BioProcess™ Modular System

11.2 Unit design specification

Table of contents

1 Introduction

1.1 Purpose and scope

The purpose of the document is to specify the units for Bioprocess system DS1-CHT01. It includes unit parameter specification, a list of Control Modules instances, and Equipment Modules instances.

Creation of Control Module and Equipment Module Classes is described in other documents.

This document also contains configuration specification for phases and a table listing all aliases on the unit, and their use in phases.

With this document, it is possible configure, test and verify the unit.

Product code	Reference	Chromatography Equipment Number	DeltaV Prefix
29597540	20CY	DS1-CHT01	D1C1
29597541	20CZ	DS1-CHT02	D1C2
29597542	20DA	DS1-CHT03	D1C3
29597543	20DB	DS2-CHT01	D2C1
29597544	20DC	DS2-CHT02	D2C2
29597545	20DD	DS2-CHT03	D2C3
29597546	20DE	DS3-CHT01	D3C1
29597547	20DF	DS3-CHT02	D3C2
29597548	20DG	DS3-CHT03	D3C3
29597549	20DH	DS4-CHT01	D4C1
29597550	20DI	DS4-CHT02	D4C2
29597551	20DK	DS4-CHT03	D4C3

Table 1 - Product code designation

1.2 References

Ref. ID	Document name	Document number(s)
1.	Terminology and Acronyms	29229457
2.	Functional specification	29633228
3.	Piping and instrumentation diagram	29616426
4.	General specification	29616428
5.	Phase Shell Design Specification	29257458
6.	Control module design specification, CBS_AXIALARM	29258597
7.	Control module design specification, CBS_AXICHROM	29258598

Table 2 - References

1.3 Terminology and acronyms

See [Ref ID 1].

2 Unit design

This section contains information for creating the unit Bioprocess. It contains the unit properties, lists all Control Module instances, all unit parameters with their default values, setup of all Equipment Module instances, all phases to be enabled on the unit including phase parameters, and specification of all aliases.

Anywhere when [XXXX] is given as a module tag number it indicates that the real instance module number shall exchange this with the actual 'DeltaV Prefix' listed in Table 1 - Product code designation.

2.1 Unit properties

The table below shows the properties of the unit as configured in the CBS database.

	CBS-SKID-[XXXX]
Area	CBS_CHROM_SKIDS
Process Cell Class	CBS_PCC
Process Cell Instance name	CBS-CHROM-SKIDS
Process Cell Instance description	CBS Chrom Skid Process Cell
Unit Class	CBS_CHROM_UC
Unit Class description	Unit Module
Unit Class Scan rate	500 ms
Unit module name	CBS-CHROM-[XXXX]
Unit Instance Primary Control	CBS_CHROM_[XXXX]
Unit Instance Controller Assignment	[XXXX]-CTRL

Table 3 – Unit Properties

2.2 Unit parameters

All custom unit parameters defined on the unit is listed in this chapter. Unit parameters created default by DeltaV is not shown and documentation of these can be found in vendor documentation (Books Online).

2.2.1 Unit parameters specification

The table below lists all unit parameters in the class.

No.	**Parameter name**	**Function**
1.	U_CHECK_BOX_SCR	Set by INIT phase when running manually. When equipment modules are ready for manual control a check box will appear, when selected INIT phase sets unit in safe state and releases equipment modules
2.	U_CHECK_CONFIRM	Set to True from screen when operator activates the checkbox described in item 1.
3.	U_CIP_STATUS	CIP status
4.	U_COL_DIAMETER	Used to specify the column diameter and to display flow in cm/h.
5.	U_COLUMN_NO	String parameter used to specify the column ID or serial number. Default set to 'Undefined'

No.	Parameter name	Function
6.	U_CUST_PRODUCT	Used for customer number /name verification in INIT phase
7.	U_CV	Parameter for the bed volume of one column, used for calculations based on column volume
8.	U_CV_MAX	Maximum allowed value to enter for column volume if prompted from phase (INIT phase)
9.	U_CV_MIN	Minimum allowed value to enter for column volume if prompted from phase (INIT phase)
10.	U_ENAB_MAN_EM	Used by INIT phase (set to False) to control EMs in part of phase with OWNER_ID = “Operator”, when the operator is running the skid in manual mode by using the INIT phase.
11.	U_FLOW_FACTOR	Calculate flow set points independent of system flow in l/m or L/h (1= L/hour, 60 = L/m). (Used by AxiChrom phase)
12.	U_HOLD	Standard PCSD function. Indicates Hold of unit. Sets all active phases in Hold if set to True by Operator from HMI/Batch Banner
13.	U_INIT_BSTATUS	Set based on state of INIT phase. Used to indicate state of skid (not running, running, hold) by altering the yellow lamp
14.	U_INLETA_VALVES	Amount (n) of inlet A valves. Used by phases for cycling through from valve 1 to valve 6
15.	U_INLETB_VALVES	Amount (n) of inlet B valves. Used by phases for cycling through from valve 1 to valve 4
16.	U_LOAD_VOL_FT	Load volume to product outlet in flow through mode. Set by phase CBS_LOAD_FT
17.	U_MANUAL_RUN	Set by INIT phase if running manually. Used by HMI to show check box defined in item 1
18.	U_OUTLET_VALVES	Amount (n) of outlet valves. Used by phases for cycling through from valve 1 to valve 4
19.	U_PROMPT_YES_NO	Store answer from prompt phase for Yes/No response
20.	U_PROMPT_INT	Store answer from prompt phase for Integer response
21.	U_PROMPT_FLOAT	Store answer from prompt phase for Float response
22.	U_TIME_REG1	Used to store time values for information exchange between phases
23.	U_UNITACQPRIO	Can be used to prioritize ownership of shared equipment if more than one unit is asking for ownership. The lower number the more prioritized.
24.	U_UNITOWNER	Set by CBS_INIT phase if running in batch and reset by CBS_STOP phase. Used to indicate that the unit

No.	Parameter name	Function
		has been initialized and to acquire/release equipment modules.
25.	U_UV_REG1	Used to store UV for information exchange between phases
26.	U_VOL_AT_WATCH	Used to store volume for information exchange between phases
27.	U_VOLUME_REG1	Used to store accumulated volume for information exchange between phases
28.	U_WATCH_TRUE	Used to register that a watch trigger has become True

Table 4 – Unit parameter specification

2.2.2 Unit parameters values

The table below lists all unit parameters instance values.

No.	Parameter name	Unit	Skid[XXXX][1)]
1.	U_CHECK_BOX_SCR	-	False
2.	U_CHECK_CONFIRM	-	False
3.	U_CIP_STATUS	NS[2)]	CBS_CIP_STATUS = Undefined [3)]
4.	U_COL_DIAMETER	NS[2)]	CBS_AC_Column_Diameter = Undefined
5.	U_COLUMN_NO	-	Undefined
6.	U_CUST_PRODUCT	NS[2)]	CBS_Customer_Product = Undefined
7.	U_CV	l	50.0
8.	U_CV_MAX	l	9999.0
9.	U_CV_MIN	l	0.0
10.	U_ENAB_MAN_EM	-	True
11.	U_FLOW_FACTOR	-	1.0
12.	U_HOLD	-	False
13.	U_INIT_BSTATUS	NS[2)]	$phase_state: Not Loaded
14.	U_INLETA_VALVES	-	6
15.	U_INLETB_VALVES	-	4
16.	U_LOAD_VOL_FT	CV	0.0
17.	U_MANUAL_RUN	-	FALSE
18.	U_OUTLET_VALVES	-	4
19.	U_PROMPT_YES_NO	NS[2)]	No
20.	U_PROMPT_INT	-	0
21.	U_PROMPT_FLOAT	-	0.0
22.	U_TIME_REG1	s	0
23.	U_UNITACQPRIO	-	5
24.	U_UNITOWNER	-	False
25.	U_UV_REG1	AU	0.0
26.	U_VOL_AT_WATCH	l	0.0

No.	Parameter name	Unit	Skid[XXXX][1)]
27.	U_VOLUME_REG1	l	0.0
28.	U_WATCH_TRUE	-	False

Table 5- Unit parameter values

1) True/False indicates a Boolean parameter. Integer values indicates an Integer parameter. Decimal values indicate Floating parameter. If not falling into these categories, it will be specified in the description column.
2) NS = Named Set
3) CBS_CIP_STATUS named set includes states: Out of Service, Process, Clean, Clean Advisory, Dirty, Dirty Advisory, and Dirty Warning. Advisory and Warning values are not visible to operator.

2.3 Control Modules

This section lists all Control Modules that exists on the unit. Table 6 – Control modules directly on the unit contains the modules that is directly connected to the unit, while Table 7- Control modules embedded in Equipment Modules contains modules embedded in Equipment Modules.

Module name	Description	Control Module Class	Primary Control	Assignment
[XXXX]-AIT-121	pH post column	CBS_AI	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-AIT-122	pH pre column	CBS_AI	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-AT-131	UV post column	CBS_AI_UV	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-AT-131-ERR	UV error	CBS_UV_ERR	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-ALARM	CBS Critical alarm handling	Not class based	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-AIR-CALIB	Air sensors calibration	CBS_DP72_ASCAL	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-ALP1-ERROR	ALP1 error	CBS_ALP1_ERROR	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-AS-151	Air in system – inlet	CBS_DI	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-AS-152	Air in system – pre column	CBS_DI	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-AXI-ALARM	CBS AxiChrom alarm handling	Not class based	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-AXICHROM	AxiChrom master communication module	Not class based	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-CAB-TEMP	Cabinet temperature	CBS_AI	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-CIT-102	Conductivity outlet	CBS_AI	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-FT-141	Flow pre column	CBS_AI_SOFT	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-HETP	HETP calculation	CBS_HETP	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-LEVEL-CALIB	Air trap sensors calibration	CBS_DP72_LSCAL	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-LSH-167	High level air trap	CBS_DI	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-LSL-166	Low level air trap	CBS_DI	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-MARKING	HETP marking	CBS_DO_SOFT_AUTR	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-PD-231	Differential pressure filter	CBS_AI_DF	CBS_CHROM_[XXXX]	[XXXX]-CTRL

Module name	Description	Control Module Class	Primary Control	Assignment
[XXXX]-PD-COL	Differential pressure column	CBS_AI_DF	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-PI-960-ERR	PI-960 error	CBS_PI_960_ERR	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-PS-351	Panel instrument air pressure	CBS_DI	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-PT-111	Pressure pre air trap	CBS_AI	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-PT-112	Pressure pre column	CBS_AI	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-PT-113	Pressure post column	CBS_AI	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-SS-1	Safety PLC SS-1	CBS_DI_MUX	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-SYS-SETTING	Default system settings	Not class based	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-TIT-101	Temperature pre air trap	CBS_AI	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-TIT-102	Temperature outlet	CBS_AI	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-PS-FAILURE	Bulk power supply failure	CBS_DI	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-YS-201A	Leak detector pump A	CBS_DI	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-YS-201B	Leak detector pump B	CBS_DI	CBS_CHROM_[XXXX]	[XXXX]-CTRL

Table 6 – Control modules directly on the unit

Module name	Description	Control Module Class	Equipment Module	Primary Control	Assignment
[XXXX]-XV-001	Inlet A1	CBS_V12_IP_CAL	[XXXX]-INLET_A	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-002	Inlet A2	CBS_V12_IP_CAL	[XXXX]-INLET_A	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-003	Inlet A3	CBS_V12_IP_CAL	[XXXX]-INLET_A	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-004	Inlet A4	CBS_V12_IP_CAL	[XXXX]-INLET_A	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-005	Inlet A5	CBS_V12_IP_CAL	[XXXX]-INLET_A	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-006	Inlet A6	CBS_V12_IP_CAL	[XXXX]-INLET_A	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-011	Inlet B1	CBS_V12_IP_CAL	[XXXX]-INLET_B	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-012	Inlet B2	CBS_V12_IP_CAL	[XXXX]-INLET_B	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-013	Inlet B3	CBS_V12_IP_CAL	[XXXX]-INLET_B	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-014	Inlet B4	CBS_V12_IP_CAL	[XXXX]-INLET_B	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-081	Inlet CIP1	CBS_V12_IP_CAL	[XXXX]-INLET-CIP	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-082	Inlet CIP2	CBS_V12_IP_CAL	[XXXX]-INLET-CIP	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-083	Inlet CIP3	CBS_V12_IP_CAL	[XXXX]-INLET-CIP	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-084	Inlet CIP4	CBS_V12_IP_CAL	[XXXX]-INLET-CIP	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-021	Air trap inlet	CBS_V12_IP_CAL	[XXXX]-AIR-TRAP	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-022	Air trap bypass	CBS_V12_IP_CAL	[XXXX]-AIR-TRAP	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-023	Air trap fill	CBS_V12_IP_CAL	[XXXX]-AIR-TRAP	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-024	Air trap outlet	CBS_V12_IP_CAL	[XXXX]-AIR-TRAP	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-071	Air trap drain	CBS_V12_IP_CAL	[XXXX]-AIR-TRAP	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-025	Filter inlet	CBS_V12_IP_CAL	[XXXX]-FILTER	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-026	Filter bypass	CBS_V12_IP_CAL	[XXXX]-FILTER	CBS_CHROM_[XXXX]	[XXXX]-CTRL

Module name	Description	Control Module Class	Equipment Module	Primary Control	Assignment
[XXXX]-XV-027	Filter outlet	CBS_V12_IP_CAL	[XXXX]-FILTER	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-028	Filter vent	CBS_V12_IP_CAL	[XXXX]-FILTER	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-072	Filter drain	CBS_V12_IP_CAL	[XXXX]-FILTER	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-031	Column in top	CBS_V12_IP_CAL	[XXXX]-COLUMN1	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-032	Column in bottom	CBS_V12_IP_CAL	[XXXX]-COLUMN1	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-033	Column connection top	CBS_V12_IP_CAL	[XXXX]-COLUMN1	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-034	Column connection bottom	CBS_V12_IP_CAL	[XXXX]-COLUMN1	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-035	Column out top	CBS_V12_IP_CAL	[XXXX]-COLUMN1	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-036	Column out bottom	CBS_V12_IP_CAL	[XXXX]-COLUMN1	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-CIC-101	Conductivity controller inlet	CBS_CMT	[XXXX]-FLOW-CTRL	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-FC-142	Flow controller inlet A	CBS_CMT_ZERO	[XXXX]-FLOW-CTRL	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-FC-143	Flow controller inlet B	CBS_CMT_ZERO	[XXXX]-FLOW-CTRL	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-P-201A	Pump inlet A	CBS_PF525_VSM	[XXXX]-FLOW-CTRL	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-P-201B	Pump inlet B	CBS_PF525_VSM	[XXXX]-FLOW-CTRL	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-PC-341	Pressure controller inlet A	CBS_CSD	[XXXX]-FLOW-CTRL	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-PC-342	Pressure controller inlet B	CBS_CSD	[XXXX]-FLOW-CTRL	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-051	Outlet 1	CBS_V12_IP_CAL	[XXXX]-OUTLET	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-052	Outlet 2	CBS_V12_IP_CAL	[XXXX]-OUTLET	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-053	Outlet 3	CBS_V12_IP_CAL	[XXXX]-OUTLET	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-XV-054	Outlet 4	CBS_V12_IP_CAL	[XXXX]-OUTLET	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-AT-131-AZ	UV autozero	CBS_DO_AUTR	[XXXX]-OUTLET	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-AT-131-RUN	UV lamp	CBS_DO_SOFT_UV	[XXXX]-OUTLET	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-FIQ-141	Total flow column	CBS_TOT	[XXXX]-OUTLET	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-FIQ-141-DN	Total down flow column	CBS_TOT	[XXXX]-OUTLET	CBS_CHROM_[XXXX]	[XXXX]-CTRL
[XXXX]-FIQ-141-UP	Total up flow column	CBS_TOT	[XXXX]-OUTLET	CBS_CHROM_[XXXX]	[XXXX]-CTRL

Table 7- Control modules embedded in Equipment Modules

2.3.1 [XXXX]-ALARM

The module provides functions for capturing up to 32 alarm conditions that sends equipment modules and the batch system into a hold position. The module also provides functions for conditionally enabling and disabling of alarms. The classless module is based on PCSD class module _IL_FL_32_50. In this document only modifications to the original class will be described.

2.3.1.1 Faceplates

The module uses faceplate CBS_ILK_50_FP which is a modified version of PBL_IL_FP. The module uses detailed faceplate CBS_ILK_50_DT which is a modified version of PBL_IL_DT.

2.3.1.2 Main faceplate

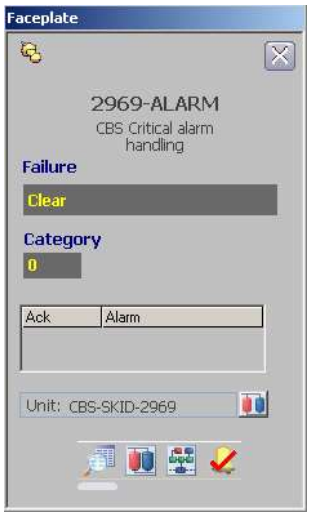


Figure 1 - CBS_ILK_50_FP

2.3.1.3 Detailed faceplate

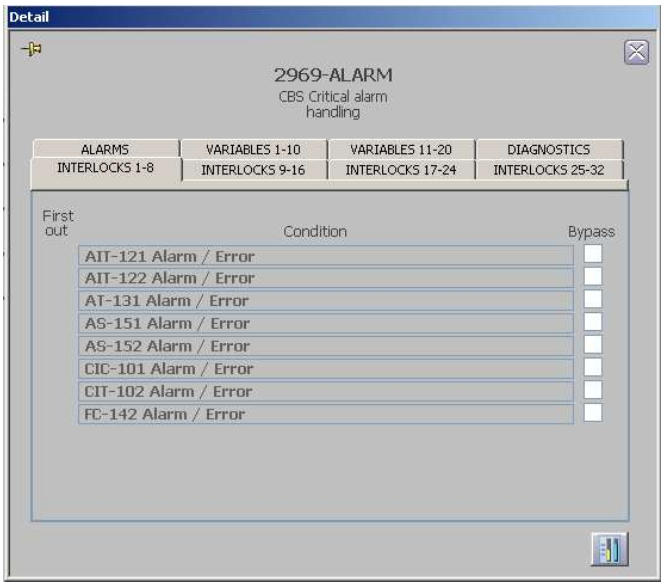


Figure 2 - CBS_ILK_50_DT

2.3.1.4 Buttons on screen

Figure 3 - Alarm module buttons on screen

2.3.1.5 List of picture links

No.	Type	Description	Control module parameter
1.	Horn button (hidden)	Acknowledge horn (Visible if [XXXX]-ALP1-ERROR/HORN_ON/OUT_D = 1)	[XXXX]-ALP1-ERROR/ CBS_SILENCE_HORN
2.	Button [XXXX]-ALARM	Open module faceplate	N/A
3.	Text (hidden)	Active bypass	BYPASSED
4.	Text (hidden)	Alarm description (Visible if FAULT_LATCH = 1)	FAULT_MSG

Table 8 – Alarm module picture links

2.3.1.6 Alarm condition expressions

All control module alarms on the unit (except from this module itself, [XXXX]-MARKING, [XXXX]-AXI-ALARM, [XXXX]-AXICHROM and [XXXX]-PS-FAILURE) with priority 'Critical' will be defined in this module. Any 'Critical' alarm will set the FAULT_LATCH which in turn will be used by the phases as an interlock. In this way any 'Critical' alarm will fail the running phase(s).

