	Cleaning pump alarm	RED
S3V_1207_03_A	Retentate line cleaning valve in wrong position	RED and “ERR” text in RED
S3V_1207_04_A	Retentate line cleaning valve in wrong position	RED and “ERR” text in RED
SV_1207_04_A	VSSL_1209_02 cleaning agent inlet valve in wrong position	RED and “ERR” text in RED
SV_1207_05_A	Filtrate side cleaning valve in wrong position	RED and “ERR” text in RED
SV_1207_06_A	Cleaning input valve to the Membrane 2 filtrate side in wrong position	
SV_1207_08_A	Cleaning input valve to Membrane 2 retentate side in wrong position	
SV_1207_10_A	Membrane 2 retentate side cleaning valve in wrong position	
SV_1207_12_A	Bypass valve between Membrane 2 outlet retentate side and	RED and “ERR” text in RED

TAG NAME	Description	Colour
	filtrate side in wrong position	
TT_1208_01_ERR	VSSL_1209_02 temperature sensor link error	"ERR" text in RED
TT_1208_01_AHH	VSSL_1209_02 temperature reaches high level 2 Alarm	RED
TT_1208_01_AH	VSSL_1209_02 temperature reaches high level 1 Alarm	YELLOW
TT_1208_01_ALL	VSSL_1209_02 temperature reaches low level 2 Alarm	RED
TT_1208_01_AL	VSSL_1209_02 temperature reaches low level 1 Alarm	YELLOW
LSH_1209_01_A	VSSL_1209_01 high level switch Alarm	RED
LSL_1209_01_A	VSSL_1209_01 low level switch Alarm	RED
LSH_1209_02_A	VSSL_1209_02 high level switch Alarm	RED
LSL_1209_02_A	VSSL_1209_02 low level switch Alarm	RED
SV_1209_01_A	VSSL_1209_02 drain valve in wrong position	RED and "ERR" text in RED
SV_1209_02_A	VSSL_1209_02 air outlet valve in wrong position	RED and "ERR" text in RED
SV_1209_03_A	VSSL_1209_01 water inlet valve in wrong position	RED and "ERR" text in RED
SV_1209_04_A	VSSL_1209_01 drain valve in wrong position	RED and "ERR" text in RED
SV_1209_05_A	VSSL_1209_01 air outlet valve in wrong position	RED and "ERR" text in RED

Table 6-39: Alarm tags of the CIP Maintenance system (Membrane 2)

6.15.2 Tags

The following tags are displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	Units	Range
TT_1200_01	Temperature in retentate line	Analogue indicator	(ºC)	0 to 100
TT_1200_03_AV	Temperature in Membrane 2	Analogue indicator	(ºC)	0 to 400
CL1200_SCI_MEMBR2_PRESENT	Membrane 2 presence in its housing	Filter animated	--	--
AT_1201_01	Turbidity in retentate side	Analogue indicator	TBD	0 to 100
FT_1201_01_IN_L_PER_H_FILTERED	Flow in retentate side	Analogue indicator	(L/h)	0 to 580
GP_1201_01_MV1	Retentate pump	Pump animated	--	--
GP_1201_01_MV1_OP	Retentate pump in manual mode	User Input	--	--
GP_1201_01_MV2_OP	Speed of retentate pump in manual mode	User Input	(%)	0 to 100
S3V_1201_01_FB	Filtration Unit bypass valve	3-way valve animated	--	--
S3V_1201_01_OP	Valve in manual mode	User input	--	--
S3V_1201_04_FB	Filtration Unit bypass valve	3-way valve animated	--	--
S3V_1201_04_OP	Valve in manual mode	User input	--	--
S3V_1201_07_FB	Valve allows flow from VSSL_1207_01 tank to retentate line.	3-way valve animated	--	--
S3V_1201_07_OP	Valve in manual mode	User input	--	--
S3V_1201_08_FB	Retentate line drain valve	3-way valve animated	--	--
S3V_1201_08_OP	Valve in manual mode	User input	--	--
SV_1201_01_FB	Valve allows flow from bioreactor to filtration unit	2-way valve animated	--	--
SV_1201_01_OP	Valve in manual mode	User input	--	--
SV_1201_02_FB	Valve allows flow from filtration unit to bioreactor	2-way valve animated	--	--
SV_1201_02_OP	Valve in manual mode	User input	--	--
SV_1201_04_FB	Membrane 2 outlet retentate side valve	2-way valve animated	--	--
SV_1201_04_OP	Valve in manual mode	User input	--	--
SV_1201_06_FB	Inlet retentate side Membrane 2 valve	2-way valve animated	--	--
SV_1201_06_OP	Valve in manual mode	User input	--	--
SV_1201_08_FB	Drain Membrane 2 valve	2-way valve animated	--	--
SV_1201_08_OP	Valve in manual mode	User input	--	--
SV_1202_01_FB	Membrane 1 filtrate side valve	2-way valve	--	--

Tag Name	Description	Type	Units	Range
		animated		
SV_1202_01_OP	Valve in manual mode	User input	--	--
SV_1202_02_FB	Filtrate side Membrane 2 valve	2-way valve animated	--	--
SV_1202_02_OP	Valve in manual mode	User input	--	--
PT_1203_04	Pressure in Membrane 2 retentate side	Analogue indicator	(bar)	0 to 4
PT_1203_05	Pressure in outlet retentate side membrane 2	Analogue indicator	(bar)	0 to 4
PT_1203_06	Pressure in Membrane 2 filtrate side	Analogue indicator	(bar)	-1 to 4
PT_1203_07	Pressure of retentate after GP_1201_01 pump	Analogue indicator	(bar)	-1 to 9
CP_1207_01_MV	Circulated cleaning pump	Pump animated	--	--
CP_1207_01_OP	Circulated cleaning pump in manual mode	User Input	--	--
CP_1207_02_MV	Retentate side circulated cleaning pump	Pump animated	--	--
CP_1207_02_OP	Retentate side circulated cleaning pump	User Input		
CL1207_TB_STOP	Status of the stop cleaning activity	Digital indicator	--	--
CL1207_TB_CL1	Status of the cleaning membrane 1	Digital indicator	--	--
CL1207_TB_CL2	Status of the cleaning membrane 2	Digital indicator	--	--
CL1207_TB_BCL1	Status of the cleaning both side of membrane 1	Digital indicator	--	--
CL1207_TB_BCL2	Status of the cleaning both side of membrane 2	Digital indicator	--	--
CL1207_TB_BW1	Status of the backwashing membrane 1	Digital indicator	--	--
CL1207_TB_BW2	Status of the backwashing membrane 2	Digital indicator	--	--
CL1207_TB_CLPMP	Status of the cleaning pump GP_1201_01	Digital indicator	--	--
CL1207_TB_VSL2_1204_01	Status of the cleaning effluent vessel	Digital indicator	--	--
CL1207_TB_ET1	Status of the cleaning effluent tank and Membrane 1 filtrate line	Digital indicator	--	--
CL1207_TB_ET2	Status of the cleaning effluent tank and Membrane 2 filtrate line	Digital indicator	--	--
CL1207_TB_P_CL1	Status of the AUTO cleaning Membrane 1	Digital indicator	--	--
CL1207_TB_P_CL2	Status of the AUTO cleaning Membrane 2	Digital indicator	--	--
CL1207_TB_CLEAN_CAB	Status of the cleaning vessels VSSL_1209_01 and VSSL_1209_02.	Digital indicator	--	--
CL1207_TB_RINSE_CA	Status of the rinsing of VSSL_1209_01	Digital indicator	--	--
CL1207_TB_RINSE_CB	Status of the rinsing of VSSL_1209_01	Digital indicator	--	--
S3V_1207_03_FB	Retentate line cleaning valve	3-way valve animated	--	--
S3V_1207_03_OP	Valve in manual mode	User input	--	--
S3V_1207_04_FB	Retentate line cleaning valve	3-way valve animated	--	--
S3V_1207_04_OP	Valve in manual mode	User input	--	--
SV_1207_04_FB	VSSL_1209_02 cleaning agent inlet valve	2-way valve animated	--	--
SV_1207_04_OP	Valve in manual mode	User input	--	--
SV_1207_05_FB	Membranes filtrate side cleaning valve	2-way valve animated	--	--
SV_1207_05_OP	Valve in manual mode	User input	--	--
SV_1207_06_FB	Cleaning input valve to the Membrane 2 filtrate side	2-way valve animated	--	--
SV_1207_06_OP	Valve in manual mode	User input	--	--
SV_1207_08_FB	Cleaning input valve to Membrane 2 retentate side	2-way valve animated	--	--

Tag Name	Description	Type	Units	Range
SV_1207_08_OP	Valve in manual mode	User input	--	--
SV_1207_10_FB	Membrane 2 retentate side cleaning valve	2-way valve animated	--	--
SV_1207_10_OP	Valve in manual mode	User input	--	--
SV_1207_12_FB	Bypass valve between Membrane 2 outlet retentate side and filtrate side	2-way valve animated	--	--
SV_1207_12_OP	Valve in manual mode	User input	--	--
HX_1208_01_MV	Cleaning buffer heat exchanger	Heat exchanger animated	--	--
HX_1208_01_OP	Cleaning buffer heat exchanger	User Input	--	--
TT_1208_01	VSSL_1209_02 temperature	Analogue indicator	--	--
PP_1209_01_MV	Pumps cleaning agent from VSSL_1209_03 to VSSL_1209_01	Pump animated	--	--
PP_1209_01_OP	Pump in manual mode	User input	--	--
LSH_1209_01	VSSL_1209_01 high level switch	Digital indicator	--	--
LSL_1209_01	VSSL_1209_01 low level switch	Digital indicator	--	--
LSH_1209_02	VSSL_1209_02 high level switch	Digital indicator	--	--
LSL_1209_02	VSSL_1209_02 low level switch	Digital indicator	--	--
CL1209_TB_FILL_CB	Status of the VSSL_1209_02 filling.	Digital indicator	--	--
CL1209_TB_EMPTY_CA	Status of the empty VSSL_1209_01	Digital indicator	--	--
CL1209_TB_EMPTY_CB	Status of the empty VSSL_1209_02	Digital indicator	--	--
CL1209_TB_FILL_CA	Status of the VSSL_1209_01 filling with cleaning agent	Digital indicator	--	--
CL1209_TB_FILL_WA	Status of the VSSL_1209_01 filling with water	Digital indicator	--	--
SV_1209_01_FB	VSSL_1209_02 drain valve	2-way valve animated	--	--
SV_1209_01_OP	Valve in manual mode	User input	--	--
SV_1209_02_FB	VSSL_1209_02 air outlet valve	2-way valve animated	--	--
SV_1209_02_OP	Valve in manual mode	User input	--	--
SV_1209_03_FB	Fill VSSL_1209_01 with water	2-way valve animated	--	--
SV_1209_03_OP	Valve in manual mode	User input	--	--
SV_1209_04_FB	VSSL_1209_01 drain valve	2-way valve animated	--	--
SV_1209_04_OP	Valve in manual mode	User input	--	--
SV_1209_05_FB	VSSL_1209_01 air outlet valve	2-way valve animated	--	--
SV_1209_05_OP	Valve in manual mode	User input	--	--

Table 6-40: Tags of the CIP Maintenance screen (Membrane 2)

6.15.3 Control loops

The following control loops are implemented on the screen:

Control Logic	Description
CL1200	Filtration Unit mode
CL1207	Cleaning in Place mode
CL1210	Sterilization in Place mode

Table 6-41: Control Loop of the CIP Maintenance Screen (Membrane 2)

6.16 Sterilization in Place screen

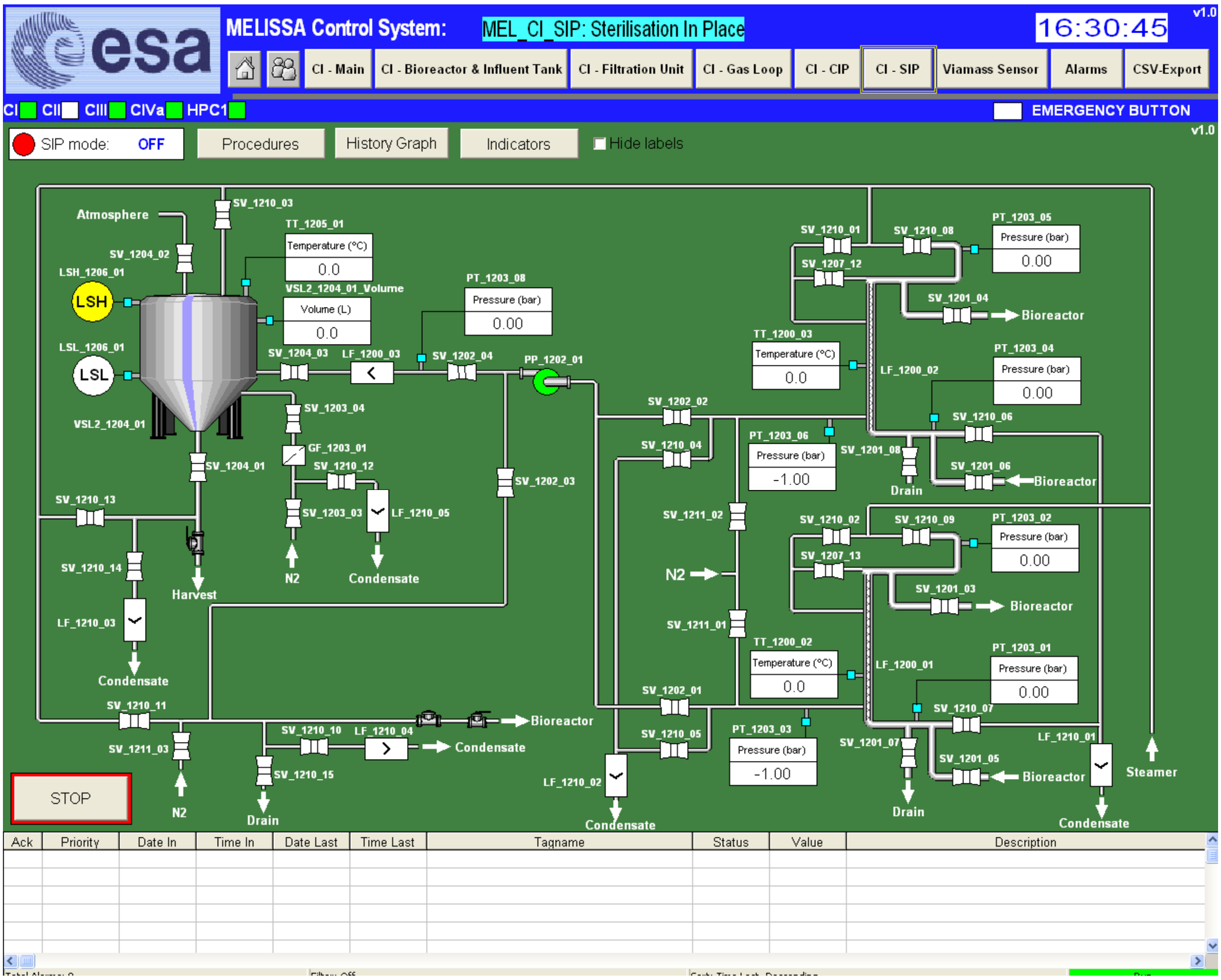


Figure 6-37: Main objects of SIP screen

This display allows the user to:

- 2-way valves, 3-way valves, level switches, pumps animations.
- Analogue indicators.
- Device alarm animations.
- Membranes background colour switch to green when ceramic membrane is present in its module.
- Hide labels selecting the “Hide labels” check box.
- Display the SIP procedures clicking “Procedures” command button. The following windows will be opened and the user will be able active one of the SIP procedures.
- Display the history graph clicking on the History graph command button.

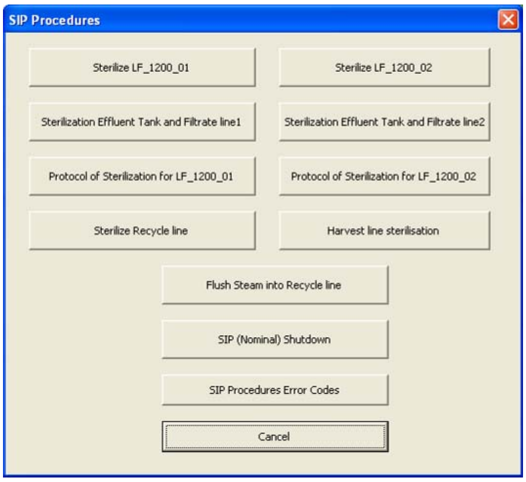


Figure 6-38: SIP procedures window

- Error Codes command button allows to open a window showing the error code of the each gas loop procedure. Operator will be able identify error code of the step inside the procedure that has been wrong executed. For error code description, please refer to [R6].

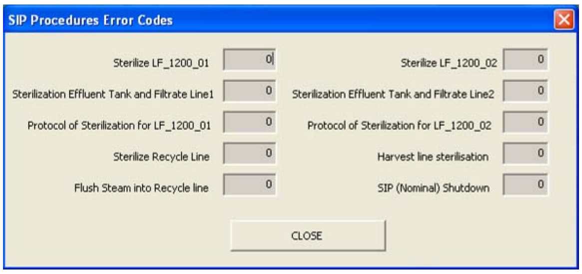


Figure 6-39: Error Codes of the sterilization in place procedures

Tag	Description	Address
CL1210_S_S1_Error	Error code of the sterilization Membrane 1 procedure	400323
CL1210_S_S2_Error	Error code of the sterilization Membrane 2 procedure	400325
CL1210_S_All1_Error	Error code of the sterilization of the effluent tank and filtrate line 1 procedure	400327
CL1210_S_All2_Error	Error code of the sterilization of the effluent tank and filtrate line 2 procedure	400329
CL1210_S_P_All1_Error	Error code of the protocol of sterilization membrane 1 procedure	400331
CL1210_S_P_All2_Error	Error code of the protocol of	400333

	sterilization membrane 2 procedure	
CL1210_S_Rec_Error	Error code of the recycle line sterilization procedure	400319
CL1210_S_Harvest_Error	Error code of the sterilization Harvest line procedure	400317
CL1210_S_Rec_Flush_Error	Error code of the flush recycle line procedure	400315
CL1210_S_Stop_Error	Error code of the stop sterilization procedure	400321

Table 6-42: Error codes description of the Sterilization procedures

- Display the SIP procedures indicators clicking "Indicators" command button. The following window is opened.

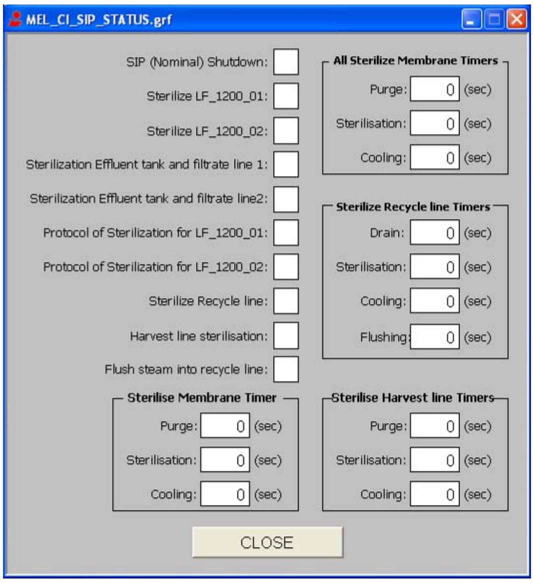


Figure 6-40: Indicators of the SIP procedures

- Display the SIP Maintenance screens. Screens from filtration unit frame are developed on specifics screens to maintenance. For SIP screens are created 2 new screens for maintenance (one for each separate area), one for filtrate side and effluent vessel and another for Membranes side. The user access to maintenance screen clicking over the area desired on the screen.

6.16.1 Alarm definition

The following alarms are linked with the operation of the SIP screen.

TAG NAME	Description	Colour
TT_1200_02_ERR	Membrane 1 temperature sensor link error	"ERR" text in RED
TT_1200_02_AHH	Membrane 1 temperature reaches high level 2 sensor	RED
TT_1200_02_AH	Membrane 1 temperature reaches high level 1 sensor	YELLOW
TT_1200_02_ALL	Membrane 1 temperature reaches low level 2 sensor	RED

TAG NAME	Description	Colour
TT_1200_02_AL	Membrane 1 temperature reaches low level 1 sensor	YELLOW
TT_1200_03_ERR	Membrane 2 temperature sensor link error	"ERR" text in RED
TT_1200_03_AHH	Membrane 2 temperature reaches high level 2 sensor	RED
TT_1200_03_AH	Membrane 2 temperature reaches high level 1 sensor	YELLOW
TT_1200_03_ALL	Membrane 2 temperature reaches low level 2 sensor	RED
TT_1200_03_AL	Membrane 2 temperature reaches low level 1 sensor	YELLOW
SV_1201_03_A	Outlet retentate side Membrane 1 valve in wrong position	RED and "ERR" text in RED
SV_1201_04_A	Outlet retentate side Membrane 2 valve in wrong position	RED and "ERR" text in RED
SV_1201_05_A	Inlet retentate Membrane 1 valve in wrong position	RED and "ERR" text in RED
SV_1201_06_A	Inlet retentate Membrane 2 valve in wrong position	RED and "ERR" text in RED
SV_1201_07_A	Drain Membrane 1 valve in wrong position	RED and "ERR" text in RED
SV_1201_08_A	Drain Membrane 2 valve in wrong position	RED and "ERR" text in RED
SV_1202_01_A	Filtrate side Membrane 1 valve in wrong position	RED and "ERR" text in RED
SV_1202_02_A	Filtrate side Membrane 2 valve in wrong position	RED and "ERR" text in RED
SV_1202_03_A	Recirculation valve in wrong position	RED and "ERR" text in RED
SV_1202_04_A	Filtrate flow valve in wrong position	RED and "ERR" text in RED
PT_1203_01_ERR	Inlet retentate side Membrane 1 pressure sensor link error	"ERR" text in RED
PT_1203_01_AHH	Inlet retentate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_01_AH	Inlet retentate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_01_ALL	Inlet retentate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_01_AL	Inlet retentate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_02_ERR	Outlet retentate side Membrane 1 pressure sensor link error	"ERR" text in RED
PT_1203_02_AHH	Outlet retentate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_02_AH	Outlet retentate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_02_ALL	Outlet retentate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_02_AL	Outlet retentate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_03_ERR	Filtrate side Membrane 1 pressure sensor link error	"ERR" text in RED
PT_1203_03_AHH	Filtrate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_03_AH	Filtrate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_03_ALL	Filtrate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_03_AL	Filtrate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_04_ERR	Inlet retentate side Membrane 2 pressure sensor link error	"ERR" text in RED
PT_1203_04_AHH	Inlet retentate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_04_AH	Inlet retentate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_04_ALL	Inlet retentate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_04_AL	Inlet retentate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_05_ERR	Outlet retentate side Membrane 2 pressure sensor link error	"ERR" text in RED
PT_1203_05_AHH	Outlet retentate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_05_AH	Outlet retentate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_05_ALL	Outlet retentate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_05_AL	Outlet retentate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_06_ERR	Filtrate side Membrane 2 pressure sensor link error	"ERR" text in RED
PT_1203_06_AHH	Filtrate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_06_AH	Filtrate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_06_ALL	Filtrate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_06_AL	Filtrate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_08_ERR	After filtrate pump pressure sensor link error	"ERR" text in RED
PT_1203_08_AHH	Pressure after filtrate pump reaches high level 2 Alarm	RED
PT_1203_08_AH	Pressure after filtrate pump reaches high level 1 Alarm	YELLOW
PT_1203_08_ALL	Pressure after filtrate pump reaches low level 2 Alarm	RED
PT_1203_08_AL	Pressure after filtrate pump reaches low level 1 Alarm	YELLOW
SV_1203_03_A	N2 input valve to harvesting tank in wrong position	RED and "ERR" text in RED
SV_1203_04_A	N2 input valve to harvesting tank in wrong position	RED and "ERR" text in RED
SV_1204_01_A	Drain valve of the harvesting tank in wrong position	RED and "ERR" text in RED
SV_1204_02_A	Air inlet valve of the harvesting tank in wrong position	RED and "ERR" text in RED

TAG NAME	Description	Colour
SV_1204_03_A	Filtrate flow valve in wrong position	RED and “ERR” text in RED
TT_1205_01_ERR	Harvesting tank temperature sensor link error	“ERR” text in RED
TT_1205_01_AHH	Harvesting tank temperature reaches high level 2 Alarm	RED
TT_1205_01_AH	Harvesting tank temperature reaches high level 1 Alarm	YELLOW
TT_1205_01_ALL	Harvesting tank temperature reaches low level 2 Alarm	RED
TT_1205_01_AL	Harvesting tank temperature reaches low level 1 Alarm	YELLOW
LT_1206_01_ERR	Harvesting tank level sensor link error	“ERR” text in RED
LT_1206_01_AHH	Harvesting tank level reaches high level 2 Alarm	RED
LT_1206_01_AH	Harvesting tank level reaches high level 1 Alarm	YELLOW
LT_1206_01_ALL	Harvesting tank level reaches low level 2 Alarm	RED
LT_1206_01_AL	Harvesting tank level reaches low level 1 Alarm	YELLOW
LSL_1206_01_A	Harvesting tank low level switch Alarm	RED
LSH_1206_01_A	Harvesting tank high level switch Alarm	RED
SV_1207_12_A	Bypass valve between outlet retentate side and filtrate side Membrane 2 in wrong position	RED and “ERR” text in RED
SV_1207_13_A	Bypass valve between outlet retentate side and filtrate side in wrong position	RED and “ERR” text in RED
SV_1210_01_A	Steam input valve in Membrane 2 filtrate side in wrong position	RED and “ERR” text in RED
SV_1210_02_A	Steam input valve in Membrane 1 filtrate side in wrong position	RED and “ERR” text in RED
SV_1210_03_A	Steam input valve of the harvest tank in wrong position	RED and “ERR” text in RED
SV_1210_04_A	Steam input valve to the Membrane 2 filtrate side in wrong position	RED and “ERR” text in RED
SV_1210_05_A	Steam input valve to the filtrate side in wrong position	RED and “ERR” text in RED
SV_1210_06_A	Steam input valve to Membrane 2 retentate side in wrong position	RED and “ERR” text in RED
SV_1210_07_A	Steam input valve to Membrane 1 retentate side in wrong position	RED and “ERR” text in RED
SV_1210_08_A	Steam input valve in Membrane 2 outlet retentate side in wrong position	RED and “ERR” text in RED
SV_1210_09_A	Steam input valve in Membrane 1 outlet retentate side in wrong position	RED and “ERR” text in RED
SV_1210_11_A	Steam input valve of the recycling line in wrong position	RED and “ERR” text in RED
SV_1210_13_A	Steam input valve of the harvesting line in wrong position	RED and “ERR” text in RED
SV_1210_14_A	Steam outlet valve of the harvesting line in wrong position	RED and “ERR” text in RED
SV_1210_15_A	Drain valve of the recycling line in wrong position	RED and “ERR” text in RED
SV_1211_01_A	N2 input valve to the filtrate side in wrong position	RED and “ERR” text in RED
SV_1211_02_A	N2 input valve to the Membrane 2 filtrate side in wrong position	RED and “ERR” text in RED
SV_1211_03_A	N2 input valve to recycling line in wrong position	RED and “ERR” text in RED

Table 6-43: Alarm tags of the SIP screen

6.16.2 Tags

The following tags are displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	Units	Range
TT_1200_02_AV	Temperature in Membrane 1	Analogue indicator	(ºC)	0 to 400
TT_1200_03_AV	Temperature in Membrane 2	Analogue indicator	(ºC)	0 to 400
CL1200_SCI_MEMBR1_PRESENT	Membrane 1 presence in its housing	Filter animated	--	--
CL1200_SCI_MEMBR2_PRESENT	Membrane 2 presence in its housing	Filter animated	--	--
SV_1201_03_FB	Membrane 1 outlet retentate side valve	2-way valve animated	--	--
SV_1201_04_FB	Outlet retentate side Membrane 2 side	2-way valve animated	--	--
SV_1201_05_FB	Inlet valve retentate line Membrane 1	2-way valve animated	--	--
SV_1201_06_FB	Inlet retentate side Membrane 2 valve	2-way valve animated	--	--
SV_1201_07_FB	Drain Membrane 1 valve	2-way valve	--	--

Tag Name	Description	Type	Units	Range
		animated		
SV_1201_08_FB	Drain Membrane 2 valve	2-way valve animated	--	--
PP_1202_01_MV1	Filtrate pump	Pump animated	--	--
SV_1202_01_FB	Membrane 1 filtrate side valve	2-way valve animated	--	--
SV_1202_02_FB	Membrane 2 filtrate side valve	2-way valve animated	--	--
SV_1202_03_FB	Recycle line valve	2-way valve animated	--	--
SV_1202_04_FB	Filtrate flow to vessel valve (before filter)	2-way valve animated	--	--
PT_1203_01	Pressure in Membrane 1 retentate side	Analogue indicator	(bar)	0 to 4
PT_1203_02	Pressure in outlet retentate side membrane 1	Analogue indicator	(bar)	0 to 4
PT_1203_03	Pressure in Membrane 1 filtrate side	Analogue indicator	(bar)	-1 to 4
PT_1203_04	Pressure in Membrane 2 retentate side	Analogue indicator	(bar)	0 to 4
PT_1203_05	Pressure in outlet retentate side Membrane 2	Analogue indicator	(bar)	0 to 4
PT_1203_06	Pressure in Membrane 2 filtrate side	Analogue indicator	(bar)	-1 to 4
PT_1203_08	Pressure after filtrate pump	Analogue indicator	(bar)	0 to 4
SV_1203_03_FB	N2 input valve to harvesting tank	2-way valve animated	--	--
SV_1203_04_FB	N2 input valve to harvesting tank	2-way valve animated	--	--
SV_1204_01_FB	Harvesting line valve	2-way valve animated	--	--
SV_1204_02_FB	Air inlet valve (harvesting tank)	2-way valve animated	--	--
SV_1204_03_FB	Filtrate flow to vessel valve (after filter)	2-way valve animated	--	--
VSL2_1204_01_VOLUME	Harvesting tank level	Analogue indicator	(L)	0 to 100
TT_1205_01	Harvesting tank temperature	Analogue Indicator	(ºC)	0 to 100
LSL_1206_01	Low level switch harvesting tank	Digital indicator	--	--
LSH_1206_01	High level switch harvesting tank	Digital indicator	--	--
SV_1207_12_FB	Bypass valve between Membrane 2 outlet retentate side and filtrate side	2-way valve animated	--	--
SV_1207_13_FB	Bypass valve between Membrane 1 outlet retentate side and filtrate side	2-way valve animated	--	--
CL1210_SCI_S1	Sterilization over Membrane 1	Button	--	--
CL1210_SCI_S2	Sterilization over Membrane 2	Button	--	--
CL1210_SCI_ALL1	Sterilize Effluent tank and membrane 1 filtrate line	Button	--	--
CL1210_SCI_ALL2	Sterilize Effluent tank and membrane 2 filtrate line	Button	--	--
CL1210_SCI_P_ALL1	Protocol of sterilization for Membrane	Button	--	--

Tag Name	Description	Type	Units	Range
	1			
CL1210_SCI_P_ALL2	Protocol of sterilization for Membrane 2	Button	--	--
CL1210_SCI_REC	Sterilize recycle line	Button	--	--
CL1210_SCI_HARVEST	Sterilize harvest line	Button	--	--
CL1210_SCI_STOP	Stop sterilization	Button	--	--
CL1210_SCI_FLUSHREC	Flush steam into recycle line	Button	--	--
CL1210_MEMBR_PURGETIME_CFG	Configuration time to purge Membrane	User input	(second)	0 to 9.999.999
CL1210_MEMBR_STERILTIME_CFG	Configuration time to sterilize Membrane	User input	(second)	0 to 9.999.999
CL1210_COOLINGTIME_CFG	Configuration time to cool Membrane	User input	(second)	0 to 9.999.999
CL1210_ALL_STERILTIME_CFG	Configuration time to sterilize protocol of Sterilization procedure.	User input	(second)	0 to 9.999.999
CL1210_ALL_PURGETIME_CFG	Configuration time to purge protocol of Sterilization procedure.	User input	(second)	0 to 9.999.999
CL1210_ALL_COOLINGTIME_CFG	Configuration time to cool protocol of Sterilization procedure.	User input	(second)	0 to 9.999.999
CL1210_REC_DRAINTIME_CFG	Configuration time to drain recycle line	User input	(second)	0 to 9.999.999
CL1210_REC_STERILTIME_CFG	Configuration time to sterilize recycle line	User input	(second)	0 to 9.999.999
CL1210_REC_COOLINGTIME_CFG	Configuration time to cool recycle line	User input	(second)	0 to 9.999.999
CL1210_REC_FLUSHINGTIME_CFG	Configuration time to flush recycle line	User input	(second)	0 to 9.999.999
CL1210_HARVEST_STERILTIME_CFG	Configuration time to sterilize harvest line	User input	(second)	0 to 9.999.999
CL1210_HARVEST_COOLINGTIME_CFG	Configuration time to cool harvest line	User input	(second)	0 to 9.999.999
CL1210_HARVEST_DRAINTIME_CFG	Configuration time to drain harvest line	User input	(second)	0 to 9.999.999
CL1210_TB_STOP	Status of the	Digital indicator	--	--
CL1210_TB_S1	Status of the Membrane 1 sterilization	Digital indicator	--	--
CL1210_TB_S2	Status of the Membrane 2 sterilization	Digital indicator	--	--
CL1210_TB_ALL1	Status of the sterilization of Effluent tank and Membrane 1 filtrate line	Digital indicator	--	--
CL1210_TB_ALL2	Status of the sterilization of Effluent tank and Membrane 2 filtrate line	Digital indicator	--	--
CL1210_TB_P_ALL1	Status of the protocol of sterilization membrane 1	Digital indicator	--	--
CL1210_TB_P_ALL2	Status of the protocol of sterilization Membrane 2	Digital indicator	--	--
CL1210_TB_REC	Status of sterilization recycle line	Digital indicator	--	--
CL1210_TB_HARVEST	Status of the sterilization harvest tank	Digital indicator	--	--
CL1210_TB_FLUSHREC	Status of the flushing recycle line	Digital indicator	--	--
CL1210_MEMBR_PURGETIME	Remaining time of the purge Membrane	Analogue indicator	(second)	0 to 9.999.999
CL1210_MEMBR_STERILTIME	Remaining time of the sterilize Membrane	Analogue indicator	(second)	0 to 9.999.999
CL1210_MEMBR_COOLINGTIME	Remaining time of the cooling Membrane	Analogue indicator	(second)	0 to 9.999.999
CL1210_ALL_PURGETIME	Remaining time of the purge protocol of sterilization.	Analogue indicator	(second)	0 to 9.999.999
CL1210_ALL_STERILTIME	Remaining time of the sterilize protocol of sterilization.	Analogue indicator	(second)	0 to 9.999.999
CL1210_ALL_COOLINGTIME	Remaining time of the cooling protocol of sterilization.	Analogue indicator	(second)	0 to 9.999.999
CL1210_REC_DRAINTIME	Remaining time of the drain recycle line	Analogue indicator	(second)	0 to 9.999.999
CL1210_REC_STERILTIME	Remaining time of the sterilize recycle	Analogue	(second)	0 to

Tag Name	Description	Type	Units	Range
	line	indicator		9.999.999
CL1210_REC_COOLINGTIME	Remaining time of the cooling recycle line	Analogue indicator	(second)	0 to 9.999.999
CL1210_REC_FLUSHINGTIME	Remaining time of the flushing recycle line	Analogue indicator	(second)	0 to 9.999.999
CL1210_HARVEST_DRAINTIME	Remaining time of the drain harvest line	Analogue indicator	(second)	0 to 9.999.999
CL1210_HARVEST_COOLINGTIME	Remaining time of the cooling harvest line	Analogue indicator	(second)	0 to 9.999.999
CL1210_HARVEST_STERILTIME	Remaining time of the sterilization of the harvesting line	Analogue Indicator	(second)	0 to 9.999.999
SV_1210_01_FB	Steam input valve in Membrane 2 filtrate side	2-way valve animated	--	--
SV_1210_02_FB	Steam input valve in Membrane 1 filtrate side	2-way valve animated	--	--
SV_1210_03_FB	Steam input valve of the harvest tank	2-way valve animated	--	--
SV_1210_04_FB	Steam input valve to the Membrane 2 filtrate side	2-way valve animated	--	--
SV_1210_05_FB	Steam input valve to the Membrane 1 filtrate side	2-way valve animated	--	--
SV_1210_06_FB	Steam input valve to Membrane 2 retentate side	2-way valve animated	--	--
SV_1210_07_FB	Steam input valve to Membrane 1 retentate side	2-way valve animated	--	--
SV_1210_08_FB	Steam input valve in Membrane 2 outlet retentate side	2-way valve animated	--	--
SV_1210_09_FB	Steam input valve in Membrane 1 outlet retentate side	2-way valve animated	--	--
SV_1210_10_MV	Steam outlet valve of the recycling line	2-way valve animated	--	--
SV_1210_11_FB	Steam input valve of the recycling line	2-way valve animated	--	--
SV_1210_12_MV	N2 outlet valve to harvesting tank	2-way valve animated	--	--
SV_1210_13_FB	Steam input valve of the harvesting line	2-way valve animated	--	--
SV_1210_14_FB	Steam outlet valve of the harvesting line	2-way valve animated	--	--
SV_1210_15_FB	Drain valve of the recycling line	2-way valve animated	--	--
SV_1211_01_FB	N2 input valve to the Membrane 1 filtrate side	2-way valve animated	--	--
SV_1211_02_FB	N2 input valve to the Membrane 2 filtrate side	2-way valve animated	--	--
SV_1211_03_FB	N2 input valve to recycling line	2-way valve animated	--	--

Table 6-44: Tags of the SIP screen

6.16.3 Control loops

The following control loops are implemented on the screen:

Control Logic	Description
CL1210	Sterilization in place mode

Table 6-45: Control Loop of the SIP screen

6.17 Sterilization in place maintenance (filtration side)

Clicking over the filtration area of the SIP screen the following screen is opened. It displays the filtrate side, effluent tank, harvesting line, recycle line and steam input.