CND No.	Description[1)]	Expression[2)]
1.	AIT-121 Alarm / Error	AIT-121/HI_HI_ALM OR AIT-121/LO_LO_ALM OR AIT-121/MODULE_ALM

CND No.	Description[1)]	Expression[2)]
2.	AIT-122 Alarm / Error	AIT-122/HI_HI_ALM OR AIT-122/LO_LO_ALM OR AIT-122/ MODULE_ALM
3.	AT-131 Alarm / Error	AT-131/HI_HI_ALM OR AT-131/LO_LO_ALM OR AT-131/ MODULE_ALM OR AT-131-ERR/UV_ERROR OR AT-131-AZ/ MODULE_ALM OR AT-131-RUN/ MODULE_ALM
4.	AS-151 Alarm / Error	AS-151/DISC_ALM OR AS-151/MODULE_ALM
5.	AS-152 Alarm / Error	AS-152/DISC_ALM OR AS-152/MODULE_ALM
6.	CIC-101 Alarm / Error	CIC-101/HI_HI_ALM OR CIC-101/LO_LO_ALM OR CIC-101/MODULE_ALM
7.	CIT-102 Alarm / Error	CIT-102/HI_HI_ALM OR CIT-102/LO_LO_ALM OR CIT-102/MODULE_ALM
8.	FC-142 Alarm / Error	FC-142/HI_HI_ALM OR FC-142/LO_LO_ALM OR FC-142/MODULE_ALM
9.	FC-143 Alarm / Error	FC-143/HI_HI_ALM OR FC-143/LO_LO_ALM OR FC-143/MODULE_ALM
10.	FT/FIQ-141 Alarm / Error	FT-141/HI_HI_ALM OR FT-141/LO_LO_ALM OR FT-141/MODULE_ALM OR FIQ-141/MODULE_ALM OR FIQ-141-DN/MODULE_ALM OR FIQ-141-UP/MODULE_ALM
11.	LSH-167 Alarm / Error	LSH-167/DISC_ALM OR LSH-167/MODULE_ALM
12.	LSL-166 Alarm / Error	LSL-166/DISC_ALM OR LSL-166/MODULE_ALM
13.	PC-341 Alarm / Error	PC-341/HI_HI_ALM OR PC-341/LO_LO_ALM OR PC-341/MODULE_ALM
14.	PC-342 Alarm / Error	PC-342/HI_HI_ALM OR PC-342/LO_LO_ALM OR PC-342/MODULE_ALM
15.	PT-111, PD-231 Alarm / Error	PT-111/HI_HI_ALM OR PT-111/LO_LO_ALM OR PT-111/MODULE_ALM OR PD-231/HI_HI_ALM OR PD-231/LO_LO_ALM OR PD-231/MODULE_ALM
16.	PT-112. PT-113, PD-COL Alarm / Error	PT-112/HI_HI_ALM OR PT-112/LO_LO_ALM OR PT-112/MODULE_ALM OR PT-113/HI_HI_ALM OR PT-113/LO_LO_ALM OR PT-113/MODULE_ALM OR PD-COL/HI_HI_ALM OR PD-COL/LO_LO_ALM OR PD-COL/MODULE_ALM
17.	TIT-101 Alarm / Error	TIT-101/HI_HI_ALM OR TIT-101/LO_LO_ALM OR TIT-101/MODULE_ALM
18.	TIT-102 Alarm / Error	TIT-102/HI_HI_ALM OR TIT-102/LO_LO_ALM OR TIT-102/MODULE_ALM
19.	Cabinet temp. Alarm / Error	CAB-TEMP/HI_HI_ALM OR CAB-TEMP/LO_LO_ALM OR CAB-TEMP/MODULE_ALM
20.	ALP Error	ALP1-ERROR/ALP_ERROR
21.	PS-351 Alarm / Error	PS-351/DISC_ALM OR PS-351/MODULE_ALM
22.	ASI Bus / Bulk Power Supply failure	ALP1-ERROR/ASI_PS_FAILURE OR PS-FAILURE/DISC_ALM OR PS-FAILURE/MODULE_ALM
23.	SS-1 Safety PLC Alarm / Error	SS-1/DISC_ALM OR SS-1/MODULE_ALM
24.	Not Used	False
25.	PI-960 Error	PI-960-ERR/PI-960_INDATA OR PI-960-ERR/PI-960_OUTDATA OR PI-960-ERR/PI-960_SLOT2 OR PI-960-ERR/PI-960_SLOT3 OR PI-960-ERR/PI-960_SLOT4 OR PI-960-ERR/PI-960_SLOT5 OR PI-960-ERR/PI-960_SLOT6 OR PI-960-ERR/PI-960_UNINET
26.	AxiChrom alarm detected	AXI-ALARM/FAULT_LATCH [5)]
27.	Leakage pump A Alarm /Error	YS-201A/DISC_ALM OR YS201A/MODULE_ALM

CND No.	Description[1)]	Expression[2)]
28.	Valve Alarm / Error	XV-001/FAIL_ALM OR XV-001/MODULE_ALM OR XV-002/FAIL_ALM OR XV-002/MODULE_ALM OR .... XV-054/FAIL_ALM OR XV-054/MODULE_ALM[3)]
29.	Pump Alarm / Error	P-201A/FAIL_ALM OR P-201A/MODULE_ALM OR P-201A/VSM_ALM OR P-201B/FAIL_ALM OR P-201B/MODULE_ALM OR P-201B/VSM_ALM
30.	Air Trap autofill failure	AIR-TRAP/AUTOFILL_FAILED[4)]
31.	Leakage pump B Alarm/Error	YS-201B/DISC_ALM OR YS201B/MODULE_ALM
32.	Unit hold from screen	CBS_UNIT_HOLD – Ref Section 2.3.1.7

Table 9- Alarm condition expressions

All conditions are without any delays.

1) Description of alarm/error shown on detail faceplate
2) Example AIT-121/HI_HI_ALM in detail means [XXXX]-AIT-121/HI_HI_ALM.CUALM. The [XXXX]- in front and the .CUALM at the end is removed from expressions in the table
3) Contains all valves, of class CBS_V12_IP_CAL listed in section 2.3
4) 'Critical' alarm outside control modules used
5) Link to the fault latch from the AxiChrom alarm module

2.3.1.7 Unit hold reset logic in Failure block no.32

When the hold button on the process graphics is pressed (and confirmed in the 'Put skid to hold?' message parameter CBS_UNIT_HOLD is set to true an alarm condition in function CND32 is triggered. The CBS_UNIT_HOLD parameter is auto reset by function ACT2, delayed by timer OND1 (default delay 2 s).

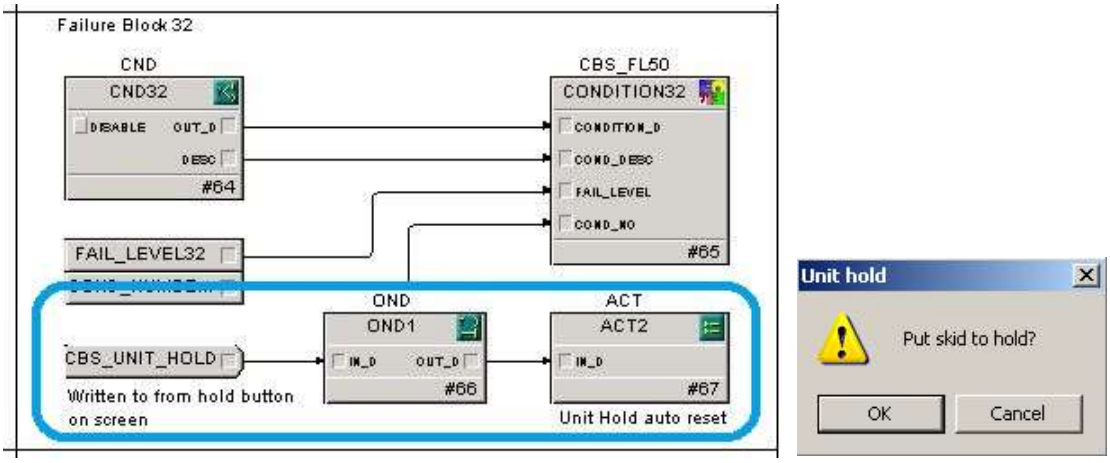


Figure 4 - Unit hold reset logic

2.3.1.8 Logic for conditionally enabling of alarms

All low and low low pressure and flow alarms will be conditionally disabled on pump stop. This to avoid alarms on normal pumps starts and stops. Default enable delay times are 30 seconds for pressure alarms and 60 seconds for flow alarms.

The description below describes FC-142 LOLO alarm as an example and the same procedure is used for all control modules. This logic will adjust the enable delay time based on the timer set in the ALM block of the origin module. If the delay time for the condition in this module is 60 seconds (as for FC-142_LL), but the enable delay in the control module (FIC-142/ALM1/LO_LO_ENAB_DELAY) is 15 seconds then the delay time will be adjusted to 45 seconds in this module. If the delay time in this module is less than the delay time in the control module the delay time in this module will be adjusted to 0 seconds. The same logic applies to all conditions.

The following list of conditions blocks have expressions for conditionally enabling/disabling of module alarms.

Condition block	**Expression**[1)]	**Delay (sec)**
FC-142_LL	NOT (P-201A= Stopped)	60
FC-142_L	NOT (P-201A= Stopped)	60
PC-341_LL	NOT (P-201A= Stopped)	30
PC-341_L	NOT (P-201A= Stopped)	30
FC-143_LL	NOT (P-201B= Stopped)	60
FC-143_L	NOT (P-201B= Stopped)	60
PC-342_LL	NOT (P-201B= Stopped)	30
PC-342_L	NOT (P-201B= Stopped)	30
PT-111_LL	NOT ((P-201A= Stopped) and (P-201B= Stopped))	30
PT-111_L	NOT ((P-201A= Stopped) and (P-201B= Stopped))	30
PT-112_LL	NOT ((P-201A= Stopped) and (P-201B= Stopped)) and AIR-TRAP autofill not active	30
PT-112_L	NOT ((P-201A= Stopped) and (P-201B= Stopped)) and AIR-TRAP autofill not active	30
PT-113_LL	NOT ((P-201A= Stopped) and (P-201B= Stopped)) and AIR-TRAP autofill not active	30
PT-113_L	NOT ((P-201A= Stopped) and (P-201B= Stopped)) and AIR-TRAP autofill not active	30
FT-141_LL	NOT ((P-201A= Stopped) and (P-201B= Stopped)) and AIR-TRAP autofill not active	60
FT-141_L	NOT ((P-201A= Stopped) and (P-201B= Stopped)) and AIR-TRAP autofill not active	60
PD-231_LL	NOT ((P-201A= Stopped) and (P-201B= Stopped)) and AIR-TRAP autofill not active	30
PD-231_L	NOT ((P-201A= Stopped) and (P-201B= Stopped)) and AIR-TRAP autofill not active	30
PD-COL_LL	NOT ((P-201A= Stopped) and (P-201B= Stopped)) and AIR-TRAP autofill not active	30
PD-COL_L	NOT ((P-201A= Stopped) and (P-201B= Stopped)) and AIR-TRAP autofill not active	30

Table 10 - Logic for conditionally enabling alarms

1) Detail expression for P-201A = Stopped is: NOT ('//[XXXX]-P-201A/PV_D.CV' = 'mtr2-pv:STOPPED')
Detail expression for P-201B = Stooped is: NOT ('//[XXXX]-P-201B/PV_D.CV' = 'mtr2-pv:STOPPED')
Detail expression for AIR-TRAP autofill not active is: AUTOFILL_ACTIVE is: '//[XXXX]-AIR-TRAP/AUTOFILL_ACTIVE.CV' = FALSE

The example FC-142_LL condition expression use pump P-201A for enabling the flow alarm. The condition is true if the PV_D parameter for module [XXXX-P-201A] is not equal to named set “STOPPED” else it is false.

Figure 5 - Condition block FC-142_LL

2.3.2 [XXXX]-ALP1-ERROR

2.3.2.1 ALP alarm

Alarm conditions are collected in condition blocks to create a summary alarm sent to the ALP unit and to the remote alarm.

2.3.2.2 AI_ALM (only in ALP1-ERROR)

The condition function block AI_ALM is true if any new unacknowledged alarm (.NALM attribute of the alarm) occurs of the type HI_ALM, HI_HI_ALM, LO_ALM, LO_LO_ALM, MODULE_ALM or RATE_ALM for the following modules:

[XXXX]-AIT-121	[XXXX]-AIT-122	[XXXX]-AT-131	[XXXX]-CAB-TEMP
[XXXX]-CIT-102	[XXXX]-FT-141	[XXXX]-PD-231	[XXXX]-PD-COL
[XXXX]-PT-111	[XXXX]-PT-112	[XXXX]-PT-113	[XXXX]-TIT-101
[XXXX]-TIT-102			

Table 11 - AI_ALM modules

2.3.2.3 DI_ALM (only in ALP1-ERROR)

The condition function block DI_ALM is true if any new unacknowledged alarm (.NALM attribute of the alarm) occurs of the type MODULE_ALM or DISC_ALM for the following modules:

[XXXX]-AS-151	[XXXX]-AS-152	[XXXX]-LSH-167	[XXXX]-LSL-166
[XXXX]-PS-351	[XXXX]-SS-1	[XXXX]-YS-201A	[XXXX]-YS-201B
[XXXX]-PS-FAILURE			

Table 12 - DI_ALM modules

2.3.2.4 DO_ALM (only in ALP1-ERROR)

The condition function block DO_ALM is true if any new unacknowledged alarm occurs of the type MODULE_ALM for the following modules:

[XXXX]-AT-131-AZ	[XXXX]-AT-131-RUN	[XXXX]-MARKING	

Table 13 - DO_ALM modules

2.3.2.5 VALVES_ALM (only in ALP1-ERROR)

The condition function block VALVES_ALM is true if any new unacknowledged alarm (.NALM attribute of the alarm) occurs of the type BYPASS_ON, FAIL_ALM, IGNORE_PV, INTERLOCK_ALM, MODULE_ALM or WA_ALM for the following modules:

[XXXX]-XV-001	[XXXX]-XV-002	[XXXX]-XV-003	[XXXX]-XV-004
[XXXX]-XV-005	[XXXX]-XV-006	[XXXX]-XV-011	[XXXX]-XV-012
[XXXX]-XV-013	[XXXX]-XV-014	[XXXX]-XV-021	[XXXX]-XV-022
[XXXX]-XV-023	[XXXX]-XV-024	[XXXX]-XV-025	[XXXX]-XV-026
[XXXX]-XV-027	[XXXX]-XV-028	[XXXX]-XV-031	[XXXX]-XV-032
[XXXX]-XV-033	[XXXX]-XV-034	[XXXX]-XV-035	[XXXX]-XV-036
[XXXX]-XV-051	[XXXX]-XV-052	[XXXX]-XV-053	[XXXX]-XV-054
[XXXX]-XV-071	[XXXX]-XV-072	[XXXX]-XV-081	[XXXX]-XV-082
[XXXX]-XV-083	[XXXX]-XV-084		

Table 14 - VALVES_ALM modules

2.3.2.6 PID_ALM (only in ALP1-ERROR)

The condition function block PID_ALM is true if any new unacknowledged alarm (.NALM attribute of the alarm) occurs of the type BYPASS_ON, DV_HI_ALM, DV_LO_ALM, HI_ALM, HI_HI_ALM, LO_ALM, LO_LO_ALM, INTERLOCK_ALM or MODULE_ALM for the following modules:

[XXXX]-CIC-101	[XXXX]-FC-142	[XXXX]-FC-143	[XXXX]-PC-341
[XXXX]-PC-342			

Table 15 - PID_ALM modules

2.3.2.7 TOT_ALM (only in ALP1-ERROR)

The condition function block TOT_ALM is true if any new unacknowledged alarm (.NALM attribute of the alarm) occurs of the type MODULE_ALM for the following modules:

[XXXX]-FIQ-141	[XXXX]-FIQ-141-UP	[XXXX]-FIQ-141-DN	

Table 16 - TOT-ALM modules

2.3.2.8 VSM_ALM (only in ALP1-ERROR)

The condition function block VSM_ALM is true if any new unacknowledged alarm (.NALM attribute of the alarm) occurs of the type BYPASS_ON, FAIL_ALM, IGNORE_PV, INTERLOCK_ALM, PFLEX_ALM, WA_ALM or MODULE_ALM for the following modules:

[XXXX]-P-201A	[XXXX]-P-201B		

Table 17 - VSM_ALM modules

2.3.2.9 EM_ALM (only in ALP1-ERROR)

The condition function block EM_ALM is true if any new unacknowledged alarm (.NALM attribute of the alarm) occurs of the type BYPASS_ON, FAIL_ALM or MODULE_ALM for the following modules:

[XXXX]-AIR-TRAP	[XXXX]-COLUMN1	[XXXX]-FILTER	[XXXX]-FLOW-CTRL
[XXXX]-INLET_A	[XXXX]-INLET_B	[XXXX]-INLET-CIP	[XXXX]-OUTLET

Table 18 - EM_ALM modules

For the [XXXX]-AIR-TRAP module the following alarm types are also monitored: AT_SENSOR_ERROR, AUTOFILL_ERROR and AUTOFILL_FAILED.

2.3.2.10 MISC_ALM (only in ALP1-ERROR)

The condition function block MISC_ALM is true if any new unacknowledged alarm (.NALM attribute of the alarm) occurs of the type:

BYPASS_ON, INTERLOCK_ALM or MODULE_ALM for the [XXXX]-ALARM module.

ASI_PS_FAILURE, BUFFER or ALP_ERROR for the [XXXX]-ALP1-ERROR module.

BUFFER or UV_ERROR for the [XXXX]-UV-ERROR module.

PI-960_INDATA, PI-960_OUTDATA, PI-960_SLOT2, PI-960_SLOT3, PI-960_SLOT4, PI-960_SLOT5, PI-960_SLOT6 or PI-960_UNINET for the [XXXX]-PI-960-ERR module.

2.3.3 [XXXX]-SYS-SETTING

The module provides configurable parameters to be used as default settings in the CBS_INIT phase when running from recipe or as a manual phase. There are also customer specific functions i.e. CIP status display and UV on timer within this classless module. Details can be found in Section 3.1 CIP status display and Section 3.2 UV on timer respectively.

In the CBS_INIT phase the following will happen at start-up: The set values in this module will be transferred to the equipment modules and alarms enabled/disabled as per the settings.

If alarm limits are set to the value -999, then the alarm will be disabled and changed to maximum range for the HI_HI alarms. Any other alarm limit value will enable the alarm at the given limit.

2.3.3.1 Parameter definition

Parameter name	Description	Type	Default value
AS-151	Discrete alarm (Enable/Disable)	Named Set	Disable
AS-152	Discrete alarm (Enable/Disable)	Named Set	Disable
AT_HOLD [3)]	Air Trap Default or Remain in Hold (Default, Remain)	Named Set	Remain
AT_AUTO_FILL [1)]	Automatic fill if inline and low level (Yes, No)	Named Set	No
AT_MAX_LSL_TIME [1)]	Max Autofill low level active time	Floating point	5 sec

Parameter name	Description	Type	Default value
AT_MAX_REFILL_TIM [1)]	Max Refill time (From LSL to LSH)	Floating point	15 sec
CAB-TEMP_HI	High temperature warning limit	Floating point	40 °C
COND_A [2)]	Conductivity A	Floating point	0 mS/cm
COND_B [2)]	Conductivity B	Floating point	0 mS/cm
FLOW [2)]	Flow	Floating point	0 L/h
GRAD_START [2)]	Gradient Start	Floating point	0 %
GRAD_TARGET [2)]	Gradient Target	Floating point	0 %
INLETA_HB_BOOST [2)]	Inlet A PCV start-up boost	Floating point	20 %
INLETA_HB_ON [2)]	Inlet A hold back activated (Yes, No)	Named Set	Yes
INLETA_HB_SP [2)]	Inlet A Buffer hold back tank pressure	Floating point	0.5 bar
INLETB_HB_BOOST [2)]	Inlet B PCV start-up boost	Floating point	20 %
INLETB_HB_ON [2)]	Inlet B hold back activated (Yes, No)	Named Set	Yes
INLETB_HB_SP [2)]	Inlet B Buffer hold back tank pressure	Floating point	0.5 bar
LSL-166	Discrete alarm (Enable/Disable)	Named Set	Disable
MAN_FLOW [2)]	Man Flow	Floating point	0 %
MIN_SPEED_AUTFIL [2)]	Min pump speed at air trap autofill	Floating point	2 %
PC-341_HI_HI	High high pressure alarm limit	Floating point	4 bar
PC-342_HI_HI	High high pressure alarm limit	Floating point	4 bar
PT-111_HI_HI	High high pressure alarm limit	Floating point	4 bar
PT-112_HI_HI	High high pressure alarm limit	Floating point	4 bar
PT-113_HI_HI	High high pressure alarm limit	Floating point	4 bar
PRESS_CTRL [2)]	Pressure control (On/Off)	Named Set	Off
PRESS_SP [2)]	Pressure control setpoint	Floating point	7 bar
RAMP_TIME [2)]	Ramp Time	Floating point	0 min
RAMP_TYPE [2)]	Ramp Type (Time, Volume)	Named Set	Time
RAMP_VOLUME [2)]	Ramp Volume	Floating point	0 liters
RESUME_COND_GRAD [2)]	In Cond Grad – resume from zero speed (Yes, No)	Named Set	No
RESUME_FLOW [2)]	In Flow – resume from zero speed (Yes, No)	Named Set	Yes
RESUME_FLOW_GRAD [2)]	In Flow Grad – resume from zero speed (yes, No)	Named Set	No

1) Parameters relates to operating and tuning parameters in Air Trap Equipment module in section 2.4.5.
2) Parameters relates to operating and tuning parameters in Gradient composite within Flow Control Equipment module in section 2.4.4
3) Parameters relates to 'CLOSE_DELAY' or 'REMAIN_IN_HOLD' parameter of the described module equipment module.