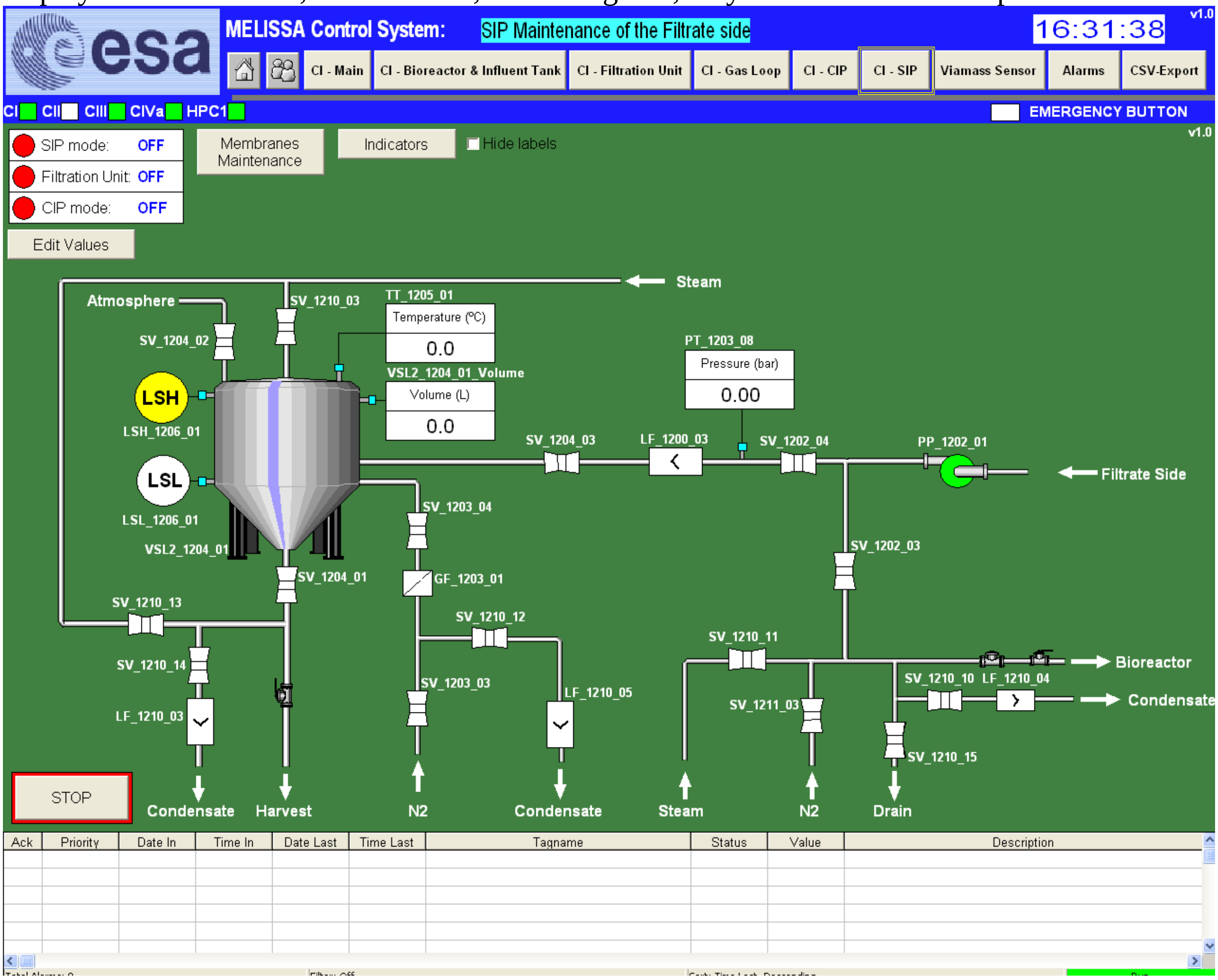


Figure 6-41: Main objects of SIP Maintenance screen (Filtrate side)

6.17.1 General actions

This display allows the user to:

- 2-way valves, 3-way valves, level switch, pumps animations.
- Analogue indicators.
- Device alarm animations.
- Change Filtration Unit, SIP and CIP control loop mode state.
- Display the status of the SIP procedures clicking "Indicators" command button.
- Navigate to the other screen of the SIP Maintenance through "Membranes Maintenance" command button.

- Hide labels selecting the “Hide labels” check box.
- Switch OFF the SIP, Filtration Unit and CIP mode clicking on the “Stop” command button.
- Activate/deactivate valves and pumps in manual mode clicking over the equipment.
- From Edit Values command button, it is possible to activate/deactivate more than one valve and pumps at the same time.

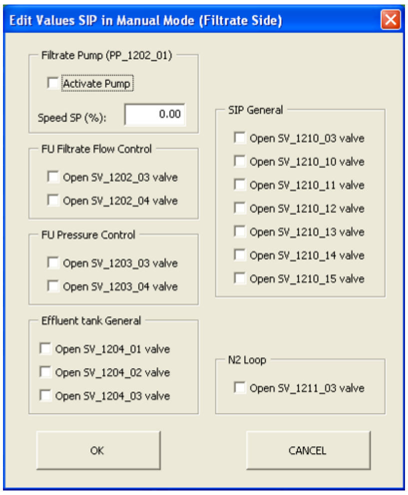


Figure 6-42: Edit Values dialog

6.17.2 Alarms

The following alarms are linked with the operation of the SIP Maintenance screen (Filtrate side)

TAG NAME	Description	Colour
SV_1202_03_A	Recirculation valve in wrong position	RED and “ERR” text in RED
SV_1202_04_A	Filtrate flow valve in wrong position	RED and “ERR” text in RED
PT_1203_08_ERR	After filtrate pump pressure sensor link error	“ERR” text in RED
PT_1203_08_AHH	Pressure after filtrate pump reaches high level 2 Alarm	RED
PT_1203_08_AH	Pressure after filtrate pump reaches high level 1 Alarm	YELLOW
PT_1203_08_ALL	Pressure after filtrate pump reaches low level 2 Alarm	RED
PT_1203_08_AL	Pressure after filtrate pump reaches low level 1 Alarm	YELLOW
SV_1203_03_A	N2 input valve to harvesting tank in wrong position	RED and “ERR” text in RED
SV_1203_04_A	N2 input valve to harvesting tank in wrong position	RED and “ERR” text in RED
SV_1204_01_A	Drain valve of the harvesting tank in wrong position	RED and “ERR” text in RED
SV_1204_02_A	Air inlet valve of the harvesting tank in wrong position	RED and “ERR” text in RED
SV_1204_03_A	Filtrate flow valve in wrong position	RED and “ERR” text in RED
TT_1205_01_ERR	Harvesting tank temperature sensor link error	“ERR” text in RED
TT_1205_01_AHH	Harvesting tank temperature reaches high level 2 Alarm	RED
TT_1205_01_AH	Harvesting tank temperature reaches high level 1 Alarm	YELLOW
TT_1205_01_ALL	Harvesting tank temperature reaches low level 2 Alarm	RED
TT_1205_01_AL	Harvesting tank temperature reaches low level 1 Alarm	YELLOW
LT_1206_01_ERR	Harvesting tank level sensor link error	“ERR” text in RED
LT_1206_01_AHH	Harvesting tank level reaches high level 2 Alarm	RED
LT_1206_01_AH	Harvesting tank level reaches high level 1 Alarm	YELLOW
LT_1206_01_ALL	Harvesting tank level reaches low level 2 Alarm	RED
LT_1206_01_AL	Harvesting tank level reaches low level 1 Alarm	YELLOW
LSL_1206_01_A	Harvesting tank low level switch Alarm	RED
LSH_1206_01_A	Harvesting tank high level switch Alarm	RED
SV_1210_03_A	Steam input valve of the harvest tank in wrong position	RED and “ERR” text in RED
SV_1210_11_A	Steam input valve of the recycling line in wrong position	RED and “ERR” text in RED

TAG NAME	Description	Colour
SV_1210_13_A	Steam input valve of the harvesting line in wrong position	RED and "ERR" text in RED
SV_1210_14_A	Steam outlet valve of the harvesting line in wrong position	RED and "ERR" text in RED
SV_1210_15_A	Drain valve of the recycling line in wrong position	RED and "ERR" text in RED
SV_1211_03_A	N2 input valve to recycling line in wrong position	RED and "ERR" text in RED

Table 6-46: Alarm tags of the SIP Maintenance screen (Filtrate side)

6.17.3 Tag name definition

The following tags are displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	Units	Range
PP_1202_01_MV1	Filtrate pump	Pump animated	--	--
PP_1202_01_MV1_OP	Filtrate pump in manual mode	User Input	--	--
PP_1202_01_MV2_OP	Speed of filtrate pump in manual mode	User Input	(%)	0 to 100
SV_1202_03_FB	Recycle line valve	2-way valve animated	--	--
SV_1202_03_OP	Valve in manual mode	User input	--	--
SV_1202_04_FB	Filtrate flow to vessel valve (before filter)	2-way valve animated	--	--
SV_1202_04_OP	Valve in manual mode	User input	--	--
PT_1203_08	Pressure after filtrate pump	Analogue indicator	(bar)	0 to 4
SV_1203_03_FB	N2 input valve to harvesting tank	2-way valve animated	--	--
SV_1203_03_OP	Valve in manual mode	User input	--	--
SV_1203_04_FB	N2 input valve to harvesting tank	2-way valve animated	--	--
SV_1203_04_OP	Valve in manual mode	User input	--	--
SV_1204_01_FB	Harvesting line valve	2-way valve animated	--	--
SV_1204_01_OP	Valve in manual mode	User input	--	--
SV_1204_02_FB	Air inlet valve (harvesting tank)	2-way valve animated	--	--
SV_1204_02_OP	Valve in manual mode	User input	--	--
SV_1204_03_FB	Filtrate flow to vessel valve (after filter)	2-way valve animated	--	--
SV_1204_03_OP	Valve in manual mode	User input	--	--
TT_1205_01	Harvesting tank temperature	Analogue indicator	(ºC)	0 to 100
VSL2_1204_01_VOLUME	Harvesting tank level	Analogue indicator	(L)	0 to 100
LSL_1206_01	Low level switch harvesting tank	Digital indicator	--	--
LSH_1206_01	High level switch harvesting tank	Digital indicator	--	--
CL1210_TB_STOP	Status of the	Digital indicator	--	--
CL1210_TB_S1	Status of the Membrane 1 sterilization	Digital indicator	--	--
CL1210_TB_S2	Status of the Membrane 2 sterilization	Digital indicator	--	--
CL1210_TB_ALL1	Status of the sterilization of Effluent tank and Membrane 1 filtrate line	Digital indicator	--	--
CL1210_TB_ALL2	Status of the sterilization of Effluent tank and Membrane 2 filtrate line	Digital indicator	--	--
CL1210_TB_P_ALL1	Status of the protocol of sterilization membrane 1	Digital indicator	--	--
CL1210_TB_P_ALL2	Status of the protocol of sterilization Membrane 2	Digital indicator	--	--
CL1210_TB_REC	Status of sterilization recycle line	Digital indicator	--	--
CL1210_TB_HARVEST	Status of the sterilization harvest tank	Digital indicator	--	--
CL1210_TB_FLUSHREC	Status of the flushing recycle line	Digital indicator	--	--

Tag Name	Description	Type	Units	Range
CL1210_MEMBR_PURGETIME	Remaining time of the purge Membrane	Analogue indicator	(second)	0 to 9.999.999
CL1210_MEMBR_STERILTIME	Remaining time of the sterilize Membrane	Analogue indicator	(second)	0 to 9.999.999
CL1210_MEMBR_COOLINGTIME	Remaining time of the cooling Membrane	Analogue indicator	(second)	0 to 9.999.999
CL1210_ALL_PURGETIME	Remaining time of the purge protocol of sterilization.	Analogue indicator	(second)	0 to 9.999.999
CL1210_ALL_STERILTIME	Remaining time of the sterilize protocol of sterilization.	Analogue indicator	(second)	0 to 9.999.999
CL1210_ALL_COOLINGTIME	Remaining time of the cooling protocol of sterilization.	Analogue indicator	(second)	0 to 9.999.999
CL1210_REC_DRAINTIME	Remaining time of the drain recycle line	Analogue indicator	(second)	0 to 9.999.999
CL1210_REC_STERILTIME	Remaining time of the sterilize recycle line	Analogue indicator	(second)	0 to 9.999.999
CL1210_REC_COOLINGTIME	Remaining time of the cooling recycle line	Analogue indicator	(second)	0 to 9.999.999
CL1210_REC_FLUSHINGTIME	Remaining time of the flushing recycle line	Analogue indicator	(second)	0 to 9.999.999
CL1210_HARVEST_DRAINTIME	Remaining time of the drain harvest line	Analogue indicator	(second)	0 to 9.999.999
CL1210_HARVEST_COOLINGTIME	Remaining time of the cooling harvest line	Analogue indicator	(second)	0 to 9.999.999
CL1210_HARVEST_STERILTIME	Remaining time of the sterilization of the harvest line.	Analogue indicator	(second)	0 to 9.999.999
SV_1210_03_FB	Steam input valve of the harvest tank	2-way valve animated	--	--
SV_1210_03_OP	Valve in manual mode	User input	--	--
SV_1210_10_MV	Steam outlet valve of the recycling line	2-way valve animated	--	--
SV_1210_10_OP	Valve in manual mode	User input	--	--
SV_1210_11_FB	Steam input valve of the recycling line	2-way valve animated	--	--
SV_1210_11_OP	Valve in manual mode	User input	--	--
SV_1210_12_MV	N2 outlet valve to harvesting tank	2-way valve animated	--	--
SV_1210_12_OP	Valve in manual mode	User input	--	--
SV_1210_13_FB	Steam input valve of the harvesting line	2-way valve animated	--	--
SV_1210_13_OP	Valve in manual mode	User input	--	--
SV_1210_14_FB	Steam outlet valve of the harvesting line	2-way valve animated	--	--
SV_1210_14_OP	Valve in manual mode	User input	--	--
SV_1210_15_FB	Drain valve of the recycling line	2-way valve animated	--	--
SV_1210_15_OP	Valve in manual mode	User input	--	--
SV_1211_03_FB	N2 input valve to recycling line	2-way valve animated	--	--
SV_1211_03_OP	Valve in manual mode	User input	--	--

Table 6-47: Tags of the SIP Maintenance screen (Filtrate side)

6.17.4 Control loops

The following control loops are implemented on the screen:

Control Logic	Description
CL1210	Sterilization in place mode
CL1200	Filtration Unit mode
CL1207	Cleaning in place mode

Table 6-48: Control Loop of the SIP Maintenance screen (Filtrate Side)

6.18 Sterilization in place maintenance (membranes side)

Clicking over Membranes area of the SIP screen the following screen is opened. Membranes area groups the entire lines of the Membranes.

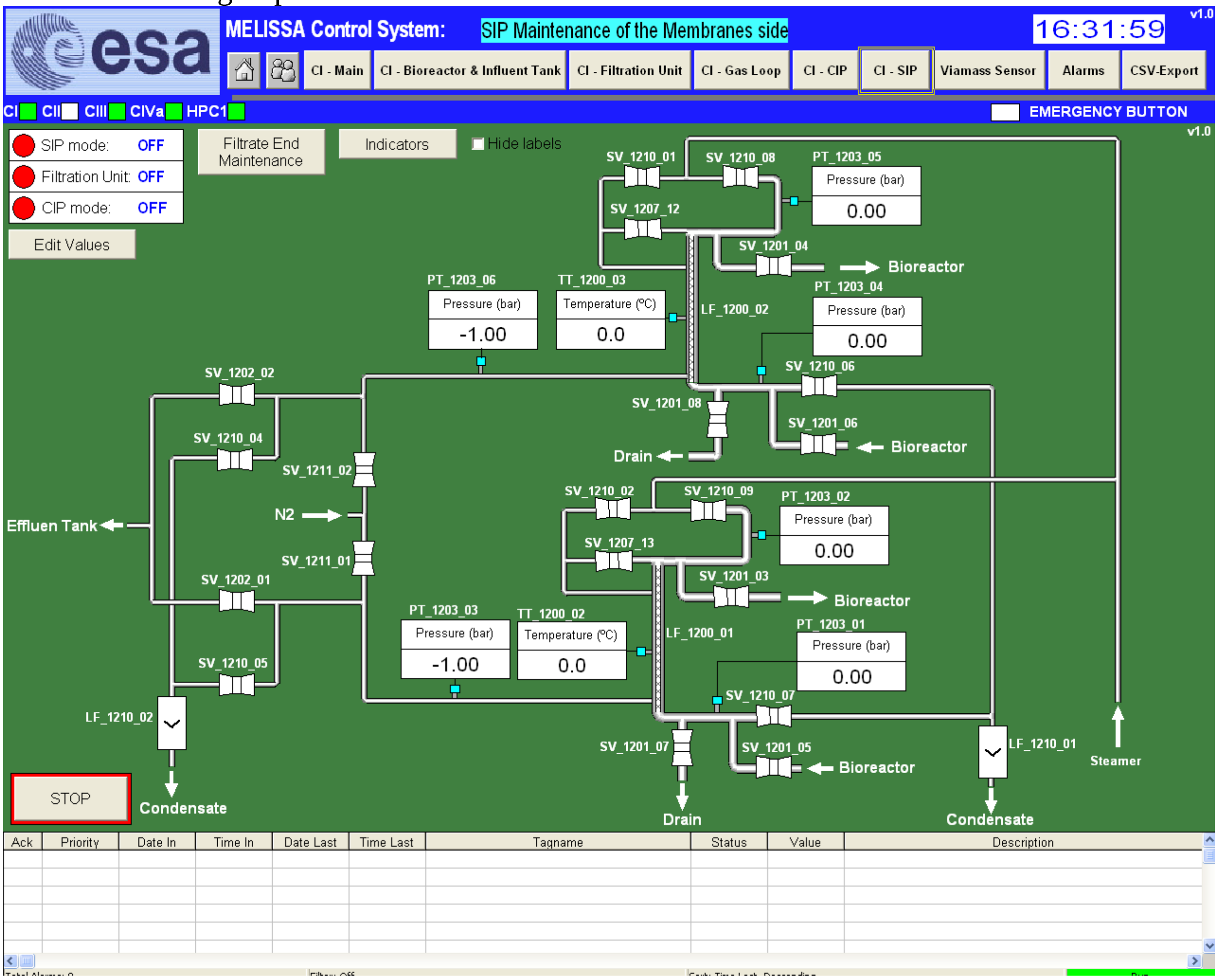


Figure 6-43: Main objects of the SIP Maintenance (Membranes side)

6.18.1 General actions

This display allows the user to:

- 2-way valves animations.
- Analogue indicators.
- Device alarm animations.
- Change Filtration Unit and SIP control loop mode state.
- Display the status of the SIP procedures clicking "Indicators" command button.
- Navigate to the other screen of the SIP Maintenance through "Filtrate End Maintenance" command button.

- Hide labels selecting the “Hide labels” check box.
- Switch OFF the SIP, Filtration Unit and CIP mode clicking on the “Stop” command button.
- Activate/deactivate valves and pumps in manual mode clicking over the equipment.
- Edit values allows to activate different equipment at the same time in manual mode.

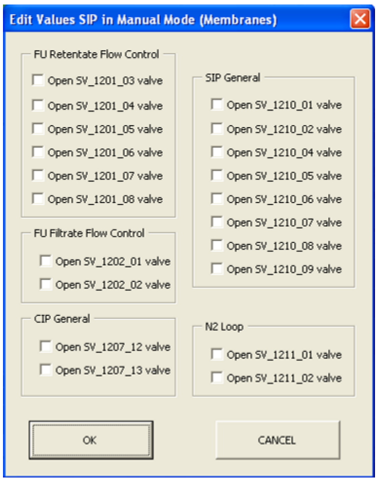


Figure 6-44: Edit Values dialog

6.18.2 Alarms

The following alarms are linked with the operation of the SIP Maintenance screen (Membranes side)

TAG NAME	Description	Colour
TT_1200_02_ERR	Membrane 1 temperature sensor link error	“ERR” text in RED
TT_1200_02_AHH	Membrane 1 temperature reaches high level 2 sensor	RED
TT_1200_02_AH	Membrane 1 temperature reaches high level 1 sensor	YELLOW
TT_1200_02_ALL	Membrane 1 temperature reaches low level 2 sensor	RED
TT_1200_02_AL	Membrane 1 temperature reaches low level 1 sensor	YELLOW
TT_1200_03_ERR	Membrane 2 temperature sensor link error	“ERR” text in RED
TT_1200_03_AHH	Membrane 2 temperature reaches high level 2 sensor	RED
TT_1200_03_AH	Membrane 2 temperature reaches high level 1 sensor	YELLOW
TT_1200_03_ALL	Membrane 2 temperature reaches low level 2 sensor	RED
TT_1200_03_AL	Membrane 2 temperature reaches low level 1 sensor	YELLOW
SV_1201_03_A	Outlet retentate side Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1201_04_A	Outlet retentate side Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1201_05_A	Inlet retentate Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1201_06_A	Inlet retentate Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1201_07_A	Drain Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1201_08_A	Drain Membrane 2 valve in wrong position	RED and “ERR” text in RED
SV_1202_01_A	Filtrate side Membrane 1 valve in wrong position	RED and “ERR” text in RED
SV_1202_02_A	Filtrate side Membrane 2 valve in wrong position	RED and “ERR” text in RED
PT_1203_01_ERR	Inlet retentate side Membrane 1 pressure sensor link error	“ERR” text in RED
PT_1203_01_AHH	Inlet retentate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_01_AH	Inlet retentate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW

TAG NAME	Description	Colour
PT_1203_01_ALL	Inlet retentate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_01_AL	Inlet retentate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_02_ERR	Outlet retentate side Membrane 1 pressure sensor link error	“ERR” text in RED
PT_1203_02_AHH	Outlet retentate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_02_AH	Outlet retentate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_02_ALL	Outlet retentate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_02_AL	Outlet retentate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_03_ERR	Filtrate side Membrane 1 pressure sensor link error	“ERR” text in RED
PT_1203_03_AHH	Filtrate side Membrane 1 pressure reaches high level 2 Alarm	RED
PT_1203_03_AH	Filtrate side Membrane 1 pressure reaches high level 1 Alarm	YELLOW
PT_1203_03_ALL	Filtrate side Membrane 1 pressure reaches low level 2 Alarm	RED
PT_1203_03_AL	Filtrate side Membrane 1 pressure reaches low level 1 Alarm	YELLOW
PT_1203_04_ERR	Inlet retentate side Membrane 2 pressure sensor link error	“ERR” text in RED
PT_1203_04_AHH	Inlet retentate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_04_AH	Inlet retentate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_04_ALL	Inlet retentate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_04_AL	Inlet retentate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_05_ERR	Outlet retentate side Membrane 2 pressure sensor link error	“ERR” text in RED
PT_1203_05_AHH	Outlet retentate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_05_AH	Outlet retentate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_05_ALL	Outlet retentate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_05_AL	Outlet retentate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
PT_1203_06_ERR	Filtrate side Membrane 2 pressure sensor link error	“ERR” text in RED
PT_1203_06_AHH	Filtrate side Membrane 2 pressure reaches high level 2 Alarm	RED
PT_1203_06_AH	Filtrate side Membrane 2 pressure reaches high level 1 Alarm	YELLOW
PT_1203_06_ALL	Filtrate side Membrane 2 pressure reaches low level 2 Alarm	RED
PT_1203_06_AL	Filtrate side Membrane 2 pressure reaches low level 1 Alarm	YELLOW
SV_1207_12_A	Bypass valve between outlet retentate side and filtrate side Membrane 2 in wrong position	RED and “ERR” text in RED
SV_1207_13_A	Bypass valve between outlet retentate side and filtrate side in wrong position	RED and “ERR” text in RED
SV_1210_01_A	Steam input valve in Membrane 2 filtrate side in wrong position	RED and “ERR” text in RED
SV_1210_02_A	Steam input valve in Membrane 1 filtrate side in wrong position	RED and “ERR” text in RED
SV_1210_04_A	Steam input valve to the Membrane 2 filtrate side in wrong position	RED and “ERR” text in RED
SV_1210_05_A	Steam input valve to the filtrate side in wrong position	RED and “ERR” text in RED
SV_1210_06_A	Steam input valve to Membrane 2 retentate side in wrong position	RED and “ERR” text in RED
SV_1210_07_A	Steam input valve to Membrane 1 retentate side in wrong position	RED and “ERR” text in RED
SV_1210_08_A	Steam input valve in Membrane 2 outlet retentate side in wrong position	RED and “ERR” text in RED
SV_1210_09_A	Steam input valve in Membrane 1 outlet retentate side in wrong position	RED and “ERR” text in RED
SV_1211_01_A	N2 input valve to the filtrate side in wrong position	RED and “ERR” text in RED
SV_1211_02_A	N2 input valve to the Membrane 2 filtrate side in wrong position	RED and “ERR” text in RED

Table 6-49: Alarm tags of the SIP Maintenance screen (Membranes side)

6.18.3 Tags

The following tags are displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	Units	Range
CL1200_SCI_MEMBR1_PRESENT	Membrane 1 presence in its housing	Filter animated	--	--
CL1200_SCI_MEMBR2_PRESENT	Membrane 2 presence in its housing	Filter	--	--

Tag Name	Description	Type	Units	Range
		animated		
TT_1200_02_AV	Temperature in Membrane 1	Analogue indicator	(ºC)	0 to 400
TT_1200_03_AV	Temperature in Membrane 2	Analogue indicator	(ºC)	0 to 400
SV_1201_03_FB	Membrane 1 outlet retentate side valve	2-way valve animated	--	--
SV_1201_03_OP	Valve in manual mode	User input	--	--
SV_1201_04_FB	Outlet retentate side Membrane 2 side	2-way valve animated	--	--
SV_1201_04_OP	Valve in manual mode	User input	--	--
SV_1201_05_FB	Inlet valve retentate line Membrane 1	2-way valve animated	--	--
SV_1201_05_OP	Valve in manual mode	User input	--	--
SV_1201_06_FB	Inlet retentate side Membrane 2 valve	2-way valve animated	--	--
SV_1201_06_OP	Valve in manual mode	User input	--	--
SV_1201_07_FB	Drain Membrane 1 valve	2-way valve animated	--	--
SV_1201_07_OP	Valve in manual mode	User input	--	--
SV_1201_08_FB	Drain Membrane 2 valve	2-way valve animated	--	--
SV_1201_08_OP	Valve in manual mode	User input	--	--
SV_1202_01_FB	Membrane 1 filtrate side valve	2-way valve animated	--	--
SV_1202_01_OP	Valve in manual mode	User input	--	--
SV_1202_02_FB	Membrane 2 filtrate side valve	2-way valve animated	--	--
SV_1202_02_OP	Valve in manual mode	User input	--	--
PT_1203_01	Pressure in Membrane 1 retentate side	Analogue indicator	(bar)	0 to 4
PT_1203_02	Pressure in outlet retentate side membrane 1	Analogue indicator	(bar)	0 to 4
PT_1203_03	Pressure in Membrane 1 filtrate side	Analogue indicator	(bar)	-1 to 4
PT_1203_04	Pressure in Membrane 2 retentate side	Analogue indicator	(bar)	0 to 4
PT_1203_05	Pressure in outlet retentate side Membrane 2	Analogue indicator	(bar)	0 to 4
PT_1203_06	Pressure in Membrane 2 filtrate side	Analogue indicator	(bar)	-1 to 4
SV_1207_12_FB	Bypass valve between Membrane 2 outlet retentate side and filtrate side	2-way valve animated	--	--
SV_1207_12_OP	Valve in manual mode	User input	--	--
SV_1207_13_FB	Bypass valve between Membrane 1 outlet retentate side and filtrate side	2-way valve animated	--	--
SV_1207_13_OP	Valve in manual mode	User input	--	--
CL1210_TB_STOP	Status of the	Digital indicator	--	--
CL1210_TB_S1	Status of the Membrane 1 sterilization	Digital indicator	--	--
CL1210_TB_S2	Status of the Membrane 2 sterilization	Digital indicator	--	--
CL1210_TB_ALL1	Status of the sterilization of Effluent tank and Membrane 1 filtrate line	Digital indicator	--	--
CL1210_TB_ALL2	Status of the sterilization of Effluent tank and Membrane 2 filtrate line	Digital indicator	--	--
CL1210_TB_P_ALL1	Status of the protocol of sterilization membrane 1	Digital indicator	--	--
CL1210_TB_P_ALL2	Status of the protocol of sterilization Membrane 2	Digital indicator	--	--
CL1210_TB_REC	Status of sterilization recycle line	Digital indicator	--	--
CL1210_TB_HARVEST	Status of the sterilization harvest tank	Digital indicator	--	--
CL1210_TB_FLUSHREC	Status of the flushing recycle line	Digital indicator	--	--

Tag Name	Description	Type	Units	Range
CL1210_MEMBR_PURGETIME	Remaining time of the purge Membrane	Analogue indicator	(second)	0 to 9.999.999
CL1210_MEMBR_STERILTIME	Remaining time of the sterilize Membrane	Analogue indicator	(second)	0 to 9.999.999
CL1210_MEMBR_COOLINGTIME	Remaining time of the cooling Membrane	Analogue indicator	(second)	0 to 9.999.999
CL1210_ALL_PURGETIME	Remaining time of the purge protocol of sterilization.	Analogue indicator	(second)	0 to 9.999.999
CL1210_ALL_STERILTIME	Remaining time of the sterilize protocol of sterilization.	Analogue indicator	(second)	0 to 9.999.999
CL1210_ALL_COOLINGTIME	Remaining time of the cooling protocol of sterilization.	Analogue indicator	(second)	0 to 9.999.999
CL1210_REC_DRAINTIME	Remaining time of the drain recycle line	Analogue indicator	(second)	0 to 9.999.999
CL1210_REC_STERILTIME	Remaining time of the sterilize recycle line	Analogue indicator	(second)	0 to 9.999.999
CL1210_REC_COOLINGTIME	Remaining time of the cooling recycle line	Analogue indicator	(second)	0 to 9.999.999
CL1210_REC_FLUSHINGTIME	Remaining time of the flushing recycle line	Analogue indicator	(second)	0 to 9.999.999
CL1210_HARVEST_DRAINTIME	Remaining time of the drain harvest line	Analogue indicator	(second)	0 to 9.999.999
CL1210_HARVEST_COOLINGTIME	Remaining time of the cooling harvest line	Analogue indicator	(second)	0 to 9.999.999
CL1210_HARVEST_STERILTIME	Remaining time of the sterilization of the harvest line	Analogue indicator	(second)	0 to 9.999.999
SV_1210_01_FB	Steam input valve in Membrane 2 filtrate side	2-way valve animated	--	--
SV_1210_01_OP	Valve in manual mode	User input	--	--
SV_1210_02_FB	Steam input valve in Membrane 1 filtrate side	2-way valve animated	--	--
SV_1210_02_OP	Valve in manual mode	User input	--	--
SV_1210_04_FB	Steam input valve to the Membrane 2 filtrate side	2-way valve animated	--	--
SV_1210_04_OP	Valve in manual mode	User input	--	--
SV_1210_05_FB	Steam input valve to the Membrane 1 filtrate side	2-way valve animated	--	--
SV_1210_05_OP	Valve in manual mode	User input	--	--
SV_1210_06_FB	Steam input valve to Membrane 2 retentate side	2-way valve animated	--	--
SV_1210_06_OP	Valve in manual mode	User input	--	--
SV_1210_07_FB	Steam input valve to Membrane 1 retentate side	2-way valve animated	--	--
SV_1210_07_OP	Valve in manual mode	User input	--	--
SV_1210_08_FB	Steam input valve in Membrane 2 outlet retentate side	2-way valve animated	--	--
SV_1210_08_OP	Valve in manual mode	User input	--	--
SV_1210_09_FB	Steam input valve in Membrane 1 outlet retentate side	2-way valve animated	--	--
SV_1210_09_OP	Valve in manual mode	User input	--	--
SV_1211_01_FB	N2 input valve to the Membrane 1 filtrate side	2-way valve animated	--	--
SV_1211_01_OP	Valve in manual mode	User input	--	--
SV_1211_02_FB	N2 input valve to the Membrane 2 filtrate side	2-way valve animated	--	--
SV_1211_02_OP	Valve in manual mode	User input	--	--

Table 6-50: Tags of the SIP Maintenance screen (Membranes side)

6.18.4 Control loops

The following control loops are implemented on the screen:

Control Logic	Description
CL1210	Sterilization in place mode

Control Logic	Description
CL1200	Filtration Unit mode
CL1207	Cleaning in place mode

Table 6-51: Control Loop of the SIP Maintenance screen (Filtrate Side)

6.19 Graph Screen

For description of its functionalities and how to use it, please refer to [R5].

6.20 Viamass sensor Screen

For description of its functionalities and how to use it, please refer to [R6].

6.21 CSV Export Data Screen

For description of its functionalities and how to use it, please refer to [R5].

6.22 Alarms Screen

For description of its functionalities and how to use it, please refer to [R5].

7 CI Maintenance screens users locking

Compartment I maintenance screens can be operated from one node (client computer/Panel PC) at time, if an operator from another node with CI privileges tries to access to CI screens it will be automatically logged off and logged in as “Guest”. This prevents the situation where more than one user is modifying CI variables. However, in any case the operator will be able monitor CI variables.

The following conditions have been analysed:

1. Node 1 (e.g. Control Room Node) user logged in with CI privileges displaying CI screen and Node 2 (e.g. CI local Node) user logged in with CI privileges accessing to CI maintenance screen.
    a. Node 2 to access CI maintenance screen. Node 1 user logged in will be logged off automatically and logged in as “Guest”.
    b. The following window will be displayed in Node 1 notifying to the user in Node 2 that is accessing to CI Maintenance screen and the user has been logged off.

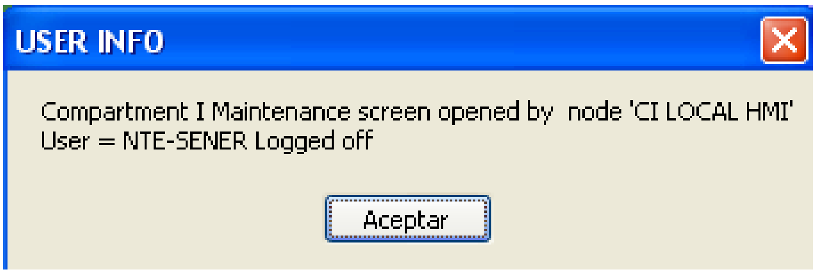


Figure 7-1: Windows fired in Node notifying another Node with CI maintenance screen opened

2. Node (e.g. Control Room Node) user logged in without CI privileges displaying CI screen to access to CI Maintenance screen.
    a. CI maintenance screen will be opened allowing to the user visualize the CI variables but not control it and the following windows will be fired notifying not CI privileges to the user.