Table 19 – SYS-SETTING parameter definition

2.3.4 [XXXX]-AXI_ALARM

The classless module is based on PCSD class module _IL_FL_32_50 and used to capture failure/alarm conditions generated from the AXICHROM interface and AxiChrom Master. Refer to Control module design specification, CBS_AXIALARM [Ref ID 6].

2.3.5 [XXXX]-AXICHROM

This classless module is used as communication interface between the DeltaV system and AxiChrom Master. Refer to Control module design specification, CBS_AXICHROM [Ref ID 7].

2.4 Equipment Modules

This section contains Equipment Modules existing on the unit. Each sub-section defines Equipment Module instances derived from the different Equipment Module classes. Specifications of the Equipment Module classes is specified in own documents.

2.4.1 CBS_FILTER_5MOD

Instance setup, named set and properties	
Description	Filter Equipment Module
Used on skid	[XXXX]
Instance name/MY_TAG	[XXXX]-FILTER
Named Set name/FP_CMD/FP_STATE	CBS_EMC_FILTER_5
Primary control	CBS_CHROM_[XXXX]
Assignment	[XXXX]-CTRL
0	Bypass
1	Inline
2	Fill
3	Fill Inline
4	Drain
5	Out Through Drain
255	Undefined

Table 20 - CBS_FILTER_5MOD instance setup

	Device setup
DEV1 / DEV01_ID	[XXXX]-XV-025
DEV2 / DEV02_ID	[XXXX]-XV-026
DEV3 / DEV03_ID	[XXXX]-XV-027
DEV4 / DEV04_ID	[XXXX]-XV-028
DEV5 / DEV05_ID	[XXXX]-XV-072

Table 21 - CBS_FILTER_5MOD device setup

2.4.2 CBS_MANIFOLD_6

Instance setup, named set and properties	
Description	Inlet A Equipment Module
Used on skid	[XXXX]
Instance name/MY_TAG	[XXXX]-INLET_A
Named Set name/FP_CMD/FP_STATE	CBS_EM_INLET_A_6
Primary control	CBS_CHROM_[XXXX]
Assignment	[XXXX]-CTRL
0	Close
1	Inlet A1
2	Inlet A2
3	Inlet A3
4	Inlet A4
5	Inlet A5
6	Inlet A6
255	Undefined

Table 22 - CBS_MANIFOLD_6 instance setup

	Device setup
DEV1 / DEV01_ID	[XXXX]-XV-001
DEV2 / DEV02_ID	[XXXX]-XV-002
DEV3 / DEV03_ID	[XXXX]-XV-003
DEV4 / DEV04_ID	[XXXX]-XV-004
DEV5 / DEV05_ID	[XXXX]-XV-005
DEV6 / DEV06_ID	[XXXX]-XV-006

Table 23 - CBS_MANIFOLD_6 Device setup

2.4.3 CBS_MANIFOLD_4

Instance setup, named set and properties		
Description	Inlet B Equipment Module	CIP Valve Block Equipment Module
Used on skid	[XXXX]	[XXXX]
Instance name/MY_TAG	[XXXX]-INLET_B	[XXXX]-INLET_CIP
Named Set name/FP_CMD/FP_STATE	CBS_EM_INLET_B_4	CBS_EM_CIP_4
Primary control	CBS_CHROM_[XXXX]	CBS_CHROM_[XXXX]
Assignment	[XXXX]-CTRL	[XXXX]-CTRL
0	Close	Close
1	Inlet B1	Inlet CIP1
2	Inlet B2	Inlet CIP2
3	Inlet B3	Inlet CIP3
4	Inlet B4	Inlet CIP4
255	Undefined	Undefined

Table 24 - CBS_MANIFOLD_4 instance setup

	Device setup	
DEV1 / DEV01_ID	[XXXX]-XV-011	[XXXX]-XV-081
DEV2 / DEV02_ID	[XXXX]-XV-012	[XXXX]-XV-082
DEV3 / DEV03_ID	[XXXX]-XV-013	[XXXX]-XV-083
DEV4 / DEV04_ID	[XXXX]-XV-014	[XXXX]-XV-084

Table 25 - CBS_MANIFOLD_4 device setup

2.4.4 CBS_FLOW_CTRL

Instance setup, named set and properties	
Description	Flow Control Equipment Module
Used on skid	[XXXX]
Instance name/MY_TAG	[XXXX]-FLOW-CTRL
Named Set name/FP_CMD/FP_STATE	CBS_EMC_FLOW_CTRL
Primary control	CBS_CHROM_[XXXX]
Assignment	[XXXX]-CTRL
0	Stop
1	Man Flow
2	Cond Grad
3	Flow Grad
4	Flow
255	Undefined

Table 26 - CBS_FLOW_CTRL instance setup

	Device setup
DEV1 / DEV01_ID	[XXXX]-P-201A
DEV2 / DEV02_ID	[XXXX]-P-201B
DEV3 / DEV03_ID	[XXXX]-FC-142
DEV4 / DEV04_ID	[XXXX]-FC-143
DEV5 / DEV05_ID	[XXXX]-CIC-101
DEV6 / DEV06_ID	[XXXX]-PC-341
DEV7 / DEV07_ID	[XXXX]-PC-342

Table 27 - CBS_FLOW_CTRL device setup

External references	Path
AUTOFILL_ACTIVE	AIR-TRAP-[XXXX]/AUTOFILL_ACTIVE
DEV05_OUT_HI_LIM	[XXXX]-CIC-101/PID1/OUT_HI_LIM
DEV05_SP_HI_LIM	[XXXX]-CIC-101/PID1/SP_HI_LIM
DEV06_OUT_HI_LIM	[XXXX]-PC-341/PID1/OUT_HI_LIM
DEV06_OUT_LO_LIM	[XXXX]-PC-341/PID1/OUT_LO_LIM
DEV07_OUT_HI_LIM	[XXXX]-PC-342/PID1/OUT_HI_LIM
DEV07_OUT_LO_LIM	[XXXX]-PC-342/PID1/OUT_LO_LIM
EQUIPMENT_LOGIC$OPEN_DR_AIR_TRAP	[XXXX]-AIR-TRAP/EQUIPMENT_LOGIC/OPEN_DRAIN
EQUIPMENT_LOGIC$OPEN_DR_FILTER	[XXXX]-FILTER/EQUIPMENT_LOGIC/OPEN_DRAIN
EQUIPMENT_LOGIC$OPEN_FP_AIR_TRAP	[XXXX]-AIR-TRAP/EQUIPMENT_LOGIC/OPEN_FLOWPATH
EQUIPMENT_LOGIC$OPEN_FP_COLUMN1	[XXXX]-COLUMN1/EQUIPMENT_LOGIC/OPEN_FLOWPATH
EQUIPMENT_LOGIC$OPEN_FP_COLUMN2	[XXXX]-FLOW-CTRL/DUMMY_TRUE
EQUIPMENT_LOGIC$OPEN_FP_FILTER	[XXXX]-FILTER/EQUIPMENT_LOGIC/OPEN_FLOWPATH
EQUIPMENT_LOGIC$OPEN_FP_INLETA	[XXXX]-INLET_A/ EQUIPMENT_LOGIC/OPEN_FLOWPATH
EQUIPMENT_LOGIC$OPEN_FP_INLETB	[XXXX]-INLET_B/ EQUIPMENT_LOGIC/OPEN_FLOWPATH
EQUIPMENT_LOGIC$OPEN_FP_OUTLET	[XXXX]-OUTLET/ EQUIPMENT_LOGIC/OPEN_FLOWPATH
PRE_COL_PRESS	[XXXX]-PT-112/PV
TOT_FLOW_PV	[XXXX]-FT-141/PV
TOT_VOLUME	[XXXX]-FIQ-141/TOTAL

Table 28 - CBS_FLOW_CTRL

2.4.5 CBS_AIR_TRAP

Instance setup, named set and properties	
Description	Air Trap Equipment Module
Used on skid	[XXXX]
Instance name/MY_TAG	[XXXX]-AIR-TRAP
Named Set name/FP_CMD/FP_STATE	CBS_EMC_AT
Primary control	CBS_CHROM_[XXXX]
Assignment	[XXXX]-CTRL
0	Inline
1	Bypass
2	Fill
3	Fill Inline
4	Drain
5	Out Through Drain
255	Undefined
STATE_00004$DEV04	Close (DEV004 closed in 'Drain')
STATE_00005$DEV04	Close (DEV004 closed in 'Out Through Drain')
EQUIPMENT_LOGIC$CND2	(DEV01 = Open AND DEV03 = Open) OR (DEV01 = Open AND DEV05 = Open)

Table 29 - CBS_AIR_TRAP instance setup

	Device setup
DEV1 / DEV01_ID	[XXXX]-XV-021
DEV2 / DEV02_ID	[XXXX]-XV-022
DEV3 / DEV03_ID	[XXXX]-XV-023
DEV4 / DEV04_ID	[XXXX]-XV-024
DEV5 / DEV05_ID	[XXXX]-XV-071

Table 30 - CBS_AIR_TRAP device setup

External references	Path
LSH_PV	[XXXX]-LSH-167/PV_D
LSL_ALARM_DELAY	[XXXX]-LSL-166/DI1/DISC_DELAY_ON
LSL_PV	[XXXX]-LSL-166/PV_D
PUMP_A_RUNNING	[XXXX]-P-201A/PV_D
PUMP_B_RUNNING	[XXXX]-P-201B/PV_D

Table 31 - CBS_AIR_TRAP external references

2.4.6 CBS_COLUMN

Instance setup, named set and properties	
Description	Column Equipment Module
Used on skid	[XXXX]
Instance name/MY_TAG	[XXXX]-COLUMN1
Named Set name/FP_CMD/FP_STATE	CBS_EM_COLUMN
Primary control	CBS_CHROM_[XXXX]
Assignment	[XXXX]-CTRL
0	BypassBoth
1	BypassOver
2	BypassUnder
3	UpFlow
4	DownFlow
255	Undefined

Table 32 - CBS_COLUMN instance setup

	Device setup
DEV1 / DEV01_ID	[XXXX]-XV-031
DEV2 / DEV02_ID	[XXXX]-XV-032
DEV3 / DEV03_ID	[XXXX]-XV-033
DEV4 / DEV04_ID	[XXXX]-XV-034
DEV5 / DEV05_ID	[XXXX]-XV-035
DEV6 / DEV05_ID	[XXXX]-XV-036

Table 33 - CBS_COLUMN device setup

2.4.7 CBS_OUTLET_4UV

Instance setup, named set and properties	
Description	Outlet Equipment Module
Used on skid	[XXXX]
Instance name/MY_TAG	[XXXX]-OUTLET
Named Set name/FP_CMD/FP_STATE	CBS_EMC_OUTLET_4_UV
Primary control	CBS_CHROM_[XXXX]
Assignment	[XXXX]-CTRL
0	Close
1	Outlet 1
2	Outlet 2
3	Outlet 3
4	Outlet 4
255	Undefined

Table 34 - CBS_OUTLET_4_UV instance setup

	Device setup
DEV1 / DEV01_ID	[XXXX]-XV-51
DEV2 / DEV02_ID	[XXXX]-XV-52
DEV3 / DEV03_ID	[XXXX]-XV-53
DEV4 / DEV03_ID	[XXXX]-XV-54
DEV9 / DEV09_ID	[XXXX]-FIQ-141
DEV10 / DEV10_ID	[XXXX]-AT-131-AZ
DEV11 / DEV11_ID	[XXXX]-AT-131-RUN
DEV12 / DEV12_ID	[XXXX]-FIQ-141-DN
DEV13 / DEV12_ID	[XXXX]-FIQ-141-UP

Table 35 - CBS_OUTLET_4_UV device setup

2.5 Alias Table

All aliases defined on the unit is listed in the table below, both control modules and equipment modules.

DeltaV Alias	Equipment and Control Modules
AIR-TRAP	[XXXX]-AIR-TRAP
AIT-121	[XXXX]-AIT-121
AIT-122	[XXXX]-AIT-122
ALARM	[XXXX]-ALARM
ALP1-ERROR	[XXXX]-ALP1-ERROR
AS-151	[XXXX]-AS-151
AS-152	[XXXX]-AS-152
AT-131	[XXXX]-AT-131
AT-131-AZ	[XXXX]-AT-131-AZ
AT-131-ERR	[XXXX]-AT-131-ERR

DeltaV Alias	Equipment and Control Modules
AT-131-RUN	[XXXX]-AT-131-RUN
AXI-ALARM	[XXXX]-AXI-ALARM
AXICHROM	[XXXX]-AXICHROM
CAB-TEMP	[XXXX]-CAB-TEMP
CIC-101	[XXXX]-CIC-101
CIT-102	[XXXX]-CIT-102
COLUMN1	[XXXX]-COLUMN1
FC-142	[XXXX]-FC-142
FC-143	[XXXX]-FC-143
FILTER	[XXXX]-FITLER
FIQ-141	[XXXX]-FIQ-141
FIQ-141-DN	[XXXX]-FIQ-141-DN
FIQ-141-UP	[XXXX]-FIQ-141-UP
FT-141	[XXXX]-FT-141
FLOW-CTRL	[XXXX]-FLOW-CTRL
HETP	[XXXX]-HETP
INLET_A	[XXXX]-INLET_A
INLET_B	[XXXX]-INLET_B
INLET_CIP	[XXXX]-INLET_CIP
LSH-167	[XXXX]-LSH-167
LSL-166	[XXXX]-LSL-166
MARKING	[XXXX]-MARKING
OUTLET	[XXXX]-OUTLET
P-201A	[XXXX]-P-201A
P-201B	[XXXX]-P-201B
PC-341	[XXXX]-PC-341
PC-342	[XXXX]-PC-342
PD-231	[XXXX]-PD-231
PD-COL	[XXXX]-PD-COL
PI-960-ERR	[XXXX]-PI-960-ERR
PS-351	[XXXX]-PS-351
PT-111	[XXXX]-PT-111
PT-112	[XXXX]-PT-112
PT-113	[XXXX]-PT-113
SS-1	[XXXX]-SS-1
SYS-SETTING	[XXXX]-SYS-SETTING
THISUNIT	CBS-CHROM-[XXXX]
TIT-101	[XXXX]-TIT-101
TIT-102	[XXXX]-TIT-102
PS-FAILURE	[XXXX]-PS-FAILURE

DeltaV Alias	Equipment and Control Modules
XV-001	[XXXX]-XV-001
XV-002	[XXXX]-XV-002
XV-003	[XXXX]-XV-003
XV-004	[XXXX]-XV-004
XV-005	[XXXX]-XV-005
XV-006	[XXXX]-XV-006
XV-011	[XXXX]-XV-011
XV-012	[XXXX]-XV-012
XV-013	[XXXX]-XV-013
XV-014	[XXXX]-XV-014
XV-021	[XXXX]-XV-021
XV-022	[XXXX]-XV-022
XV-023	[XXXX]-XV-023
XV-024	[XXXX]-XV-024
XV-025	[XXXX]-XV-025
XV-026	[XXXX]-XV-026
XV-027	[XXXX]-XV-027
XV-028	[XXXX]-XV-028
XV-031	[XXXX]-XV-031
XV-032	[XXXX]-XV-032
XV-033	[XXXX]-XV-033
XV-034	[XXXX]-XV-034
XV-035	[XXXX]-XV-035
XV-036	[XXXX]-XV-036
XV-051	[XXXX]-XV-051
XV-052	[XXXX]-XV-052
XV-053	[XXXX]-XV-053
XV-054	[XXXX]-XV-054
XV-071	[XXXX]-XV-071
XV-072	[XXXX]-XV-072
XV-081	[XXXX]-XV-081
XV-082	[XXXX]-XV-082
XV-083	[XXXX]-XV-083
XV-084	[XXXX]-XV-084
YS-201A	[XXXX]-YS-201A
YS-201B	[XXXX]-YS-201B

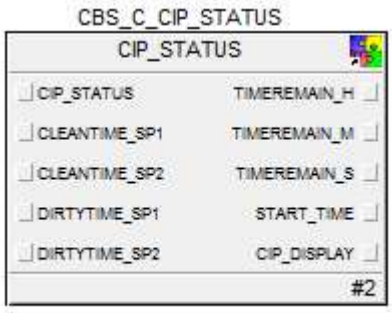
Table 36 - Alias table

3 Customer specific functions

3.1 CIP status display

CIP status (Dirty and Clean) will be displayed on graphic depends on the Wash phase completion and parameter value such as conductivity reading of post CIP. Details to be updated in next release of this document followed by technical review with customer.

3.1.1 CBS_C_CIP_STATUS linked composite



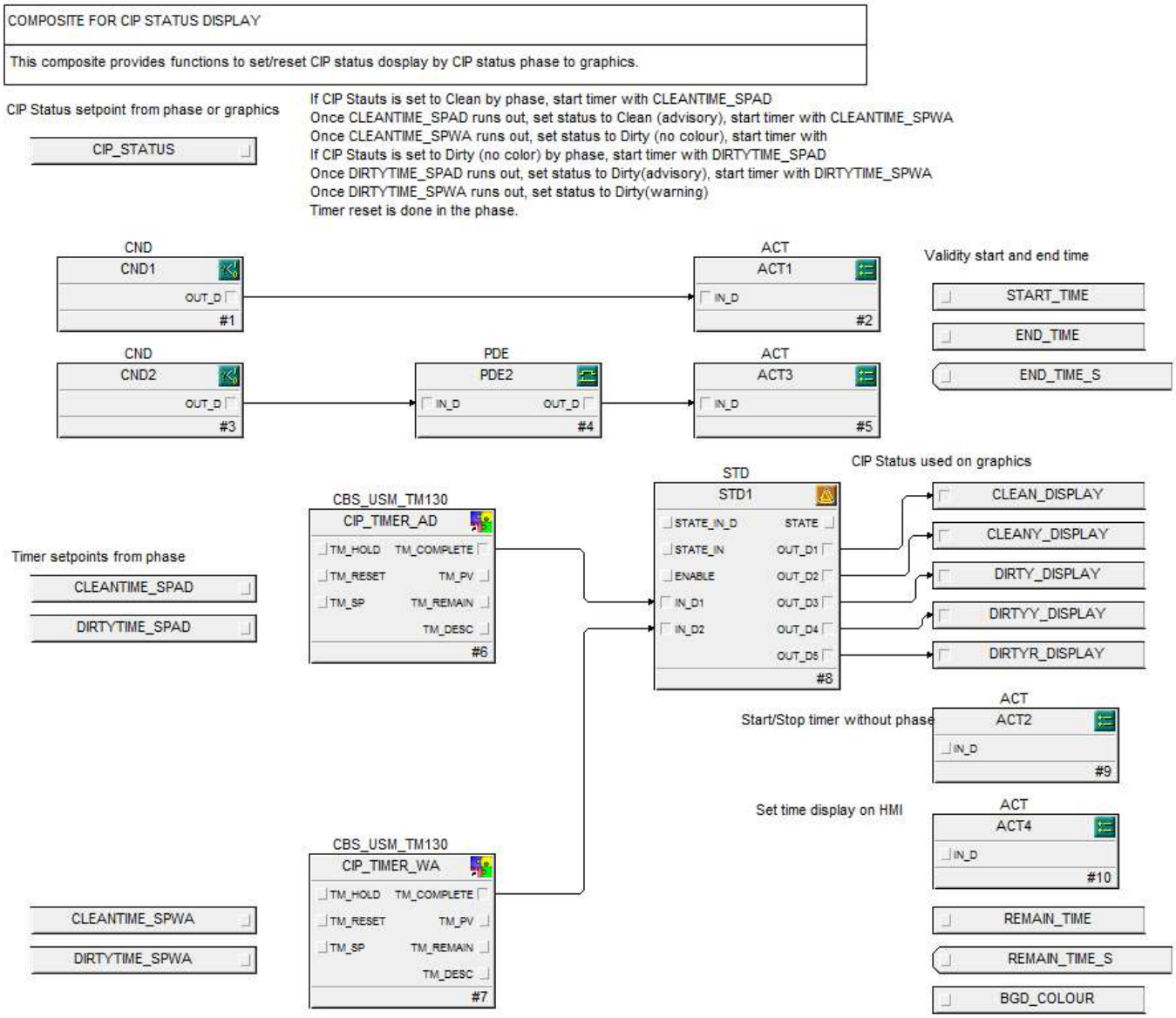


Figure 6 - CBS_C_CIP_STATUS logic

3.1.2 CIP status and time display on screen

Figure 7 – CIP Status display

3.1.3 List of picture links

No.	Type	Description	Control module parameter
1.	ColorAnimation	Update hygienic status background color	[XXXX]-SYS-SETTING/CIP_STATUS/BGD_COLOUR.F_CV
2.	Datalink	Display validity start time	[XXXX]-SYS-SETTING/CIP_STATUS/START_TIME.A_CV
3.	Datalink	Display validity end time	[XXXX]-SYS-SETTING/CIP_STATUS/END_TIME.A_CV
4.	Datalink	Display dirty expired timer	[XXXX]-SYS-SETTING/CIP_STATUS/REMAIN_TIME.A_CV
5.	Datalink	Allow supervisor to change CIP status without running of CIP status phase	[XXXX]-SYS-SETTING/CIP_STATUS/CIP_STATUS.A_CV

Table 37 – CIP status picture links

3.2 UV on timer

The UV on timer functionality is added in the SYS-SETTING module where the standard DeltaV EDC function block active state timer is enabled. The function block mode is set to CAS (cascade) and the UV lamp on command is linked to the block CAS_IN_D parameter. Active on time is recorded in the ACT_TIME parameter in seconds.