Figure 7-2: Windows fired notifying user logged in doesn’t have CI privileges

3. Node 1 (e.g. CI Local Node) user logged in with CI privileges displaying CI maintenance screen and Node 2 (e.g. Control Room Node) user logged in with CI privileges navigating in other compartment screens and access to CI screen.
    a. Node 2 user logged in is automatically logged off and logged in as “Guest”.
    b. The following window is fired Node 2 when access to CI screen.

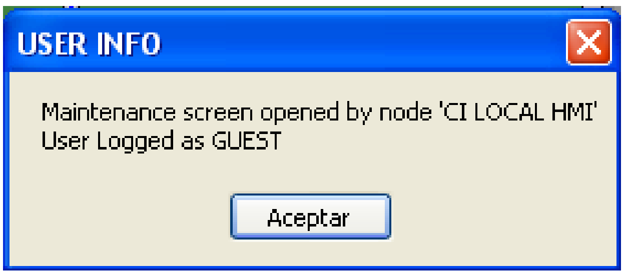


Figure 7-3: Windows fired when user access CI screen and another user has CI maintenance screen opened

4. Node 1 (e.g. CI Local Node) user logged in with CI privileges displaying CI maintenance screen and Node 2 (e.g. Control Room Node) user logged in without CI privileges navigating in other compartment screens and access to CI screen.
    a. No window is displayed until user tries to modify any CI variable.

5. Node 1 (e.g. CI Local Node) user logged in with CI privileges displaying CI maintenance screen and Node 2 (e.g. Control Room Node) user logged in without CI privileges displaying CI screen and tries to change user logged in by another one with CI privileges.
    a. Node 2 user will be logged off automatically and logged in as “Guest” because Node 1 is displaying CI maintenance screen with privileges.

Node 1 must exit from CI maintenance screen to allow Node 2 to access CI maintenance screen.

b. In Node 2 a window is fired notifying to the user other Node is accessing to CI Maintenance screen.

8 Master control

The Master Control is executed by the iFix Scheduler module. This module allows the configuration of a task that needs to be executed periodically at fixed time intervals. The tasks can be configured to run in background, and therefore, is not necessary to start a Windows session in the Supervision Server. From this module, algorithms can access to process variables. By default, tasks will be running in background, to perform a change or to initialize a control algorithm, task configuration needs to be changed to run in foreground.

Task configuration is managed from the Supervision Server Workspace application.
In MELISSA compartment CI system, following tasks are configured:

- MEL_CI_SAVEVALUES

This task saves the principal process variable values of the Compartment I in the Supervision Database.

- VIAMASS_SAVEVALUES

This task saves the process variable values of the Compartment I VIAMASS system in the Supervision Database.

- SystemControl

This task is a daily execution task that updates the PLCs system clock with the server clock.

Refer to R5 to change the task run mode (foreground or background) and to enable/disable logs.

8.1 Supervision Database

Supervision Database is updated by means of the tasks MEL_CI_SAVEVALUES running under the iFIX Task Scheduler. These tasks are scripts that build the SQL sentence to update the corresponding Microsoft Access® database. Data can be retrieved using the Microsoft Access® application export features.

Refer to R5 to change the update rate of the schedule.

8.1.1 Compartment I

The following values of the “Compartment I” are saved in the Supervision Database:

Scheduler Task: MEL_CI_SAVEVALUES

Tag Name	Description	HMI address	Units	Range
VSL2_1000_01_VOL_FILTERED	Inlfuent tank level	400107	(L)	0 to 60
CL1001_SCI_FEED_AMOUNT_PER_DAY	Feeding timer mode, amount per daty set point	400115	(L/day)	0 to 200
CL1001_SCI_FEED_INTERV_IN_HOUR	Feeding timer mode, interval in hour	400117	(Hour)	0 to 1
CL1001_FEED_VOLUME_SP	Feeding volume mode, volume set point	400443	(L)	TBD
PT_1001_01	Pressure after pump GP_1001_01	400193	(mBar)	-200 to 200
TT_1002_01_AV	Temperature in influent tank	400105	(ºC)	0 to 100
TT_1002_02_AV	Temperature in influent tank	400039	(ºC)	0 to 100
TT_1002_AVERAGE	Influent tank temperature average	400037	(ºC)	0 to 100
TT_1002_SP	Influent tank temperature set point	400181	(ºC)	0 to 100
PT_1003_01	Pressure in gas phase in influent tank	400191	(mBar)	-200 to 200
TT_1008_01_AV	Temperature in bioreactor	400103	(ºC)	0 to 100
TT_1008_02_AV	Temperature in VSL2_1008_01	400113	(ºC)	0 to 100
TT_1008_SP	Bioreactor temperature set point	400183	(ºC)	0 to 100
PT_1009_01	Pressure in gas phase in bioreactor	400175	(mBar)	-200 to 200
PT_1009_02	Pressure in liquid phase in bioreactor	400177	(mBar)	-200 to 200
CL1010_VSL2_1007_01_VOL_FILTER	Bioreactor volume	400215	(L)	0 to 120
AT_1011_01	pH in bioreactor	400211	(pH)	0 to 10
TT_1011_01	Temperature of the pH probe (AT_1011_01)	400065	(ºC)	0 to 100
AT_1011_02	pH in bioreactor	400213	(pH)	0 to 10
TT_1011_02	Temperature of the pH probe (AT_1011_02)	400067	(ºC)	0 to 100
AT_1011_AVERAGE	Bioreactor pH average	400053	(pH)	0 to 10
CL1011_PH_SP	Bioreactor pH set point	400185	(pH)	0 to 10
CL1011_PH_DEADZONE	Dead zone of the pH set point	400049	(pH)	0 to 1
AT_1014_01	Biomass in bioreactor	TBD	TBD	TBD
AT_1014_02	Biomass in filtration Unit	TBD	TBD	TBD
SCV_1100_01_MV	Proportional valve (active gas loop)	400171	(%)	0 to 100
PT_1100_01	Pressure in buffer tank	400035	(mBar)	0 to

Tag Name	Description	HMI address	Units	Range
				10000
PT_1100_02	Pressure in buffer tank (Passive Gas Loop)	400249	(mBar)	0 to 200
FT_1101_01	Gas input flow in gas analysers	400153	(L/h)	0 to 58
AT_1101_01_CH4	CH4 Analyser	400447	(%)	0 to 100
AT_1101_01_CO2	CO2 Analyser	400445	(%)	0 to 100
PT_1101_01	Gas pressure after gas analyser	400033	(mBar)	0 to 400
SCV_1103_01_MV	Proportional valve, N2 input into bioreactor.	400173	(%)	0 to 100
FT_1103_01_AV	N2 flow into bioreactor	400155	(L/h)	0 to 2
CL1103_N2_FLOW_L_PER_DAY	N2 flow	400235	(L/day)	TBD
CL1103_TOTAL_N2_FLOW	Total N2 flow inlet to bioreactor	400119	(L/day)	TBD
TT_1104_01	Temperature in buffer tank (Passive gas loop)	400247	(ºC)	0 to 100
CL1104_TOTAL_BIOGAS_L_PER_DAY	Total Biogas produced	400237	(L/day)	0 to 1000
CL1104_TOTAL_CO2_MOL	Total CO2 mol since last reset executed.	400025	(mg)	TBD
CL1104_TOTAL_CH4_MOL	Total CH4 mol since last reset executed.	400027	(mg)	TBD
CL1104_TOTAL_N2_MOL	Total N2 mol since last reset executed.	400029	(mg)	TBD
CL1104_TOTAL_MOLE_ESCAPE	Total mole escape	400233	(Mol)	TBD
TT_1200_01	Temperature in retentate line	400125	(ºC)	0 to 100
TT_1200_02_AV	Temperature in Membrane 1	400073	(ºC)	0 to 400
TT_1200_03_AV	Temperature in Membrane 2	400075	(ºC)	0 to 400
AT_1201_01	Turbidity in retentate side	400151	(NTU)	0 to 100
FT_1201_01_IN_L_PER_H_FILTERED	Flow in retentate side	400205	(L/h)	0 to 580
CL1201_SCI_FLOWRATE_SP	Retentate pump flowrate set point	400412	(L/h)	0 to 450
PP_1202_01_MV2	Speed of filtrate pump	400167	(%)	0 to 100
GP_1201_01_MV2	Speed of retentate pump	400169	(%)	0 to 100
PT_1203_01	Pressure in Membrane 1 retentate side	400217	(bar)	0 to 4
PT_1203_02	Pressure in outlet retentate side membrane 1	400219	(bar)	0 to 4
PT_1203_03	Pressure in Membrane 1 filtrate side	400221	(bar)	-1 to 4

Tag Name	Description	HMI address	Units	Range
PT_1203_04	Pressure in inlet retentate side Membrane 2	400143	(bar)	0 to 4
PT_1203_05	Pressure in outlet retentate side Membrane 2	400141	(bar)	0 to 4
PT_1203_06	Pressure in filtrate side Membrane 2	400139	(bar)	-1 to 4
PT_1203_07	Pressure of retentate after GP_1201_01 pump	400137	(bar)	-1 to 9
PT_1203_08	Pressure after filtrate pump	400133	(bar)	0 to 4
VSL2_1204_01_VOLUME	Effluent tank volume	400453	(L)	0 to 100
TT_1205_01	Harvesting tank temperature	400127	(ºC)	0 to 100
TT_1208_01	VSSL_1209_02 temperature	400129	(ºC)	0 to 100
CL1208_SCI_CB_TEMP_SP	VSSL_1209_02 temperature set-point	400400	(ºC)	0 to 100

9 APPENDIX B. Problem Report Form

MELISSA Control System Demonstrator - Problem Report		
Reported by:	Identifier:	Date:
Title:		Reference:
Problem Found		
Suspected Cause		
Disposition Result		
Disposition option: ☐ *Reject*	☐ *Repair, rework*	☐ *Use as is*
Disposition Date:		
Actions		
Close Out		
Verification results:		
Verified by: Date:	Authorised by: Date:	

VIAMASS SENSOR INSTALLED ON MELISSA PILOT PLANT COMPARTMENT I USER MANUAL

Frame Contract 19445/05/NL/CP

APPROVAL LIST		
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Approved by: E. Creus		
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CHANGE RECORD			
AUTHOR	ISSUE	DATE	CHANGE
Martí Bassas	1	04/11/08	New document
Martí Bassas Jordi Carbonell	2.0	16/10/2009	Update with MPP comments (04/12/08) List of acronyms added Second Ethernet connection in embeddedPC added (Figure 2) Sensor's name normalized within the whole document. Section 7 updated to define more accurately the sterilisation process. Section 8 modified to define more accurately cleaning procedure. Figure 3.2 note updated to remark that actual T-junction is made of Delrin. Some minor wording errors fixed.
J.Carbonell	2.1	14/10/2010	Add T-junction drawing in Annex section.

CONTENTS

LIST OF ACRONYMS

UAB	Universitat Autonoma de Barcelona
MPP	MELISSA Pilot Plant
VI	Virtual Instrument (Labview console)
DCE	Data Communication Equipment
DTE	Data Terminal Equipment
HMI	Human Machine Interface
PLC	Programmable Logic Controller.

0. Scope

This document describes the operational and maintenance procedures for the use of the VIAMASS system once implemented as part of MELISSA CI system. This document is an update of NTE-VSS-HB-017.

1. APPLICABLE AND REFERENCE DOCUMENTS

1.1 APPLICABLE DOCUMENTS

AD1 Frame contract 19445/05/NL/CP

1.2 REFERENCE DOCUMENTS

RD1 TN 2.1 Design Report: VIAMASS sensor for use on bioreactors, ref.: NTE-VSS-TN-009, is.: 2, 29/06/06

RD2 NTE's note of response to ESA's request for clarifications to RFQ-AO-1-4638-NTE/04/NL/PA/jk, 09/11/04

RD3 KO Minutes of Meeting, ref. NTE-VSS-KOMN-002, 30/03/05

RD4 VIAMASS SW User Manual, ref.: NTE-MC1-HB-007, is. : 2.0

2. Introduction

The VIAMASS Sensor is a device that uses Electrical Impedance Spectroscopy techniques to measure the viable biomass suspended in a medium.

The VIAMASS Sensor has been adapted for use in the first compartment of MELiSSA, according to the agreements stemming from RD2 and RD3. The VIAMASS system is integrated in MELISSA CI as shown in Figure 2.

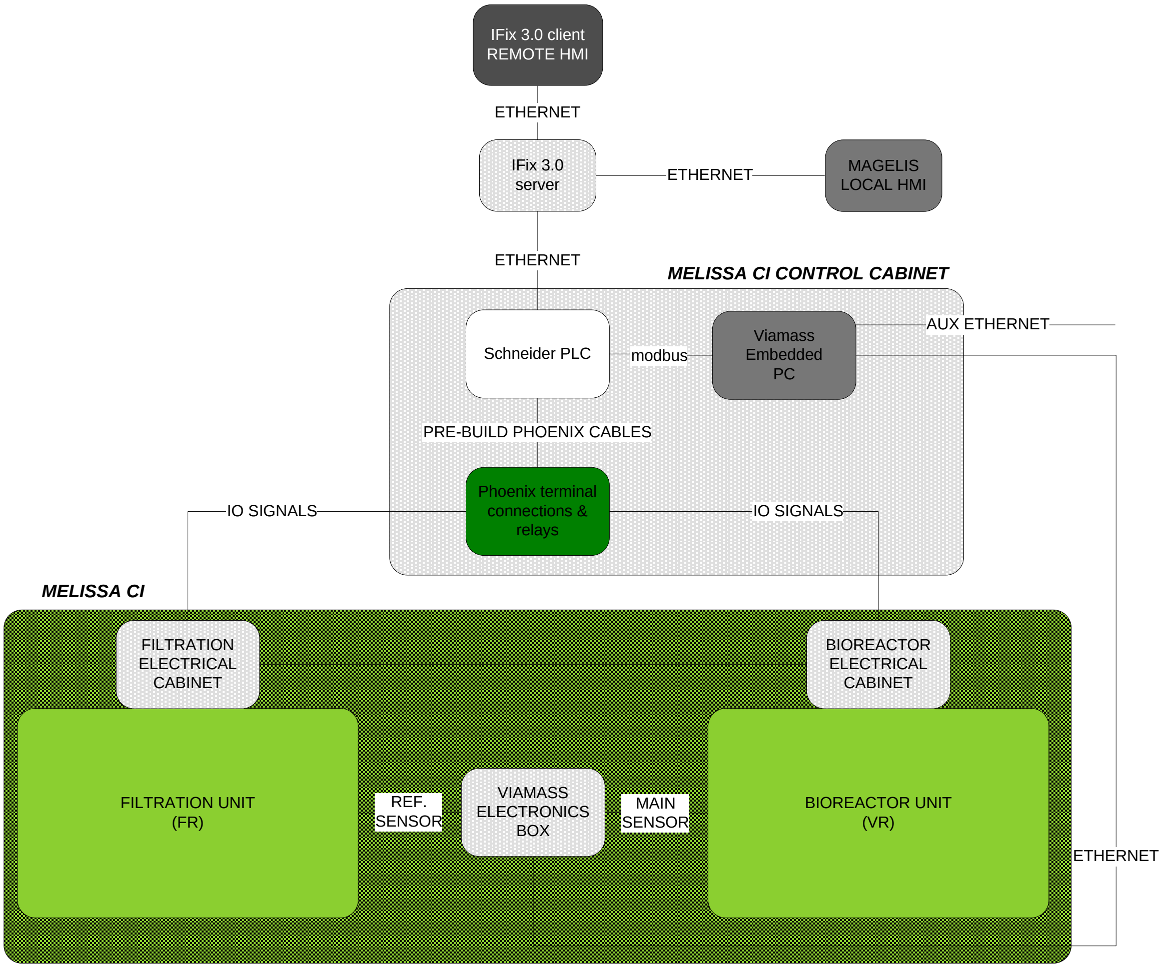


Figure 2: MELISSA CI block diagram with VIAMASS Sensor System.

The elements involved in biomass detection in MELISSA CI are the following:

- Main Sensor (process probe): It contains the electrodes and the front-end electronics. The sensor has been encapsulated so that it is compatible with an

INTRACK 777 retractable housing by METTER TOLEDO. The Main sensor is in direct contact with the contents of the bioreactor. This sensor is associated with the measurement Channel 1.

- Reference Sensor (calibration probe): From electrical point of view, it is identical to the Main Sensor. It has been mechanically adapted so that it can be placed in the filtration loop (DELRIN fitting part with clamp), external to the CI bioreactor, and used for calibration purposes. It is associated to the measurement Channel 2.

- VIAMASS Electronics box: It contains the electronic circuitry in charge of generating the measuring signal at the defined frequencies, driving the front-ends, and reading and temporary storing the measurement data. These electronics are commanded by a microprocessor that also handles the communication between the sensors and the box electronics, and the communication with the embedded PC, either directly or through Ethernet. This box also includes the power conditioning electronics and the connector interfaces for the sensors and Ethernet.

- VIAMASS Embedded PC: It runs the software controlling the Electronics box. It works as an interface between the VIAMASS Electronics box and the PLC.

- MELISSA CI PLC: It runs the main program to control and monitor MELISSA plant detectors and actuators. Independently, it is used as a communication interface VIAMASS Embedded PC and the server controlling the whole plant.

- Server: It controls and monitor’s MELISSA CI PLC.

- Client Computer: It can open an iFix front panel and have access to server’s data or request services.

3. SET-UP PROCEDURE

This procedure describes how to set up the system initially for a measurement session.

Place the process probe carefully inside the InTrac 777 retractable housing and leave it in the locked position (follow the InTrac 777 instructions). Small resistance is to be encountered due to the InTrack internal O-ring. (shown in Figure 3-1)

Process probe
inside Intrack
housing

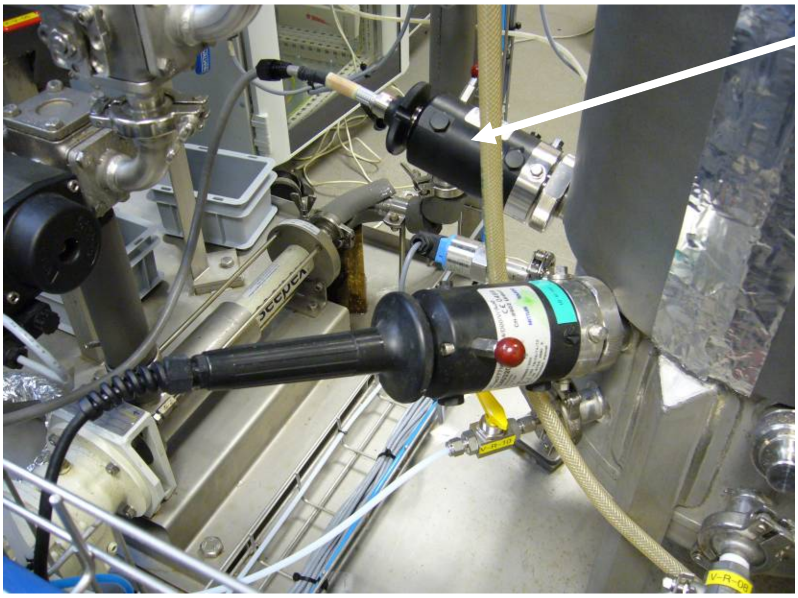
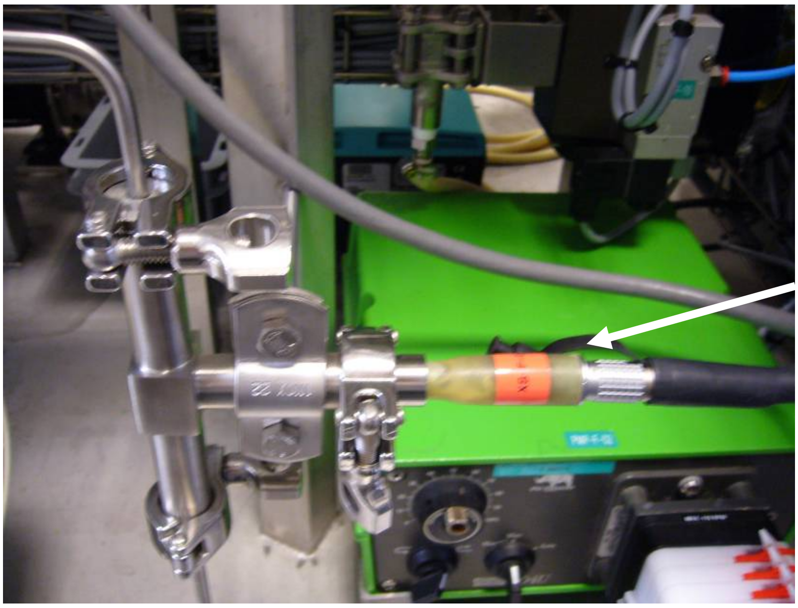


Figure 3-1

Place the calibration probe in the T-junction access located in the Filtration Loop and secure it with the TriClamp



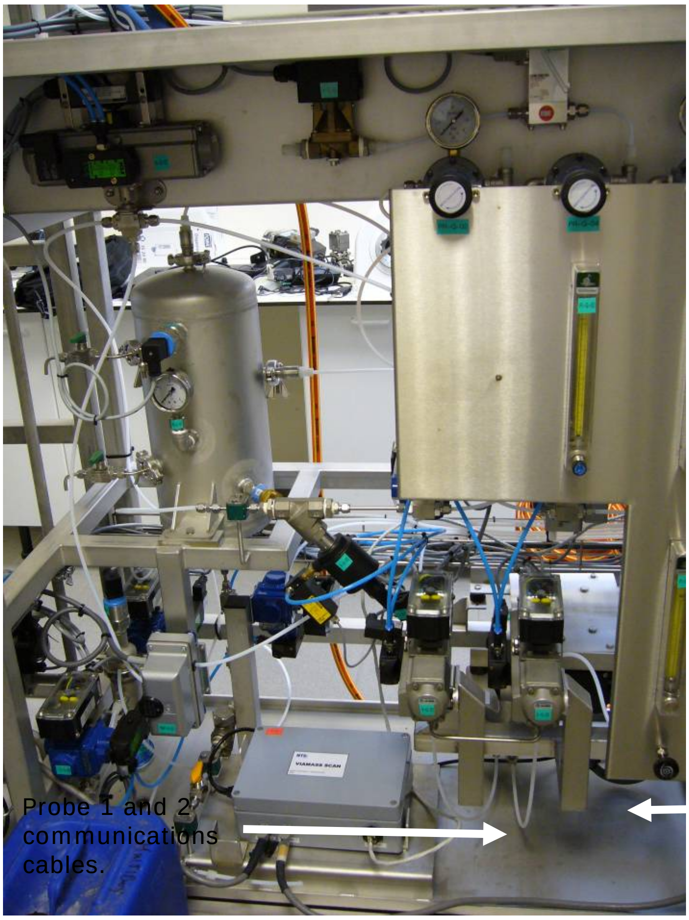
Calibration probe inside T-junction fitting

Figure 3.2: Metalic T-junction corresponding with an old configuration. It has been replaced by a Delrin T-junction

Connect the communication cable between the process probe (it should have a cap that fits into the InTrac 777) and the electronics box Channel 1 input

Connect the communication cable between the calibration probe and the electronics box Channel 2 input

Connect an Ethernet twisted-pair cable between the Ethernet port in the box and the Ethernet port in the embedded PC.



Ethernet cable connecting with the embedded PC

Figure 3.3

Connect the serial communication ModBus cable between the EmbeddedPC COM1 port and MELISSA CI control PLC COM1 port.

The ModBus cable is described in the following table:

DCE		DTE
DB9 female connector		DB9 female connector
Pins	**Signal description**	**Pins**
2	Transmitted Data	3
3	Received Data	2
7	Clear to Send	8
8	Request to Send	7
5	Signal Common	5

The cable is symmetric, so it can be in both ways.

The PLC and the embedded PC application are configured to communicate using the following serial port settings:+

Baud rate	19200
Data bits	8
Stop bits	1
Parity	Even
Flow control	None
Timeout	10000
Mode	RTU

Connect the power cable into the electronics box and switch on the unit

Figure 3.4

Turn the EmbeddedPC on and wait for the control software initialization.

Allow a warm up time of 15 – 30 minutes for capacitors charging in the electronics box.

Turn iFix Server PC on and Login session.

Turn iFix Client on and Login session.

From the Start Menu, run the Intellution iFIX 3.0 Application.

From the Start Menu, run the Login application and input the User name and Password.

Once logged in correctly, select to run the iFix Workspace application.

The system is ready to start the measurement session

4. SHUT DOWN PROCEDURE

When a measurement session is completed the system can be shut down simply by switching off the power switch in the power box.

The system elements can be left connected, as per the configuration defined in the set Up procedure.

5. START UP PROCEDURE

Assuming that the system and all its elements are connected as defined in the Set Up procedure, go through the following steps to initiate a new measurement procedure:

Power the system on.

Allow a warm up time of 15 – 30 minutes for capacitors charging

Turn the embedded PC on and wait some minutes until it is properly initialized.

The system is ready to start the measurement session

6. MEASUREMENT PROCEDURE

The VIAMASS system is designed to perform continuous electrical impedance spectrum measurement of the bioreactor’s content over a prolonged period of time with the purpose of conducting a qualitative validation of this technology in detecting viable biomass concentration and its variation over time.

Once the system is ready to start the measurements (i.e. the Set Up or Start Up procedures’ steps have been completed) the user only needs to run the HMI on a remote client for the measurement session to begin.

The system will automatically proceed until the process is halted by the user. This is further detailed in the SW User manual (RD4).

7. STERILIZATION PROCEDURE

Reference sensor (calibration probe) can be sterilized in place executing procedure 69: “SIP membrane LF_1200_01/LF_1200_02, filtrate line and filtrate tank VSL2_1204_01” from HMI.

There is no procedure foreseen to sterilize the bioreactor and, thus, the process probe in place. To sterilize the process probe the following steps have to be followed:

Probe must be disconnected from its harness and removed from its operational position

Place the probe in the sterilization device (e.g. autoclave) according to its specific procedure. It is advisable to place the probe inside a sealed box to avoid any contamination problems (e.g. outgassing).

Set the sterilization process at 120 ºC for 20 minutes.

Once finished retrieve the probe and let it cool to room temperature before returning to operational position.

8. CLEANING PROCEDURE

The four electrodes located at the measuring end of the process probe may dirty after prolonged contact with the bioreactor contents. This may degrade the measurement.

Electrodes can be cleaned as follows:

Extract the probe from the InTrack retractable housing carefully

Disconnect it from the communications cable

Perform a visual inspection of the four electrodes to detect any waste material

Clean the electrodes carefully with a cotton stick embedded with isopropyl alcohol

Rinse the electrodes with distilled water

Reassemble the probe into its operational position

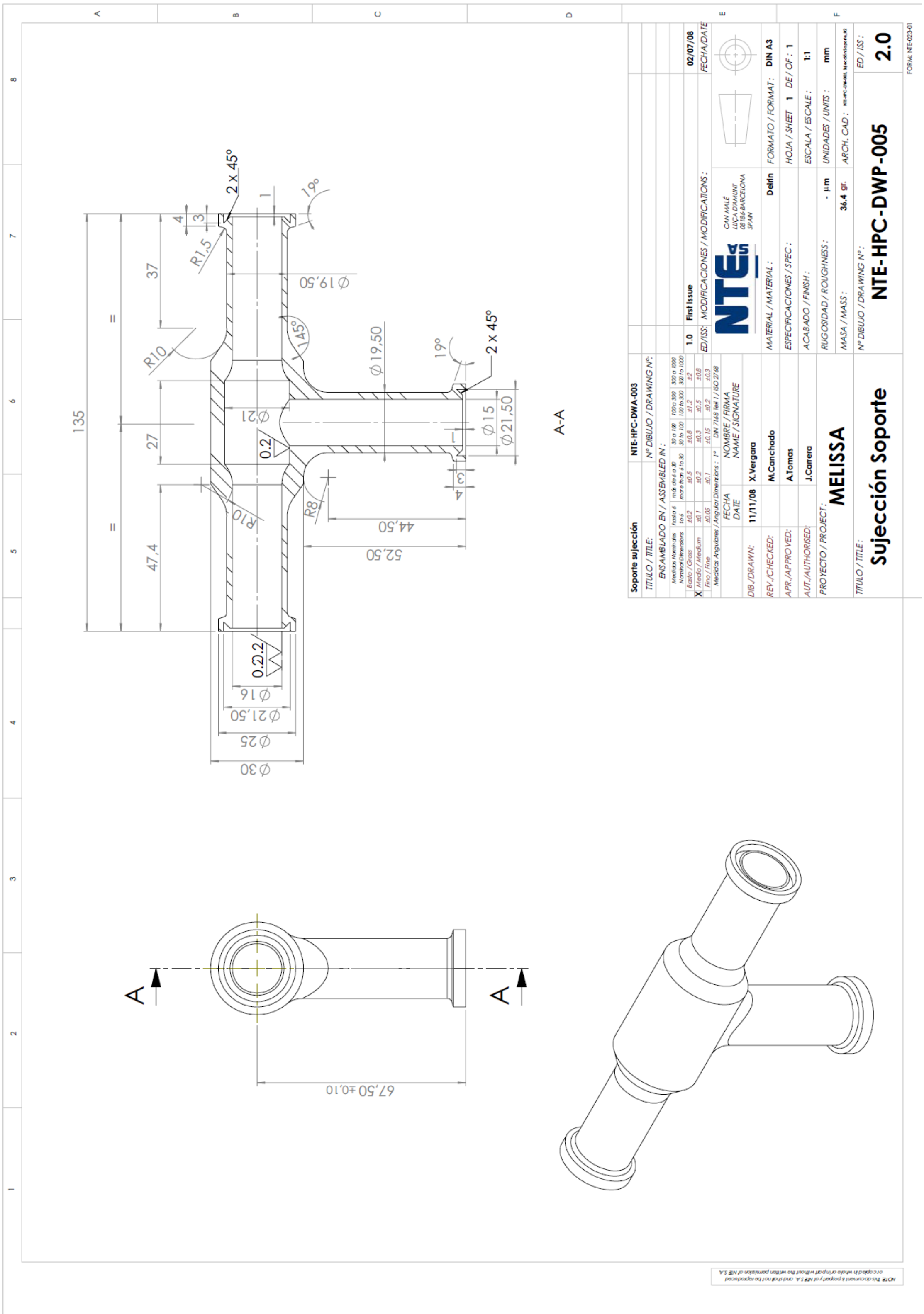
Notes:

There are no specific indications regarding the periodicity of the cleaning procedure. It is advised to check regularly the status of the process probe taking advantage of the retractable housing and to perform a cleaning operation if deemed necessary. The cleaning periodicity will be further determined after test campaigns, as the effect of dirt to the sensor is tested.

The same cleaning procedure can be applied to the calibration probe

9. ANNEX1

9.1 T-junction drawing


A-A
Sujeción Soporte
NTE-HPC-DWP-005
MELISSA
2.0

MELiSSA

DATA PACKAGE 94.1 Issue 1

VIAMASS SENSOR SW USER MANUAL

Frame contract 19445/05/NL/CP

APPROVAL LIST		
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Reviewed by: Jordi Carbonell		
Approved by: Eva Creus		
Authorised by: Jordi Duatis		

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CHANGE RECORD			
AUTHOR	ISSUE	DATE	CHANGE
Martí Bassas Jordi Carbonell	1	14/11/08	New document
Martí Bassas Jordi Carbonell	2.0	16/10/2009	Update with MPP comments (03/12/2008) List of acronyms added. Second Ethernet connection en embedded PC added (Figure 2.1). Sensor's names normalized within the whole document. Some minor wording errors fixed.

CONTENTS

LIST OF ACRONYMS

UAB	Universitat Autonoma de Barcelona
MPP	MELISSA Pilot Plant
VI	Virtual Instrument (Labview console).
MBE	Modbus Ethernet driver
PLC	Programmable Logic Controller.
SCADA	Supervisory Control and Data Acquisition.
HMI	Human Machine Interface.
DB	Data Base

0. Scope

This document describes the software involved in the VIAMASS measurements system and the use of the user interfaces. It is analogous to NTE-VSS-HB-010 but updated according to the PLC implementation in MELISSA CI.

1. APPLICABLE AND REFERENCE DOCUMENTS

1.1 APPLICABLE DOCUMENTS

A 1 Frame Contract 19/445/05/NL/CP

1.2 REFERENCE DOCUMENTS

RD1 Portable Device for Viable Biomass Measurement in Waste Water Treatment Plants (VIAMASS); ref. VSS-0000-OF-001-NTE, issue 2, 15/09/04 (NTE's proposal to AO/1-4638/04/NL/PA)

RD2 NTE's note of response to ESA's request for clarifications to RFQ-AO-1-4638-NTE/04/NL/PA/jk, dated 09/11/04

RD3 KO Minutes of Meeting, ref. NTE-VSS-KOMN-002, 30/03/05

RD4 TN 2.1: System design description of the VIAMASS sensor for use on bioreactors, ref.: NTE-VSS-TN-009, is.: 1.1, 22/05/06

RD5 TN78.72 ed 2 draft

2. OVERVIEW

The VIAMASS Sensor is a device that uses Electrical Impedance Spectroscopy techniques to measure the viable biomass suspended in a medium.

The VIAMASS Sensor has been adapted for use in the first compartment of MELiSSA, according to the agreements stemming from **¡Error! No se encuentra el origen de la referencia.** and **¡Error! No se encuentra el origen de la referencia.**. The VIAMASS system is integrated in MELISSA CI as shown in Figure 2-1.

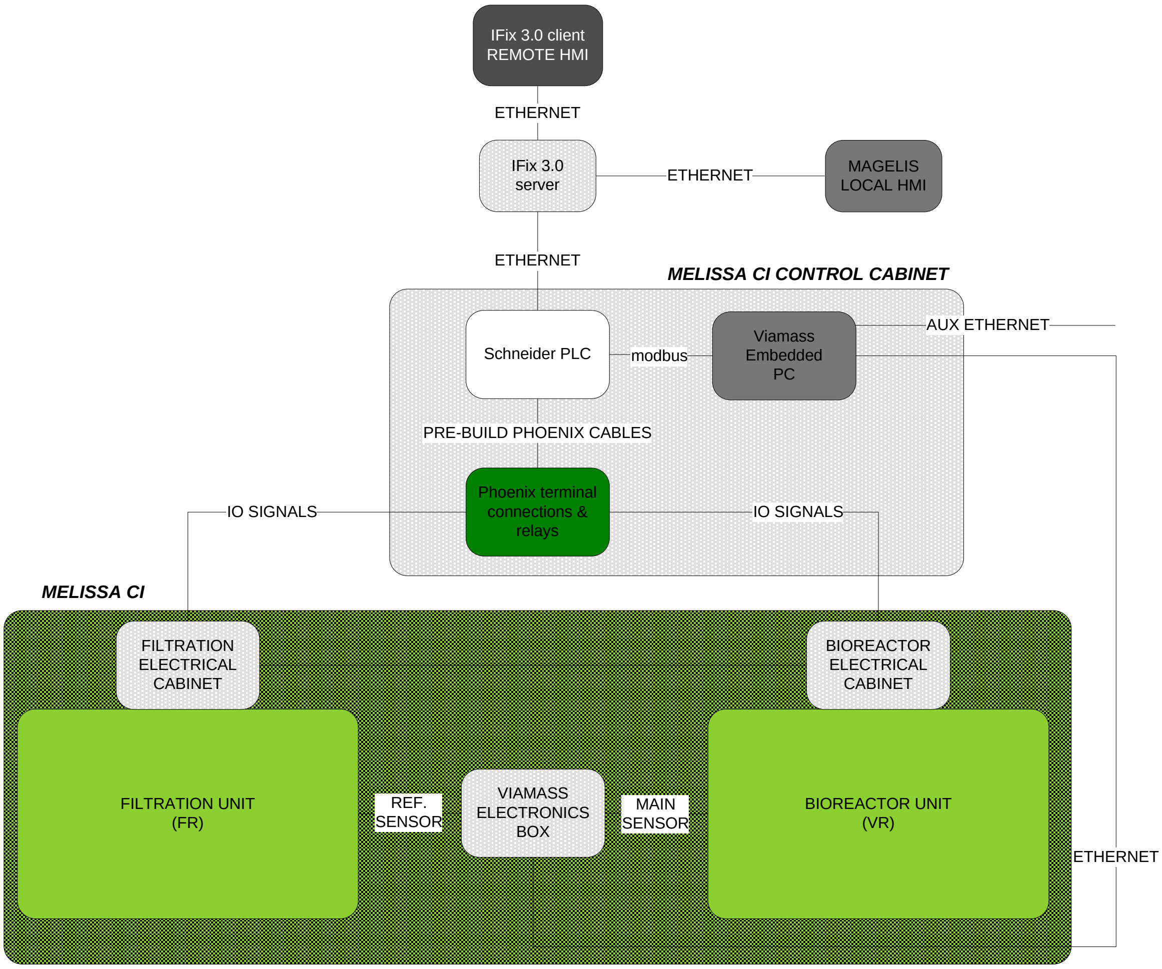


Figure 2-1: MELISSA CI block diagram with VIAMASS Sensor System.