3.2.1 Logic for UV on time

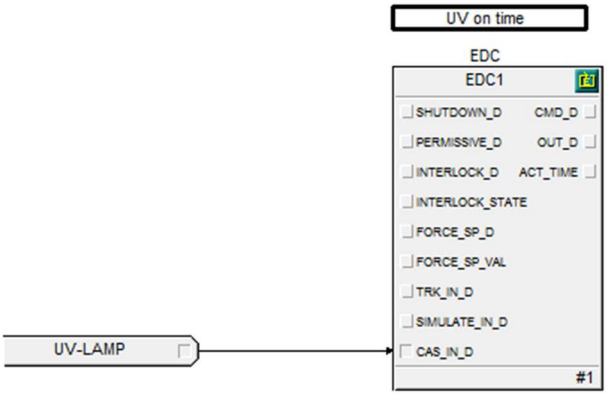


Figure 8 – Logic for UV on time

External references	Path
UV-LAMP	[XXXX]-AT-131-RUN/OUT_D

Table 38 – UV on time external reference

3.2.2 UV on time and reset on screen

Figure 9 – UV on time and reset

3.2.3 List of picture links

No.	Type	Description	Control module parameter
1.	Datalink	UV on time in hours. (ACT_TIME in seconds / 3600)	[XXXX]-SYS-SETTING/EDC1/ACT_TIME
2.	Button	Reset UV on time counter	N/A

Table 39 – UV on time picture links

3.3 Column information

In addition to the standard column volume (L) displayed on the graphics the column volume flow velocity (cm/h), column diameter (selection of all available AxiChrom column diameters) and column ID/serial number are added.

The column volume, column diameter and column ID/serial number can be changed directly by the operator from the screen, but in addition parameters for the column diameter and the column ID has be added to the CBS_INIT phase. If set different 'Undefined' the value(s) will be updated to the column information.

In addition to changing the column volume directly from the display, it can be changed using the CBS_INIT phase if parameter CV_CHECK = Yes. The column volume will automatically be updated after each column pack using the CBS_AXICHROM phase.

3.3.1 Column information on screen

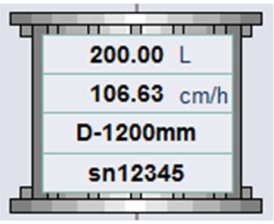


Figure 10 – Column information

3.3.2 List of picture links

No.	Type	Description	Control module parameter
1.	Datalink	Column volume (L). Can be changed directly by operator.	U_CV
2.	Datalink (Hidden)	Flow velocity (cm/h). Flow velocity (cm/h) = ([XXXX]-FT-141/PV (L/h) * 1000) / (U_COL_DIAMETER (cm) * U_COL_DIAMETER / 4 * 3.1415927) (Visible only if U_COL_DIAMETER != 'Undefined')	U_COL_DIAMETER, [XXXX]-FT-141/PV
3.	Datalink	Column diameter. Can be changed directly by operator.	U_COL_DIAMETER
4.	Datalink	Column ID/ serial number. Can be changed directly by operator.	U_COLUMN_NO

Table 40 – Column picture links

4 Phase design

This section describes the phase functionality included in the system, based on the FS [Ref ID 2] and P&ID [Ref ID 3].

All phases have been designed from the phase shell CBS_SHELL_16_13. This phase shell contains generic logic and none, or little, additional logic has been added in the specific phases for the following features:

- RUN_LOGIC: Acquire and release of equipment modules
- HOLD_LOGIC: How to set the unit in hold
- RESTART_LOGIC: How to restart the unit from a hold state
- ABORT-/STOP_LOGIC: How to stop or abort a unit

More details about this functionality is described in the PSDS [Ref ID 5].

This specification also describes the intended use of developed phases in operations to enable processing of a traditional Chromatography Process.

The system is sanitary in design with a PP piping configuration that provides optimal fluid management with minimal dead volumes.

The gradient formation feature of the system allows for formation of linear gradients where mobile phase composition varies over time.

4.1 Chromatography modes

Depending on the application, the definition of the phases should facilitate two types of chromatographic operations:

- Bind and Elute (BE). This is where the product is recovered during an elution phase.
- Flow Through (FT). This is where the product is recovered at the loading step and subsequent wash step.

4.2 Recipe operations

An operation contains an ordered group of phases. The operation is the most basic recipe that can be created using the DeltaV Batch subsystem. A phase is an individual step in the recipe. By grouping one or more phases in sequential order, it is possible to define recipe operations.

4.2.1 Phase chasses

The following phase types are used to create operations. To easily see which phase class are used in the operations the phases has been given a color code in the following illustrations. Phases of the same class (color) have the same code but are named per its function where used in the operation. The phases are to be regarded as basic templates suitable for testing the functionality of the system.

Figure 11 - Phase classes and functionality

4.2.2 Operations overview example

Below is an example of how the process can be divided into seven operations, see the left column below. Phases, to the right, are combined to form the operations. The operations may then be linked in a Unit Procedure to form a complete process, see Start-End below. This example is in Bind/Elute mode.

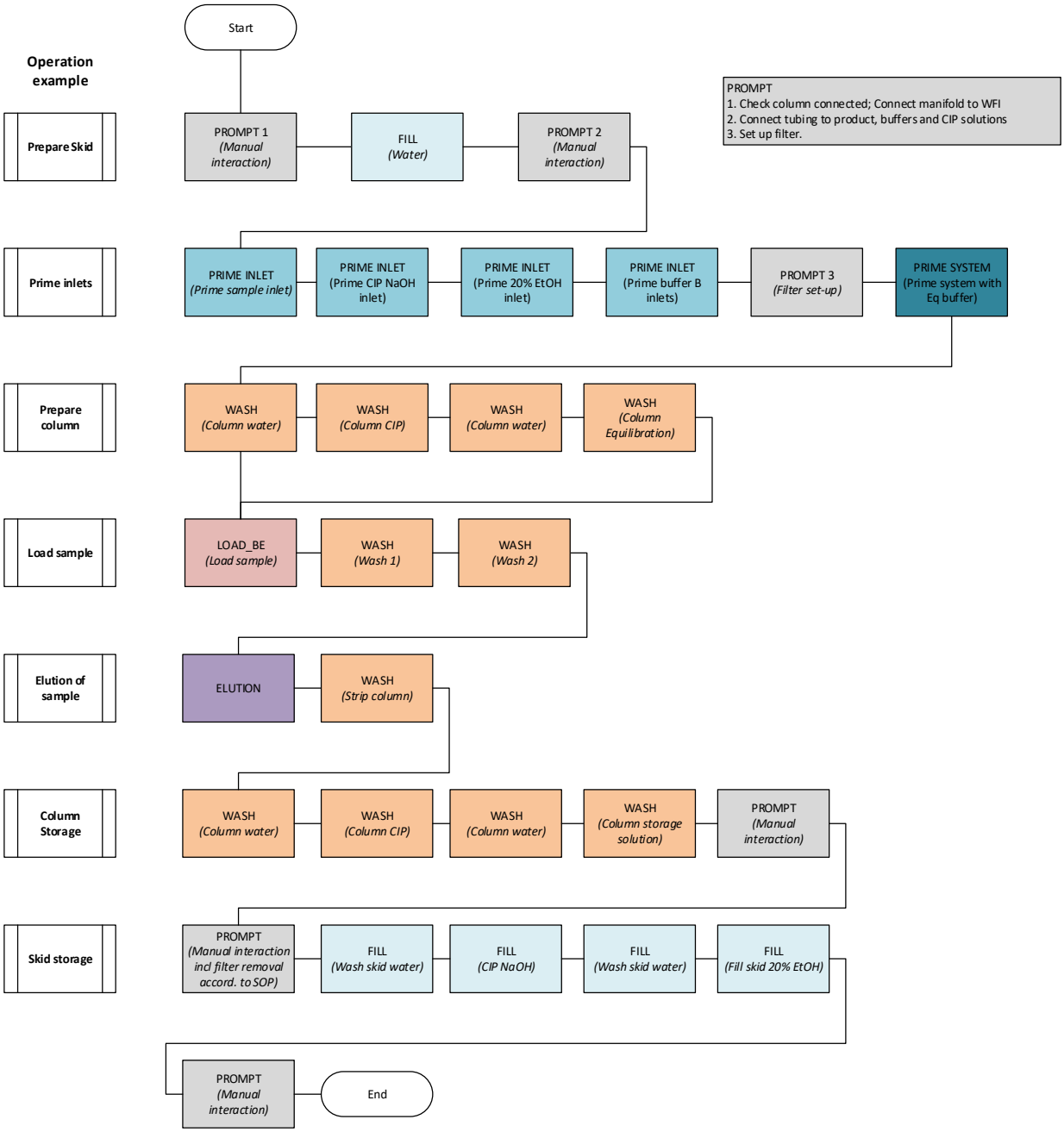


Figure 12 - Operation overview example

4.3 Phase design high level description

The logic in the phases is described in the figure below.

- The instruction/instructions in boxes are describing the requested process action to move forward in the phase.
- To the right of the boxes are the required Equipment module (EQM) instructions and parameters needed to execute the requested action described in the box. Phase parameters that have a hashtag in front of their name are variable parameters and are described in more detail in a table at the end of each phase description.

  EQM instructions are described by EQM alias = EQM instruction

  EQM parameters are described by EQM alias/EQM parameter = #Phase parameter name

- Transitions, other than EQM instructions and/or parameters, are the only ones specified between boxes. For EQM instructions and/or parameters it is implicitly required to be true before moving on to the next process step.

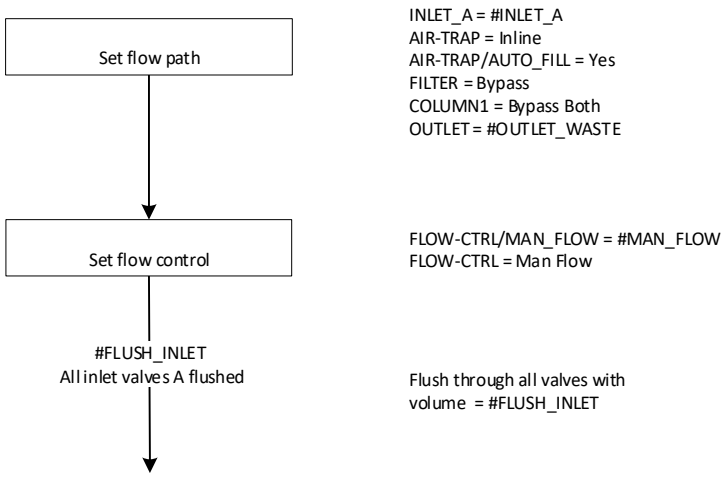


Figure 13 - SFC steps and transitions

As already mentioned above, each phase segment will end with a table describing all the phase parameters. In the table, there is one column for input and one for report. Input phase parameter will be marked with an R in the table. If a phase parameter should be logged in the batch report it will be marked with an L in the table. When configured input parameters will have the prefix “R_” and report parameters “L_”.

The sequential flow charts (SFC) describing the phases isn’t necessary implemented 1:1 in DeltaV. This document will describe the functionality and will be enough to test the phase. One box in the SFC might have been implemented with one or more steps in the configuration, or several boxes in the SFC might have been implemented with more or less steps in the configuration.

4.4 Phase logic INIT

The INIT phase will acquire all Equipment Modules on the unit. After that it will enable all module and fail alarms, and then set the system in a known safe state. If running in a recipe the process phases will start. If running manually by Operator the INIT phase will transfer the control of the Equipment Modules to the Operator. It will continue to run in the background monitoring all equipment alarms, and all enabled process alarms. If a critical alarm is enabled and violated, then it will bring the skid to hold. When the alarm(s) are inactive again it can restart the unit back to where it was, also if it is run by the Operator. It is recommended to run the skid by used of the INIT phase, also if the skid is going to be manually controlled from the Equipment Modules. When the recipe or manual run is complete it will set the system in a known safe state and disable the alarms.

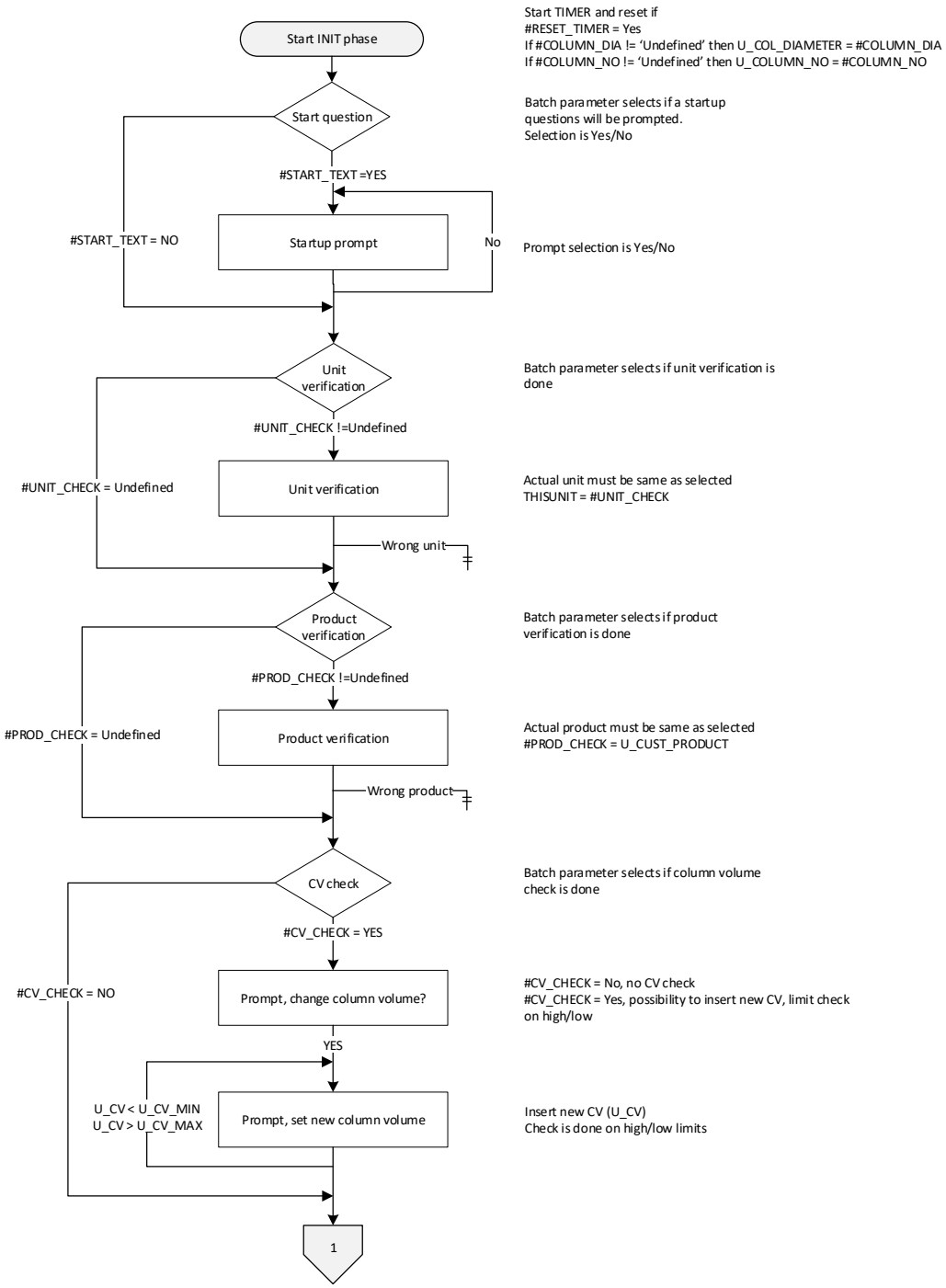
4.4.1 Aliases

The following aliases is specified in FAIL_MONITOR for acquiring of Equipment Modules.

DeltaV Alias	EQxx	EQxx_PRIVATE	EQxx_HOLD_TIME	EQxx_RESTART_1ST	EQxx_HOLD
FLOW-CTRL	EQ01	True	10	False	True
INLET_A	EQ02	True	10	True	True
INLET_B	EQ03	True	10	True	True
INLET_CIP	EQ04	True	10	True	True
AIR-TRAP	EQ05	True	10	True	False
FILTER	EQ06	True	10	True	False
COLUMN1	EQ07	True	10	True	False
OUTLET	EQ08	True	10	True	True

Table 41 - INIT phase aliases

4.4.2 Sequential function chart



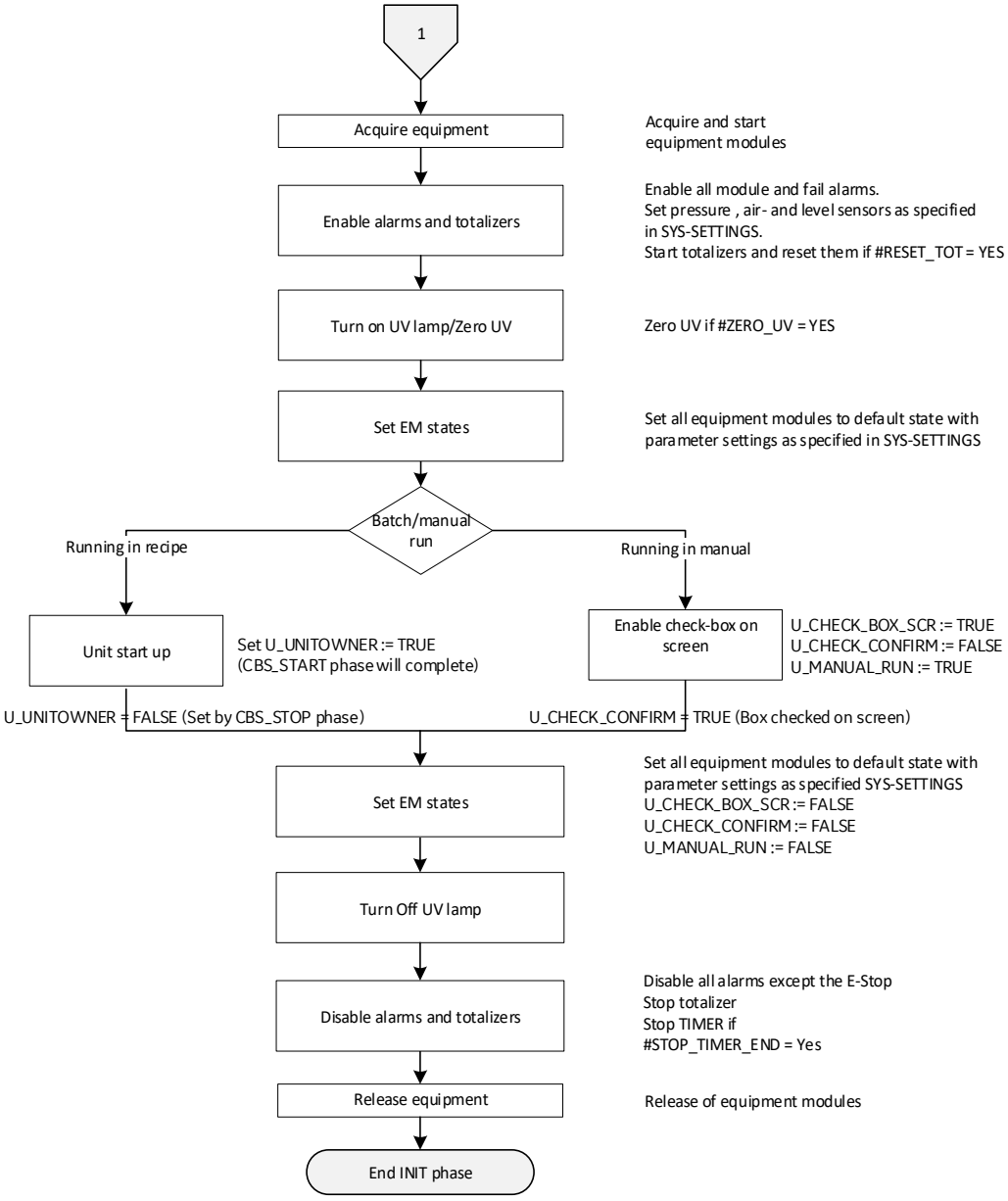


Figure 14 - INIT phase sequential function chart

4.4.3 Hold logic

This section specifies changes in Hold logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S200 (Hold)	A6	1	EQ05: AIR-TRAP
	A7	2	EQ06: FILTER
	A8	3	EQ07: COLUMN1
	A9	4	EQ08: OUTLET

Table 42 - INIT phase hold logic

4.4.4 Restart logic

This section specifies changes in Restart logic compared to the standard Phase Shell: None

4.4.5 Stop and Abort logic

This section specifies changes in Stop- and Abort logic compared to the standard Phase Shell:

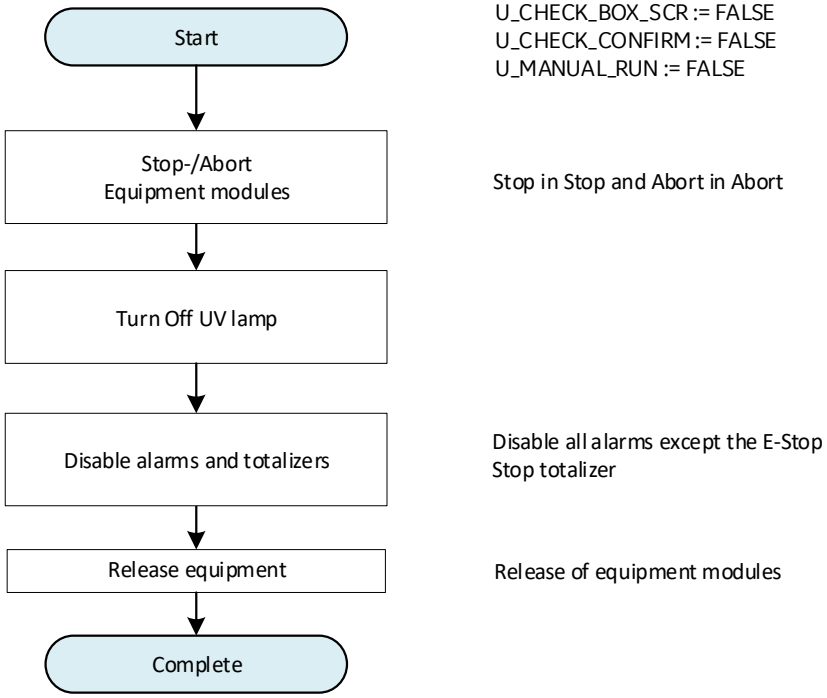


Figure 15 - INIT phase stop and abort logic

Step	Action	Time delay	EQ number / Alias / Description
S100 (Stop / Abort)	A5	1	EQ04: INLET-CIP
	A6	2	EQ05: AIR-TRAP
	A7	3	EQ06: FILTER
	A8	4	EQ07: COLUMN1
	A9	5	EQ08: OUTLET
S9999	A5	0	Enable manual run of EMs by operator when no phase is running
	A6	0	Set unit batch status to stopped

Table 43 - INIT phase stop and abort logic

4.4.6 Parameter description

Parameters and a description on how to use them are presented in the table below.

No.	Parameter name	Function	Unit	Input	Report	Nominal value		
						Default	MIN	MAX
1.	COLUMN_DIA	Column diameter	-	R	-	D-1200mm	D-300mm	D-2000mm
2.	COLUMN_NO	Column ID	-	R	-	Undefined	N/A	N/A
3.	CV_CHECK	Check column volume	-	R	-	NO	NO	YES
4.	PROD_CHECK	[Product 000 – Product 010]	-	R	-	Undefined	Product 000	Product 010
5.	RESET_TOT	Reset totalizers	-	R	-	YES	NO	YES
6.	START_QUESTION	Selects if startup question shall be prompted	-	R	-	NO	NO	YES
7.	START_TEXT	Startup question text	-	R	-	Undefined	N/A	N/A
8.	UNIT_CHECK	Unit verification	-	R	-	Undefined	CBS-CHROM-D1C1	CBS-CHROM-D4C3
9.	ZERO_UV	Selects if UV shall be auto zeroed	-	R	-	NO	NO	YES

Table 44 - INIT phase parameter description

4.4.7 Interlocks

Condition	Description	Expression	Delay (sec)
1.	Critical alarm detected	#ALARM#/FAULT_LATCH	0

Table 45 - INIT phase interlocks

4.5 Phase logic FILL

Used to completely fill inlets, bubble trap and column manifold with any liquid. This can for example be NaOH, EtOH or WFI. It requires manual interaction before and after to connect or disconnect manifold to relevant buffer.

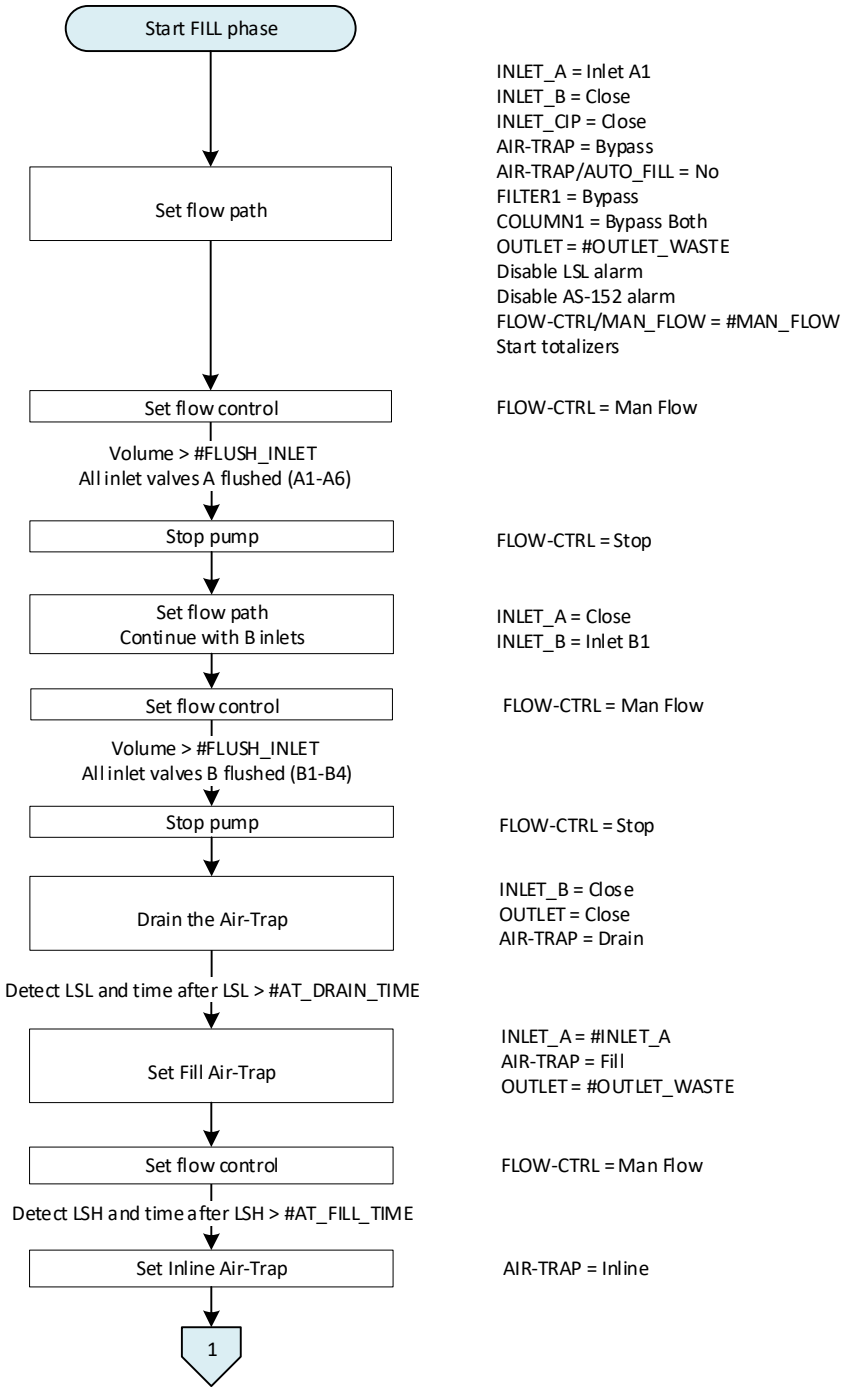
4.5.1 Aliases

The following aliases is specified in FAIL_MONITOR for acquiring of Equipment Modules.

DeltaV Alias	EQxx	EQxx_PRIVATE	EQxx_HOLD_TIME	EQxx_RESTART_1ST	EQxx_HOLD
FLOW-CTRL	EQ01	True	10	False	True
INLET_A	EQ02	True	10	True	True
INLET_B	EQ03	True	10	True	True
INLET_CIP	EQ04	True	10	True	True
AIR-TRAP	EQ05	True	10	True	False
FILTER	EQ06	True	10	True	False
COLUMN1	EQ07	True	10	True	False
OUTLET	EQ08	True	10	True	True

Table 46 - FILL phase aliases

4.5.2 Sequential function chart



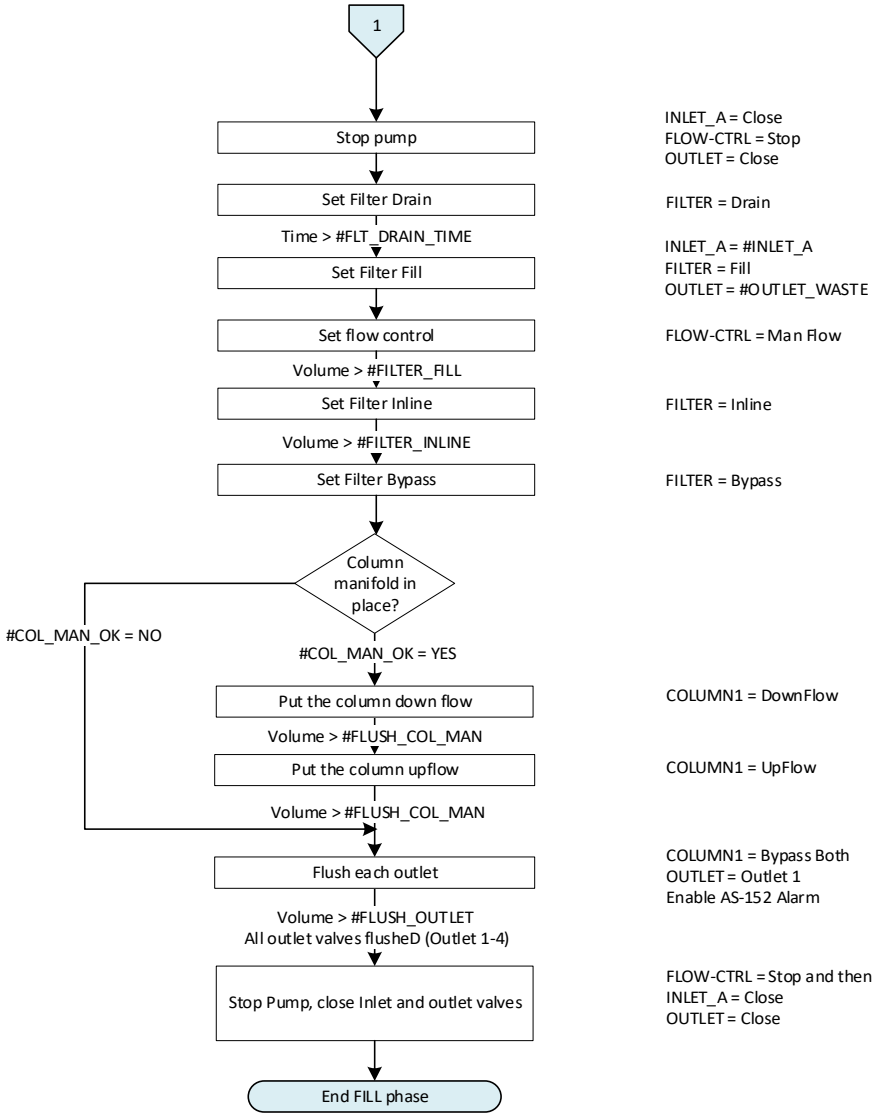


Figure 16 - FILL phase sequential function chart

4.5.3 Hold logic

This section specifies changes in Hold logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S200 (Hold)	A6	1	EQ05: AIR-TRAP
	A7	2	EQ06: FILTER
	A8	3	EQ07: COLUMN1

Step	Action	Time delay	EQ number / Alias / Description
	A9	4	EQ08: OUTLET

Table 47 - FILL phase hold logic

4.5.4 Restart logic

This section specifies changes in Restart logic compared to the standard Phase Shell: None

4.5.5 Stop and Abort logic

This section specifies changes in Stop- and Abort logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S100 (Stop / Abort)	A5	1	EQ04: INLET-CIP
	A6	2	EQ05: AIR-TRAP
	A7	3	EQ06: FILTER
	A8	4	EQ07: COLUMN1
	A9	5	EQ08: OUTLET

Table 48 - FILL phase stop and abort logic

4.5.6 Parameter description

Parameters and a description on how to use them are presented in the table below.

No.	Parameter name	Function	Unit	Input	Report	Nominal value		
						Default	MIN	MAX
1.	AT_DRAIN_TIME	Drain time for air trap after LSL active	min	R	-	5.0	0	100
2.	COL_MAN_OK	Column bypass installed	-	R	-	No	No	Yes
3.	FILL_TIME_AT	Fill time after LSH	sec	R	-	10	0	120
4.	FILTER_FILL	Filter fill volume	l	R	-	10.0	0	200
5.	FILTER_INLINE	Inline volume for filter	l	R	-	10.0	0	100
6.	FLT_DRAIN_TIME	Sets the time to drain the filter	min	R	-	5.0	0	100
7.	FLUSH_COL_MAN	Volume to flush column connections with	l	R	-	10.0	0	100
8.	FLUSH_INLET	Volume to flush each inlet	l	R	-	10.0	0	100
9.	FLUSH_OUTLET	Volume to flush each outlet with	l	R	-	10.0	0	100
10.	INLET_A	Inlet A for filling system	-	R	-	Inlet A1	Close	Inlet A6
11.	MAN_FLOW	Set pump speed	%	R	-	20.0	0	100
12.	OUTLET_WASTE	Outlet waste valve	-	R	-	Close	Close	Outlet 4

Table 49 - FILL phase parameter description

4.5.7 Interlocks

Condition	Description	Expression	Delay (sec)
1.	Critical alarm detected	#ALARM#/FAULT_LATCH	0

Table 50 - FILL phase interlocks

4.6 Phase logic PRIME INLET

Used to prime any one inlet by running the corresponding pump without flow feedback (ManFlow). This phase must be run for each buffer or sample that may be used in later phases. The phase can end either by stopping the pump and closing the flow path, or keeping the pump run and the flow path open.

4.6.1 Aliases

The following aliases is specified in FAIL_MONITOR for acquiring of Equipment Modules.

DeltaV Alias	EQxx	EQxx_PRIVATE	EQxx_HOLD_TIME	EQxx_RESTART_1ST	EQxx_HOLD
FLOW-CTRL	EQ01	True	10	False	True
INLET_A	EQ02	True	10	True	True
INLET_B	EQ03	True	10	True	True
INLET_CIP	EQ04	True	10	True	True
AIR-TRAP	EQ05	True	10	True	False
FILTER	EQ06	True	10	True	False
COLUMN1	EQ07	True	10	True	False
OUTLET	EQ08	True	10	True	True

Table 51 – PRIME INLET phase aliases

4.6.2 Sequential function chart

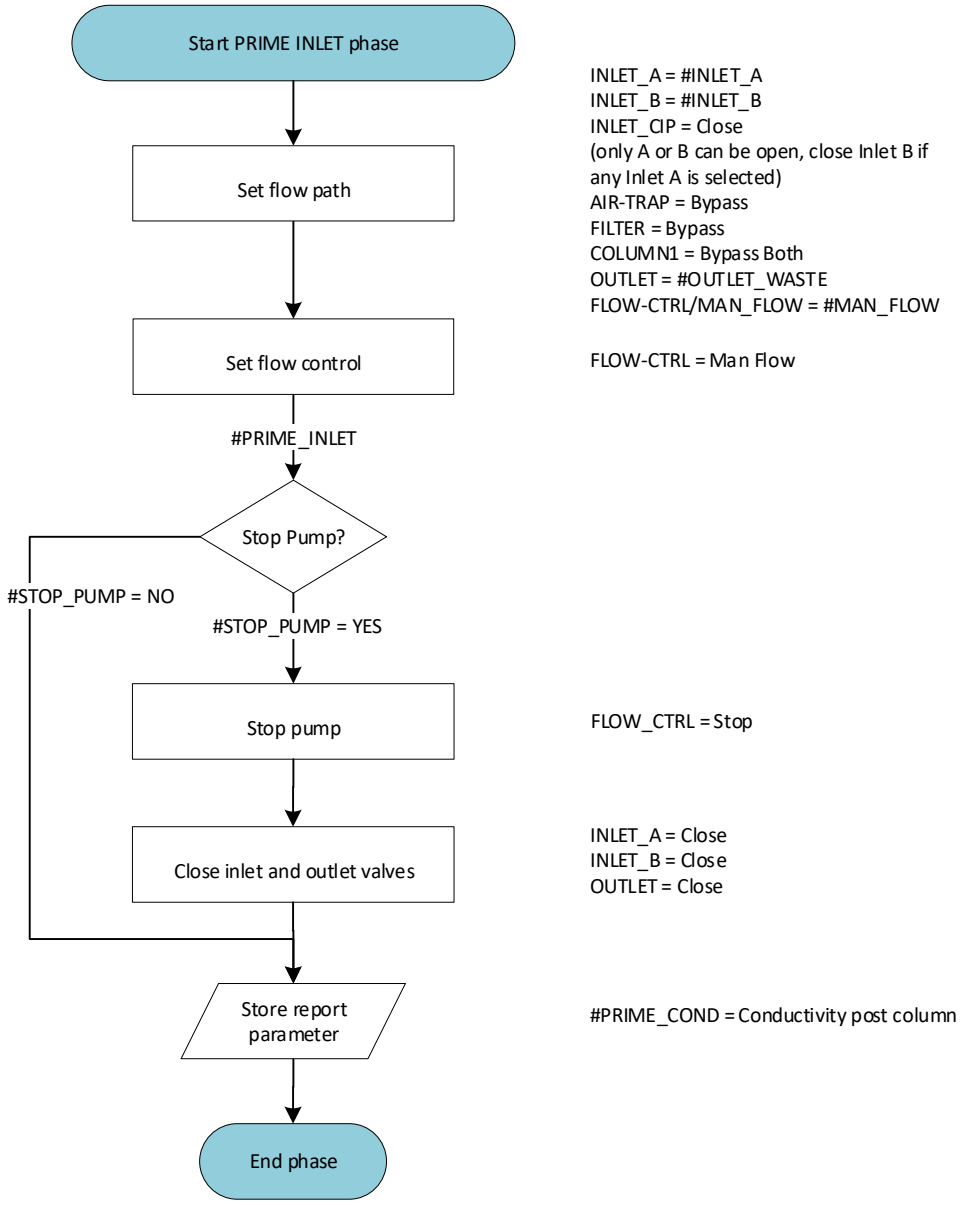


Figure 17 – PRIME INLET phase sequential function chart

4.6.3 Hold logic

This section specifies changes in Hold logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S200 (Hold)	A6	1	EQ05: AIR-TRAP
	A7	2	EQ06: FILTER
	A8	3	EQ07: COLUMN1
	A9	4	EQ08: OUTLET

Table 52 – PRIME INLET phase hold logic

4.6.4 Restart logic

This section specifies changes in Restart logic compared to the standard Phase Shell: None

4.6.5 Stop and Abort logic

This section specifies changes in Stop- and Abort logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S100 (Stop / Abort)	A5	1	EQ04: INLET-CIP
	A6	2	EQ05: AIR-TRAP
	A7	3	EQ06: FILTER
	A8	4	EQ07: COLUMN1
	A9	5	EQ08: OUTLET

Table 53 – PRIME INLET phase parameter description

4.6.6 Parameter description

Parameters and a description on how to use them are presented in the table below.