The elements involved in biomass detection in MELISSA CI are the following:

- Main Sensor (process probe): It contains the electrodes and the front-end electronics. The sensor has been encapsulated so that it is compatible with an INTRACK 777 retractable housing by METTER TOLEDO. The Main sensor is in direct contact with the contents of the bioreactor. This sensor is associated with the measurement Channel 1.

- Reference Sensor (calibration probe): From electrical point of view, it is identical to the Main Sensor. It has been mechanically adapted so that is can be placed in the filtration loop, external to the CI bioreactor, and used for calibration purposes. It is associated to the measurement Channel 2.

- VIAMASS Electronics box: It contains the electronic circuitry in charge of generating the measuring signal at the defined frequencies, driving the front-ends, and reading and temporary storing the measurement data. These electronics are commanded by a microprocessor that also handles the communication between the sensors with the box electronics, and the communication with the embedded PC, either directly or through Ethernet. This box also includes the power conditioning electronics and the connector interfaces for the sensors and Ethernet.

- VIAMASS Embedded PC: It runs the software controlling the Electronics box. It works as an interface between the VIAMASS Electronics box and the PLC.
- MELISSA CI PLC: It runs the main program to control and monitor MELISSA plant detectors and actuators. Independently, it is used as a communication interface VIAMASS Embedded PC and the server controlling the whole plant.
- Server: It controls and monitor’s MELISSA CI PLC.
- Client Computer: It can open an iFix front panel and have access to server’s data or request services.

3. NETWORK ENVIRONMENT

The PLC, embedded pc, the iFix SCADA server and the clients are in the linked through an Ethernet network (using a switch). The addresses reserved and used for each element are the following:

Network Address: 172.16.0.0 (reserved for private networks, not routed in Internet)

Group	Addresses
Supervision Servers	172.16.0.1 to 172.16.0.63
Supervision Clients	172.16.0.65 to 172.16.0.85
HMI	172.16.0.86 to 172.16.0.128
Local Control	172.16.0.129 to 172.16.0.256

Server Name	IP Address	Mask
MEL_SUPV_SERV01	172.16.0.1	255.255.255.0

Client Name	IP Address	Mask
MEL_SUPV_CLI01	172.16.0.65	255.255.255.0

Local Control	IP Address	Mask
CI_PLC	172.16.0.129 (*)	255.255.255.0

Four addresses are reserved for each PLC to reserve addresses for a second CPU for redundant configuration and for a second Ethernet module to implement the redundant network.

Embedded PC stores the acquisition data from Viamass sensor in a shared folder, as defined in VIAMASS532.exe description, available through the LAN for the PC client.

Viamass data	IP Address	Mask
Embedded PC	172.16.0.64	255.255.255.0

The EmbeddedPC and the VIAMASS sensor electronic box are also linked using an independent Ethernet network. In this case a single cross-over cable is used. The addresses for each element are:

Embedded PC	IP Address	Mask
Embedded PC	20.20.11.150	255.255.255.0

VIAMASS sensor	IP Address	Mask
VIAMASS sensor	20.20.11.152	255.255.255.0

4. software introduction

There are three SW modules associated with the VIAMASS sensor, namely:

- VIAMASS5.c, running in the VIAMASS Electronics box..
- VIAMASS532.exe, compiled VI running on the VIAMASS embedded PC
- Supervision software, Running on MELISSA CI server. Clients may have access to some data and services provided by the server.

The VIAMASS532.c module is an embedded SW running in the sensor's microcontroller. This SW reads the commands sent by the PC, manages all the measurement process and sends to the PC the obtained results when they are requested. User has no access to this SW.

The VIAMASS532.exe SW runs on the VIAMASS Embedded PC. It controls the system and manages the communication between the sensor and the Embedded PC through Ethernet. This program issues commands to measure the medium impedance at the commanded frequency and channel and receives data packages with the measurement values obtained at these commanded frequencies and channel. One measurement consists in injecting 32 signals at different frequencies in the range from 1KHz to 10MHz, organized in 16 consecutive pairs of signals, each pair containing one low and one high frequency signal. For each injected signal the system returns the measured impedance of the medium plus three temperature readings, obtained from three different temperature sensors located at:

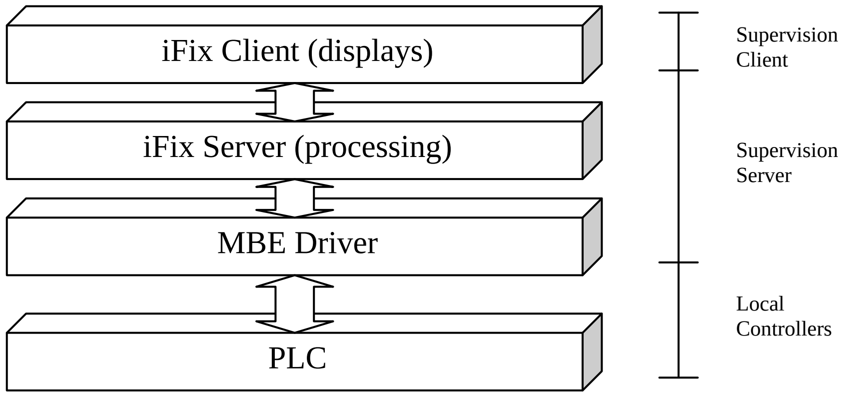
- Process or calibration probe (depending on channel sweep).
- The electronics box structure.
- On PCB electronics in the electronics box.

These measurement values are sent through ModBus to the PLC. The VI can be used as an auxiliary console to control and monitor the VIAMASS sensor. Its main features are:

- Monitor data received from the VIAMASS sensor.
- Monitor data sent to the PLC.
- Manually Start/stop measurements.
- Storing data to a log file.

These features may be used for debugging purposes or troubleshooting by manufacturer, but are not meant to be used during standard measurement campaigns. This document is intended to be the user interface user manual, so a detailed description of this software module is out of the scope of this document.

Supervision software is implemented using the Intellution iFix platform. Intellution iFix is a SCADA software that allows the monitoring and modification of process variables. Variable values are acquired through an interface driver (the so-called Mod-Bus Ethernet driver) that communicates with the PLC. Values are acquired and processed by the iFix Server, according to the information stored in the iFix Database. Once processed, these values are displayed numerically, as object animations or in charts in the client displays. In addition, iFix handles automatically alarm events, displaying the alarm information in a predefined area (Alarm Area) and can execute pre-programmed tasks defined in scripts using Visual Basic for Applications (VBA).



The MBE driver runs in the Supervision Server. This application uses Modbus over TCP/IP to communicate with the PLC. The configuration of the driver is edited with the MBE Power Tool, this application can be accessed directly from the iFix Database Manager. The resulting file defines the configuration of the blocks of information transferred from/to the PLC.

Data sent and received from the MBE driver are processed according to the iFix Database configuration. The iFix Database Manager application is used to modify this information, allowing the addition, modification and deletion of tags. A tag is an element of information that can be displayed, product of a calculation or directly a measured process variable (input) or process set point/parameter (output). The configuration of a tag includes alarm generation by allowing the definition of several predefined alarm conditions. The iFix Database Manager application can be accessed directly from a desktop icon or from the iFix Workspace application.

Clients may have access to server information and request services.

5. VIAMASS SW DESCRIPTION

5.1 VIAMASS5.c

As it is explained in the software introduction, this program decodes the commands issued from the PC and manages the measurement process. Once the measurement command is decoded this SW issues instructions to configure the HW in order to inject the signals and execute the measurement. After completing the measurement it reads the impedance and temperature values (obtained from the front-ends and the temperature sensors, respectively) generates the data frame and stores it, waiting for the request-to-send command to be issued by the PC.

This SW features adaptive routines whose purpose is to reduce potential measurement errors. These routines repeat several times the measurement (e.g. several batches of 16 frequency pairs) and perform some processing until a correct impedance value is obtained. The processing time of these adaptive routines is depending on the characteristics of the biological process under measurement. For this reason the user can pre-select this delay through configuring the VIAMASS user SW (see parameter Measure Delay, below).

5.2 VIAMASS532.exe

This software is an interface between the MELISSA CI PLC and the VIAMASS control electronics. Its main functions are:

- Request a measurement sweep to the VIAMASS sensor electronics: It requests the values of module and phase for each one of the 32 pre-selected frequencies by using a communications protocol based on Ethernet. The frequencies are issued in an ascending order and their values are fixed. These requests are performed periodically. One sweep is performed for every channel alternatively: one for the Main probe and one for the calibration probe.

- Receive data sent from the VIAMASS sensor electronics.
- Log received data into a file for further study.

The default wait time between measurements' sweep is 5 minutes. Sweeps for channel 1 & 2 are taken alternatively following the sequence: Channel1 sweep, 5min pause, Channel 2 sweep, 5 minutes pause, Channel1 sweep, 5min pause and so on, so that a measurements' sweep for each channel is taken every 10 minutes.

The data is automatically stored in the embeddedPC, in folder

C:\Documents and Settings\MPP\My Documents\VIAMASS_log_files\

Every time measurements are restarted a new folder is generated named, for example,

\11_6_2008_7_59_49_PM\

This would be the case for measurements begun the 6th November 2008, at 7:59 and 49 seconds PM (at the embeddedPC clock).

A new directory is generated every time measurements are restarted, with its storage file inside, called \log2.txt.

The data arrangement adopted in the storage file allows measurement results to be easily handled using data processing programs. Data are organized in a matrix structure. Rows provide time information and columns provide frequency-related measurements. Each row contains consecutively the results of a complete sweep (i.e. 32 frequencies) distributed as follows:

- 1 column with the time stamp
- 32 columns with the measured impedance modulus for every injected frequency
- 32 columns with the measured impedance phase for every injected frequency
- 1 column with the measured electronics box temperature
- 1 column with the measured electronics board temperature
- 1 column with the measured front-end electronics temperature (which is also displayed at the bottom window of the Graphics tab)
- 1 column with the capacitors charge level

With this it is possible to process the measurement data and to present the information as needed (e.g. time response, frequency response, etc.). The following table shows partially (only 7 columns) the data-recording format.

log2.txt 05/08/2006

Channel 1

Time	Module					
	1.34kHz	1.78kHz	2.37kHz	3.16kHz	4.22kHz	5.62kHz
15:11:16	22136	22118	22052	21951	21835	21729
15:11:27	22143	22120	22051	21952	21838	21731
15:12:25	22135	22116	22050	21951	21836	21730
15:13:25	22136	22119	22051	21953	21839	21730

This format is compatible with MS Excel.

5.3 Supervision software

5.3.1 INTRODUCTION

Supervision is accessed by means of the Intellution iFIX Workspace application. The same application is used to create and modify Supervision displays, the Configure Mode, and to run the displays, the Run Mode.
The system is configured to start automatically in Run Mode.

To start Supervision Client application:
1) Switch on the Supervision Client.
2) From the Start Menu, run the Intellution iFIX 3.0 Application.
3) From the Start Menu, run the Login application and input the User name and Password.
4) Once logged in correctly, select to run the iFix Workspace application.

Workspace Application will start and display the MELISSA Control System Main Window.

To close Supervision Client application:
1) Press F10, a main menu will appear on the top of the window.
2) Select File/Exit. Workspace application will close.
3) Run the Login application and press Logout.

Display Hierarchy

Figure 5-1: shows the general structure of the different screens that can be manipulated by the user to interact with the system. This map establishes the logical relations among the screens.

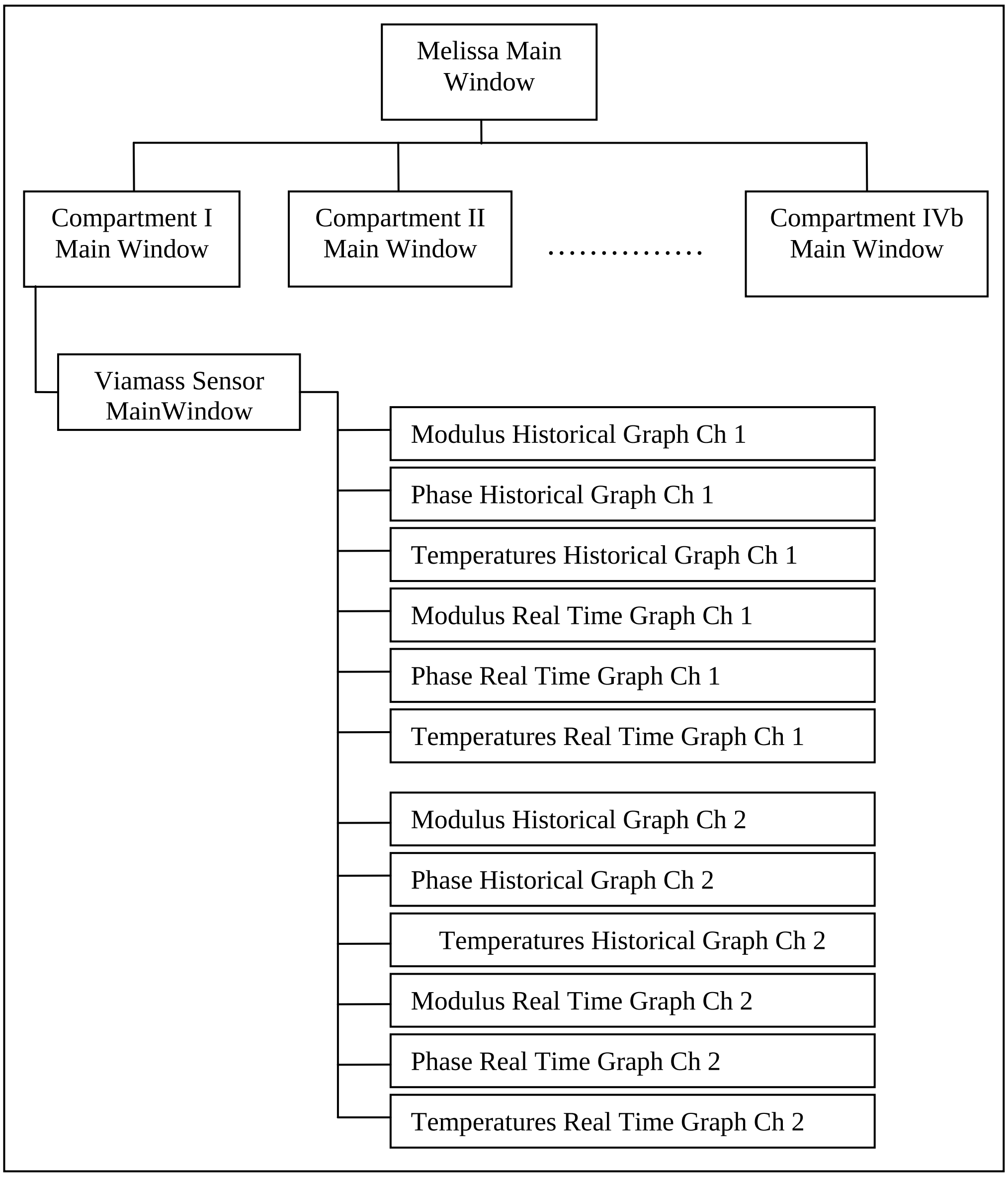


Figure 5-1: Melissa supervision software display hierarchy.

5.3.1.1 MELISSA main window

The Melissa Main Window displays all compartments of the Melissa Control Loop with its numerical display of the most significant variables. From this screen, the user can navigate to the screens of the different compartments.

All implemented displays follow the same display layout as shown in Figure 5-2.

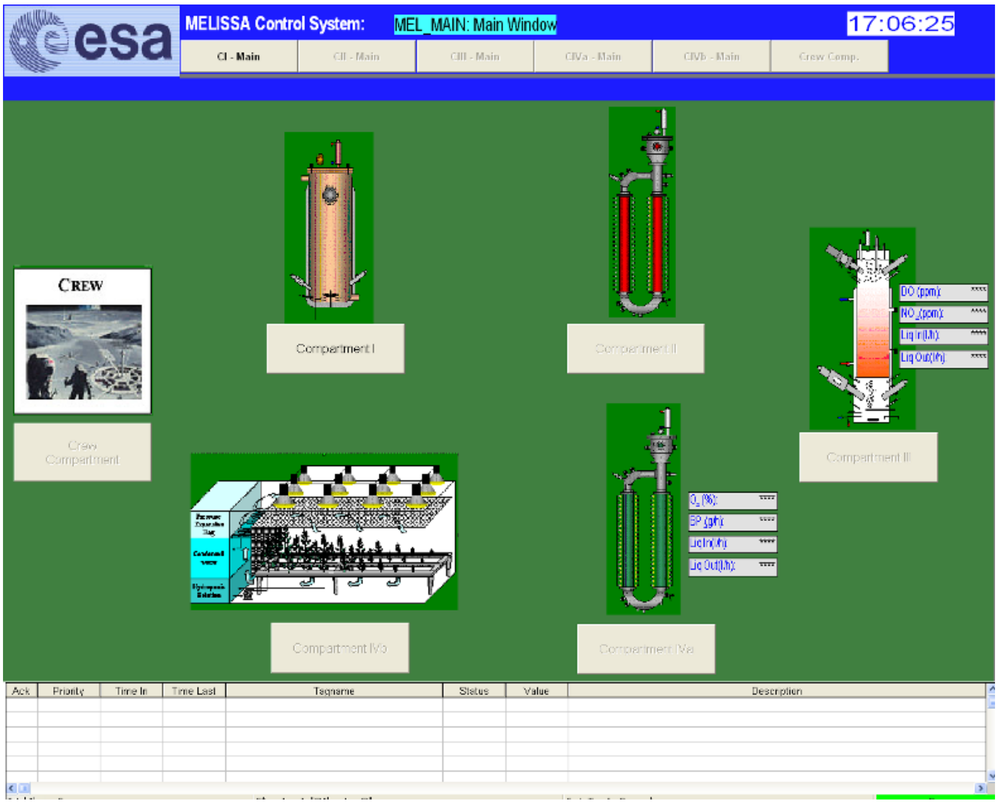


Figure 5-2: Melissa Main Window

Display Title

The title of the current display can be located in the top of the window, in light blue background.

Navigation Bar

The Navigation bar is located below the display title. It allows, by pressing one of the buttons, the navigation to the indicated display. The button with a house allows returning to the main screen.

Working Area

The working area is where variables are displayed using a scheme of the process (pumps, valves, pipes, etc.). The working area is placed under the Navigation bar, with green background.

Alarm Area

The Alarm Area is placed in the lower part of the display. This area contains information about the alarms detected. Alarms can be acknowledged by performing a double click with the mouse over the alarm.

Pressing the right mouse button over the Alarm Area displays a menu pop-up with allowed alarm actions.

5.3.1.2 Compartment I main window

This screen is an overview of CI Compartment. In this screen, the user only can visualize the most significant variables (temperatures, pressure, level, biomass production, etc.) of the compartment I. If the user wants to change a process variable or open a chart to analyze the data, he must open the screen that corresponds to the subsystem racks that compose CI (Bioreactor & Influent tank, Filtration unit, Gas Loop, Viamass Sensor, Cleaning in place, Sterilization in place and maintenance).

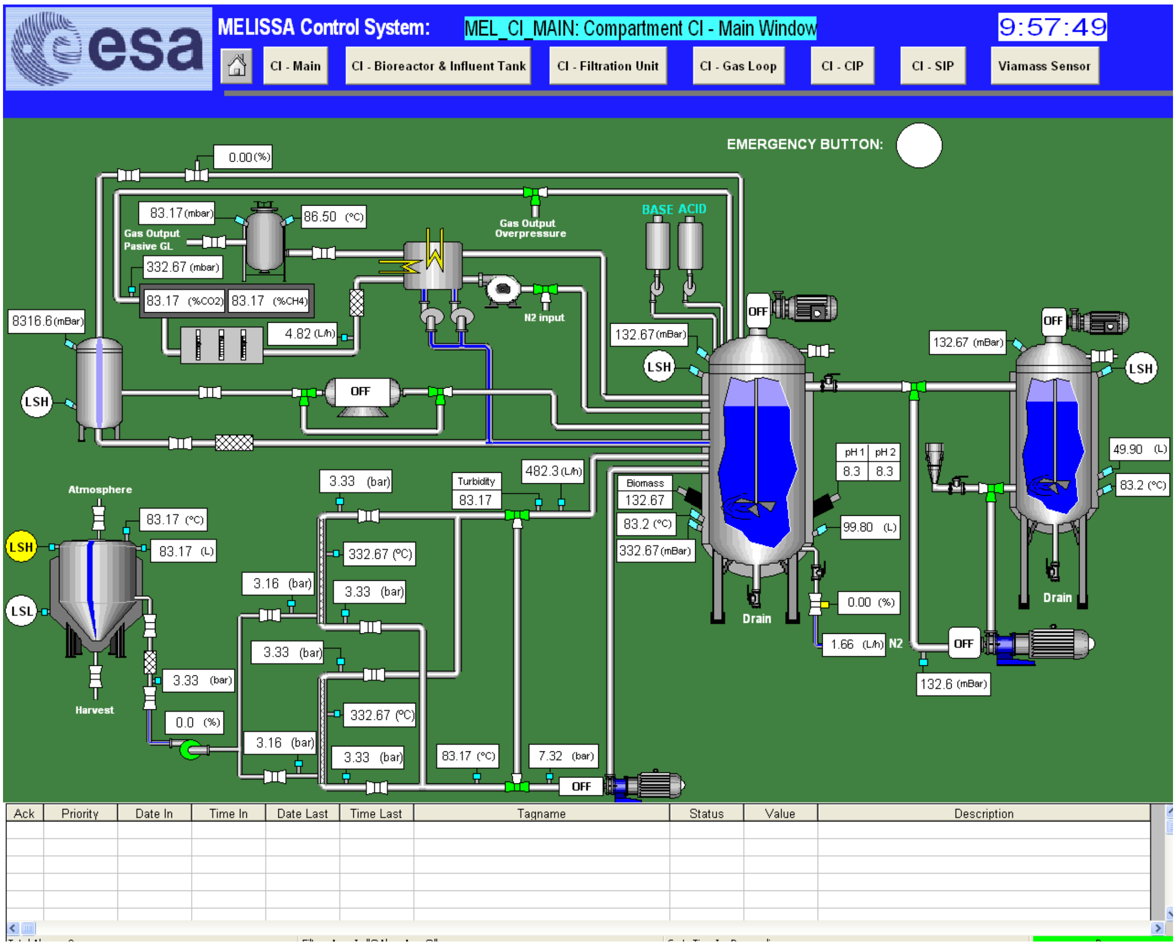


Figure 5-3: Compartment I Main Window

To open the Viamass sensor main window, press the Viamass sensor command button in the navigation bar.

5.3.2 VIAMASS sensor HMI

5.3.2.1 VIAMASS main window

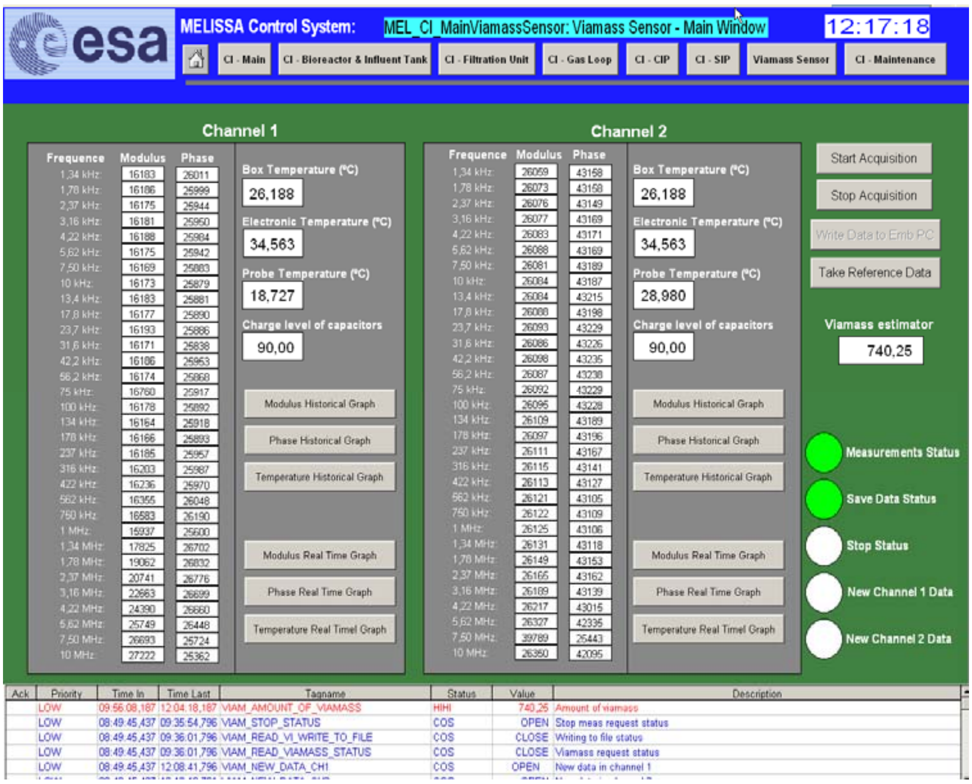


Figure 5-4: Viamass Sensor Main Window

Viamass main window interacts with the application running in the embedded PC.

The display is divided in three different parts:

- Channel 1: Data acquired from bioreactor probe (Modulus and Phase of the 32 frequencies, Temperatures and capacitor charge level). There are 6 command buttons to open the historical or real time data screens of the channel 1 acquired data.
  - Modulus Historical Graph
  - Phase Historical Graph
  - Temperature and capacitor charge level historical graph
  - Modulus Real time Graph
  - Phase Real Time Graph
  - Temperature and capacitor charge level real time graph.

Historical graph allows displaying data from past.
Real time graph displays current data.

- Channel 2: Data acquired from filtration unit probe and for calibration procedures (Modulus, Phase of the 32 frequencies, temperatures and capacitor charge level).
  - Modulus Historical Graph
  - Phase Historical Graph

- o Temperature and capacitor charge level historical graph
- o Modulus Real time Graph
- o Phase Real Time Graph
- o Temperature and capacitor charge level real time graph.

Historical graph allows displaying data from past.
Real time graph displays current data.

- In the right side screen, there are the buttons and indicators to interact with the embedded PC application.
    - o Start Acquisition (Press to start acquisition if it is stopped)
    - o Stop Acquisition (Press to stop acquisition if it is running and want to stop it)
    - o Write Data to Embedded PC (Disable) → always saving data.
    - o Take Reference Data (Press command button to take the reference data and calculates de biomass estimator from the last acquired data and reference data).
    - o Biomass estimator (numeric indicator): This value is calculated from the acquired data. The reliability and meaning of this number depends on the VIAMASS sensor and estimator calculator. This number may be meaningless at early development stages.
    - o Measurements Status: indicates if the acquisition is running.
        - ▪ True (Green) → Running
        - ▪ False (White) → Stopped.
    - o Save Data Status: indicates if the embedded pc is saving acquired data in the local disk (For default, always saving data in local disk)
        - ▪ True (Green) → Saving data into local disk.
        - ▪ False (White) → Not saving data into local disk.

    - o Stop Status: Indicates if the user has requested the stop acquisition from the HMI.
        - ▪ True (Green) → HMI user request the stop acquisition and wait the embedded pc finishes the last acquisition to stop it and reset the stop status.
        - ▪ False (White) → User hasn’t requested the stop acquisition..
    - o New channel 1 data: This bit is used to synchronize the writing to the PLC registry from Embedded PC with the reading of the PLC registry from the HMI to save data into Access Database.
        1. Embedded PC writes data to PLC registries.
        2. Sets new channel 1 data bit.
        3. HMI reads and saves the data in Access Database.
        4. HMI resets new channel 1 data bit.

    - o New channel 2 data: This bit is used to synchronize the writing to the PLC registry from Embedded PC with the reading of the PLC registry from the HMI to save data into Access Database.
        1. Embedded PC writes data to PLC registries.

2. Sets new channel 2 data bit.
3. HMI reads and saves the data in Access Database.
4. HMI resets new channel 2 data bit.

5.3.2.2 Graph Screens

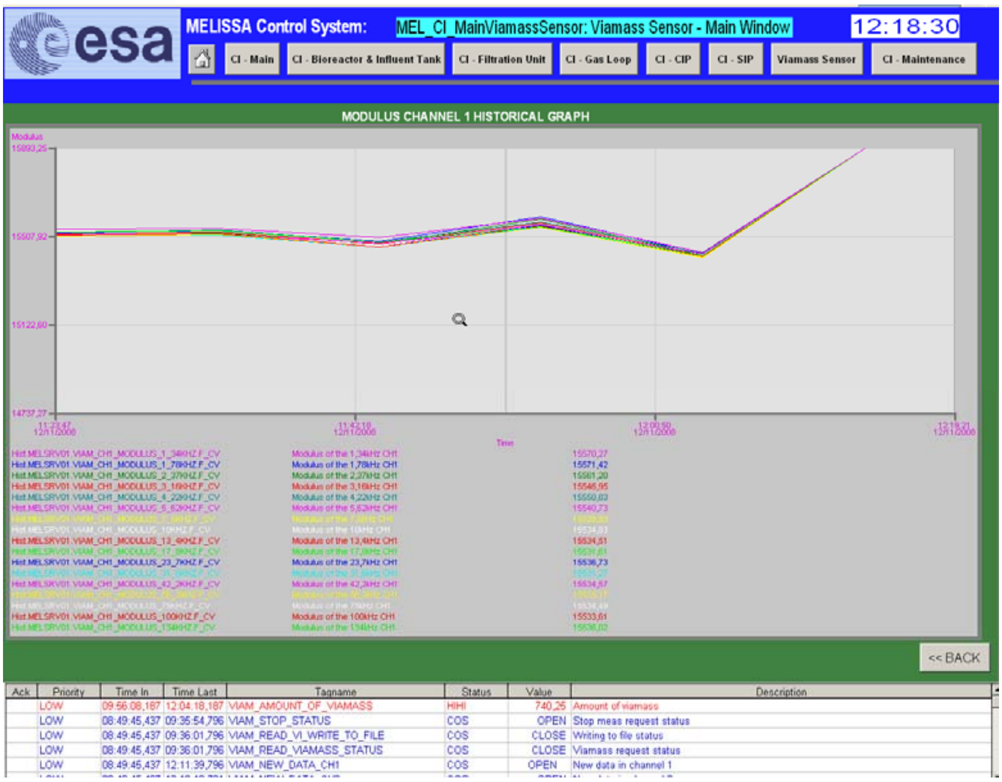


Figure 5-5: Modulus CH1 Historical Graph

Each graph screen has a command button (<<BACK) to back to the Viamass Main Window screen, also the user can back to the Viamass Main Window pressing the Viamass Sensor Command Button of the Navigation Bar.

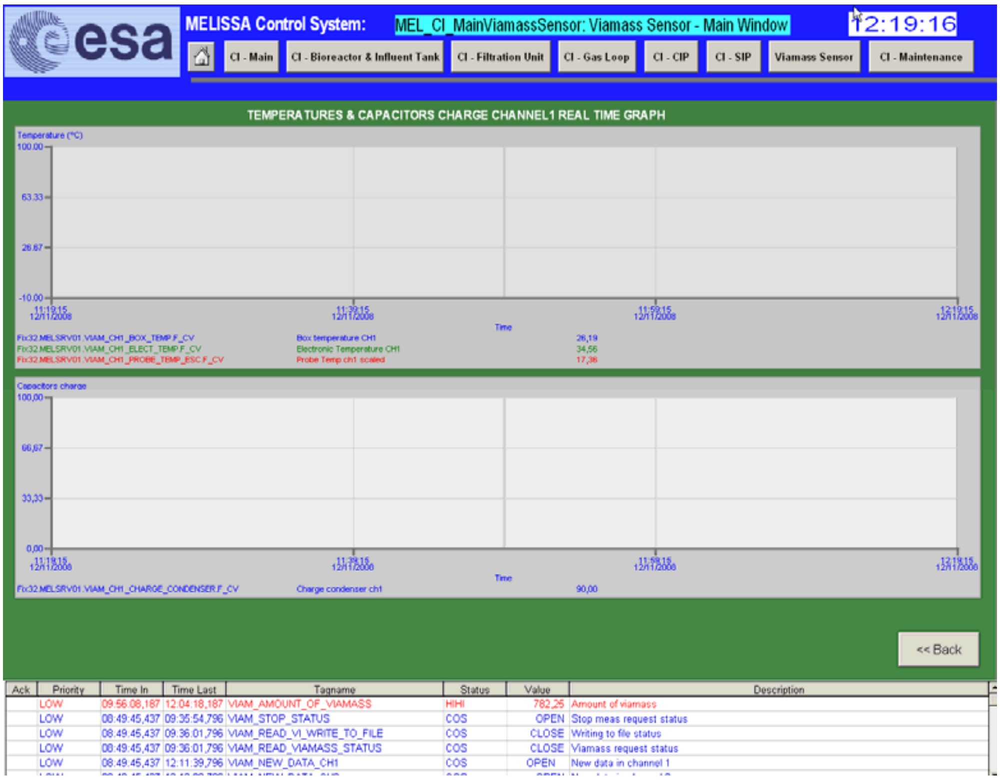


Figure 5-6: Temperatures and Capacitors Charge CH1 Real time Graph

5.3.2.3 Data storage

The data acquired from Viamass Sensor is stored in 2 ways:

- Historical Assignment: Stores data every 10 minutes. This data is used for historical graphs.
- Access Database, through event base entries executed by the iFix Scheduler module. This module allows the configuration of a task that needs to be executed periodically or when a change occurs in a process. In this case, there are two tasks executed when Embedded PC writes data to PLC.

5.3.2.3.1 Historical Charts

The charts are configured to allow their manipulation in run mode.

Zoom functions

Click in the chart area, drag and drop to control zoom in the selected area.
To restore to the default zoom press the right mouse button on the chart area.

Add a pen

- Double click the chart and click the chart tab.

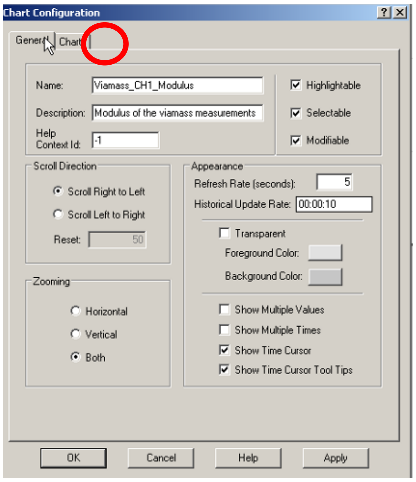


Figure 5-7: Chart configuration

- In the pen list area, click the add pen button, or click the blank area in the pen list.

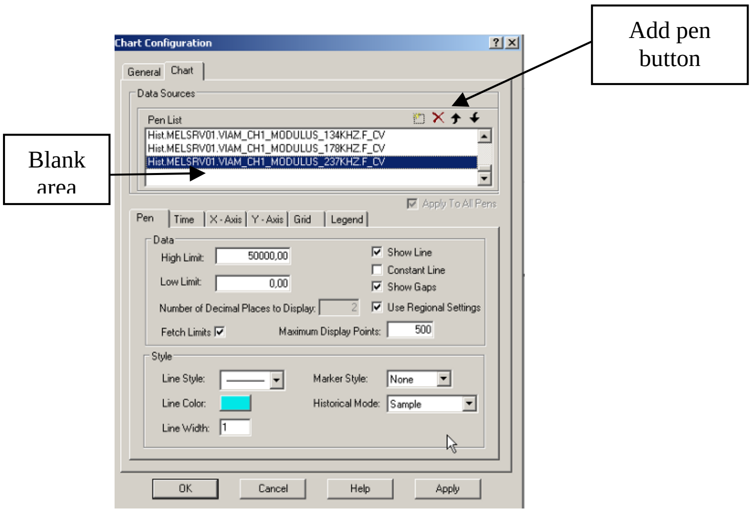


Figure 5-8: Add pen in chart configuration

- Click the Browse button and select the historical data source from the expression builder.

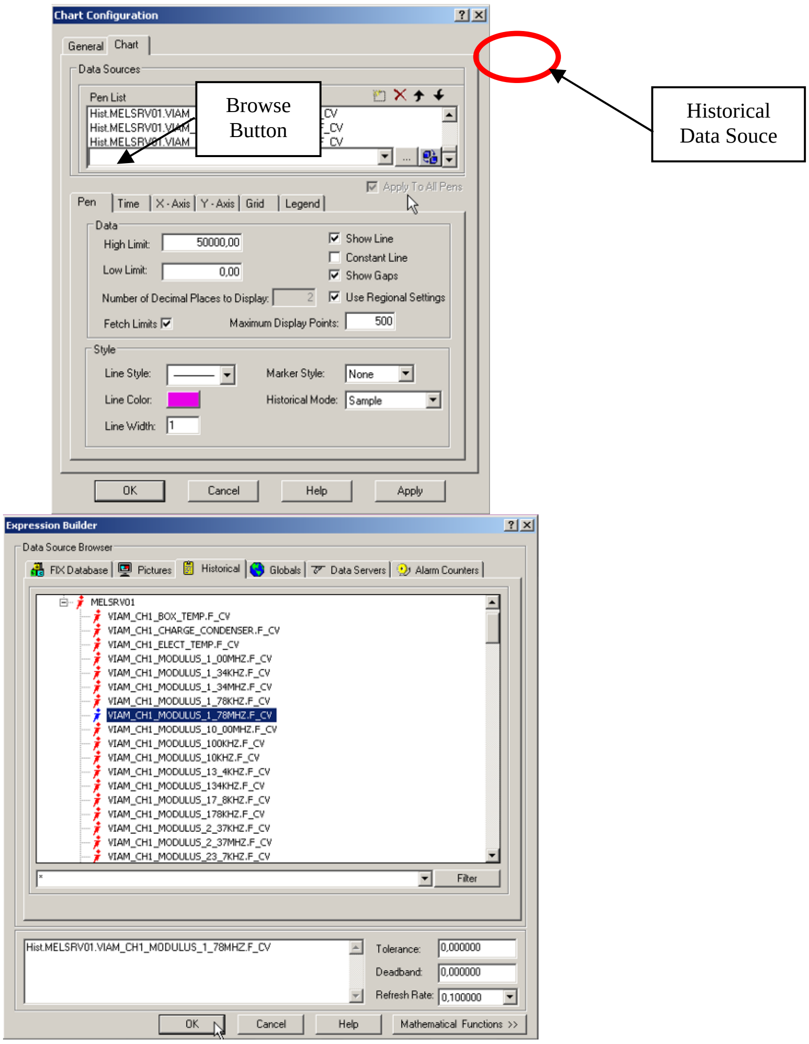


Figure 5-9: Select historical data source

Remove a pen
Double click the chart and click the chart tab.
In the pen list area, select the pen and click remove pen button.

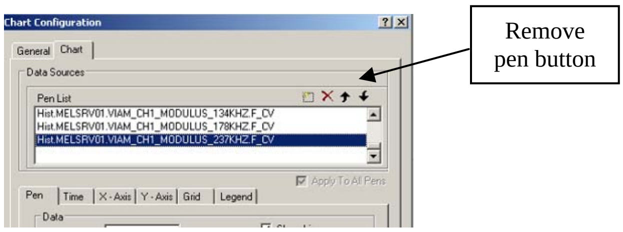


Figure 5-10: Remove a Pen

Change a pen position
Double click the chart and click the chart tab
In the pen list area, select the pen and click up button or down button.

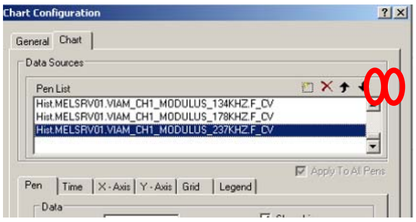


Figure 5-11 Change pen position

Change Chart Properties
Double click the chart and click the chart tab.
Select the tab

- Pen (change pen style properties, establish the Y axis limits and the maximum display points)
- Time (select the start time, duration and interval of the data displayed in the chart).
- X axis (x axis title)
- Y axis (y axis title)
- Grid (establish chart grid properties)
- Legend (items and order to visualize)

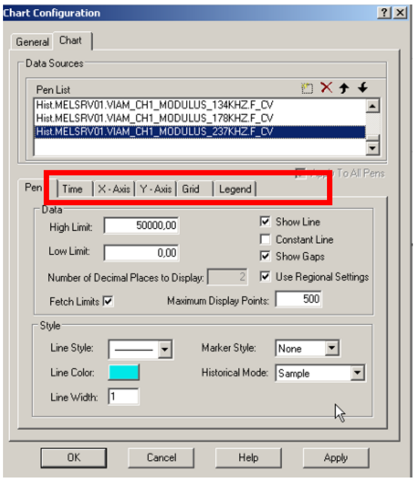


Figure 5-12: Chart Properties

5.3.2.3.2 Access DB data manipulation

Data from Viamass is saved into Access Database. To open it from a supervision Client PC follow the next steps:

1) Close the Workspace Supervision Client application.
2) From the start menu, run the Microsoft Office Access.
3) Open the Viamass_CI.mdb, located in the folder \\SUPERVISION\PIC\Database

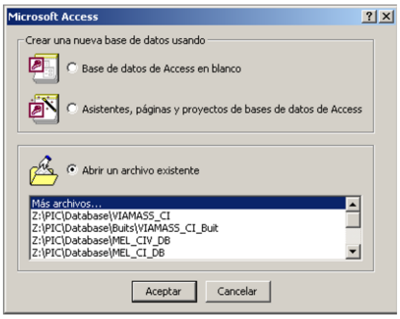


Figure 5-13: Select open file

4) Select and open table. There are 2 tables, one for each channel.
   - Viamass_MeasuredValues_ch1
   - Viamass_MeasuredValues_ch2

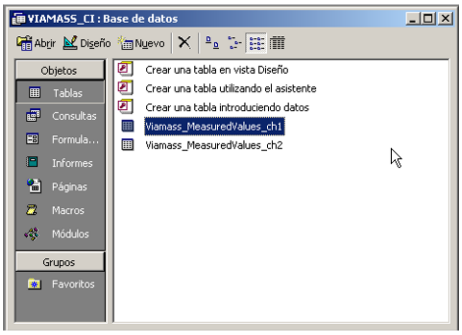
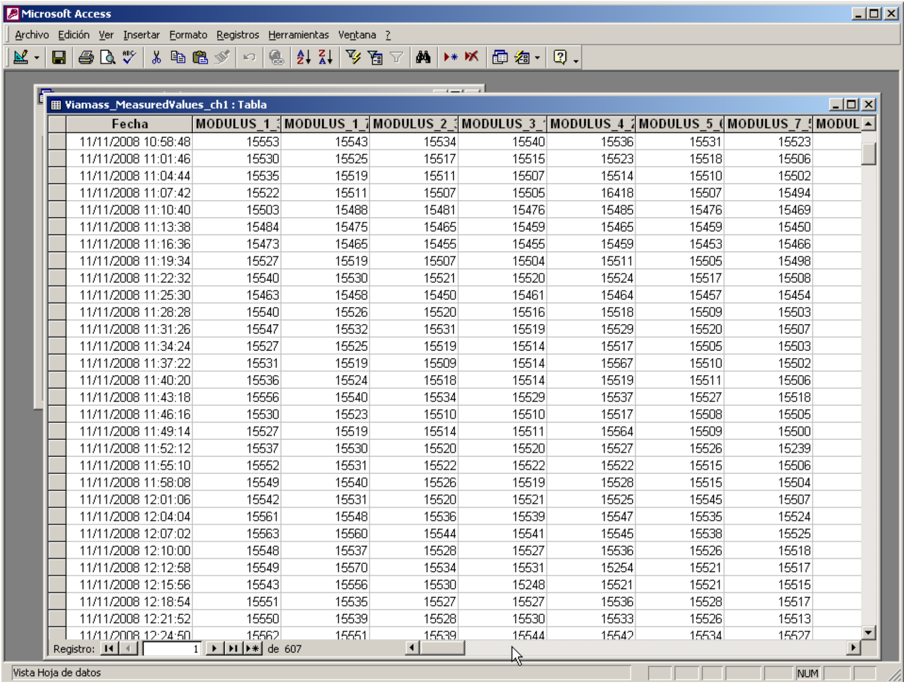


Figure 5-14: Select DB table

5) Viamass channel 1 data opened. This data may be exported to excel format.



Fecha	MODULUS_1_	MODULUS_1_	MODULUS_2_	MODULUS_3_	MODULUS_4_	MODULUS_5_	MODULUS_7_	MODUL
11/11/2008 10:58:48	15553	15543	15534	15540	15536	15531	15523	
11/11/2008 11:01:46	15530	15525	15517	15515	15523	15518	15506	
11/11/2008 11:04:44	15535	15519	15511	15507	15514	15510	15502	
11/11/2008 11:07:42	15522	15511	15507	15505	16418	15507	15494	
11/11/2008 11:10:40	15503	15488	15481	15476	15485	15476	15469	
11/11/2008 11:13:38	15484	15475	15465	15459	15465	15459	15450	
11/11/2008 11:16:36	15473	15465	15455	15455	15459	15453	15466	
11/11/2008 11:19:34	15527	15519	15507	15504	15511	15505	15498	
11/11/2008 11:22:32	15540	15530	15521	15520	15524	15517	15508	
11/11/2008 11:25:30	15463	15458	15450	15461	15464	15457	15454	
11/11/2008 11:28:28	15540	15526	15520	15516	15518	15509	15503	
11/11/2008 11:31:26	15547	15532	15531	15519	15529	15520	15507	
11/11/2008 11:34:24	15527	15525	15519	15514	15517	15505	15503	
11/11/2008 11:37:22	15531	15519	15509	15514	15567	15510	15502	
11/11/2008 11:40:20	15536	15524	15518	15514	15519	15511	15506	
11/11/2008 11:43:18	15556	15540	15534	15529	15537	15527	15518	
11/11/2008 11:46:16	15530	15523	15510	15510	15517	15508	15505	
11/11/2008 11:49:14	15527	15519	15514	15511	15564	15509	15500	
11/11/2008 11:52:12	15537	15530	15520	15520	15527	15526	15239	
11/11/2008 11:55:10	15552	15531	15522	15522	15522	15515	15506	
11/11/2008 11:58:08	15549	15540	15526	15519	15528	15515	15504	
11/11/2008 12:01:06	15542	15531	15520	15521	15525	15545	15507	
11/11/2008 12:04:04	15561	15548	15536	15539	15547	15535	15524	
11/11/2008 12:07:02	15563	15560	15544	15541	15545	15538	15525	
11/11/2008 12:10:00	15548	15537	15528	15527	15536	15526	15518	
11/11/2008 12:12:58	15549	15570	15534	15531	15254	15521	15517	
11/11/2008 12:15:56	15543	15556	15530	15248	15521	15521	15515	
11/11/2008 12:18:54	15551	15535	15527	15527	15536	15528	15517	
11/11/2008 12:21:52	15550	15539	15528	15530	15533	15526	15513	
11/11/2008 12:24:50	15562	15551	15539	15544	15542	15534	15527	

Figure 5-15: Viamass channel 1 data

VIAMASS SYSTEM UPDATED TEST REPORT

FOR THE

MELISSA CS CI

APPROVAL LIST		
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Revised by: Martí Bassas Portús		
Approved by: Jordi Duatis		
Authorised by: Toni López Ortiz		

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Christophe Bourg		SHERPA
Arnaud Fossen		MPP
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Raúl Moyano		MPP

CHANGE RECORD			
AUTHOR	ISSUE	DATE	CHANGE
Jordi Carbonell Muñoz	1	12/02/2009	First Version

CONTENTS

1. PURPOSE

The present document reports the activities performed to check the correct operation of the CI Viamass Sensor (probes and box) after a long period of inactivity and the integration of the Viamass Sensor system with the SCADA system.

2. Scope

Test realized in the Melissa Pilot Plant at 19 of November of 2008 with the collaboration of the MPP staff.

3. REFERENCE DOCUMENTS

3.1 APPLICABLE DOCUMENTS

VSS-0000-OF-001-NTE	Portable Device for Viable Biomass Measurement in Waste Water Treatment Plants (VIAMASS)

3.2 REFERENCE DOCUMENTS

NTE-VSS-TN-009	System design description of the VIAMASS sensor for use on bioreactor.
NTE-MCI-HB-007	Software User Manual
NTE-VSS-TN-021	Viamass sensors for use on bioreactor (Final report)

4. Approach

To verify correct performance of the CI Viamass Sensor, the following activities have been carried out:

Verification	Activity
Communications between Viamass measure system and the embedded PC.	Executing the ping command from the embedded pc to Viamass measure system and checking the packets reception.
Embedded PC doesn't have interaction with the user, then the Labview application	Start-up Embedded PC and check Labview application is running when operating

start running with the start-up of the operating system and wait to the reception of the commands sent from the SCADA system to start/stop measurement request.	system desktop starts.
Communications between Embedded PC and Schneider Quantum PLC through serial communications under Modbus protocol and between SCADA system and Schneider Quantum PLC through Ethernet communications and also under Modbus protocol.	From the Viamass sensor main window (SCADA) starts the acquisition pushing the Start Acquisition command button and wait to the first measure received from the Viamass measure system, then compare data from embedded pc and SCADA system are equal.
Viamass sensor system detects different levels of biomass concentration.	From the Viamass charts screens (SCADA) and Labview application graphs analyze the biomass evolution in time function and check the biomass reading changes to every biomass concentration.
Labview application configuration parameters (time between samples, temperatures limits, communications parameters)	Communications parameters are indirectly tested in the previous steps.
Communication protocol between Labview application and SCADA system (start/stop measurement request, new data, write to file request).	Start acquisition from the SCADA system (pushing start acquisition command button) and check the Labview application start acquisition boolean indicator is set. In the Viamass sensor screen a Boolean indicator displays every new data acquired and SCADA resets this variable when data is saved in Access database.
Acquired measures from Viamass sensors system are sent to the Embedded PC, and this writes data to the PLC registers.	SCADA displays data received and also comparing this data with the embedded pc data.
SCADA system represents data read from PLC registers in numeric displays and charts.	In the Viamass sensor main window there are numeric displays changing every new acquisition. In graphs screens, data acquired show in time function.
SCADA system executes a script, every new acquisition, to save data in access database.	Comparing data between data saved in Embedded PC in text format and data from SCADA saved in access database.

5. SET-UP DESCRIPTION

Before to start the test, the hardware connections were to be checked, the samples ready and test environments defined.
Time between samples, defined in the embedded pc application, was 1 minute and 30 seconds. (This is the default time between samples)
HMI used to start / stop acquisition and monitoring the process. Data process was stored in embedded pc and in Access Database SCADA Server to compare the two sources data to the ending test.

5.1 HARDWARE CONNECTIONS

Before start the test, following connections were checked:

- XS-R-01(bioreactor probe) probe connected to the Viamass sensor box channel 1
- XS-F-01 (filtration unit probe) probe connected to the viamass sensor box channel 2.
- Viamass sensor box connected to the Embedded PC with Ethernet crossed wire.
- Embedded PC connected to the CI PLC with serial wire through Modbus protocol.
- CI_PLC connected to the switch through Ethernet cable.
- iFIX SCADA Server connected to the switch through Ethernet cable.
- iFIX SCADA Client connected to the switch through Ethernet cable.

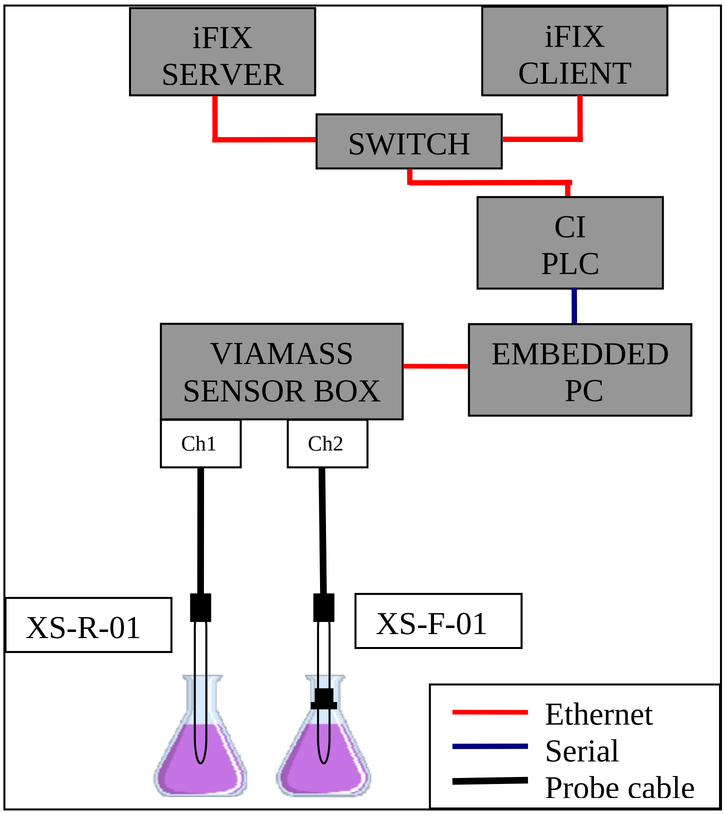


Figure 1: Hardware communications

5.2 BIOMASS SAMPLES

To check the probes correct operation used three different samples, inside Erlenmeyer bottle, with different biomass concentration (see Table 1). The samples were not calibrated and then the amount of biomass concentration wasn't known. Each sample was tested with the two probes. Table

Sample 1	Pure Water (without biomass concentration)	High impedance
Sample 2	Fecal material with vegetables (biomass concentration)	Medium impedance
Sample 3	Same at Sample 2, but with the double of biomass concentration.	Low impedance

Table 1: Samples used for the test

Figure 2 From left to right, samples 1 to 3

5.3 TESTS ENVIRONMENTS

The CI control cabinet has been used to send data from Viamass box to PLC. To check the probes with three different samples used three environment of test. With the next combination, each probe was in contact with each sample in a different environment.

	Sample 1	Sample 2	Sample 3
Environment 1	XS-F-01	XS-R-01	
Environment 2		XS-F-01	XS-R-01
Environment 3	XS-R-01		XS-F-01

Table 2: Environments test

5.3.1 Test Environment 1

First test environment, XS-F-01 (filtration probe) was in contact with distilled water and XS-R-01 (bioreactor probe) with sample 2.

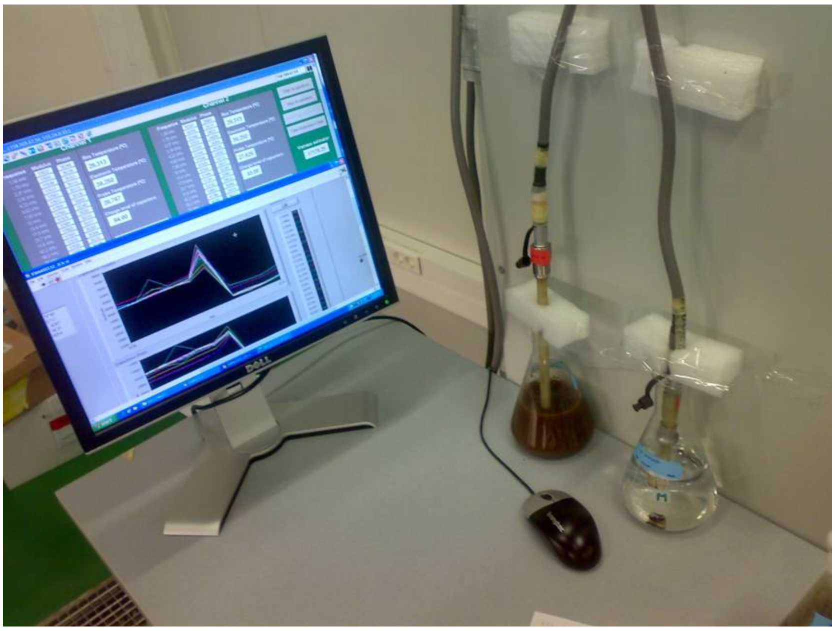


Figure 3: Test Environment 1

5.3.2 Test environment 2

In the second test environment, XS-F-01 (filtration probe) was in contact with sample 2 and XS-R-01 (bioreactor probe) with sample 3.

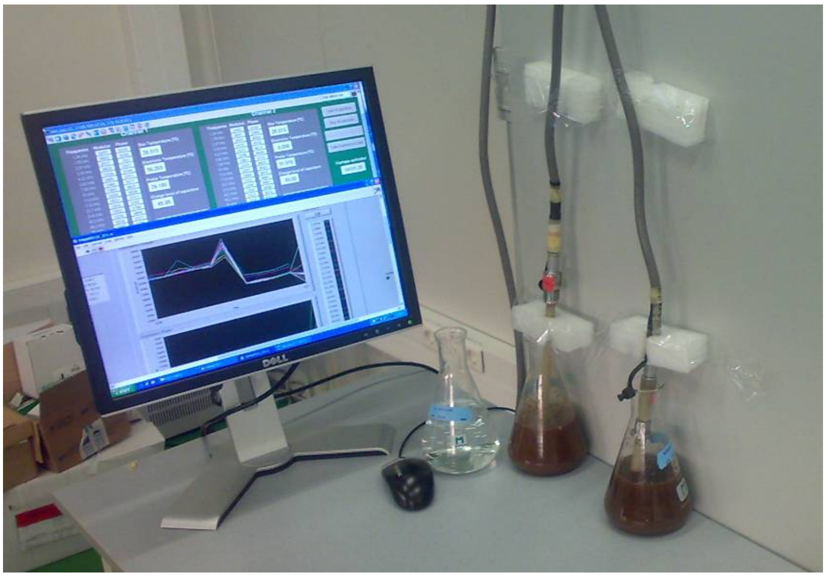


Figure 4: Test environment 2

5.3.3 Test environment 3

The last test environment, XS-F-01 (filtration probe) was in contact with sample 3 and XS-R-01 (bioreactor probe) with sample 1.

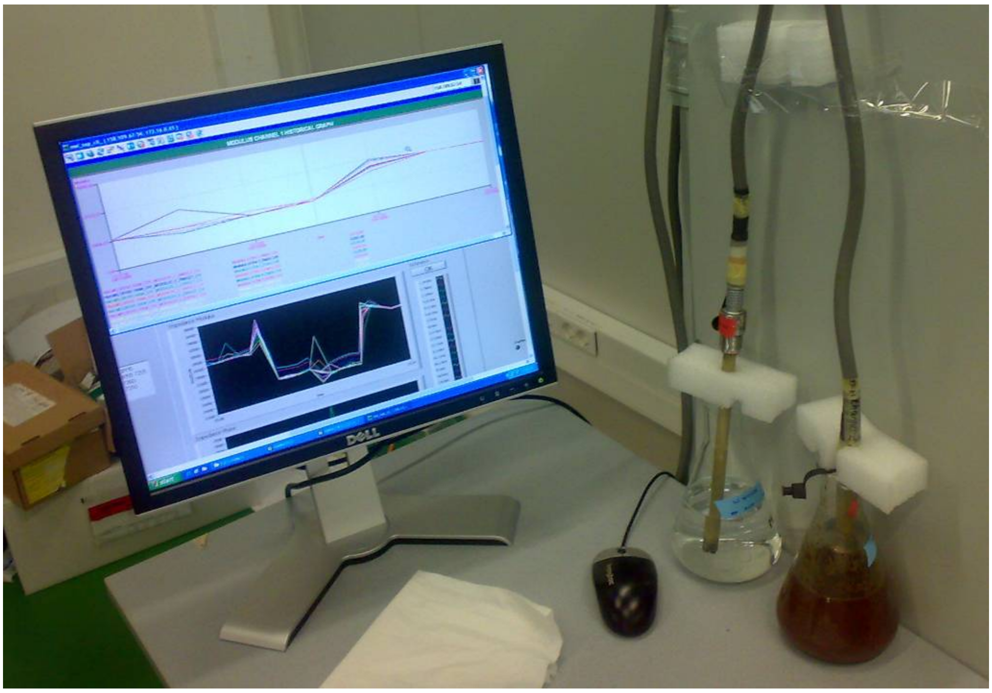


Figure 5: Test environment 3

6. RESULTS

Modulus and phase of the impedances, temperatures and charge capacitor were to be acquired and stored. See ANNEX (TEST RESULTS) for more details.
Next charts show the obtained results during the test.
Modulus Channel 1 graph shown in Figure 6 displays the modulus impedance for frequencies between 1,34 kHz and 10MHz, both included, readings of XS-R-01. At the start acquisition the probe was in contact with expanded polyester (estimator= 28000 counts), after there is a sample peak (estimator= 34500 counts) because probe was on air to move the probe from expanded polyester to Erlenmeyer bottle with sample 2. In this graph clearly can see the transitions from sample 2 to sample 3 and from sample 3 to sample 1. The estimator modulus of the sample 2 is about 17434 counts, sample 3 is about 15171 counts and sample 1 is 30235. Modulus (counts) value is higher when the biomass concentration is smaller.

The test was approximately two hours long.

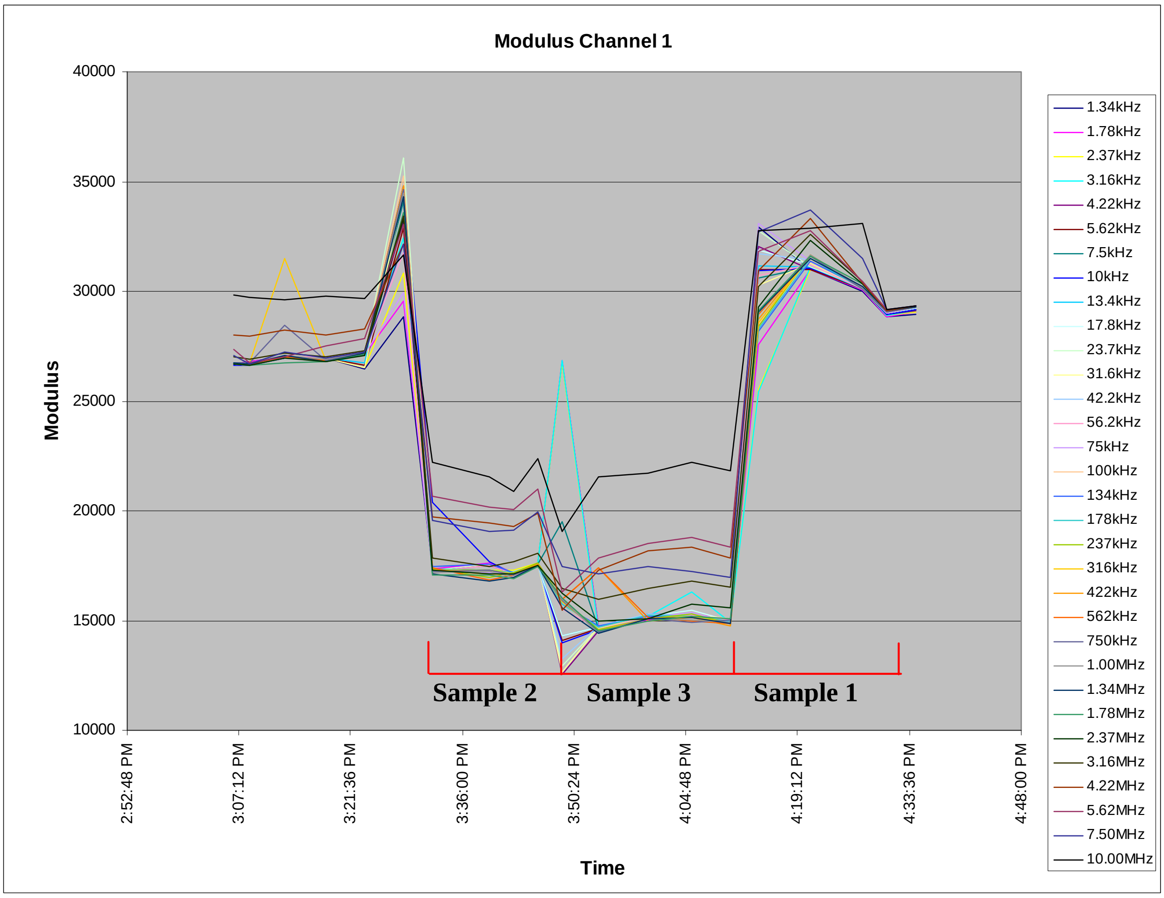


Figure 6: Modulus Channel 1

The channel 2 (XS-F-01) readings start with sample 1(distilled water) with approximately estimator equal to 54139 counts, then reading sample 2 with 23526 counts and finally XS-F-01 read sample 3 with approximately 21865 counts.

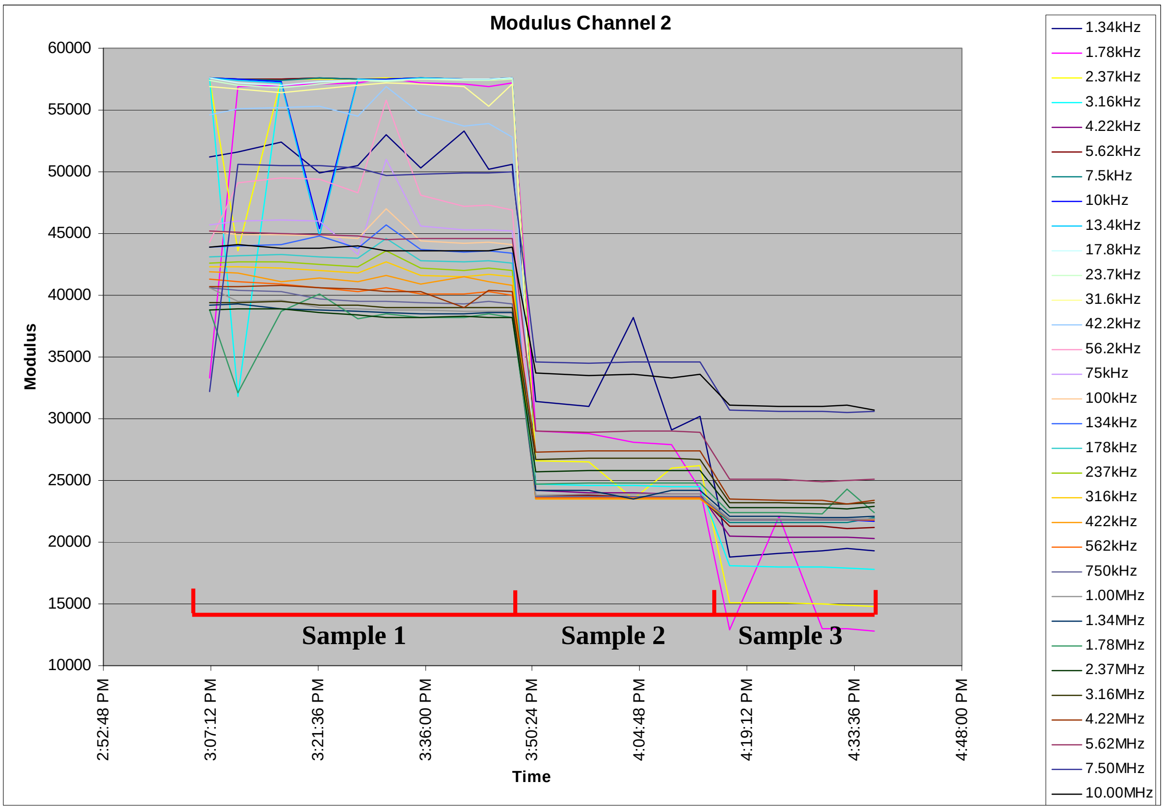


Figure 7: Modulus channel 2

Results Test Environment 1

Probe	Sample	Biomass estimator
XS-R-01	2	17000
XS-F-01	1	54000

Results Test Environment 2

Probe	Sample	Biomass estimator
XS-R-01	3	15500
XS-F-01	2	23000

Results Test Environment 3

Probe	Sample	Biomass estimator
XS-R-01	1	30000
XS-F-01	3	21500

Biomass estimator channel 1 graph shows the modulus median of the range of frequencies between 10 kHz and 75 kHz, both included, acquired from XS-R-01.

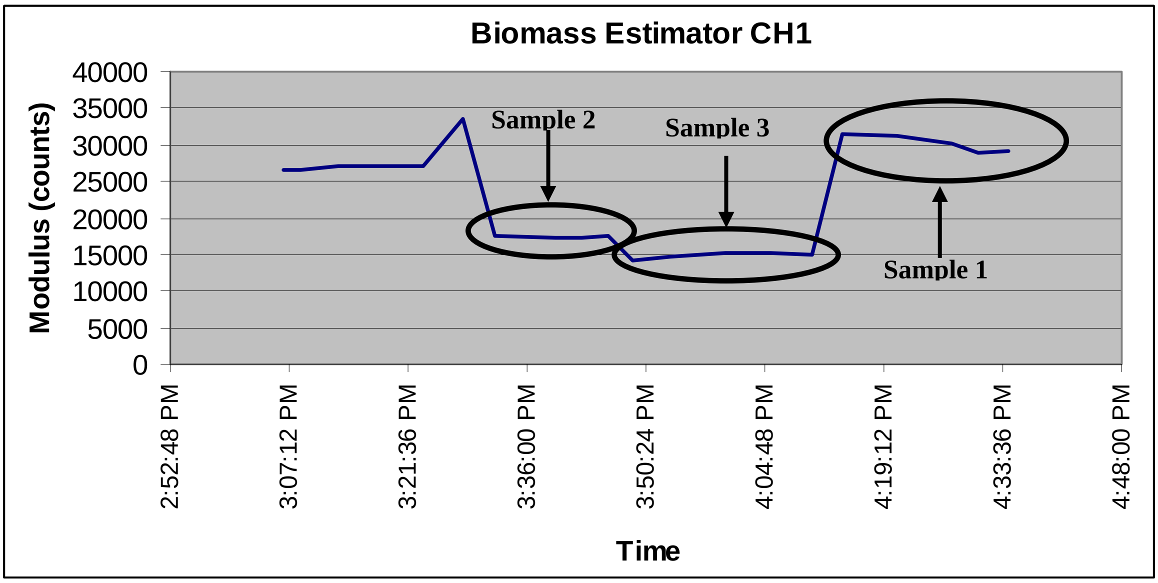


Figure 8: Biomass estimator ch1fromEmbedded PC

Biomass estimator channel 2 graph shows the modulus median of the range of frequencies between 10 kHz and 75 kHz, both included, acquired from XS-F-01.