No.	Parameter name	Function	Unit	Input	Report	Nominal value		
						Default	MIN	MAX
1.	INLET_A	Inlet A to prime	-	R	-	Close	Close	Inlet A6
2.	INLET_B	Inlet B to prime (only if A is set to close)	-	R	-	Close	Close	Inlet B4
3.	MAN FLOW	Pump speed	%	R	-	20.0	0	100
4.	OUTLET_WASTE	Outlet waste valve	-	R	-	Outlet 1	Close	Outlet 4
5.	PRIME_COND	Conductivity after priming (post column)	mS/cm	-	L	-	-	-
6.	PRIME_INLET	Volume to prime inlet	l	R	-	10.0	0	100
7.	STOP_PUMP	Stop pump or keep running after phase ends	-	R	-	YES	NO	YES

Table 54 – PRIME INLET phase parameter description

4.6.7 Interlocks

Condition	Description	Expression	Delay (sec)
1.	Critical alarm detected	#ALARM#/FAULT_LATCH	0

Table 55 – PRIME INLET phase interlocks

4.7 Phase logic PRIME SYSTEM

Used to prime the system with equilibration buffer by using Man Flow. In addition, one outlet (for instance a product outlet) can be primed.

4.7.1 Aliases

The following aliases is specified in FAIL_MONITOR for acquiring of Equipment Modules.

DeltaV Alias	EQxx	EQxx_PRIVATE	EQxx_HOLD_TIME	EQxx_RESTART_1ST	EQxx_HOLD
FLOW-CTRL	EQ01	True	10	False	True
INLET_A	EQ02	True	10	True	True
INLET_B	EQ03	True	10	True	True
INLET_CIP	EQ04	True	10	True	True
AIR-TRAP	EQ05	True	10	True	False
FILTER	EQ06	True	10	True	False
COLUMN1	EQ07	True	10	True	False
OUTLET	EQ08	True	10	True	True

Table 56 – PRIME SYSTEM phase aliases

4.7.2 Sequential function chart

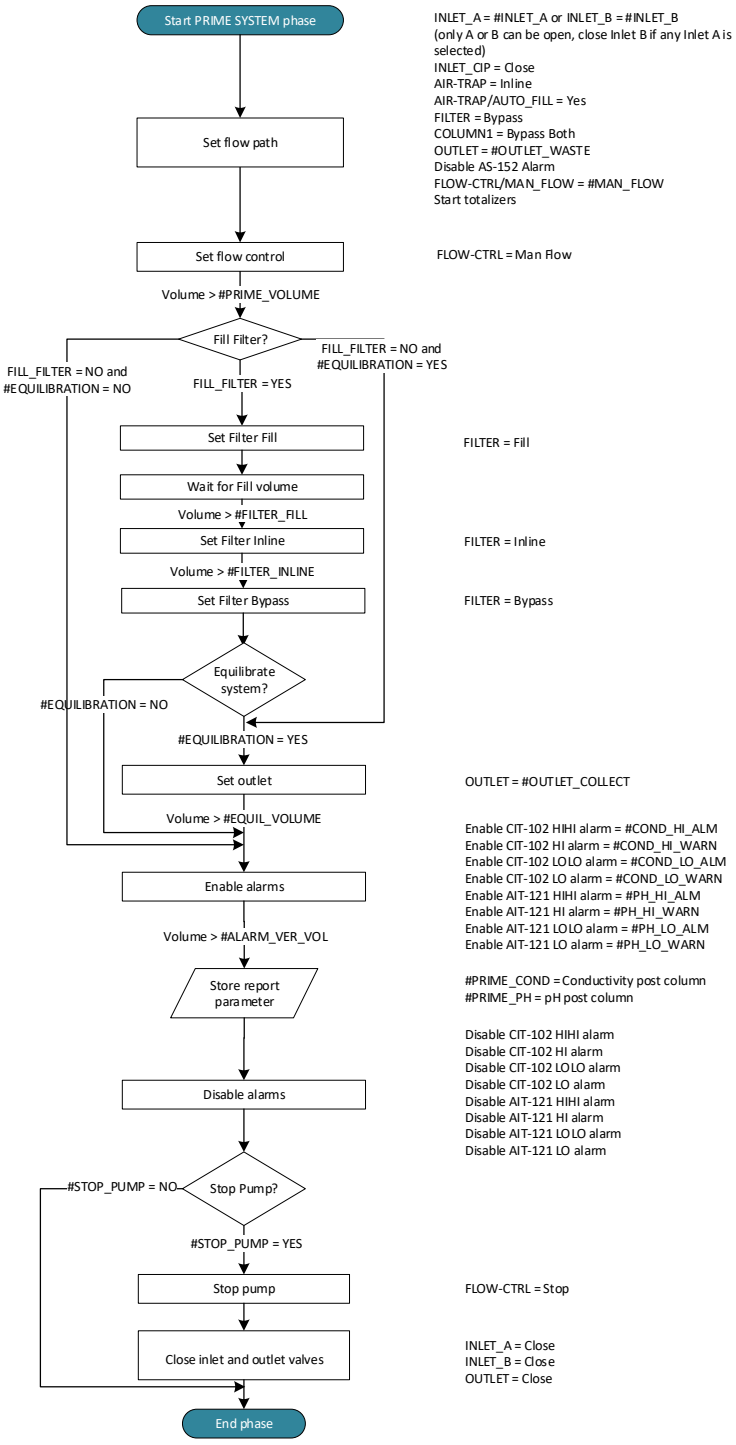


Figure 18 – PRIME SYSTEM phase sequential function chart

4.7.3 Hold logic

This section specifies changes in Hold logic compared to the standard Phase Shell:

Step	Action	Description	Default value
S110 (Hold)	A6	1	EQ05: AIR-TRAP
	A7	2	EQ06: FILTER
	A8	3	EQ07: COLUMN1
	A9	4	EQ08: OUTLET

Table 57 – PRIME SYSTEM phase hold logic

4.7.4 Restart logic

This section specifies changes in Restart logic compared to the standard Phase Shell: None

4.7.5 Stop and Abort logic

This section specifies changes in Stop- and Abort logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S100 (Stop / Abort)	A5	1	EQ04: INLET-CIP
	A6	2	EQ05: AIR-TRAP
	A7	3	EQ06: FILTER
	A8	4	EQ07: COLUMN1
	A9	5	EQ08: OUTLET
S9999	A5	0	Disable CIT-102 HIHI alarm Disable CIT-102 HI alarm Disable CIT-102 LOLO alarm Disable CIT-102 LO alarm Disable AIT-121 HIHI alarm Disable AIT-121 HI alarm Disable AIT-121 LOLO alarm Disable AIT-121 LO alarm

Table 58 – PRIME SYSTEM phase stop and abort logic

4.7.6 Parameter description

Parameters and a description on how to use them are presented in the table below.

No.	Parameter name	Function	Unit	Input	Report	Nominal value		
						Default	MIN	MAX
1.	COND_HI_ALM	Outlet conductivity high alarm limit	mS/cm	R	-	200.0	0	200
2.	COND_HI_WARN	Outlet conductivity high warning limit	mS/cm	R	-	200.0	0	200
3.	COND_LO_ALM	Outlet conductivity low alarm limit	mS/cm	R	-	0.0	0	200
4.	COND_LO_WARN	Outlet conductivity high alarm limit	mS/cm	R	-	0.0	0	200
5.	EQUIL_VOLUME	Equilibration volume	l	R	-	50.0	0	100
6.	EQUILIBRATION	Equilibrate outlet	-	R	-	No	No	Yes
7.	FILL_FILTER	Fill filter?	-	R	-	No	No	Yes
8.	INLET_A	Inlet A	-	R	-	Close	Close	Inlet A6
9.	INLET_B	Inlet B (only if A is set to close)	-	R	-	Close	Close	Inlet B4
10.	MAN FLOW	Pump speed	%	R	-	20.0	0	100
11.	OUTLET_COLLECT	Outlet to be equilibrated	-	R	-	Outlet 2	Close	Outlet 4
12.	OUTLET_WASTE	Outlet waste valve	-	R	-	Outlet 1	Close	Outlet 4
13.	PH_HI_ALM	Outlet pH high alarm limit	pH	R	-	14.0	0	14
14.	PH_HI_WARN	Outlet pH high warning limit	pH	R	-	14.0	0	14
15.	PH_LO_ALM	Outlet pH low alarm limit	pH	R	-	0.0	0	14
16.	PH_LO_WARN	Outlet pH high alarm limit	pH	R	-	0.0	0	14
17.	PRIME_COND	Conductivity after priming (post column)	mS/cm	-	L	-	-	-
18.	PRIME_PH	pH after priming (post column)	pH	-	L	-	-	-
19.	PRIME_VOLUME	Volume for system prime	l	R	-	20.0	0	100
20.	STOP_PUMP	Stop pump or keep running after phase ends	-	R	-	YES	NO	YES

Table 59 – PRIME SYSTEM phase parameter description

4.7.7 Interlocks

Condition	Description	Expression	Delay (sec)
1.	Critical alarm detected	#ALARM#/FAULT_LATCH	0

Table 60 – PRIME_SYSTEM phase interlocks

4.8 Phase logic WASH

Used to run any liquid or buffer over the column with the option to autozero of UV monitor (Equilibration). The phase can be used for Column Equilibration, Wash 1, Wash 2 or strip or to wash the column with WFI, CIP or storage solution. The phase can end either by stopping the pump(s) and closing the flow path or keeping the pump(s) running and the flow path open.

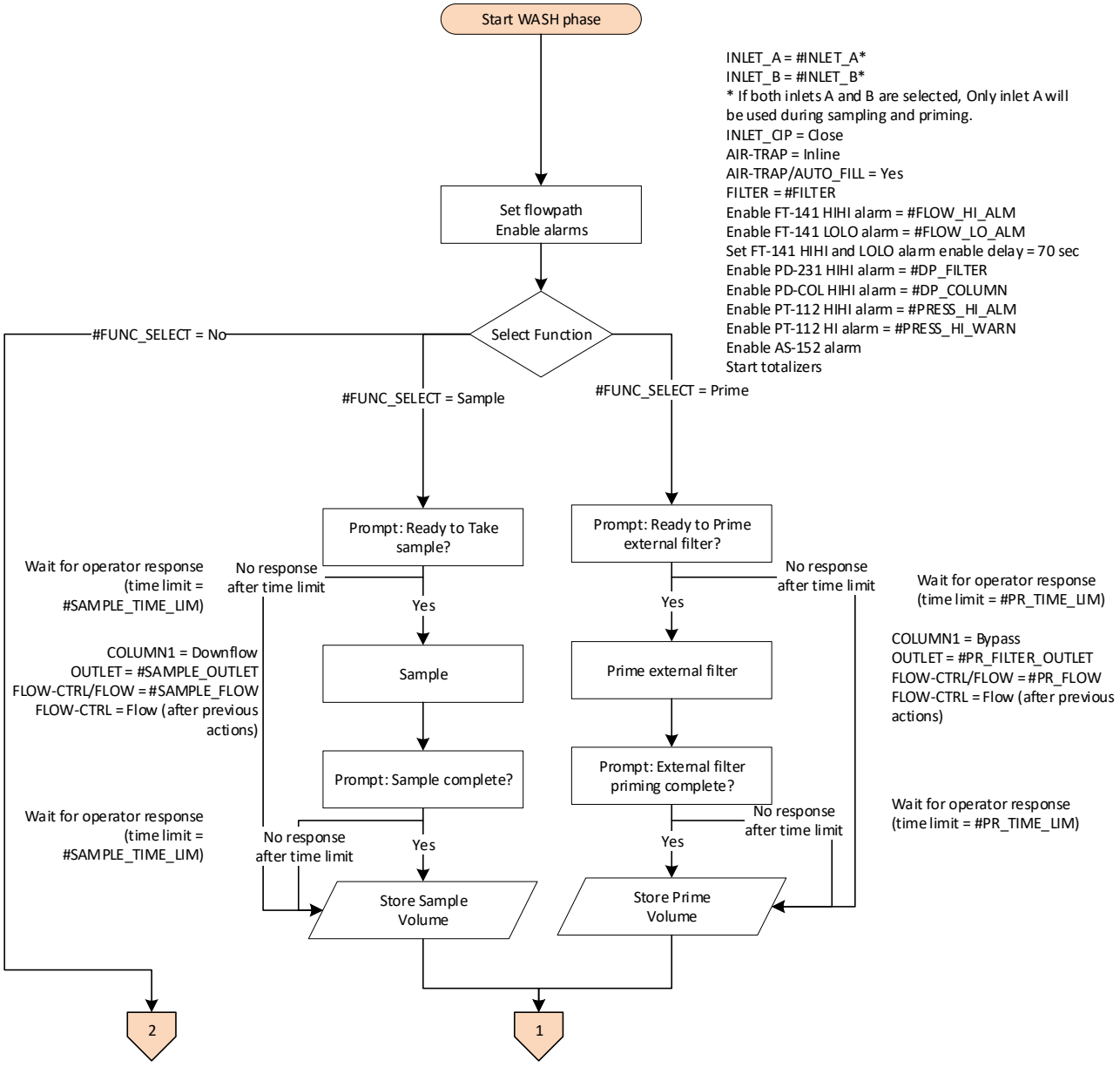
4.8.1 Aliases

The following aliases is specified in FAIL_MONITOR for acquiring of Equipment Modules.

DeltaV Alias	EQxx	EQxx_PRIVATE	EQxx_HOLD_TIME	EQxx_RESTART_1ST	EQxx_HOLD
FLOW-CTRL	EQ01	True	10	False	True
INLET_A	EQ02	True	10	True	True
INLET_B	EQ03	True	10	True	True
INLET_CIP	EQ04	True	10	True	True
AIR-TRAP	EQ05	True	10	True	False
FILTER	EQ06	True	10	True	False
COLUMN1	EQ07	True	10	True	False
OUTLET	EQ08	True	10	True	True

Table 61 – WASH phase aliases

4.8.2 Sequential function chart



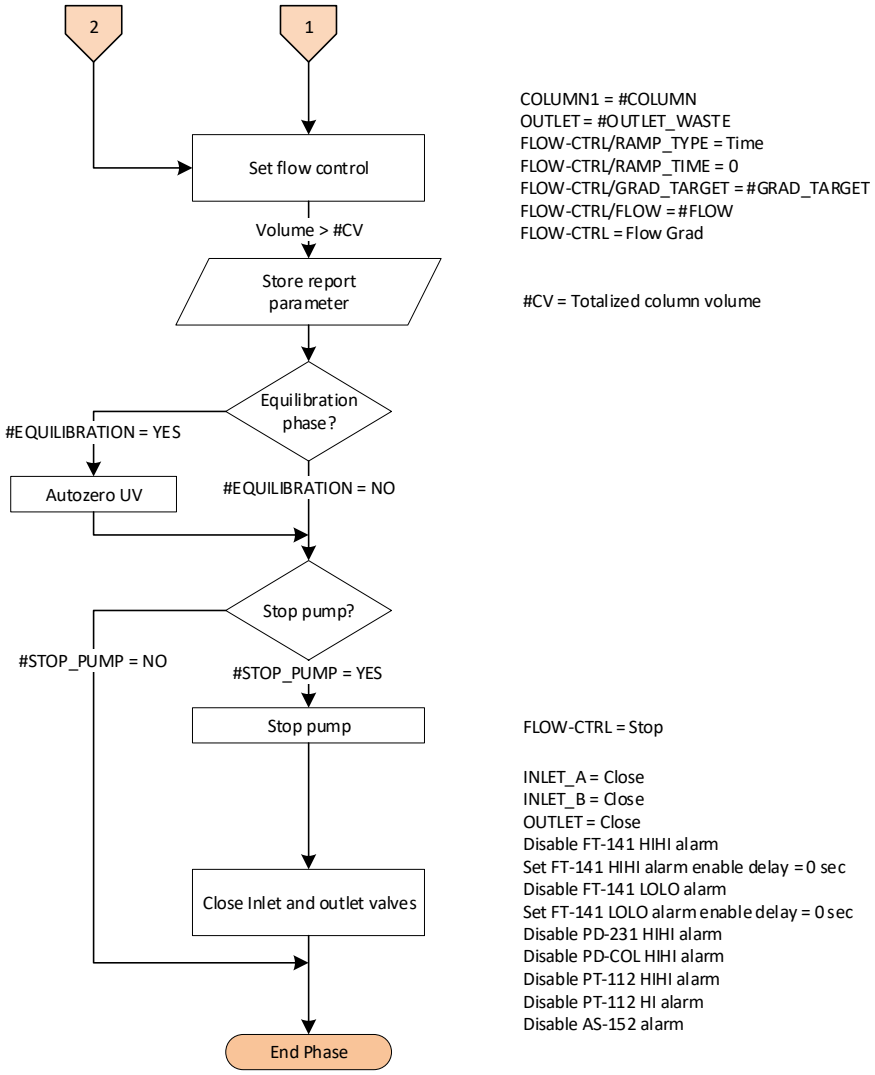


Figure 19 – WASH phase sequential function chart

4.8.3 Hold logic

This section specifies changes in Hold logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S200 (Hold)	A6	1	EQ05: AIR-TRAP
	A7	2	EQ06: FILTER
	A8	3	EQ07: COLUMN1
	A9	4	EQ08: OUTLET

Table 62 – WASH phase hold logic

4.8.4 Restart logic

This section specifies changes in Restart logic compared to the standard Phase Shell: None

4.8.5 Stop and Abort logic

This section specifies changes in Stop- and Abort logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S100 (Stop / Abort)	A5	1	EQ04: INLET-CIP
	A6	2	EQ05: AIR-TRAP
	A7	3	EQ06: FILTER
	A8	4	EQ07: COLUMN1
	A9	5	EQ08: OUTLET
S9999	A5	0	Disable FT-141 HIHI alarm
			Disable FT-141 LOLO alarm
			Set FT-141 HIHI and LOLO enable delay to 0 sec
			Disable PD-231 HIHI alarm
			Disable PD-COL HIHI alarm
			Disable PT-112 HIHI alarm
			Disable PT-112 HI alarm
	A6	0	Disable AS-152 alarm

Table 63 – WASH phase stop and abort logic

4.8.6 Parameter description

Parameters and a description on how to use them are presented in the table below.

No.	Parameter name	Function	Unit	Input	Report	Nominal value		
						Default	MIN	MAX
1.	COLUMN	Column position	-	R	-	Bypass Both	Bypass Both	DownFlow
2.	CV	Wash amount as column volume	CV	R	L	-	-	-
3.	DP_COLUMN	Max. diff. pressure column	bar	R	-	4.0	0	4.0
4.	DP_FILTER	Max. diff. pressure filter	bar	R	-	4.0	0	4.0
5.	EQUILIBRATION	Autozero UV	-	R	-	NO	NO	YES
6.	FILTER[2)]	Filter position	-	R	-	Bypass	Bypass	Inline
7.	FLOW	Total flow	L/h	R	-	240.0	0	5000.0
8.	FLOW_HI_ALM	Pre column flow high alarm limit	L/h	R	-	5000.0	0	6000.0
9.	FLOW_LO_ALM	Pre column flow low alarm limit	L/h	R	-	0.0	0	5000.0
10.	FUNC_SELECT[1)]	Function selection	-	R	-	No	No	Prime
11.	GRAD_TARGET	Percentage of buffer B	%	R	-	0.0	0	100.0
12.	INLET_A	Inlet A	-	R	-	Close	Close	Inlet A6
13.	INLET_B	Inlet B	-	R	-	Close	Close	Inlet B4
14.	OUTLET_WASTE	Outlet waste valve	-	R	-	Outlet 1	Close	Outlet 4
15.	PRESS_HI_ALM	Pre column high alarm limit	bar	R	-	4.0	0	4.0
16.	PRESS_HI_WARN	Pre column high warning limit	bar	R	-	4.0	0	4.0
17.	PR_FILTER_OUTLET	Outlet valve for priming external filter	-	R	-	Close	Close	Outlet 4
18.	PR_FLOW	Flow control setpoint for priming external filter	L/h	R	-	100.0	0	5000.0
19.	PR_TIME_LIM	Time limit for prime external filter completion prompt	sec	R	-	60	0	999
20.	SAMPLE_FLOW	Flow control setpoint for sampling	L/h	R	-	100.0	0	5000.0
21.	SAMPLE_OUTLET	Outlet valve for sampling	-	R	-	Close	Close	Outlet 4
22.	SAMPLE_TIME_LIM	Time limit for sample completion prompt	sec	R	-	60	0	999
23.	STOP_PUMP	Stop pump(s) or keep running after phase ends	-	R	-	YES	NO	YES

Table 64 – WASH phase parameter description

1) Named set with options: No, Sample and Prime.
2) Named set options: Bypass or Inline

4.8.7 Interlocks

Condition	Description	Expression	Delay (sec)
1.	Critical alarm detected	#ALARM#/FAULT_LATCH	0

Table 65 – WASH phase interlocks

4.9 Phase logic LOAD_BE

Used to load the sample onto the column using the A-pump when running chromatography in bind/elute mode. The phase can end either by stopping the pump and closing the flow path, or keeping the pump running and the flow path open.