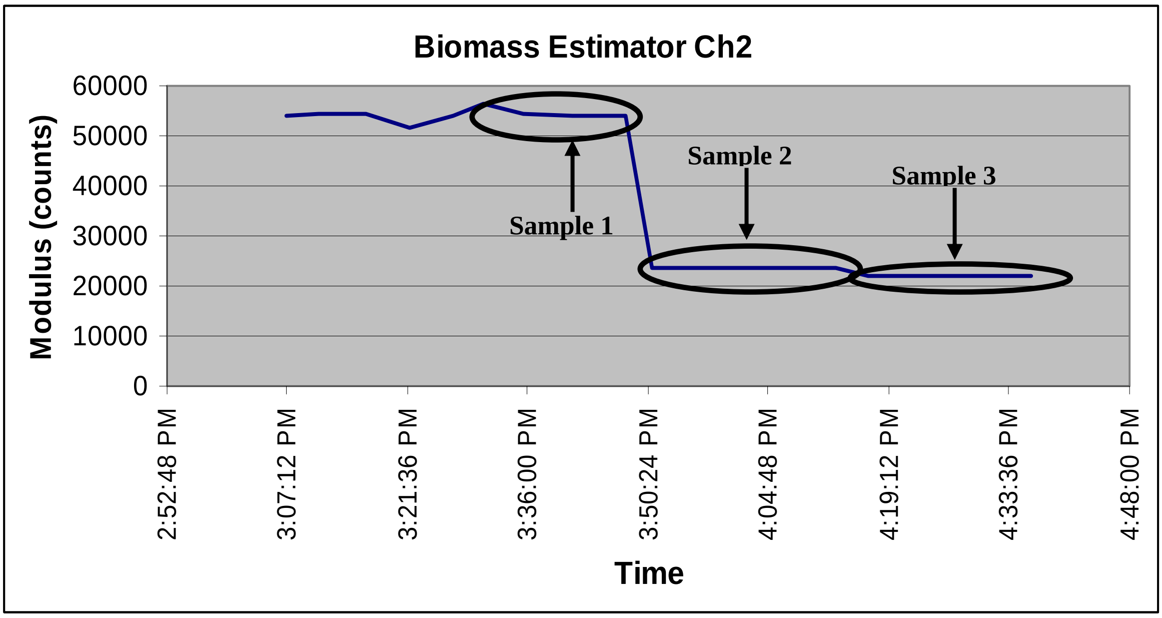


Figure 9: Biomass estimator ch2 from Embedded PC

From the HMI screens could see the acquired data in numerical digital display format or in graphs (function of time) and check the system status through of the Boolean indicators.

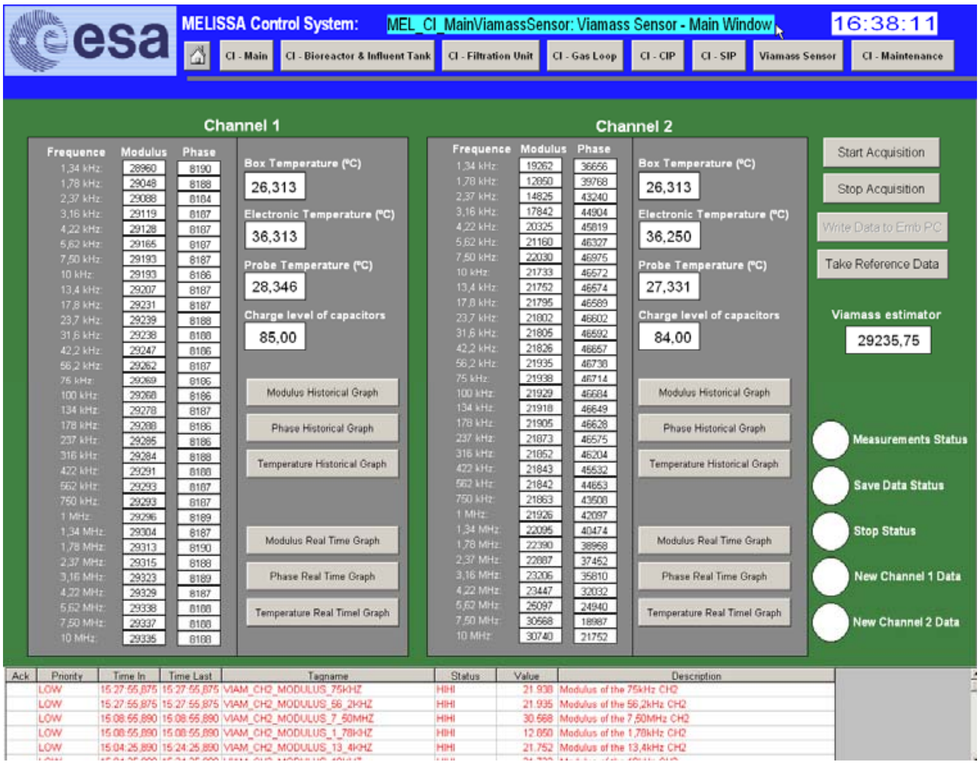


Figure 10: HMI Viamass Sensor Main Window

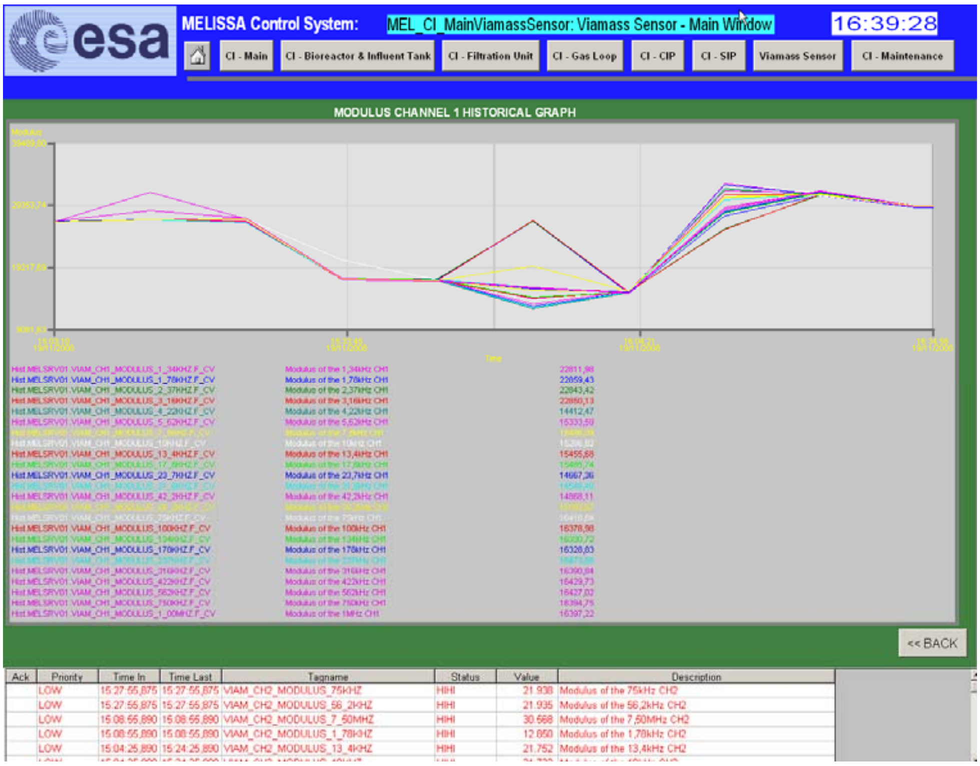


Figure 11: HMI Modulus Channel 1

7. CONCLUSIONS

The obtained results indicate the probe correct mode operation. Probes read the changing biomass concentration in the medium. Temperatures (probes, electronics and box) and charge condenser measures are read correctly.

Labview Application starts running with the start-up of the O.S. and wait to the commands sent from the SCADA system. During the test period, Labview application saves data acquired from Viamass sensor system for default.

From the Scada node point of view, communications between Scada Server and Viamass sensor system operate correctly, system has been controlled (start and stop acquisition) and monitored from SCADA node. From the Scada node screens, the signals temporal evolutions are shown. The VBA script is executed every new acquisition and data is written in the Access database correctly.

With the same sample in contact with different probe, the results are different.

There is a delay between data from Embedded PC and data stored in HMI because the Operation systems clock times were not synchronized.

During the test, the configuration time between samples was 1 minute and 30 seconds but the time measured was higher than configuration, due to the system needs more time between samples to charge capacitor. Default time between samples will be changed to 10 minutes due to the system dynamics is slow and because this time used on “Viamass sensor for use on bioreactors” test realized in EPAS facilities.

Results obtained show 2 errors in the channel 2 electronics temperature acquisition, there are two measures samples fall down to 0 degree, the reason may be due to the time between samples was faster than 10 minutes.

Test should be repeated in the Compartment I functional tests execution during a longer period of time and to keep 10 minutes between samples time to check the system reliability for long time period.

8. ANNEX (TEST RESULTS)

8.1 Data from Channel 1

8.1.1 Modulus

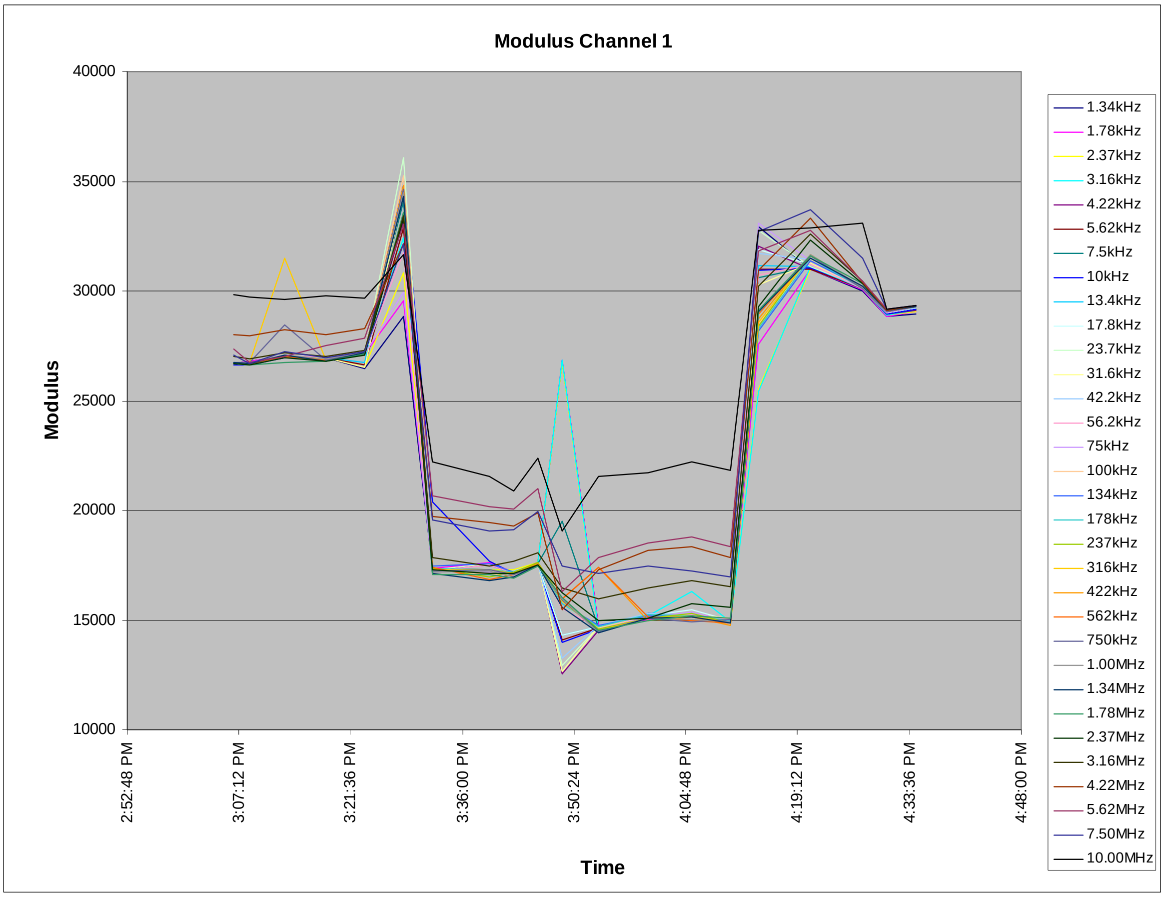


Chart 1: Channel 1 Modulus

8.1.2 Phase

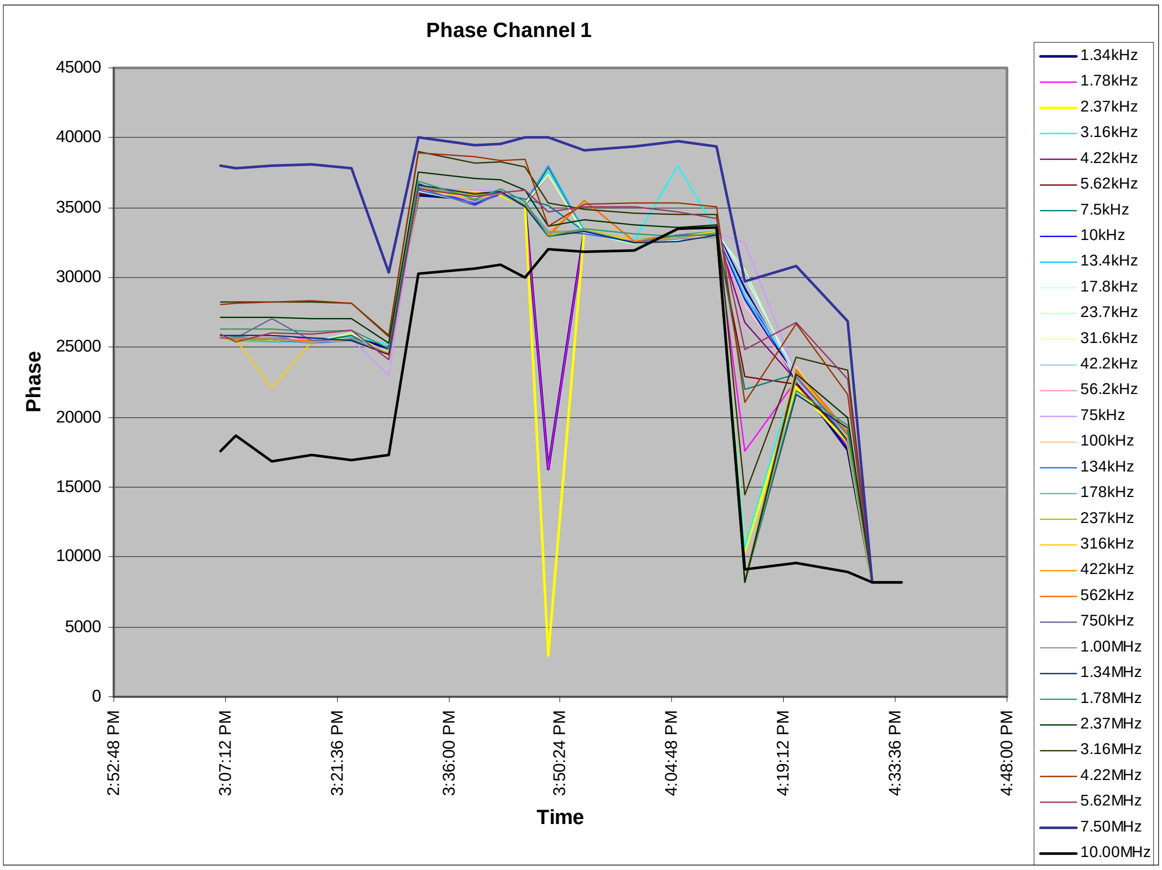


Chart 2: Channel 1 Phases

8.1.3 Temperatures

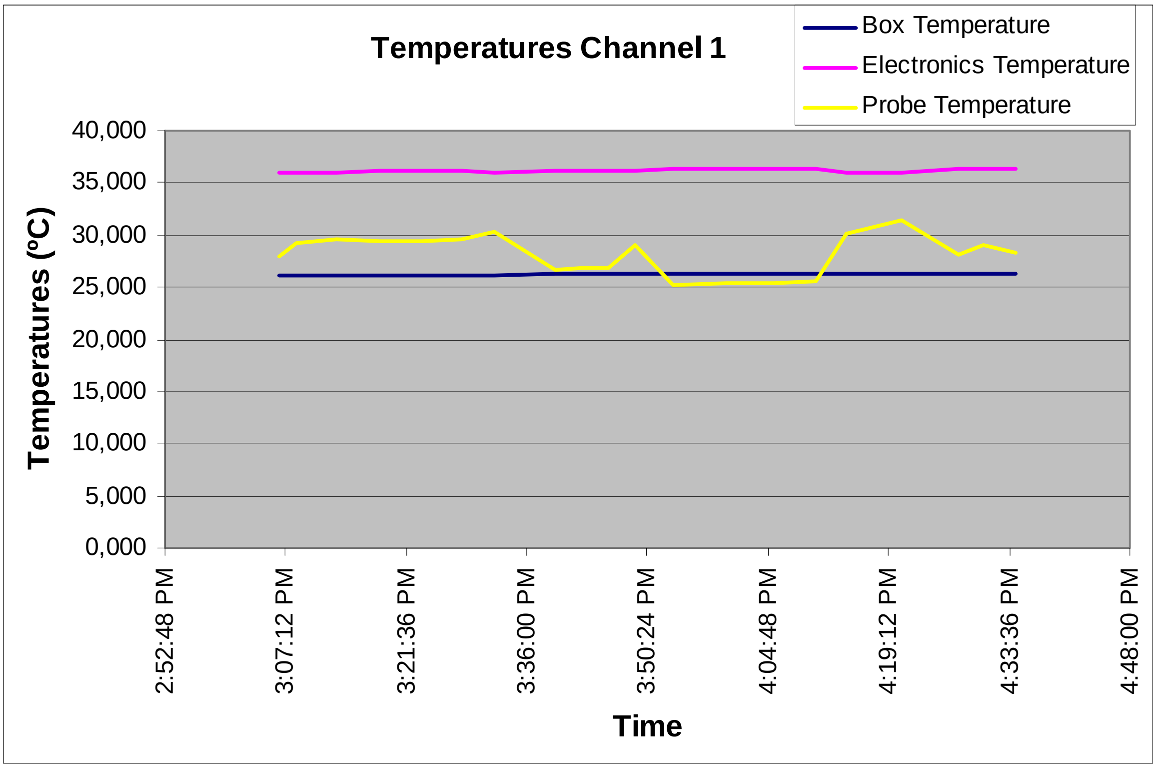


Chart 3: Channel 1 Temperatures

8.1.4 Charge Capacitor

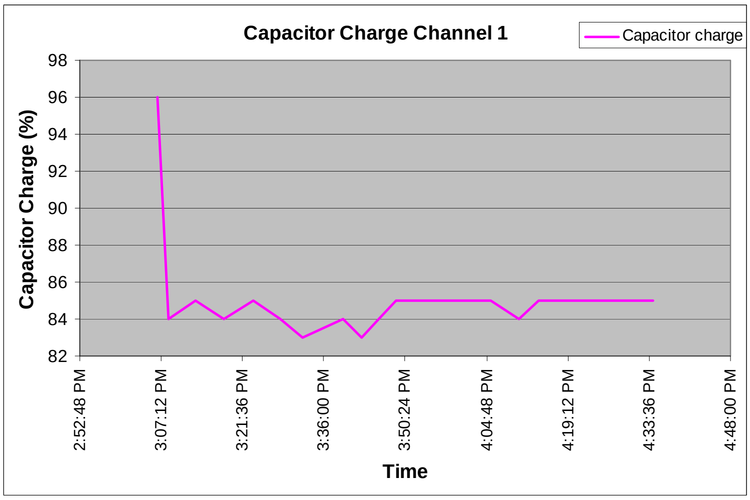


Chart 4: Channel 1 Charge Capacitor

8.2 Data from Channel 2

8.2.1 Modulus

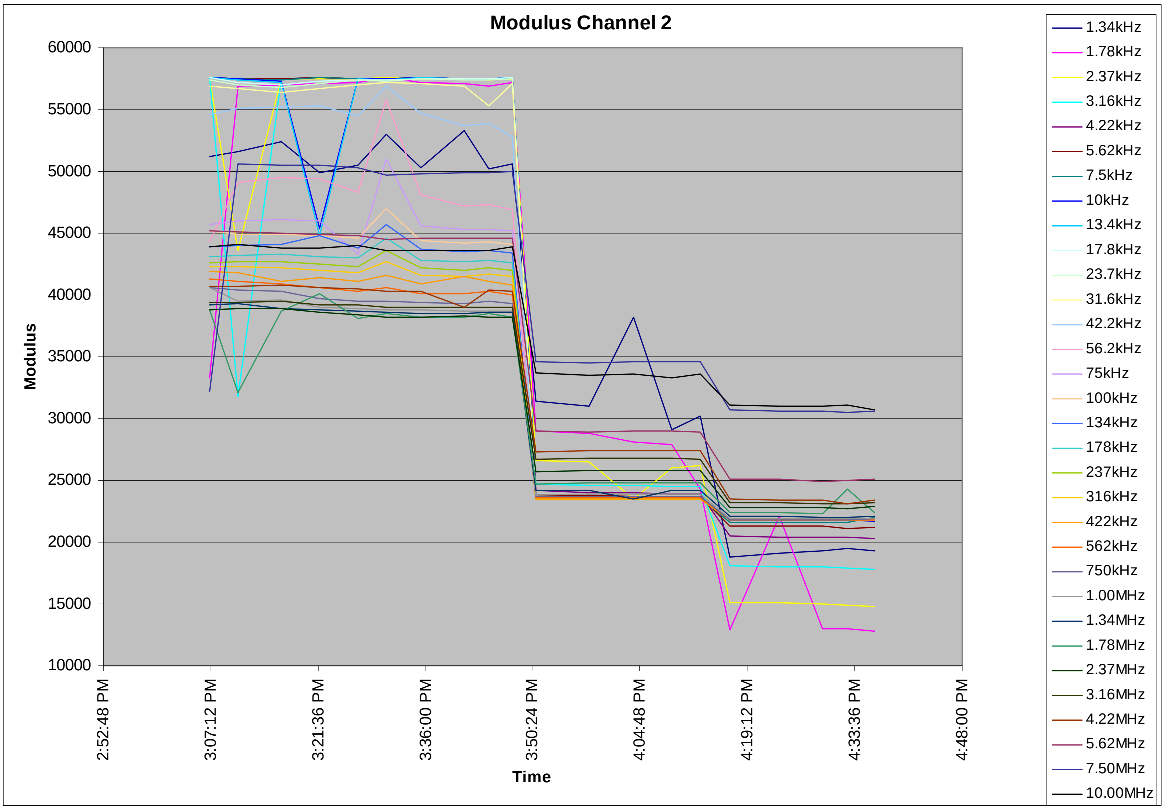


Chart 5: Channel 2 Modulus

8.2.2 Phase

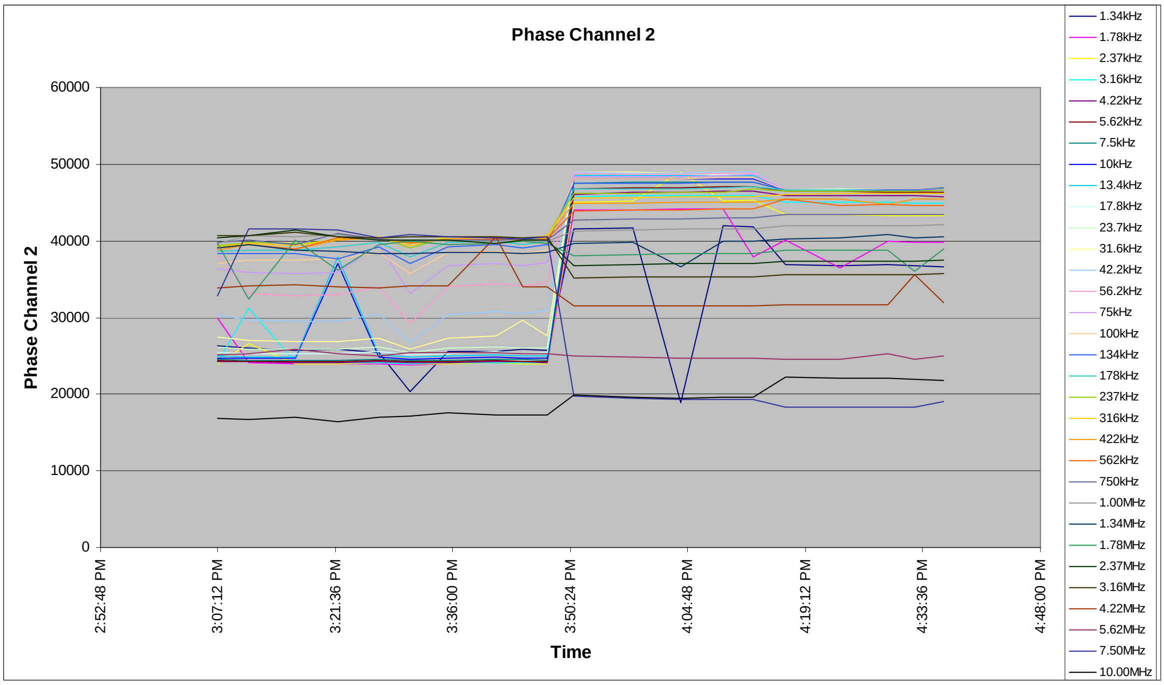


Chart 6: Channel 2 Phases

8.2.3 Temperatures

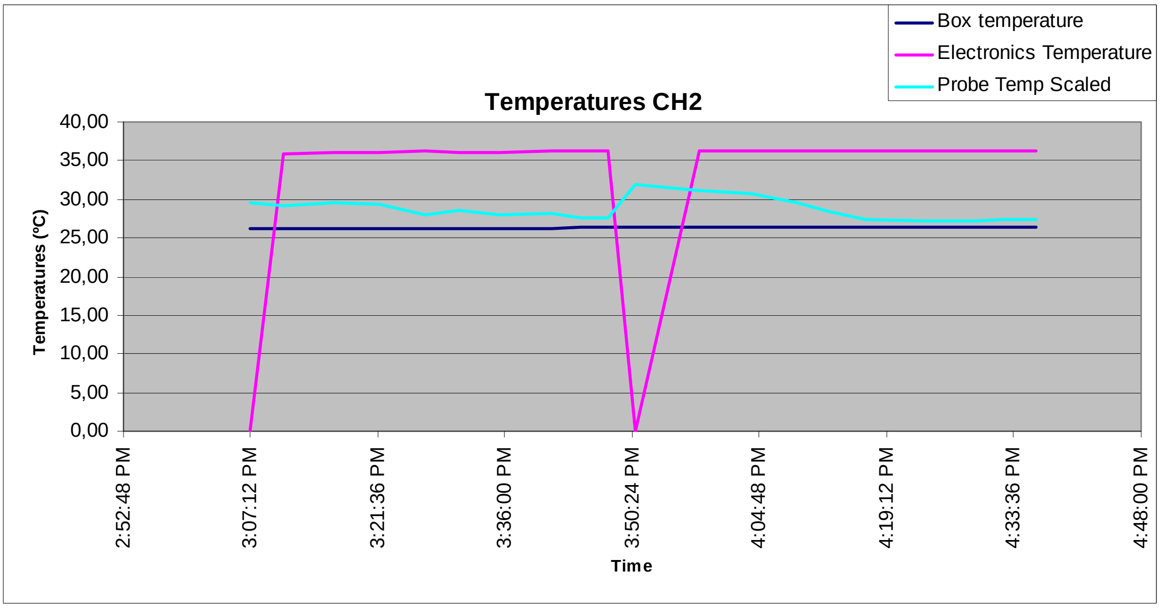


Chart 7: Channel 2 Temperatures

8.2.4 Charge Capacitor

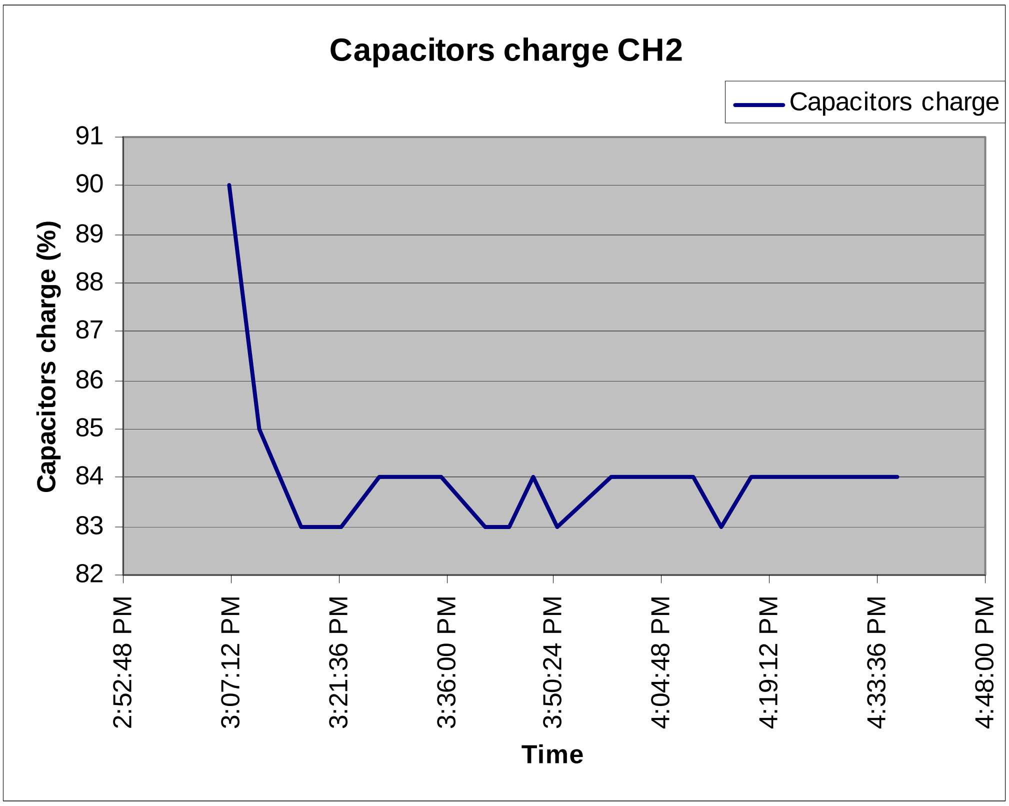


Chart 8: Channel 2 Charge Capacitor

MELISSA CI CONTROL CABINET HARDWARE DESIGN

APPROVAL LIST		
NAME	SIGNATURE	DATE
Prepared by: J.Carbonell		
Revised by: J.Duatis		
Approved by: E.Creus		
Authorised by: J.Duatis		

DISTRIBUTION LIST		
NAME	POSITION	COMPANY
Olivier Gerbi		SHERPA
Enrique Peiro		MPP
Arnaud Fossen		MPP

CHANGE RECORD			
AUTHOR	ISSUE	DATE	CHANGE
Toni López	1.0		First Version
Jordi Carbonell	2.0	16/02/2009	New Digital Input and Digital Output PLC card added.
Jordi Carbonell	2.1	01/10/2010	Update “comments” column of the rows 3,4,7 and 8 of the first table in section 4.5.1
Jordi Duatis	2.2	11/11/2011	Created section 2.2 to include Local HMI Updated section 4.1 to include CI Control Cabinet electrical distribution schematic.

CONTENTS

1. acronyms list

MELISSA	Micro-Ecological Life support System Alternative
MPP	MELISSA Pilot Plant
CI	Compartment I
VR	Vessel Reactor
FR	Filtration Reactor
HMI	Human Machine interface
IFix	Commercial supervision software
MAGELIS	Panel pc from Schneider
Panel pc	Small touch screen and embedded pc all in one.
DI	Digital Input
DO	Digital Output
AI	Analog Input
AO	Analog Output
AVI	Analog Voltage Input
ACI	Analog Current Input
GPIO	General Purpose Input Output

2. MELISSA CI system overview

MELISSA Compartment I (CI) is first compartment of MELISSA loop. This compartment transform wastes to CO2 and volatile fatty acids. See **¡Error! No se encuentra el origen de la referencia.**~~Figure 1~~ and MELISSA documentation to further information.

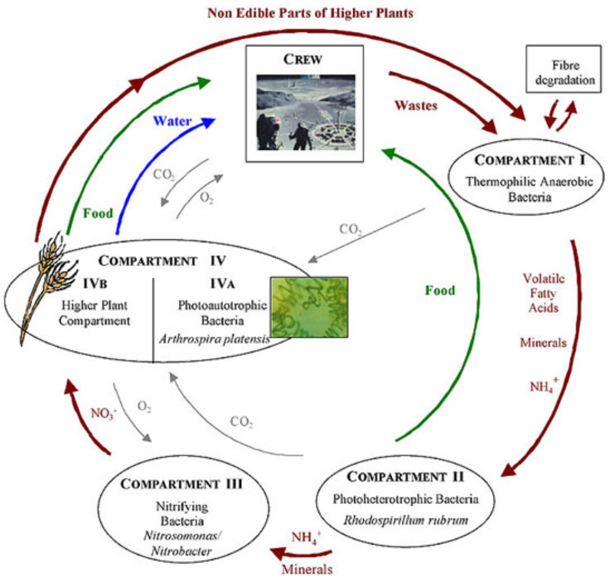


Figure 1 MELISSA LOOP CONCEPT

MELISSA CI system can be represent by five main hardware blocks. All these hardware is needed to correct operation. MELISSA CI system overview is show in **¡Error! No se encuentra el origen de la referencia.**~~Figure 2~~

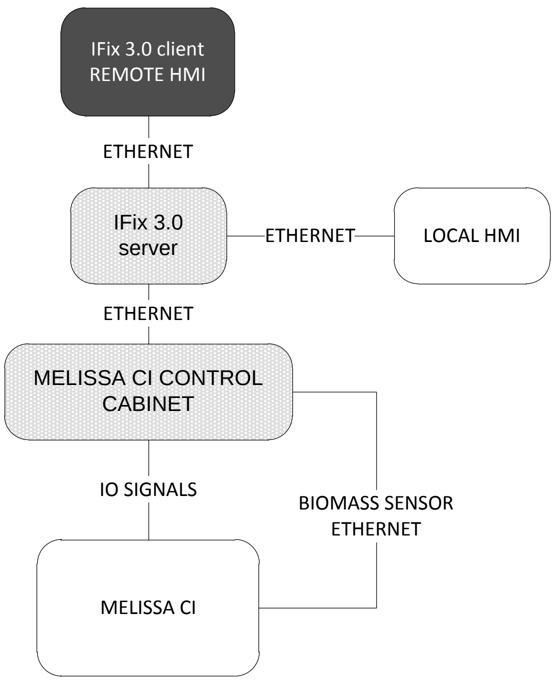


Figure 2 MELISSA CI system overview

2.1 MELISSA CI control system overview

MELISSA CI SYSTEM have three main blocks: MELISSA CI, CONTROL CABINET and Scada Supervisor system. See figure 4.

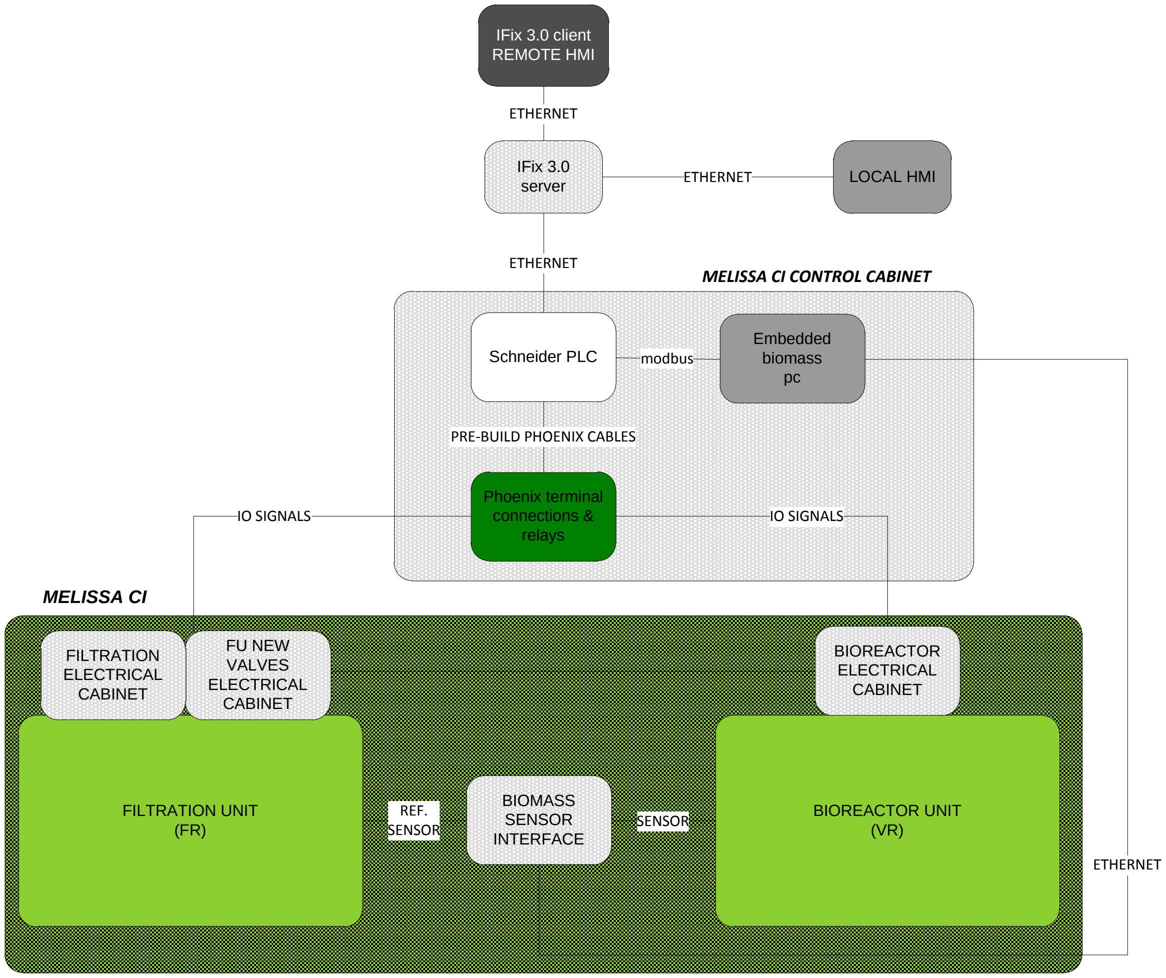


Figure 3 MELISSA CI system second approach

Detail connection of Biomass sensor is described in NTE-VSS-HB-017 document. Basically there are two sensor connectors (sensor and reference sensor) and one cross Ethernet wire.

Connections between filtration electrical cabinet and bioreactor electrical cabinet are describe in EPAS documentation.

Connections between filtration electrical cabinet, bioreactor electrical cabinet and MELISSA CI CONTROL CABINET, are described in this document. At the end of this documents there are wiring tables that explain.

In following sections all these blocks are explained.

2.1.1 MELISSA CI

From control point of view is a set of sensors and actuators. There are about 266 sensors and actuators. All these signals are divided in two electrical cabinets: Filtration Unit Cabinet and Bioreactor Cabinet. Each of these cabinet have: electrical protection, electrical power interfaces and electrical interfaces necessaries to connect directly to control cabinet. These means that all the power are in the electrical cabinets of Compartment I not in control cabinet.

Figure 4 MELISSA CI OVERVIEW

2.1.2 MELISSA CI CONTROL CABINET

It is the real-time stand-alone controller of MELISSA CI, Biomass sensor estimator and information MELISSA CI kernel.

2.1.3 SCADA SUPERVISION SYSTEM

Scada Supervisor system is divided in three main blocks: IFIX server, IFIX client (remote HMI) and another iFix client as local HMI running on a Panel PC. The IFIX server store in real-time all the MELISSA CI variables. From IFIX client it is possible to: set commands, read information in real-time, analyze historical information, customize graph.
For further information see MEL-3320-HB-042-NTE.

2.2 CI Local HMI

The Local HMI is a Panel PC installed in a metallic box Optipanel from Rittal connected to the Ethernet network and taking 24 Volts power supply from Bioreactor and Influent tank EPIC Cabinet.

The Panel PC has the following specifications:

- HDD160GB2,5 S HDD 160 GB 2,5" SATA
- WindowsXP Prof WINDOWS XP SP3 Professional (OEM)
- TPC-1770H-C1A TPC-1770H-C1AE 17" TPC with Intel Celeron M1.0Ghz and 512Gb RAM
- iFix Client 5.1

Figure 5 Local HMI design

3. MELISSA CI Control cabinet overview

It is a single 600x600x1800 mm rittal electrical cabinet with two panel assembly and two synthetic glass doors. One side contains electrical components and the other side electrical connections of MELISSA CI. See **¡Error! No se encuentra el origen de la referencia.**~~Figure 5~~

The electrical components side has: plc, power supplies, embedded pc and electrical protections.

The electrical connection side contents phoenix interface connectors, digital IOs have implemented a small relays of control, while analog output are connected directly with plc cards.

Figure 6 electrical connection side (left hand-side), side view and electrical components side

Distribution of all components is show in a draw of figure 6. Side A is electronic side while Side B is phoenix terminal connector side. Side B are prepared for a IOs expansion. The limitation of IOs expansion is determinate by PLC bus and wire section.

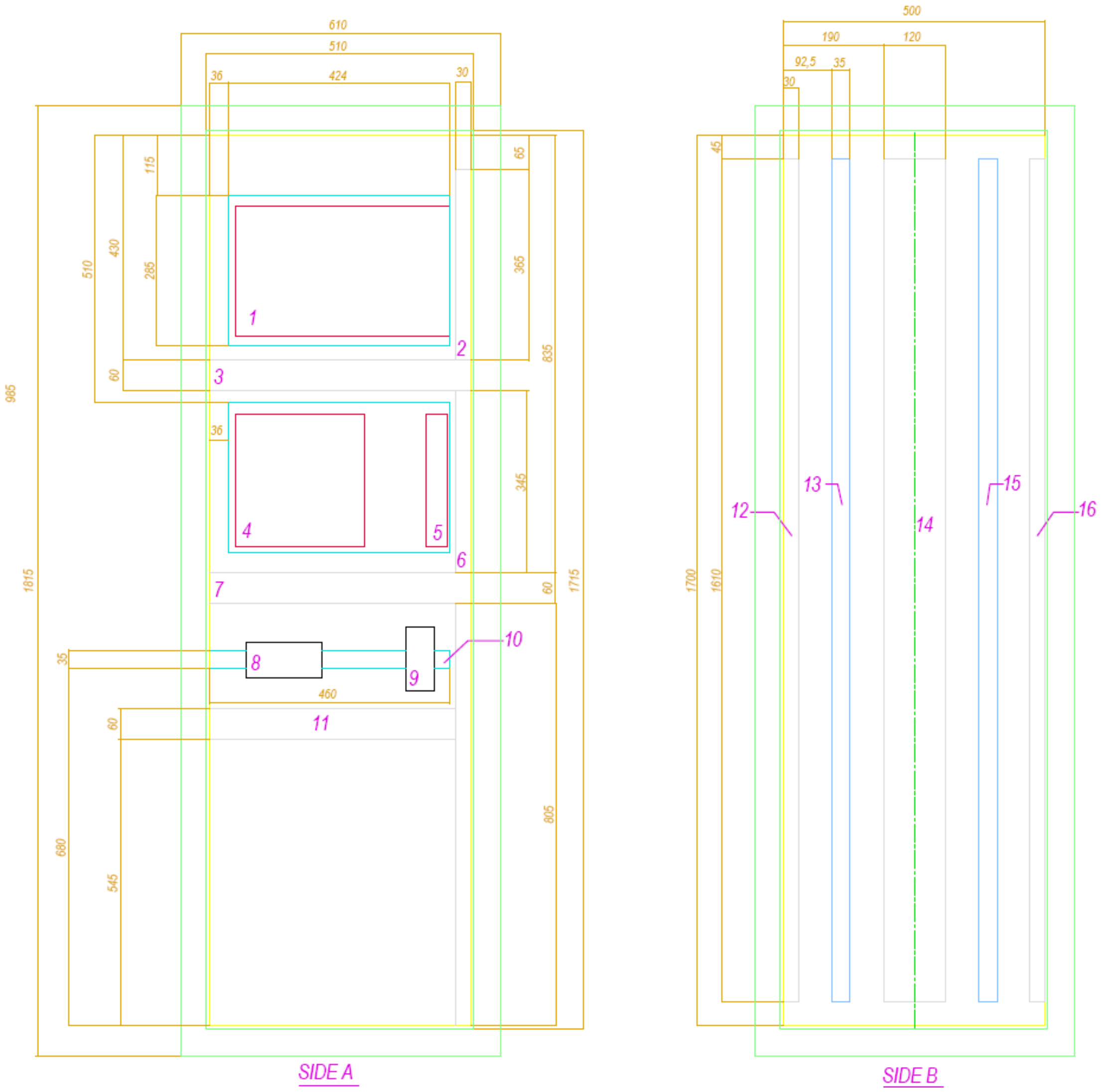


Figure 7 Mounted plate layout.

Mount plate layout component description:

Side A, Electronic side:

1. PLC BACKPLANE
2. MOUNT PLATE
3. GREY PLASTIC GUIDE WIRE
4. PLC EXPANSION
5. EXPANSION CARD
6. GREY PLASTIC GUIDE WIRE
7. GREY PLASTIC GUIDE WIRE
8. ELECTRICAL CONNECTIONS
9. POWER SUPPLY
10. DIN RAIL
11. GREY PLASTIC GUIDE WIRE

Side B, Electrical side:

12. GREY PLASTIC GUIDE WIRE
13. DIN RAIL
14. GREY PLASTIC GUIDE WIRE
15. METALIC DIN RAIL
16. GREY PLASTIC GUIDE WIRE

4. MELISSA CI control cabinet description

Control cabinet diagram is show in **¡Error! No se encuentra el origen de la referencia.**~~Figure 7~~. Basically there are 3 subsystems:

1. ENERGY DISTRIBUTION
   1.1. ELECTRICAL PROTECTIONS
      1.1.1. Magnetothermic AC_MGTH_1: Merlin Gerin C60HB B6
      1.1.2. Magnetothermic AC_MGTH_2: Merlin Gerin C60H D2A
      1.1.3. Magnetothermic AC_MGTH_3: Merlin Gerin C60HB B2
      1.1.4. Differential AC_DIFF: Merlin Gerin VIGI C60
   1.2. POWER SUPPLIES
      1.2.1. 24 VDC (Telemecanique ABL7RE2405)
      1.2.2. 24 VDC (Mean Well Power Supply DR-4524)
      1.2.3. PLC POWER SUPPLY
2. ELECTRONICS
   2.1. PLC
      2.1.1. IOs
   2.2. BIOMASS PANEL PC
3. TERMINAL BLOCKS
   3.1. AIO CONNECTORS
   3.2. DIO RELAYS CONNECTORS

All this subsystems will be detail described in following chapters

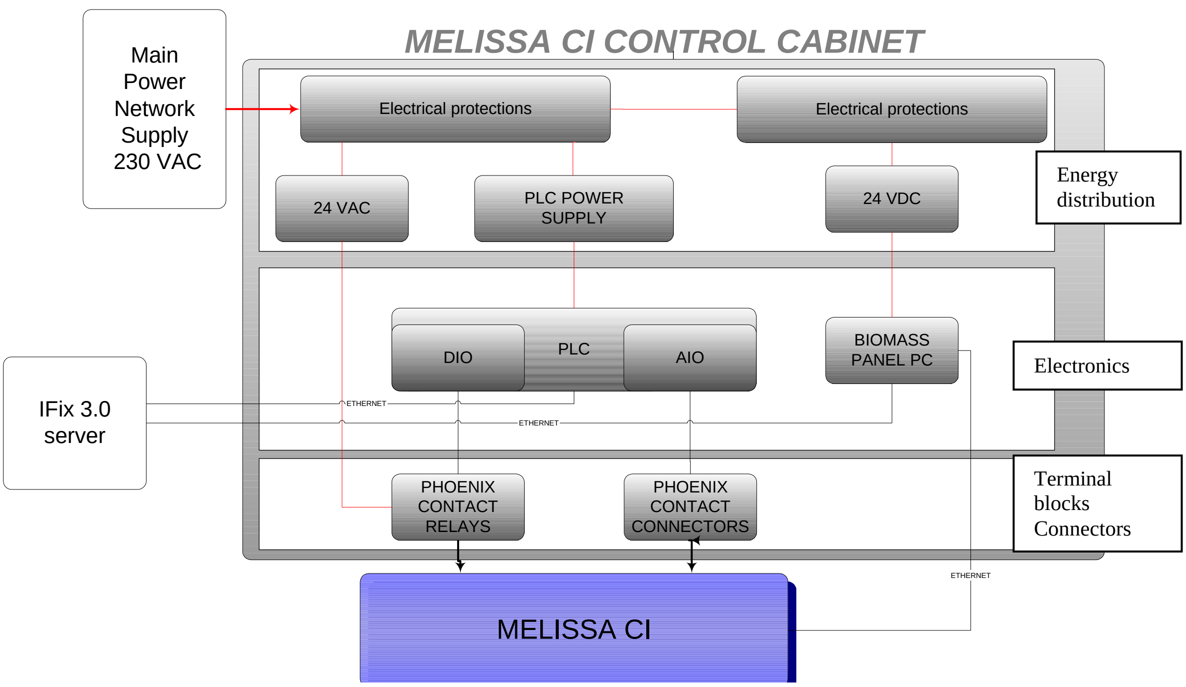


Figure 8 MELISSA CI CONTROL CABINET DETAIL VIEW

4.1 MELISSA CI CONTROL CABINET ENERGY DISTRIBUTION

This subsystem supply energy at all components of control cabinet. Power devices like pump, fan and other actuators will be feed from other sources (see section 2.1.1)

Components of ENERGY DISTRIBUTION SUBSYSTEM:

- ELECTRICAL PROTECTIONS
- POWER SUPPLIES
  - 24 VDC IOs
  - 24 VDC Embedded PC
  - PLC POWER SUPPLY

¡Error! No se encuentra el origen de la referencia.~~TABLE 1~~ show all loads of MELISSA CI control cabinet. These consumptions are nominal worse case. Regular nominal operation power consumption is lower.

DEVICE	*POWER CONSUPTION [W]*	*Operational range voltage*
24VDC POWER SUPPLY	150 W	relay power supply
24VDC POWER SUPPLY	48 W	Embedded pc power supply
CABINET FANS	50 W	230 V
PLC POWER SUPPLY x 2	300 W	plc power supply

Total	**548 W**

TABLE 1 ELECTRICAL LOADS OF MELISSA CI CONTROL CABINET

MELISSA CI power consumption in worse case is below 1Kw, so 1mm2 for main supply is enough. In order to simplify wiring all plc control cabinet is wired with 1 mm2 of section.

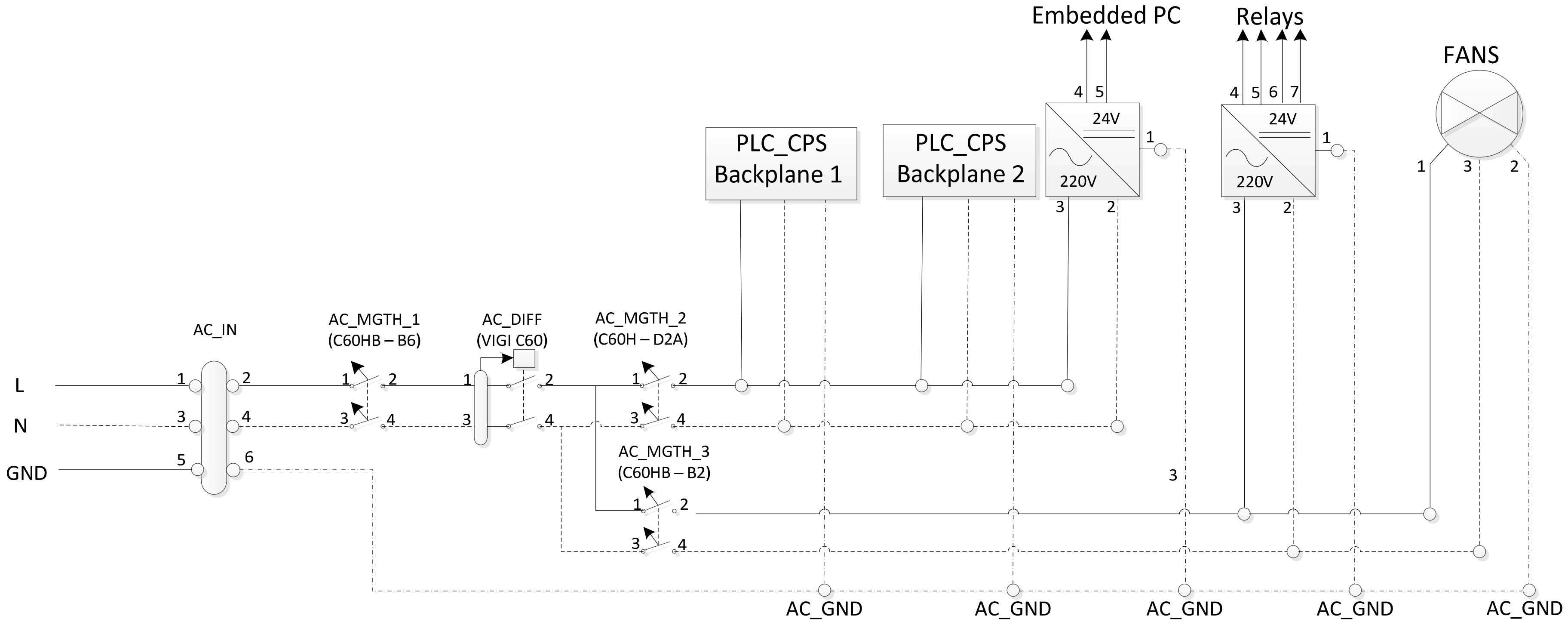


Figure9 CI Control Cabinet Power Distribution Schematic

4.2 CI ELECTRONICS

4.2.1 IOs PLC

Compartmet CI Quantum (by Schneider) Programmable Logic Controller is mounted on two backplane with 10 available slots in each backplane. The PLC module and PLC I/O expansion distribution is displayed in the following tables, showing the manufacturer reference identification (140XXXXXXXX), the description of the module and the mnemonic identification used in CI_RACK.

PLC									
1	2	3	4	5	6	7	8	9	10
A	B	C	D	E	F	G	H	I	Intentionally blank
140CPS11420	140CPU43412A	140NOE77101	140ACI04000	140ACI04000	140ACI04000	140ACO2000	140DDI35300	140DDI35300	140XBE10000
Backplane Power Supply module	CPU module	Ethernet module	16 Analog input 4-20 mA	16 Analog input 4-20 mA	16 Analog input 4-20 mA	4 Analog output 4-20 mA	32 Digital inputs 10-60 VCC	32 Digital inputs 10-60 VCC	Rack expansion
CI_PLC_CPS	CI_PLC_CPU	CI_PLC_NOE	CI_PLC_IO_ACI	CI_PLC_IO_ACI	CI_PLC_IO_ACI	CI_PLC_IO_ACO	CI_PLC_IO_DDI	CI_PLC_IO_DDI	CI_PLC_XBE

TABLE 2 PLC BACKPLANE CARD DISTRIBUTION

PLC EXPANSION									
1	2	3	4	5	6	7	8	9	10
Intentionally blank	J	K	L	M	N	O	P	Intentionally blank	Intentionally blank
140CPS11420	140DDI35300	140DDI35300	140DDO35300	140DDO35300	140DDO35300	140DDO35300	140DDI35300	Intentionally blank	140XBE10000
Backplane Power Supply module	32 Digital inputs 10-60 VCC	32 Digital inputs 10-60 VCC	32 Digital output 10-60VCC	32 Digital output 10-60VCC	32 Digital output 10-60VCC	32 Digital output 10-60VCC	32 Digital inputs 10-60 VCC	Intentionally blank	Rack expansion
CI_PLC_CPS	CI_PLC_IO_DDI	CI_PLC_IO_DDI	CI_PLC_IO_DDO	CI_PLC_IO_DDO	CI_PLC_IO_DDO	CI_PLC_IO_DDO	CI_PLC_IO_DDI	Intentionally blank	CIVb_PLC_XBE

TABLE 3 PLC BACKPLANE EXPANSION CARD DISTRIBUTION

Each card has a specific number of IOs. Table 2 show IOs available for each card reference.

CARD	*Number of cards*	*IO type*	*IO per card*	*total IO*
140ACI4000	3	current in	16	48
140ACO2000	1	current out	4	4
140DDI35300	5	digital in	32	160
140DDO35300	4	digital out	32	128

TABLE 4 plc card and I/O available in the control cabinet

Table 3 explains distribution of IOs. For example VR (Vessel Reactor) use 64 IOs while FR (Filtration Reactor) use 188 IOs. Free IOs are just 24, 16 DI and 8 DO.

I/Os	**ACI**	**ACO**	**DDI**	**DDO**	***Total***
Available	48	4	160	128	340
USE IN VR	16	0	33	17	66
USE IN FR	32	4	96	86	218
TOTAL USE	48	4	129	103	284
Free	0	0	31	25	56

TABLE 5 overview of I/O needed, available and free IOs

4.2.2 Embedded pc

Embedded pc is the interface between biomass sensor and PLC. The current version takes data from biomass sensor box (bioimpedance value) and sends it to the plc through serial modbus. In future version, it will estimate the biomass present in the bioreactor. For further information see NTE-VSS-HB-017 and NTE-VSS-HB-018 documents.

4.3 CI TERMINALS BLOCKS

4.3.1 VARIOFACE PHOENIX PLUGGABLE SYSTEM

MELISSA CI control cabinet is wiring with PHOENIX VARIOFACE PLUGGABLE SYSTEM. In **¡Error! No se encuentra el origen de la referencia.**~~Figure 8~~, there is compare traditional wiring system and pluggable phoenix wiring system. Phoenix system uses two idc connectors instead of 80 screws of traditional plc wiring. Main parts of phoenix pluggable system are: plc Schneider adaptor, idc phoenix wire and phoenix terminal block.

MELISSA CI control cabinet is wired from plc to terminals phoenix blocks. From user point of view all IOs are disposable in terminal phoenix block. Plc manipulation IOs is not necessary in any circumstance. All relationship between plc and terminal block are described in IOs table section 4.5.

Further information is available in http://www.phoenixcontact.com

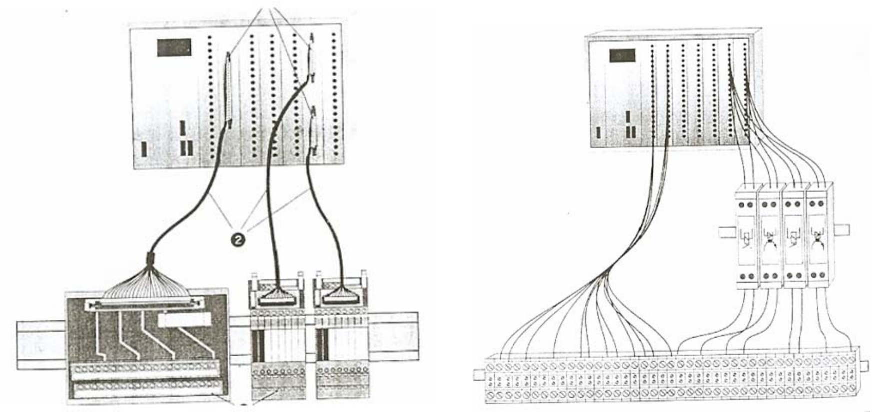
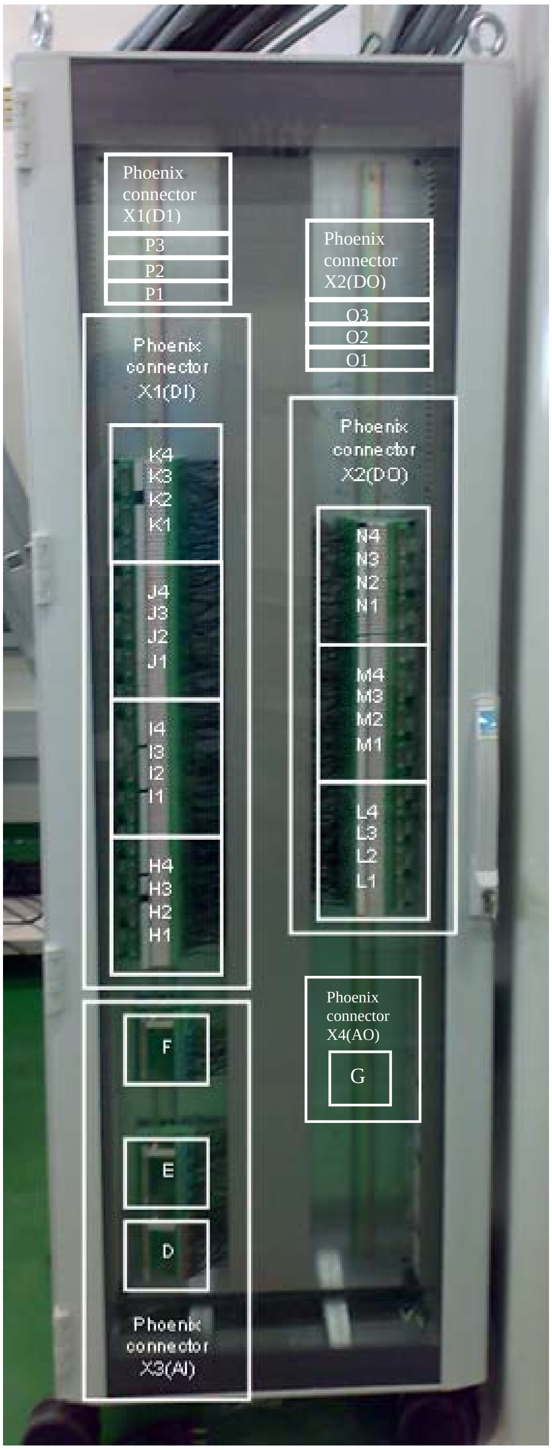


Figure 10 PHOENIX VARIOFACE PLUGGABLE SYSTEM vs TRADITIONAL WIRING SYSTEM

4.4 PHOENIX TERMINAL IDENTIFICATION



4.4.1 CS CI control cabinet terminal identification

CS-CI control cabinet terminals are divided in four major BLOCKS (DI(160),DO(128),AI(48),AO(4)). Each of them is divided in TERMINAL SET of (DI(32),DO(32),AI(16)). Again some of them are divided in SUBSET (DI(8),DO(8)). See figure x . Each pin of each block is identified by a number labeling.

- PHOENIX Digital Input BLOCK (160 DI)
    - PHOENIX TERMINAL SET H (32 DI)
        - PHOENIX TERMINAL SUBSET H1 (8 DI)
            - DI_1
            - …..
            - DI_8
        - PHOENIX TERMINAL SUBSET H2 (8 DI)
        - PHOENIX TERMINAL SUBSET H3 (8 DI)
        - PHOENIX TERMINAL SUBSET H4 (8 DI)
    - ……………
    - PHOENIX TERMINAL SET K (32 DI)
        - PHOENIX TERMINAL SUBSET K1 (8 DI)
        - PHOENIX TERMINAL SUBSET K2 (8 DI)
        - PHOENIX TERMINAL SUBSET K3 (8 DI)
        - PHOENIX TERMINAL SUBSET K4 (8 DI)
    - PHOENIX TERMINAL SET P (24 DI)
        - PHOENIX TERMINAL SUBSET P1 (8 DI)
        - PHOENIX TERMINAL SUBSET P2 (8 DI)
        - PHOENIX TERMINAL SUBSET P3 (8 DI)

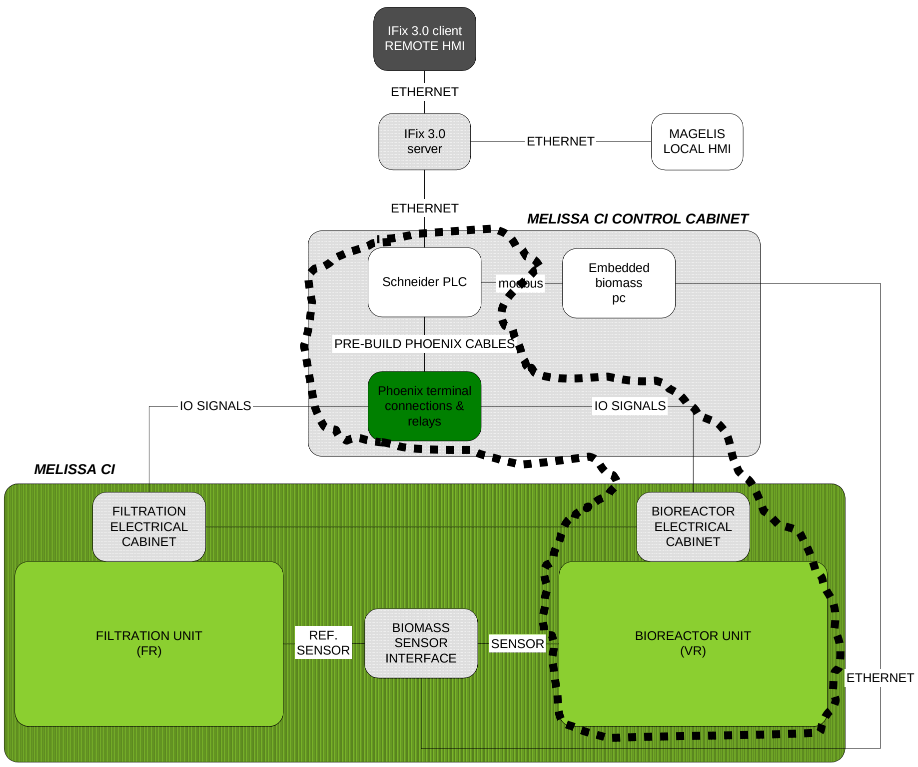
- PHOENIX Digital Output BLOCK (96 DO)
    - PHOENIX TERMINAL SET L (32 DO)
        - PHOENIX TERMINAL SUBSET L1 (8 DO)
            - DO1
            - …
            - DO8
        - PHOENIX TERMINAL SUBSET L2 (8 DO)
        - PHOENIX TERMINAL SUBSET L3 (8 DO)
        - PHOENIX TERMINAL SUBSET L4 (8 DO)
    - ……………
    - PHOENIX SET TERMINAL N (32 DO)
        - PHOENIX TERMINAL SUBSET N1 (8 DO)
        - PHOENIX TERMINAL SUBSET N2 (8 DO)
        - PHOENIX TERMINAL SUBSET N3 (8 DO)
        - PHOENIX TERMINAL SUBSET N4 (8 DO)
    - PHOENIX SET TERMINAL O (24 DO)
        - PHOENIX TERMINAL SUBSET O1 (8 DO)
        - PHOENIX TERMINAL SUBSET O2 (8 DO)
        - PHOENIX TERMINAL SUBSET O3 (8 DO)

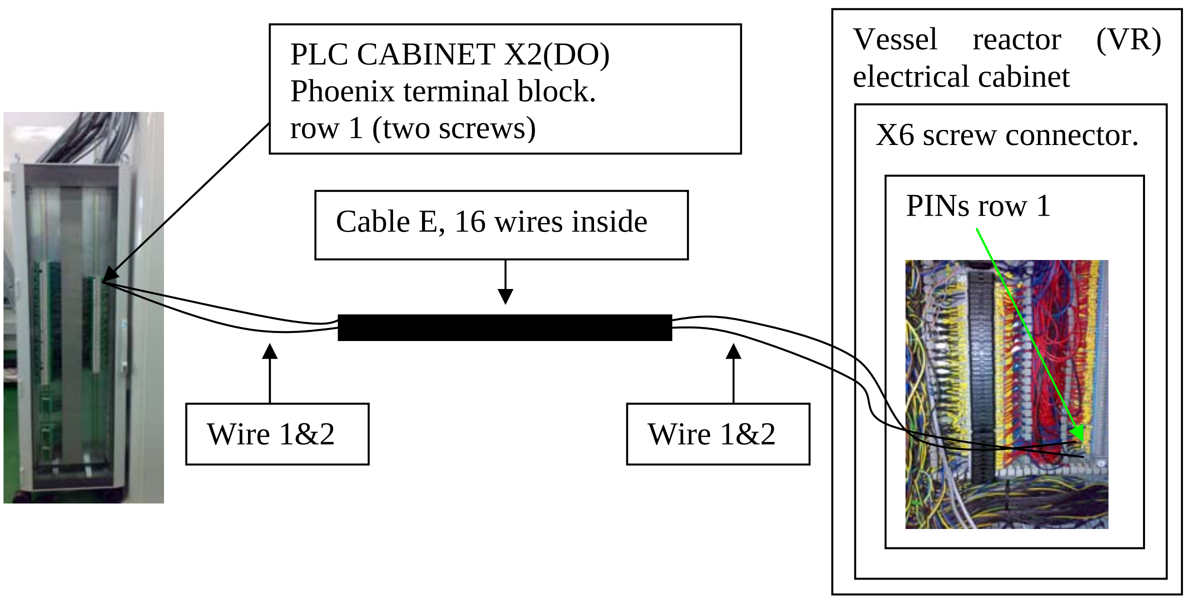
- PHOENIX Analog inputs BLOCK (48 AI)
    - PHOENIX SET TERMINAL D (16 AI)
    - PHOENIX SET TERMINAL E (16 AI)
    - PHOENIX SET TERMINAL F (16 AI)
- PHOENIX Analog outputs BLOCK (4 A0)

4.4.2 IOs connection table interpretation example

In this example is described the connection from CS-C1 control cabinet output1 and GP_1001_01_MV2 (Vessel bioreactor pump1)

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			VR CABINET	Compartment I electrical devices tags	
	X2 (D0)						X6	EPAS VARIABLE NAME	MPP VARIABLE NAME
000008	1	L1	L	E	1	2	1	PMP_V_01_Bwd	GP_1001_01_MV2





4.5 IOs Tables

4.5.1 Bioreactor Digital Output Table (BDOT)

PLC ADRESS	PLC CABINET X2 (D0)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			VR CABINET X6	Compartment I electrical devices tags: EPAS VARIABLE NAME	Compartment I electrical devices tags: MPP VARIABLE NAME	Comments
000008	1	L1	L	E	1	2	1	PMP_V_01_Bwd	GP_1001_01_MV2	Worm gearpump turning counterclockwise
000007	2			E	3	4	2	PMP_V_01_Fwd	GP_1001_01_MV1	Worm gear pump turning clockwise
000006	3			E	5	6	3	HX_R_001	HX_1008_01_MV	Heat bioreactor (R-R-01)
000005	4			E	7	8	4	HX_V_001	HX_1002_01_MV	Cool down influent tank (R-V-01) to prevent pre-degradation
000004	5			E	9	10	5	BL_R_01	BLE_1012_01_MV	Homogenize influent tank content (R-V-01)
000003	6			E	11	12	6	BL_V_01	BLE_1005_01_MV	Homogenize bioreactor content (R-R-01)
000002	7			E	13	14	7	PMP_R_02	PP_1011_02_MV	Pumps base in the bioreactor (R-R-01) to correct pH
000001	8			E	15	16	8	PMP_R_01	PP_1011_01_MV	Pumps acid in the bioreactor (R-R-01) to correct Ph
000016	9	L2		F	1	2	9	V_V_03	S3V_1001_01_MV	Used to feed the bioreactor R-R-01 with influent at regular intervals of time
000015	10			F	3	4	10	V_V_04	S3V_1001_02_MV	Used to fill in the influent tank R-V-01 with fresh influent or to circulate the influent in a loop
000014	11			F	5	6	11	V_V_07	SV_1003_01_MV	Siren + flashing light

PLC ADRESS	PLC CABINET X2 (D0)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			VR CABINET X6	Compartment I electrical devices tags: EPAS VARIABLE NAME	Compartment I electrical devices tags: MPP VARIABLE NAME	Comments
000013	12			F	7	8	12	V_R_19	SV_1009_01_MV	Releases gas from the influent tank (R-V-01) when the pressure increases to the point Pressure sensors PS-V-01 and LS-V-02 are about to go out of their ranges Powered 2-way valve(safety). During feeding of the influent tank it switches to release gas fast
000012	13			F	9	10	13	SIREN	SIREN_ALARM	Releases gas from bioreactor (R-R-01) when the pressure increases over the set point
000011	14			F	11	12	14	-	-	-
000010	15			F	13	14	15	-	-	-
000009	16			F	15	16	16	-	-	-

4.5.2 Filtration Unit Digital Output Table (FUDOT)

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X2 (DO)						X6	EPAS VARIABLE NAME	MPP VARIABLE NAME	
000024	17	L3	L	S	1	2	1	PMP_F_02	PP_1202_01_MV1	Pumps filtrate out of membranes Fi-F-01 and Fi-F-02 to filtrate tank R-F-01 and keeps the flux constant
000023	18			S	3	4	2	PMP_G_02	PP_1101_01_MV	Pumps gas from the bioreactor through gas analyser
000022	19			S	5	6	3	PMP_G_01	PP_1100_01_MV	Pumps gas from the bioreactor through the buffer vessel R-G-01 (active gas loop)
000021	20			S	7	8	4	PMP_F_05	PP_1204_01_MV	Pumps filtrate out of R-F-01 for harvesting
000020	21			S	9	10	5	PMP_C_03	CP_1207_02_MV	Pumps cleaning agent from cleaning buffer R-C-02 to FU retentate line
000019	22			S	11	12	6	PMP_C_02	PP_1209_01_MV	Pumps pure detergent (R-C-03) to cleaning agent tank (R-C-01)
000018	23			S	13	14	7	PMP_C_01	CP_1207_01_MV	Pumps cleaning agent or water to the tanks
000017	24			S	15	16	8	HX_C_01	HX_1208_01_MV	Heats cleaning buffer R-C-02
000032	25	L4		T	1	2	9	PMP_F_01	GP_1201_01_MV1	Pumps reactor content through membranes Fi-F-01 and Fi-F-02 in retentate loop. Is also used during cleaning of the retentate loop