4.9.1 Aliases

The following aliases is specified in FAIL_MONITOR for acquiring of Equipment Modules.

DeltaV Alias	EQxx	EQxx_PRIVATE	EQxx_HOLD_TIME	EQxx_RESTART_1ST	EQxx_HOLD
FLOW-CTRL	EQ01	True	10	False	True
INLET_A	EQ02	True	10	True	True
INLET_B	EQ03	True	10	True	True
INLET_CIP	EQ04	True	10	True	True
AIR-TRAP	EQ05	True	10	True	False
FILTER	EQ06	True	10	True	False
COLUMN1	EQ07	True	10	True	False
OUTLET	EQ08	True	10	True	True

Table 66 – LOAD_BE phase aliases

4.9.2 Sequential function chart

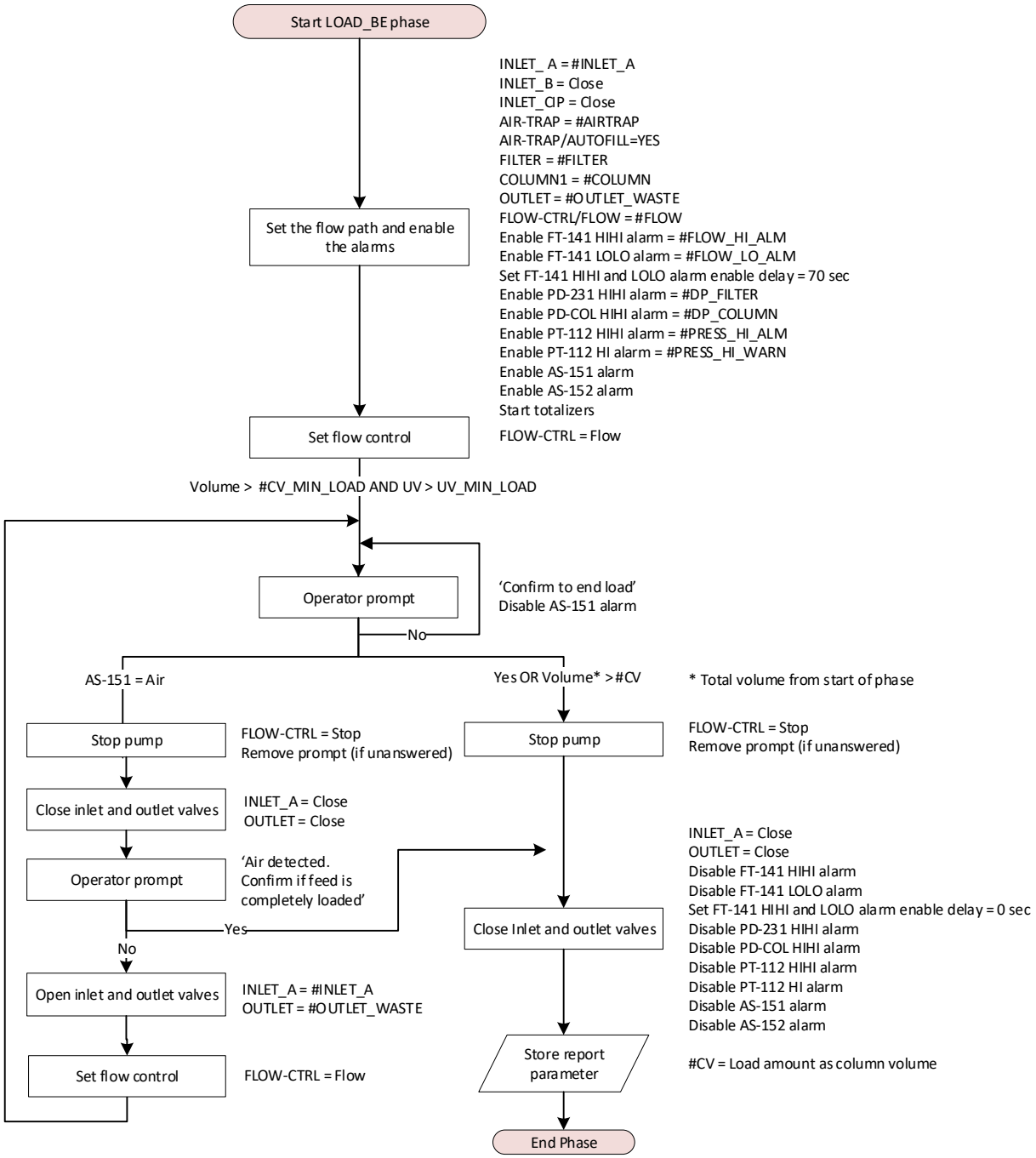


Figure 20 – LOAD_BE phase sequential function chart

4.9.3 Hold logic

This section specifies changes in Hold logic compared to the standard Phase Shell:

Step	Action	Delay	Default value
S110 (Hold)	A6	1	EQ05: AIR-TRAP
	A7	2	EQ06: FILTER
	A8	3	EQ07: COLUMN1
	A9	4	EQ08: OUTLET

Table 67 – LOAD_BE phase hold logic

4.9.4 Restart logic

This section specifies changes in Restart logic compared to the standard Phase Shell: None

4.9.5 Stop and Abort logic

This section specifies changes in Stop- and Abort logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S100 (Stop / Abort)	A5	1	EQ04: INLET-CIP
	A6	2	EQ05: AIR-TRAP
	A7	3	EQ06: FILTER
	A8	4	EQ07: COLUMN1
	A9	5	EQ08: OUTLET
S9999	A5	0	Disable FT-141 HIHI alarm
			Disable FT-141 LOLO alarm
			Set FT-141 HIHI and LOLO enable delay to 0 sec
			Disable PD-231 HIHI alarm
			Disable PD-COL HIHI alarm
			Disable PT-112 HIHI alarm
			Disable PT-112 HI alarm
	A6	0	Disable AS-152 alarm

Table 68 – LOAD_BE phase stop and abort logic

4.9.6 Parameter description

Parameters and a description on how to use them are presented in the table below.

No.	Parameter name	Function	Unit	Input	Report	Nominal value		
						Default	MIN	MAX
1.	AIRTRAP [1)]	Air-Trap position	-	R	-	Inline	Inline	Bypass
2.	COLUMN	Column position	-	R	-	Bypass Both	Bypass Both	Down
3.	CV	Load amount as column volume	CV	-	L	-	-	-
4.	CV_MIN_LOAD	Minimum column volume to end load	CV	R	-	1.0	0.2	1000
5.	DP_COLUMN	Max. diff. pressure column	bar	R	-	4.0	0	4.0
6.	DP_FILTER	Max. diff. pressure filter	bar	R	-	4.0	0	4.0
7.	FILTER [1)]	Filter position	-	R	-	Bypass	Bypass	Inline
8.	FLOW	Total flow	L/h	R	-	240.0	0	5000.0
9.	FLOW_HI_ALM	Pre column flow high alarm limit	L/h	R	-	5000.0	0	6000.0
10.	FLOW_LO_ALM	Pre column flow low alarm limit	L/h	R	-	0.0	0	5000.0
11.	INLET_A	Inlet A	-	R	-	Close	Close	Inlet A6
12.	OUTLET_WASTE	Outlet waste valve	-	R	-	Outlet 1	Close	Outlet 4
13.	PRESS_HI_ALM	Pre column high alarm limit	bar	R	-	4.0	0	4
14.	PRESS_HI_WARN	Pre column high warning limit	bar	R	-	4.0	0	4
15.	UV_MIN_LOAD	Minimum UV to end load	AU	R	-	0.1	0.01	2.0

Table 69 – LOAD_BE phase parameter description

1) Named set options: Bypass or Inline

4.9.7 Interlocks

Condition	Description	Expression	Delay (sec)
1.	Critical alarm detected	#ALARM#/FAULT_LATCH	0

Table 70 – LOAD_BE phase interlocks

4.10 Phase logic ELUTION

Elution of a column when in Bind/Elute mode, the trigger to start and stop product collection is absorbance measured after the column. Elution can be isocratic or gradient. Gradient can be conductivity or flow controlled. The phase can end either by stopping the pump(s) and closing the flow path, or keeping the pump(s) running and the flow path open.

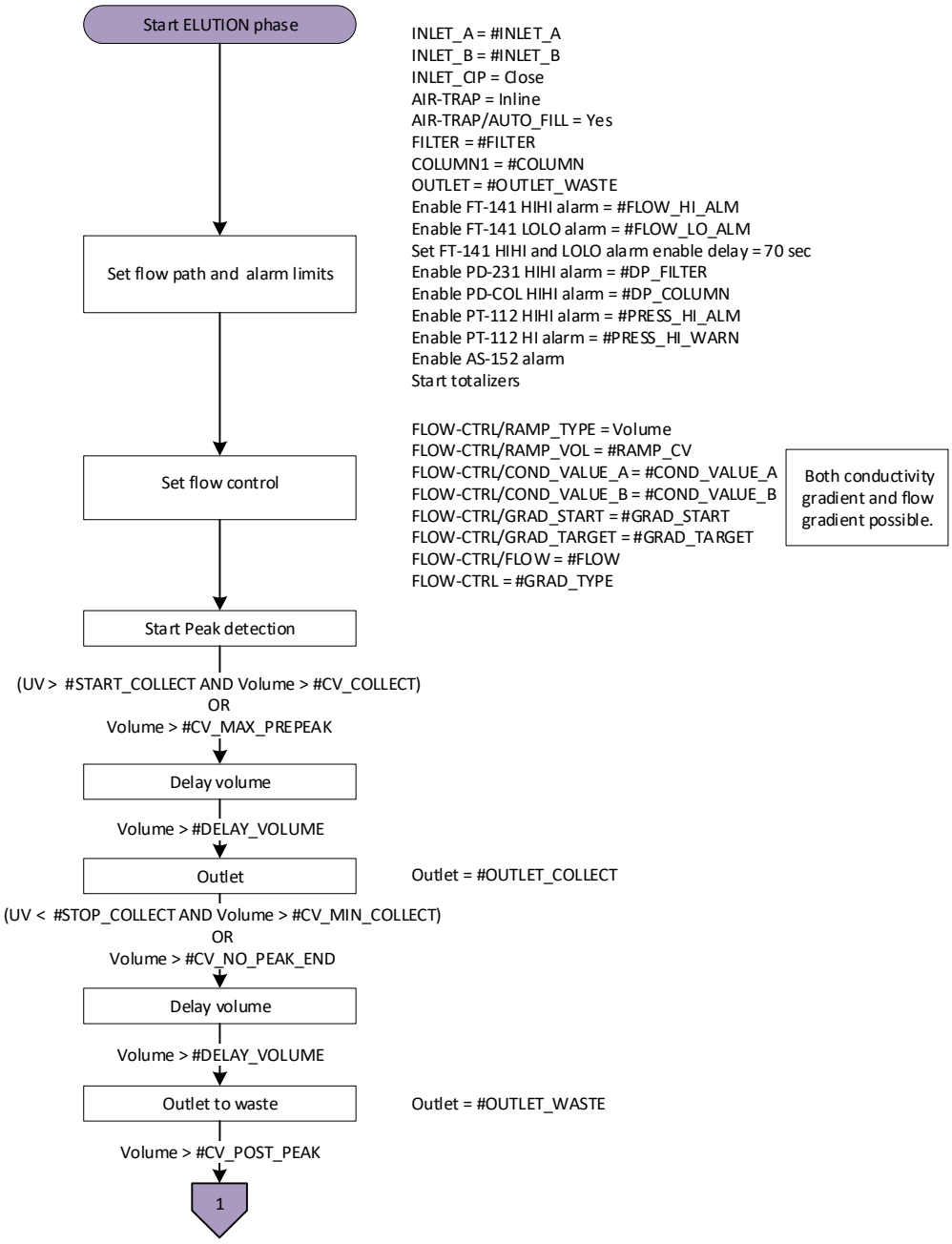
4.10.1 Aliases

The following aliases is specified in FAIL_MONITOR for acquiring of Equipment Modules.

DeltaV Alias	EQxx	EQxx_PRIVATE	EQxx_HOLD_TIME	EQxx_RESTART_1ST	EQxx_HOLD
FLOW-CTRL	EQ01	True	10	False	True
INLET_A	EQ02	True	10	True	True
INLET_B	EQ03	True	10	True	True
INLET_CIP	EQ04	True	10	True	True
AIR-TRAP	EQ05	True	10	True	False
FILTER	EQ06	True	10	True	False
COLUMN1	EQ07	True	10	True	False
OUTLET	EQ08	True	10	True	True

Table 71 – ELUTION phase aliases

4.10.2 Sequential function chart



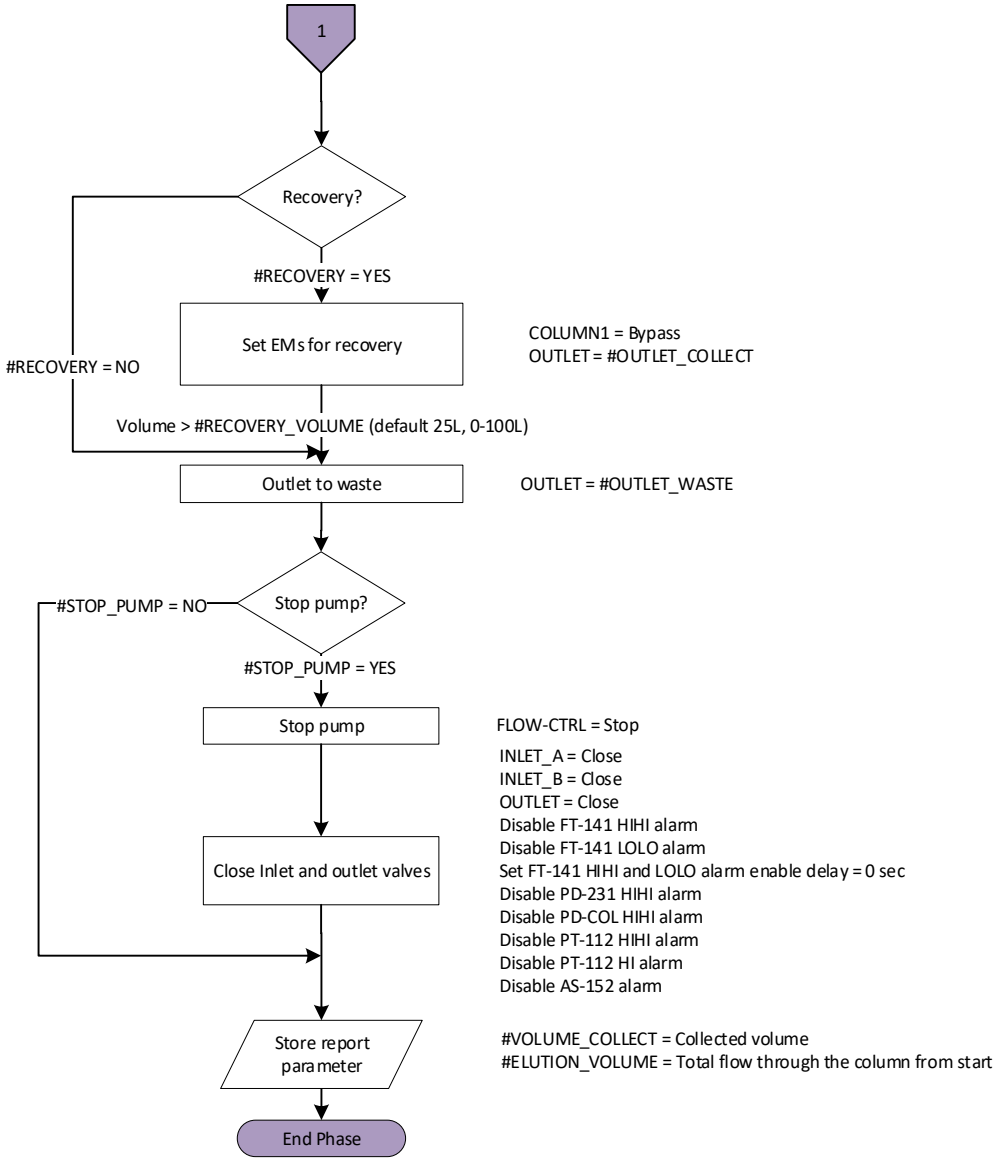


Figure 21 – ELUTION phase sequential function chart

4.10.3 Hold logic

This section specifies changes in Hold logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S200 (Hold)	A6	1	EQ05: AIR-TRAP
	A7	2	EQ06: FILTER

Step	Action	Time delay	EQ number / Alias / Description
	A8	3	EQ07: COLUMN1
	A9	4	EQ08: OUTLET

Table 72 – ELUTION phase hold logic

4.10.4 Restart logic

This section specifies changes in Restart logic compared to the standard Phase Shell: None

4.10.5 Stop and Abort logic

This section specifies changes in Stop- and Abort logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S100 (Stop / Abort)	A5	1	EQ04: INLET-CIP
	A6	2	EQ05: AIR-TRAP
	A7	3	EQ06: FILTER
	A8	4	EQ07: COLUMN1
	A9	5	EQ08: OUTLET
S9999	A5	0	Disable FT-141 HIHI alarm
			Disable FT-141 LOLO alarm
			Set FT-141 HIHI and LOLO enable delay to 0 sec
			Disable PD-231 HIHI alarm
			Disable PD-COL HIHI alarm
			Disable PT-112 HIHI alarm
			Disable PT-112 HI alarm
	A7	0	Disable AS-152 alarm

Table 73 – ELUTION phase stop and abort logic

4.10.6 Parameter description

Parameters and a description on how to use them are presented in the table below.

No.	Parameter name	Function	Unit	Input	Report	Nominal value		
						Default	MIN	MAX
1.	COLUMN	Column position	-	R	-	Bypass Both	Bypass Both	DownFlow
2.	COND_VALUE_A	Conductivity buffer A	mS/cm	R	-	0.0	0	200
3.	COND_VALUE_B	Conductivity Buffer B	mS/cm	R	-	0.0	0	200
4.	CV_COLLECT	Volume before watch on UV starts	CV	-	L	-	-	-
5.	CV_MAX_PREPEAK	Volume when product collection will start even if absorbance level is not reached	CV	R	-	1.5	0	15.0
6.	CV_MIN_COLLECT	Minimum CV to collect	CV	R	-	0.0	0	30
7.	CV_NO_PEAK_END	Stop CV if peak doesn't end	CV	R	-	10.0	0	500
8.	CV_POST_PEAK	CV after stop collection	CV	R	-	1.0	0	10.0
9.	DELAY _VOLUME	Volume from UV sensor to product outlet valve	l	R	-	1.0[2)]	0	10
10.	DP_COLUMN	Max. diff. pressure column	bar	R	-	4.0	0	4.0
11.	DP_FILTER	Max. diff. pressure filter	bar	R	-	4.0	0	4.0
12.	FILTER [3)]	Filter position	-	R	-	Bypass	Bypass	Inline
13.	ELUTION_VOLUME	Total flow through the column from start	CV	-	L	-	-	-

No.	Parameter name	Function	Unit	Input	Report	Nominal value		
						Default	MIN	MAX
14.	FLOW	Total flow	L/h	R	-	240.0	0	5000.0
15.	FLOW_HI_ALM	Pre column flow high alarm limit	L/h	R	-	5000.0	0	6000.0
16.	FLOW_LO_ALM	Pre column flow low alarm limit	L/h	R	-	0.0	0	5000.0
17.	GRAD_START	Gradient start	%	R	-	0.0	0	100
18.	GRAD_TARGET	Percentage of buffer B	%	R	-	0.0	0	100
19.	GRAD_TYPE	Flow or conductivity gradient	-	R	-	Flow Grad[1)]	Flow Grad	Cond Grad
20.	INLET_A	Inlet A	-	R	-	Close	Close	Inlet A6
21.	INLET_B	Inlet B	-	R	-	Close	Close	Inlet B4
22.	OUTLET_COLLECT	Outlet product valve	-	R	-	Outlet 2	Close	Outlet 4
23.	OUTLET_WASTE	Outlet waste valve	-	R	-	Outlet 1	Close	Outlet 4
24.	PRESS_HI_ALM	Pre column high alarm limit	bar	R	-	4.0	0	4.0
25.	PRESS_HI_WARN	Pre column high warning limit	bar	R	-	4.0	0	4.0
26.	RAMP_CV	CV duration ramp	CV	R	-	0.0	0	100
27.	RECOVERY	Option to recover product from external filter	-	R	-	NO	NO	YES
28.	RECOVERY_VOL	Recovery collection volume	l	R	-	25	0	100
29.	START_COLLECT	UV for start collecting product	AU	R	-	0.05	0.01	2.0
30.	STOP_COLLECT	UV for stop collecting product	AU	R	-	0.05	0.01	2.0
31.	STOP_PUMPS	Stop pump(s) or keep running when phase ends.	-	R	-	YES	NO	YES
32.	VOLUME_COLLECT	Collected volume	l	-	L	-	-	-

Table 74 – ELUTION phase parameter description

1) Only Flow and Cond Grad options.
2) System specific
3) Only Bypass and Inline options.