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X2 (DO)						X6	EPAS VARIABLE NAME	MPP VARIABLE NAME	
~~000031~~	~~26~~			~~T~~	~~3~~	~~4~~	~~10~~	~~V_S_08~~	~~S3CV_1210_07_MV~~	~~Allows flow of steam and condens in effluent vessel VR-F-01 to steam trap V-S-14 and condensate vessel R-S-03 when activated~~
000030	27			T	5	6	11		SV_1210_04_MV	Steam valve
000029	28			T	7	8	12		SV_1210_05_MV	Steam valve
000028	29			T	9	10	13		SV_1210_08_MV	Steam valve
000027	30			T	11	12	14		SV_1210_09_MV	Steam valve
000026	31			T	13	14	15		SV_1210_06_MV	Steam valve
000025	32			T	15	16	16		SV_1210_07_MV	Steam valve
000040	33			U	1	2	17	V_G_28	SV_1101_01_MV	Analysis & Calibration Gas Loop valve
000039	34	M1	M	U	3	4	18	V_G_25	SV_1100_05_MV	Opens/ closes gas flow from buffer vessel R-G-01 to bioreactor R-R-01
000038	35			U	5	6	19	V_G_21	SV_1203_03_MV	Used to flush N2 in the filtrate tank
000037	36			U	7	8	20	V_G_20	SV_1203_02_MV	Used to flush N2 in the retentate loop of the FU in order to prevent under pressure in the loop

PLC ADDRESS	PLC CABINET X2 (DO)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET X6	Compartment I electrical devices tags: EPAS VARIABLE NAME	Compartment I electrical devices tags: MPP VARIABLE NAME	Comments
000036	37			U	9	10	21			
000035	38			U	11	12	22	V_G_16	S3V_1101_01_MV	Used to evacuate N2 gas from the gas analysis loop in case of gas analyser calibration
000034	39			U	13	14	23	V_G_10	SV_1102_01_MV	Opens/ closes condensate flow from buffer vessel R-G-01 to bioreactor R-R-01
000033	40			U	15	16	24	V_G_08	SV_1100_03_MV	Opens / closes outlet of gas from R-G-02 for produced biogas flow determination
000048	41	M2		V	1	2	25	V_G_05	SV_1100_01_MV	Opens/closes inlet of biogas in buffer vessel R-G-01
000047	42			V	3	4	26	V_G_03	S3V_1100_02_MV	Used to by-pass the gas compressor PMP-G-01
000046	43			V	5	6	27	V_G_02	S3V_1100_01_MV	Used to by-pass the gas compressor PMP-G-01
000045	44			V	7	8	28	V_G_01	S3V_1103_01_MV	Used to connect N2 gas inlet to gas analysis loop for gas analyser calibration
000044	45			V	9	10	29	V_F_18	S3V_1201_09_MV	Used to drain retentate from FU retentate line in R-C-04 or in a vessel
000043	46			V	11	12	30	V_F_17	S3V_1201_08_MV	Used to drain retentate from FU retentate line in R-C-04 or in a vessel
000042	47			V	13	14	31	V_F_16	S3V_1201_07_MV	Used to pump back retentate from R-C- 04 to retentate line in FU
000041	48			V	15	16	32		SV_1201_07_MV	Used to drain the retentate side of membrane Fi-F-01

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X2 (DO)						X6	EPAS VARIABLE NAME	MPP VARIABLE NAME	
000056	49			W	1	2	33		SV_1201_08_MV	Used to drain the retentate side of membrane Fi-F-02
000055	50			W	3	4	34	V_F_13	SV_1203_01_MV	Used to keep atmospheric pressure in the retentate line by letting enter/escape air when draining/ filling the tubes
000054	51			W	5	6	35	V_F_12	SV_1204_02_MV	Is closed during SIP of effluent vessel R-F-01 to allow pressure and temperature to rise
000053	52	M3		W	7	8	36	V_F_11		
000052	53			W	9	10	37	V_F_10	SV_1204_01_MV	Used to drain the filtrate tank R-F-01
000051	54			W	11	12	38		SV_1202_03_MV	Used to send back filtrate to bioreactor or to collect filtrate in filtrate tank R-F-01
000050	55			W	13	14	39		SV_1202_01_MV	Used to select outlet filtrate from membrane Fi-F-01 or Fi-F02
000049	56			W	15	16	40	V_F_06	SV_1201_02_MV	Opens/ closes retentate flow from FU to bioreactor R-R-01
000064	57			X	1	2	41	V_F_05	S3V_1201_04_MV	Used to bypass the FU
000063	58			X	3	4	42		SV_1201_03_MV	Used to select outlet retentate from membrane Fi-F-01 or Fi-F-02
000062	59	M4		X	5	6	43		SV_1201_05_MV	Used to select inlet retentate of membrane Fi-F-01 or Fi-F02
000061	60			X	7	8	44	V_F_02	S3V_1201_01_MV	Used to bypass the FU
000060	61			X	9	10	45	V_F_01	SV_1201_01_MV	Opens/ closes retentate flow from bioreactor R-R-01 to Filtration Unit

PLC ADDRESS	PLC CABINET X2 (DO)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET X6	Compartment I electrical devices tags: EPAS VARIABLE NAME	Compartment I electrical devices tags: MPP VARIABLE NAME	Comments
000059	62			X	11	12	46	V_C_21	SV_1207_05_MV	When activated, allows cleaning agent to filtratte side of membranes Fi-F-01 and -02 during backwashing
000058	63			X	13	14	47		SV_1207_11_MV	Activated during backwashing and cleaning of retentate side of membrane Fi-F-01
000057	64			X	15	16	48		SV_1207_10_MV	Activated during backwashing and cleaning of retentate side of membrane Fi-F-02
000072	65	N1	N	Y	1	2	49		SV_1207_08_MV	Activated for cleaning of retentate side of membrane Fi-F-02
000071	66			Y	3	4	50		SV_1207_09_MV	Activated for cleaning of retentate side of membrane Fi-F-01
000070	67			Y	5	6	51	V_C_15	S3V_1207_04_MV	Activated during cleaning of retentate loop
000069	68			Y	7	8	52	V_C_14	S3V_1207_03_MV	Activated during cleaning of retentate loop
000068	69			Y	9	10	53		SV_1207_07_MV	Activated for backwashiong mbne membrane Fi-F-01
000067	70			Y	11	12	54		SV_1207_06_MV	Activated for backwashing membrane Fi-F-02
000066	71			Y	13	14	55	V_C_11	SV_1209_05_MV	Allows outside air to enter during draining and rincing of cleaning agent vessel (R-C-01) and allows air to leave the vessel when it is being filled
000065	72			Y	15	16	56	V_C_10	SV_1209_04_MV	Used to drain and during rincing of cleaning agent vessel (R-C-01)

PLC ADDRESS	PLC CABINET X2 (DO)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET X6	Compartment I electrical devices tags EPAS VARIABLE NAME	MPP VARIABLE NAME	Comments
000080	73	N2		Z	1	2	57	V_C_09	SV_1209_03_MV	Used to fill R-C-01 with water
000079	74			Z	3	4	58	V_C_07	SV_1209_02_MV	Allows outside air to enter cleaning buffer vesel (R-C-02) while it is drained and allows air to leave the vessel when it is being filled
000078	75			Z	5	6	59	V_C_06	SV_1209_01_MV	Drains cleaning buffer vessel (R-C-02) when open
000077	76			Z	7	8	60	V_C_05	SV_1207_04_MV	Allows water to No-C-04 for rincing and filling cleaning buffer vessel (R-C-02)
000076	77			Z	9	10	61	V_C_04	SV_1207_03_MV	Allows water to No-C-03 for rincing of effluent vessel (R-F-01)
000075	78			Z	11	12	62	V_C_02	SV_1207_02_MV	Allows water to No-C-02 for rincing of bioreactor (R-R-01)
000074	79			Z	13	14	63	V_C_01	SV_1207_01_MV	Allows water to No-C-01 for rincing of Feeding Vessel (R-V-01)
~~000073~~	~~80~~			~~Z~~	~~15~~	~~16~~	~~64~~	~~V_S_24~~	~~SV_1207_01_MV~~	~~Allows water to No-C-01 for rincing of Feeding Vessel (R-V-01)~~
000088	81	N3		2A	1	2	65	V_S_13	SV_1210_03_MV	Allows steam in efflluent vessel R-F-01 and the filtrate side of Fi-F-03 when activated
000087	82			2A	3	4	66	V_G_07	SV_1100_02_MV	Opens/ closes inlet of gas in R-G-02 for produced biogas flow determination
000086	83			2A	5	6	67	V_S_11	SV_1210_01_MV	Allows steam in filtrate side of membrane Fi-F-02 when activated

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X2 (DO)						X6	EPAS VARIABLE NAME	MPP VARIABLE NAME	
000085	84			2A	7	8	68	V_S_12	SV_1210_02_MV	Allows steam in filtrate side of membrane Fi-F-01 when activated
000084	85			2A	9	10	69	ST_F_01	SG_1210_01_MV	Generates steam of 3.8bara or 140°C when activated
000083	86			2A	11	12	NC	-	-	-
000082	87			2A	13	14	NC	-	-	-
000081	88			2A	15	16	NC	-	-	-
000096	NC	N4					NC	-	-	-
000095	NC						NC	-	-	-
000094	NC						NC	-	-	-
000093	NC						NC	-	-	-
000092	NC						NC	-	-	-
000091	NC						NC	-	-	-
000090	NC						NC	-	-	-
000089	NC						NC	-	-	-

4.5.3 New Digital Output card

PLC ADDRES	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X2 (D0)						X6	EPAS VARIABLE NAME	MPP VARIABLE NAME	
000104	97	O1	O	2G	8	25		-	SV_1210_12_MV	
000103	98			2G	7	24		-	SV_1210_10_MV	
000102	99			2G	6	23		-	SV_1210_15_MV	
000101	100			2G	5	22		-	SV_1204_03_MV	
000100	101			2G	4	21		-	SV_1202_04_MV	
000099	102			2G	3	20		-	SV_1202_02_MV	
000098	103			2G	2	19		-	SV_1201_04_MV	
000097	104			2G	1	18		-	SV_1201_06_MV	
000112	105	O2		2G	16	2I;3		-	SV_1210_13_MV	
000111	106			2G	15	2I;2		-	SV_1210_11_MV	
000110	107			2G	14	2I;1		-	SV_1207_12_MV	
000109	108			2G	13	2I:5		-	SV_1207_13_MV	
000108	109			2G	12	29		-	SV_1211_03_MV	
000107	110			2G	11	28		-	SV_1203_04_MV	
000106	111			2G	10	27		-	SV_1211_02_MV	
000105	112			2G	9	26		-	SV_1211_01_MV	
000120	113	O3		-	-	-	-	-		
000119	114			-	-	-	-	-		
000118	115			-	-	-	-	-		
000117	116			-	-	-	-	-		
000116	117			-	-	-	-	-		
000115	118			-	-	-	-	-		
000114	119			-	-	-	-	-		

PLC ADDRES	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X2 (D0)						X6	EPAS VARIABLE NAME	MPP VARIABLE NAME	
000113	120			2G	17	2I;4		-	SV_1210_14_MV	
000128	NC	O4								
000127	NC									
000126	NC									
000125	NC									
000124	NC									
000123	NC									
000122	NC									
000121	NC									

4.5.4 Bioreactor Digital Inputs Table (BDIT)

PLC ADDRESS	PLC CABINET X1 (D0)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			VR CABINET X6	Compartment I electrical devices tags EPAS VARIABLE NAME	MPP VARIABLE NAME	Comments
100001	1	H1	H	A	1	2	1	E_RV_F4_F5	E_RV_F4_F5	Tension control Steering circuit 230VAC
100002	2			A	3	4	2	E_RV_F6_F8	E_RV_F6_F8	Tension control Steering circuit 24VDC
100003	3			A	5	6	3	E_RV_F9_F10	E_RV_F9_F10	Tension control Power circuit 230VAC
100004	4			A	7	8	NC	E_RV_F1_NC		
100005	5			A	9	10	NC	E_RV_F3_NC		
100006	6			A	11	12	NC	E_RV_F9_NC		
100007	7			A	13	14	7	E_RV_F14_F15	CL1008_E_RV_F14_F15	Cicuit Breaker 14 of PMP_R_03
100008	8			A	15	16	8	E_RV_F16_F17		Circuit Breaker 16 of PMP_V_02
100009	9	H2		B	1	2	9	E_RV_Q2_F19	CL1001_E_RV_Q2_F19	Motor Switch Q2
100010	10			B	3	4	10	E_RV_K1_F21	CL1001_E_RV_K2_F21	Control Contactor K1 Counterclockwise
100011	11			B	5	6	11	E_RV_K2_F20	CL1001_E_RV_K1_F20	Control Contactor K2 Clockwise
100012	12			B	7	8	12	E_RV_Q4_F23	CL1008_E_RV_Q4_F23	Control Circuit-breaker Q4
100013	13			B	9	10	13	E_RV_K4_F22	CL1008_E_RV_K4_F22	Control Contactor K4

PLC ADDRESS	PLC CABINET X1 (D0)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			VR CABINET X6	Compartment I electrical devices tags EPAS VARIABLE NAME	Compartment I electrical devices tags MPP VARIABLE NAME	Comments
100014	14			B	11	12	14	E_RV_Q3_F26	CL1002_E_RV_Q3_F26	Control Circuit-breaker Q3
100015	15			B	13	14	15	E_RV_K3_F27	CL1002_E_RV_K3_F27	Control Contactor K3
100016	16			B	15	16	16	E_RV_U1_ALM	CL1005_E_RV_U1_ALM	Alarm Frequency regulator U1
100017	17	H3		C	1	2	17	E_RV_F29_F31	CL1005_E_RV_F29_F31	Control Circuit-breaker F29
100018	18			C	3	4	18	E_RV_U2_ALM	CL1012_E_RV_U2_ALM	Alarm Frequency regulator U2
100019	19			C	5	6	19	E_RV_F33_F35	CL1012_E_RV_F33_F35	Control Circuit-breaker F33
100020	20			C	7	8	20	E_RV_pHT_R_01_ALM	TT_1011_01_ALM	Alarm Ph transmitter 1
100021	21			C	9	10	21	E_RV_pHT_R_02_ALM	TT_1011_02_ALM	Alarm Ph transmitter 2
100022	22			C	11	12	22	LS_V_01	LSH_1004_01	Gives an alarm when the level in influent tank (R-V-01) becomes too high
100023	23			C	13	14	23	LS_R_01	LSH_1010_01	Gives an alarm/action when the level in bioreactor (R-R-01) becomes too high
100024	24			C	15	16	24	LS_R_03	LSL_1008_01	

PLC ADDRESS	PLC CABINET X1 (D0)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			VR CABINET X6	Compartment I electrical devices tags EPAS VARIABLE NAME	MPP VARIABLE NAME	Comments
100025	25	H4		D	1	2	25	V_GetCakeButton	CL1001_GetCakeButton	Button for filling feeder
100026	26			D	3	4	NC			
100027	27			D	5	6	27	V_V_03_FB	S3V_1001_01_FB	Valve state feedback
100028	28			D	7	8	28	V_V_04_FB	S3V_1001_02_FB	Valve state feedback
~~100029~~	~~29~~			~~D~~	~~9~~	~~10~~	~~29~~	~~V_V_07_FB~~	~~SV_1003_01_FB~~	~~Valve state feedback~~
~~100030~~	~~30~~			~~D~~	~~11~~	~~12~~	~~30~~	~~V_R_19_FB~~	~~SV_1009_01_FB~~	~~Valve state feedback~~
100031	31			D	13	14	31	ERR_R_pH_PMP_powersupply	CL1011_ERR_PP_pwrsupply	Control Circuit-breaker F43
100032	32			D	15	16	32	Emergency_Button_Pressed	Emergency_Button_Pressed	emergency button pressed

4.5.5 Filtration Unit Digital Inputs Table (FUDIT)

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X1 (DI)						X5	EPAS VARIABLE NAME	MPP VARIABLE NAME	
100033	33	I1	I	I	1	2	1	Control_Tens230VAC_steerFiltrate		
100034	34			I	3	4	2	Control_Tens24VDC_steerFiltrate		
100035	35			I	5	6	3	Control_Tens230VAC_powerFiltrate		
100036	36			I	7	8	4	Control_Emergency		
100037	37			I	9	10	5	HX_G_01_ALM		
~~100038~~	~~38~~			~~I~~	~~11~~	~~12~~	~~6~~	~~HX_G_02_ALM~~	-	-
100039	39			I	13	14	7	FS_F_01_ALM	FT_1201_01_ALM	AlarmContact Flow Meter
100040	40			I	15	16	8	A_G_01_ALM		
100041	41	I2		J	1	2	9	A_G_02_ALM		
100042	42			J	3	4	10	E_FG_U1_ALM_F34	CL1201_E_FG_U1_ALM_F34	Alarm Contact Frequency regulator
100043	43			J	5	6	11	E_FG_F35_F36	CL1201_E_FG_F35_F36	Tension Control Pump F35
~~100044~~	~~44~~			~~J~~	~~7~~	~~8~~	~~12~~	-	-	-
~~100045~~	~~45~~			~~J~~	~~9~~	~~10~~	~~13~~	-	-	-
~~100046~~	~~46~~			~~J~~	~~11~~	~~12~~	~~14~~	-	-	-

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X1 (DI)						X5	EPAS VARIABLE NAME	MPP VARIABLE NAME	
100047	47			J	13	14	15	LS_G_01	LSH_1102_01	Gives an alarm/action when the condensate level in buffer vessel R-G-01 becomes too high (=> problem with condensate evacuation system)
100048	48			J	15	16	16	LS_F_01	LSH_1206_01	Measures upper volume in gas phase for volume measurement in filtrate tank (R-F-01)
100049	49	I3		K	1	2	17	LS_C_04	LSL_1209_02	Detects low level in cleaning buffer tank (R-C-02)
100050	50			K	3	4	18	LS_C_03	LSH_1209_02	Detects high level in cleaning buffer tank (R-C-02)
100051	51			K	5	6	19	LS_C_02	LSL_1209_01	Detects low level in cleaning agent tank (R-C-01)
100052	52			K	7	8	20	LS_C_01	LSH_1209_01	Detects high level in cleaning agent tank (R-C-01)
100053	53			K	9	10	21	LS_F_02	LSH_1206_02	Measures pressure in liquid phase for volume measurement in filtrate tank (R-F-01)

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X1 (DI)						X5	EPAS VARIABLE NAME	MPP VARIABLE NAME	
100054	54			K	11	12	22	V_S_08_FB	SV_1210_04_FB	Valve state feedback
100055	55			K	13	14	~~23~~	~~V_S_07_FB~~	~~S3V_1210_07_FB~~	~~Valve state feedback~~
100056	56			K	15	16	24	V_S_06_FB	SV_1210_05_FB	Valve state feedback
100057	57	I4		L	1	2	25	V_S_05_FB	SV_1210_08_FB	Valve state feedback
100058	58			L	3	4	26	V_S_04_FB	SV_1210_09_FB	Valve state feedback
100059	59			L	5	6	27	V_S_03_FB	SV_1210_06_FB	Valve state feedback
100060	60			L	7	8	28	V_S_02_FB	SV_1210_07_FB	Valve state feedback
100061	61			L	9	10	29	V_G_28_FB	SV_1101_01_FB	Valve state feedback
100062	62			L	11	12	30	V_G_25_FB	SV_1100_05_FB	Valve state feedback
100063	63			L	13	14	31	V_G_21_FB	SV_1203_03_FB	Valve state feedback
100064	64			L	15	16	32	V_G_20_FB	SV_1203_02_FB	Valve state feedback
~~100065~~	~~65~~	J1	J	~~M~~	~~1~~	~~2~~	~~33~~	-		
100066	66			M	3	4	34	V_G_16_FB	S3V_1101_01_FB	Valve state feedback
100067	67			M	5	6	35	V_G_10_FB	SV_1102_01_FB	Valve state feedback
100068	68			M	7	8	36	V_G_08_FB	SV_1100_03_FB	Valve state feedback
100069	69			M	9	10	37	V_G_05_FB	SV_1100_01_FB	Valve state feedback
100070	70			M	11	12	38	V_G_03_FB	S3V_1100_02_FB	Valve state feedback
100071	71			M	13	14	39	V_G_02_FB	S3V_1100_01_FB	Valve state feedback
100072	72			M	15	16	40	V_G_01_FB	S3V_1103_01_FB	Valve state feedback
100073	73	J2		N	1	2	41	V_F_18_FB	S3V_1201_09_FB	Valve state feedback
100074	74			N	3	4	42	V_F_17_FB	S3V_1201_08_FB	Valve state feedback
100075	75			N	5	6	43	V_F_16_FB	S3V_1201_07_FB	Valve state feedback
100076	76			N	7	8	44	V_F_15_FB	SV_1201_07_FB	Valve state feedback

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X1 (DI)						X5	EPAS VARIABLE NAME	MPP VARIABLE NAME	
100077	77			N	9	10	45	V_F_14_FB	SV_1201_08_FB	Valve state feedback
100078	78			N	11	12	46	V_F_13_FB	SV_1203_01_FB	Valve state feedback
100079	79			N	13	14	47	V_F_12_FB	SV_1204_02_FB	Valve state feedback
~~100080~~	~~80~~			~~N~~	~~15~~	~~16~~	~~48~~	~~V_F_11_FB (the same comment)~~	-	~~Valve state feedback~~
100081	81			O	1	2	49	V_F_10_FB	SV_1204_01_FB	Valve state feedback
100082	82			O	3	4	50	V_F_08_FB	SV_1202_03_FB	Valve state feedback
100083	83			O	5	6	51	V_F_07_FB	SV_1202_01_FB	Valve state feedback
100084	84	J3		O	7	8	52	V_F_06_FB	SV_1201_02_FB	Valve state feedback
100085	85			O	9	10	53	V_F_05_FB	S3V_1201_04_FB	Valve state feedback
100086	86			O	11	12	54	V_F_04_FB	SV_1201_03_FB	Valve state feedback
100087	87			O	13	14	55	V_F_03_FB	SV_1201_05_FB	Valve state feedback
100088	88			O	15	16	56	V_F_02_FB	S3V_1201_01_FB	Valve state feedback
100089	89			P	1	2	57	V_F_01_FB	SV_1201_01_FB	Valve state feedback
100090	90			P	3	4	58	V_C_21_FB	SV_1207_05_FB	Valve state feedback
100091	91			P	5	6	59	V_C_19_FB	SV_1207_11_FB	Valve state feedback
100092	92	J4		P	7	8	60	V_C_18_FB	SV_1207_10_FB	Valve state feedback
100093	93			P	9	10	61	V_C_17_FB	SV_1207_08_FB	Valve state feedback
100094	94			P	11	12	62	V_C_16_FB	SV_1207_09_FB	Valve state feedback
100095	95			P	13	14	63	V_C_15_FB	S3V_1207_04_FB	Valve state feedback
100096	96			P	15	16	64	V_C_14_FB	S3V_1207_03_FB	Valve state feedback
100097	97	K1	K	Q	1	2	65	V_C_13_FB	SV_1207_07_FB	Valve state feedback
100098	98			Q	3	4	66	V_C_12_FB	SV_1207_06_FB	Valve state feedback

PLC ADDRESS	PLC CABINET X1 (DI)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET X5	Compartment I electrical devices tags: EPAS VARIABLE NAME	Compartment I electrical devices tags: MPP VARIABLE NAME	Comments
100099	99			Q	5	6	67	V_C_11_FB	SV_1209_05_FB	Valve state feedback
100100	100			Q	7	8	68	V_C_10_FB	SV_1209_04_FB	Valve state feedback
100101	101			Q	9	10	69	V_C_09_FB	SV_1209_03_FB	Valve state feedback
100102	102			Q	11	12	70	V_C_07_FB	SV_1209_02_FB	Valve state feedback
100103	103			Q	13	14	71	V_C_06_FB	SV_1209_01_FB	Valve state feedback
100104	104			Q	15	16	72	V_C_05_FB	SV_1207_04_FB	Valve state feedback
100105	105	K2		R	1	2	73	V_S_12_FB	SV_1210_02_FB	Valve state feedback
100106	106			R	3	4	74	V_S_11_FB	SV_1210_01_FB	Valve state feedback
100107	107			R	5	6	75	V_G_07_FB	SV_1100_02_FB	Valve state feedback
100108	108			R	7	8	76	V_S_13_FB	SV_1210_03_FB	Valve state feedback
100109	109			R	9	10	77	~~V_G_24_FB~~	~~?~~	~~Valve state feedback~~
100110	110			R	11	12	78	V_C_01_FB	SV_1207_01_FB	Valve state feedback
100111	111			R	13	14	79	V_C_02_FB	SV_1207_02_FB	Valve state feedback
100112	112			R	15	16	80	V_C_04_FB	SV_1207_03_FB	Valve state feedback
100113	NC	K3					NC	-	-	-
100114	NC						NC	-	-	-
100115	NC						NC	-	-	-
100116	NC						NC	-	-	-
100117	NC						NC	-	-	-
100118	NC						NC	-	-	-
100119	NC						NC	-	-	-
100120	NC						NC	-	-	-
100121	NC	K4					NC	-	-	-

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X1 (DI)						X5	EPAS VARIABLE NAME	MPP VARIABLE NAME	
100122	NC						NC	-	-	-
100123	NC						NC	-	-	-
100124	NC						NC	-	-	-
100125	NC						NC	-	-	-
100126	NC						NC	-	-	-
100127	NC						NC	-	-	-
100128	NC						NC	-	-	-

4.5.6 New Digital Input card (added February 2009)

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X1 (DI)						X5	EPAS VARIABLE NAME	MPP VARIABLE NAME	
100129	129	P1	P	2H	1	16		-	SV_1201_06_FB	Valve state feedback
100130	130			2H	2	17		-	SV_1201_04_FB	Valve state feedback
100131	131			2H	3	18		-	SV_1202_02_FB	Valve state feedback
100132	132			2H	4	19		-	SV_1202_04_FB	Valve state feedback

100133	133			2H	5	20		-	SV_1204_03_FB	Valve state feedback
100134	134			2H	6	21		-	SV_1210_15_FB	Valve state feedback
100135	135			2H	7	22		-	SV_1211_01_FB	Valve state feedback
1000136	136			2H	8	23		-	SV_1211_02_FB	Valve state feedback
100137	137			2H	9	24		-	SV_1203_04_FB	Valve state feedback
100138	138			2H	10	25		-	SV_1211_03_FB	Valve state feedback
100139	139			2H	11	26		-	SV_1207_13_FB	Valve state feedback
100140	140			2H	12	27		-	SV_1207_12_FB	Valve state feedback
100141	141	P2		2H	13	28		-	SV_1210_11_FB	Valve state feedback
100142	142			2H	14	29		-	SV_1210_13_FB	Valve state feedback
100143	143			2H	15	2i:6			SV_1210_14_FB	Valve state feedback
100144	144			NC	NC	NC	NC	-	-	-
100145	145			NC	NC	NC	NC	-	-	-
100146	146			NC	NC	NC	NC	-	-	-
100147	147			NC	NC	NC	NC	-	-	-
100148	148	P3		NC	NC	NC	NC	-	-	-
100149	149			NC	NC	NC	NC	-	-	-
100150	150			NC	NC	NC	NC	-	-	-
100151	151			NC	NC	NC	NC	-	-	-
100152	152			NC	NC	NC	NC	-	-	-
100153	NC			NC	NC	NC	NC	-	-	-
100154	NC			NC	NC	NC	NC	-	-	-
100155	NC	P4		NC	NC	NC	NC	-	-	-
100156	NC			NC	NC	NC	NC	-	-	-
100157	NC			NC	NC	NC	NC	-	-	-

100158	NC			NC	NC	NC	NC	-	-	-
100159	NC			NC	NC	NC	NC	-	-	-
100160	NC			NC	NC	NC	NC	-	-	-

4.5.7 Bioreactor Analog Input Table (BAIT)

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			VR CABINET	Compartment I electrical devices tags		Comments
	X3(AI)						X3	EPAS VARIABLE NAME	MPP VARIABLE NAME	
300001	1,2			G	1	2	1	pHs_R_01	AT_1011_01	Measures pH in bioreactor (R-R-01)
300002	3,4			G	3	4	2	T_pH_R_01	TT_1011_01	Temperature Output transmitter 1
300003	5,6			G	5	6	3	pHs_R_02	AT_1011_02	Measures pH in bioreactor (R-R-01)
300004	7,8			G	7	8	4	T_pH_R_02	TT_1011_02	Temperature Output transmitter 2
300005	11,12			G	9	10	5	LS_V_02	LT_1004_01	Measures pressure in liquid phase for volume measurement in influent tank (R-V-01)
300006	13,14	D	D	G	11	12	6	PS_V_01	PT_1003_01	Measures pressure in gas phase for gas and volume measurement in influent tank (R-V-01)
300007	15,16			G	13	14	7	PS_V_03	PT_1001_01	Measures pressure immediately after pump PMP-V-01 and gives an alarm if pressure increases above the pump's limit
300008	17,18			G	15	16	NC			
300009	21,22			H	1	2	NC			
300010	23,24			H	3	4	10	PS_R_01	PT_1009_01	Measures pressure in gas phase for gas and volume measurement in bioreactor (R-R-01)

PLC ADDRESS	PLC CABINET X3(AI)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			VR CABINET X3	Compartment I electrical devices tags EPAS VARIABLE NAME	MPP VARIABLE NAME	Comments
300011	25,26			H	5	6	11	PS_R_02	PT_1009_02	Measures pressure in liquid phase for volume measurement in bioreactor (R-R-01)
300012	27,28			H	7	8	NC			
300013	31,32			H	9	10	13	LS_R_02	LT_1010_01	Measures pressure in liquid phase for volume measurement in bioreactor (R-R-01)
300014	33,34			H	11	12	14	TS_V_01	TT_1002_01	Measures temperature in influent tank (R-V-01)
300015	35,36			H	13	14	15	TS_R_01	TT_1008_01	Measures temperature in bioreactor (R-R-01)
300016	37,38			H	15	16	16	TS_R_02	TT_1008_02	Measures temperature in warm water bath HX-R-01

4.5.8 Filtration Unit Analog Input Table (FUAIT)

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X3 (AI)						X3	EPAS VARIABLE NAME	MPP VARIABLE NAME	
300018	17			2B	1	2	1	FS_F_01	FT_1201_01	Measures the retentate flow
~~300019~~	~~18~~			~~2B~~	~~3~~	~~4~~	~~2~~	~~A_G_01_H2~~	~~AT_1101_02_H2~~	~~Analyses bioreactor gas phase composition for H2~~
300020	19			2B	5	6	3	A_G_02_CO2	AT_1101_01_MV1	Analyses bioreactor gas phase composition for CO2 and CH4
300021	20			2B	7	8	4	TS_F_02	TT_1200_01	Measures temperature in retentate
300022	21			2B	9	10	5	TS_F_01	TT_1205_01	Measures temperature in filtrate tank R-F-01
300023	22	E	E	2B	11	12	6	TS_C_01	TT_1208_01	Measures temperature in cleaning buffer vessel (R-C-02). Is Measureed. Value for temperature control in (R-C-02)
~~300024~~	~~23~~			~~2B~~	~~13~~	~~14~~	~~7~~	~~PS_G_03~~	~~PT_1104_01~~	~~Measures pressure of gas after R-G-02~~
300025	24			2B	15	16	8	PS_G_02	PT_1101_01	Measures pressure of gas after gas analyser
300026	25			2C	1	2	9	PS_G_01	PT_1100_01	Measures pressure in buffer vessel R-G- 01
300027	26			2C	3	4	10	PS_F_07	PT_1203_07	Measures pressure of retentate after pump PMP-F-01 (safety pump)
300028	27			2C	5	6	11	PS_F_06	PT_1203_06	Measures pressure of filtrate at outlet of membrane Fi-F-02

PLC ADDRESS	PLC CABINET X3 (AI)	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET X3	Compartment I electrical devices tags: EPAS VARIABLE NAME	Compartment I electrical devices tags: MPP VARIABLE NAME	Comments
300029	28			2C	7	8	12	PS_F_05	PT_1203_05	Measures pressure of retentate at outlet of membrane Fi-F-02
300030	29			2C	9	10	13	PS_F_04	PT_1203_04	Measures pressure of retentate at inlet of membrane Fi-F-02
300031	30			2C	11	12	14	PS_F_03	PT_1203_03	Measures pressure of filtrate at outlet of membrane Fi-F-01
300032	31			2C	13	14	15	PS_F_02	PT_1203_02	Measures pressure of retentate at outlet of membrane Fi-F-01
300033	32			2C	15	16	16	PS_F_01	PT_1203_01	Measures pressure of retentate at inlet of membrane Fi-F-01
300035	33			2D	1	2	17	SS_F_01	AT_1201_01	Measures turbidity of retentate
300036	34			2D	3	4	18	FS_G_01	FT_1101_01	Measures the gas flow entering in the gas analyser Measures the gas flow entering in the
300037	35			2D	5	6	19	FS_G_04	FT_1103_01	Measures the N2 gas flow entering the bioreactor R-R-01 (passive gas loop configuration)
300038	36			2D	7	8	20	LS_F_03	LT_1206_01	Measures pressure in gas phase for volume measurement in filtrate tank (R-F-01)
300039	37			2D	9	10	21	A_G_02_CH4	AT_1101_01_MV2	Analyses bioreactor gas phase composition for CO2 and CH4

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X3 (AI)						X3	EPAS VARIABLE NAME	MPP VARIABLE NAME	
300040	38			2D	11	12	22	PS_G_04	PT_1100_02	Measures pressure of gas produced by bioreactor (R-R-01) and accumulated in R-G-02 for flow measurement
300041	39			2D	13	14	23	TS_G_01	TT_1104_01	Measures temperature in R-G-02 for determination of produced gas flow
300042	40			2D	15	16	24	PS_F_09	PT_1203_08	Measures pressure at inlet of dead end filter Fi-F-03 (to follow clogging)
300043	41			2E	1	2	25	TS_F_03_Av	TT_1200_02_Av	Temperature measured on Mbne 1
300044	42			2E	3	4	26	TS_F_04_Av	TT_1200_03_Av	Temperature measured on Mbne 2
300045	43			2E	5	6	NC	-	-	-
300046	44			2E	7	8	NC	-	-	-
300047	45			2E	9	10	NC	-	-	-
300048	46			2E	11	12	NC	-	-	-
300049	47			2E	13	14	NC	-	-	-
300050	48			2E	15	16	NC	-	-	-

4.5.9 Filtration Unit Analog Output Table (FUAOT)

PLC ADDRESS	PLC CABINET	PHOENIX CONNECTOR	SCHNEIDER CARD	CABLE			FG CABINET	Compartment I electrical devices tags		Comments
	X4 (A0)						X4	EPAS VARIABLE NAME	MPP VARIABLE NAME	
400001	1	G	G	2F	1	2	1	PMP_F_02_Speed	PP_1202_01_MV2	Speed control of the filtratie pump By freq.reg.
400002	2			2F	3	4	2	PMP_F_01_Speed	GP_1201_01_MV2	Speed control of the filtratie pump By freq.reg.
400003	3			2F	5	6	3	V_G_09_SETPOINT	SCV_1103_01_MV	Valve control setpoint. Used to adapt the gas flow coming from buffer vessel R-G-01 and going to bioreactor R-R-01 in order to keep the pressure constant in the
400004	4			2F	7	8	4	V_G_29_SETPOINT	SCV_1100_01_MV	to keep bioreactor pressure constant (passive gas loop configuration) Regulates N2 inlet in bioreactor R-R-01 Valve control setpoint