4.10.7 Interlocks

Condition	Description	Expression	Delay (sec)
1.	Critical alarm detected	#ALARM#/FAULT_LATCH	0

Table 75 – ELUTION phase interlocks

4.11 Phase logic LOAD_FT

This phase is designed for flow through mode to load sample onto the column using the A pump. The trigger to start product collection is absorbance measured after the column. This phase is designed to be followed by the phase WASH_FT.

4.11.1 Aliases

The following aliases is specified in FAIL_MONITOR for acquiring of Equipment Modules.

DeltaV Alias	EQxx	EQxx_PRIVATE	EQxx_HOLD_TIME	EQxx_RESTART_1ST	EQxx_HOLD
FLOW-CTRL	EQ01	True	10	False	True
INLET_A	EQ02	True	10	True	True
INLET_B	EQ03	True	10	True	True
INLET_CIP	EQ04	True	10	True	True
AIR-TRAP	EQ05	True	10	True	False
FILTER	EQ06	True	10	True	False
COLUMN1	EQ07	True	10	True	False
OUTLET	EQ08	True	10	True	True

Table 76 – LOAD_FT phase aliases

4.11.2 Sequential function chart

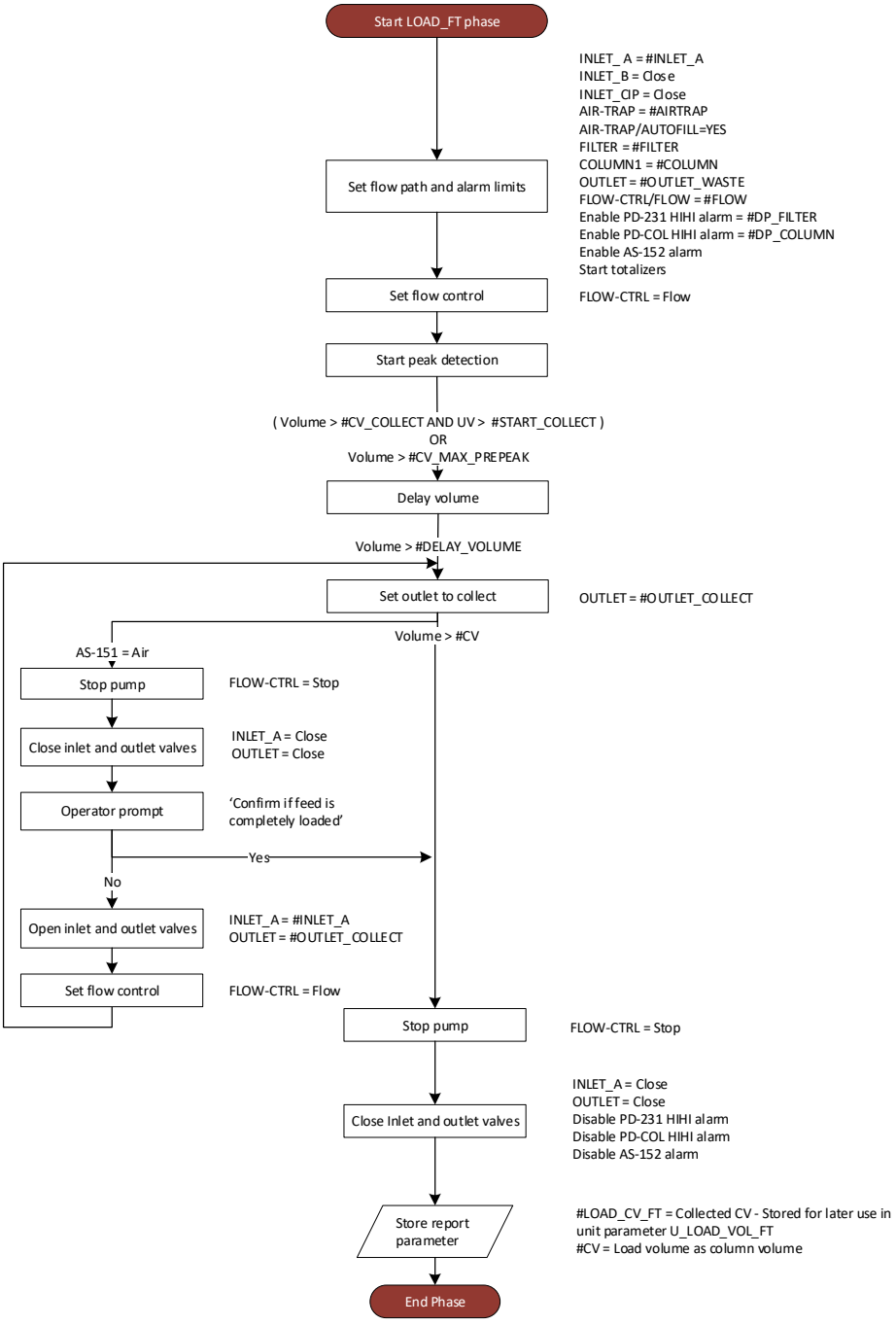


Figure 22 - LOAD_FT phase sequential function chart

4.11.3 Hold logic

This section specifies changes in Hold logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S200 (Hold)	A6	1	EQ05: AIR-TRAP
	A7	2	EQ06: FILTER
	A8	3	EQ07: COLUMN1
	A9	4	EQ08: OUTLET

Table 77 – LOAD_FT phase hold logic

4.11.4 Restart logic

This section specifies changes in Restart logic compared to the standard Phase Shell: None

4.11.5 Stop and Abort logic

This section specifies changes in Stop- and Abort logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S100 (Stop / Abort)	A5	1	EQ04: INLET-CIP
	A6	2	EQ05: AIR-TRAP
	A7	3	EQ06: FILTER
	A8	4	EQ07: COLUMN1
	A9	5	EQ08: OUTLET
S9999	A5	0	Disable PD-231 HIHI alarm
	A6	0	Disable PD-COL HIHI alarm
	A7	0	Disable AS-152 alarm

Table 78 – LOAD_FT phase stop and abort logic

4.11.6 Parameter description

Parameters and a description on how to use them are presented in the table below.

No.	Parameter name	Function	Unit	Input	Report	Nominal value		
						Default	MIN	MAX
1.	AIRTRAP [2)]	Air-Trap position	-	R	-	Inline	Inline	Bypass
2.	COLUMN	Column position	-	R	-	Bypass Both	Bypass Both	DownFlow
3.	CV	Load amount as column volume	CV	-	L	-	-	-
4.	CV_COLLECT	Minimum CV before collection starts	CV	R	-	1.0	0	15
5.	CV_MAX_PREPEAK	Volume when product collection will start even if absorbance level is not reached	CV	R	-	1.5	0	15.0
6.	DELAY _VOLUME	Volume from UV sensor to product outlet valve	l	R	-	0.0[1)]	0	10
7.	DP_COLUMN	Max. diff.pressure column	bar	R	-	4.0	0	4.0
8.	DP_FILTER	Max. diff.pressure filter	bar	R	-	4.0	0	4.0
9.	FILTER [2)]	Filter position	-	R	-	Bypass	Bypass	Inline
10.	FLOW	Total flow	L/h	R	-	240.0	0	5000.0
11.	INLET_A	Inlet A	-	R	-	Close	Close	Inlet A6
12.	LOAD_CV_FT	Collected CV	CV	-	L	-	-	-
13.	OUTLET_COLLECT	Outlet product valve	-	R	-	Outlet 2	Close	Outlet 4
14.	OUTLET_WASTE	Outlet waste valve	-	R	-	Outlet 1	Close	Outlet 4
15.	START_COLLECT	UV for start collecting product	AU	R	-	0.1	0.05	2.0

Table 79 – LOAD_FT phase parameter description

1) System specific
2) Only Bypass and Inline

4.11.7 Interlocks

Condition	Description	Expression	Delay (sec)
1.	Critical alarm detected	#ALARM#/FAULT_LATCH	0

Table 80 – LOAD_FT phase interlocks

4.12 Phase logic WASH_FT

WASH_FT phase to be run after LOAD_FT with product collection until absorbance measured after the column is below set value. The phase can end either by stopping the pump(s) and closing the flow path or keeping the pump(s) running and the flow path open with the option to change the inlets.

4.12.1 Aliases

The following aliases is specified in FAIL_MONITOR for acquiring of Equipment Modules.

DeltaV Alias	EQxx	EQxx_PRIVATE	EQxx_HOLD_TIME	EQxx_RESTART_1ST	EQxx_HOLD
FLOW-CTRL	EQ01	True	10	False	True
INLET_A	EQ02	True	10	True	True
INLET_B	EQ03	True	10	True	True
INLET_CIP	EQ04	True	10	True	True
AIR-TRAP	EQ05	True	10	True	False
FILTER	EQ06	True	10	True	False
COLUMN1	EQ07	True	10	True	False
OUTLET	EQ08	True	10	True	True

Table 81 – WASH_FT phase aliases

4.12.2 Sequential function chart

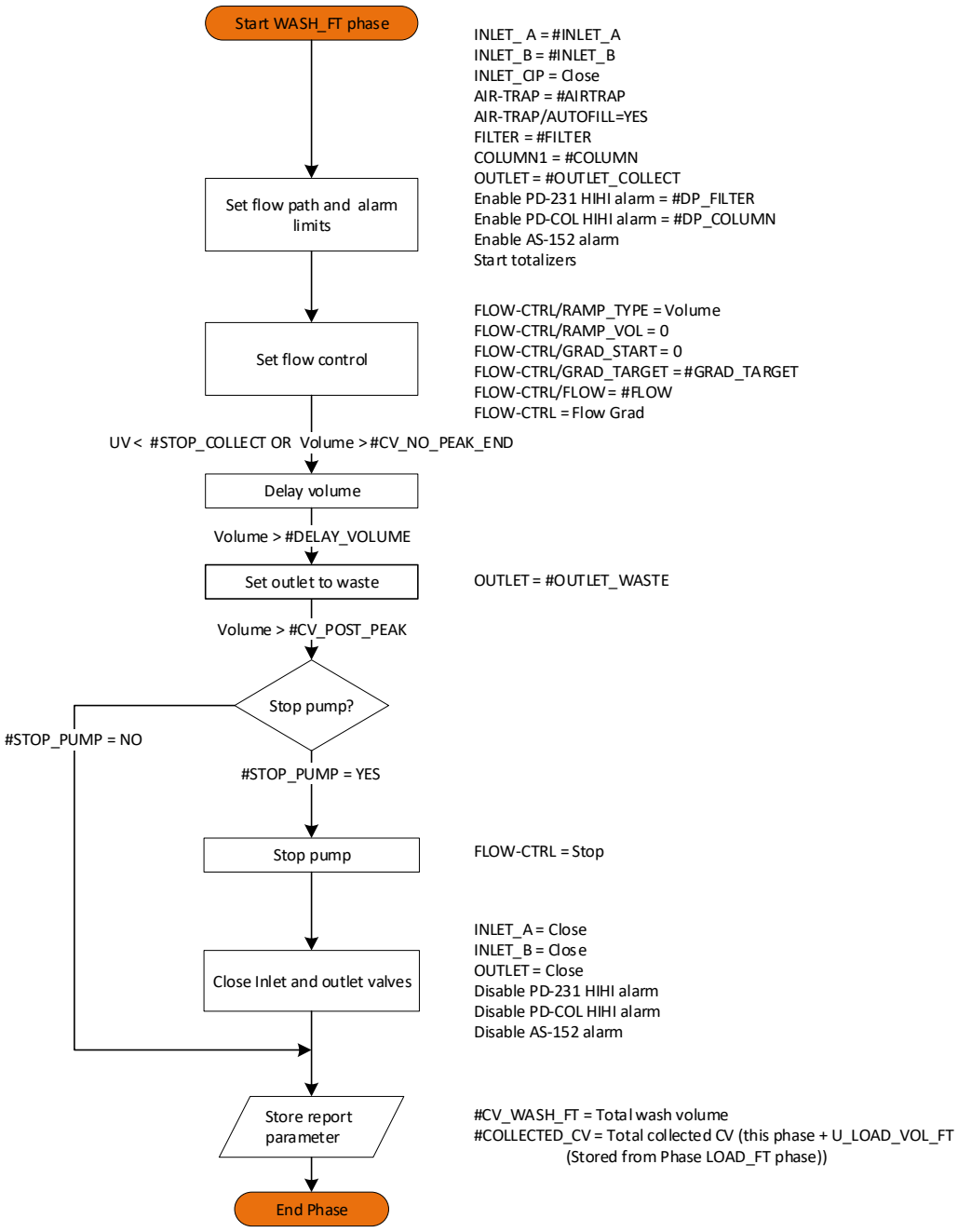


Figure 23 - WASH_FT phase sequential function chart

4.12.3 Hold logic

This section specifies changes in Hold logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S200 (Hold)	A6	1	EQ05: AIR-TRAP
	A7	2	EQ06: FILTER
	A8	3	EQ07: COLUMN1
	A9	4	EQ08: OUTLET

Table 82 – WASH_FT phase hold logic

4.12.4 Restart logic

This section specifies changes in Restart logic compared to the standard Phase Shell: None

4.12.5 Stop and Abort logic

This section specifies changes in Stop- and Abort logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S100 (Stop / Abort)	A5	1	EQ04: INLET-CIP
	A6	2	EQ05: AIR-TRAP
	A7	3	EQ06: FILTER
	A8	4	EQ07: COLUMN1
	A9	5	EQ08: OUTLET
S9999	A5	0	Disable PD-231 HIHI alarm
	A6	0	Disable PD-COL HIHI alarm
	A7	0	Disable AS-152 alarm

Table 83 – WASH_FT phase stop and abort logic

4.12.6 Parameter description

Parameters and a description on how to use them are presented in the table below.

No.	Parameter name	Function	Unit	Input	Report	Nominal value		
						Default	MIN	MAX
1.	AIRTRAP [2)]	Air-Trap position	-	R	-	Inline	Inline	Bypass
2.	COLUMN	Column position	-	R	-	Bypass Both	Bypass Both	Downflow
3.	CV_POST_PEAK	CV after stop collection	CV	R	-	1.0	0	15
4.	CV_NO_PEAK_END	Stop CV if peak doesn't end	CV	R	-	10.0	0	500
5.	CV_WASH_FT	Total wash volume	CV	-	L	-	-	-
6.	DELAY _VOLUME	Volume from UV sensor to product outlet valve	l	R	-	1.0[1)]	0	10
7.	DP_COLUMN	Max. diff.pressure column	bar	R	-	4.0	0	4.0
8.	DP_FILTER	Max. diff.pressure column	bar	R	-	4.0	0	4.0
9.	COLLECTED_CV	Total collected CV (Load FT + Wash FT)	CV	-	L	-	-	-
10.	FILTER [2)]	Filter position	-	R	-	Bypass	Bypass	Inline
11.	FLOW	Total flow	L/h	R	-	240.0	0	5000.0
12.	GRAD_TARGET	Percentage of buffer B	%	R	-	0.0	0	100.0
13.	INLET_A	Inlet A	-	R	-	Close	Close	Inlet A6
14.	INLET_B	Inlet B	-	R	-	Close	Close	Inlet B4
15.	OUTLET_COLLECT	Outlet product valve	-	R	-	Outlet 2	Close	Outlet 4
16.	OUTLET_WASTE	Outlet waste valve	-	R	-	Outlet 1	Close	Outlet 4
17.	STOP_COLLECT	UV for stop collecting product	AU	R	-	0.1	0.05	2.0
18.	STOP_PUMP	Stop pump(s) or keep running after phase ends	-	R	-	YES	NO	YES

Table 84 – WASH_FT phase parameter description

1) System specific
2) Only Bypass or Inline

4.12.7 Interlocks

Condition	Description	Expression	Delay (sec)
1.	Critical alarm detected	#ALARM#/FAULT_LATCH	0

Table 85 - WASH_FT phase interlocks

4.13 Phase logic CIP_STATUS

Used to verify CIP status, set new CIP status and start/stop/set/reset CIP timer.

4.13.1 Sequential function chart

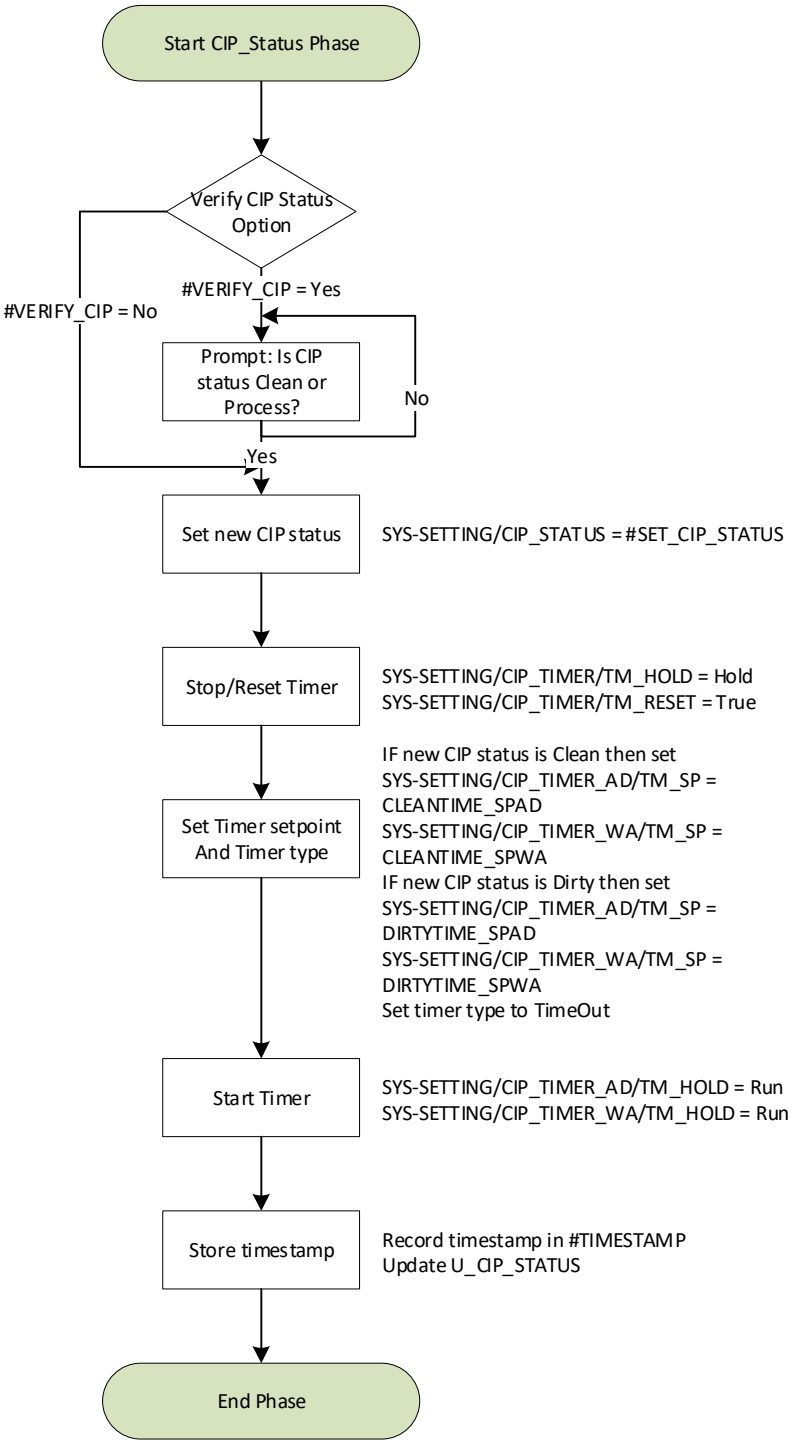


Table 86 – CIP_STATUS phase sequential function chart

4.13.2 Parameter description

Parameters and a description on how to use them are presented in the table below.

No.	Parameter name	Function	Unit	Input	Report	Nominal value		
						Default	MIN	MAX
1.	VERIFY_CIP	Option to let operator verify current CIP status via prompt.	-	R	-	NO	NO	YES
2.	SET_CIP_STATUS	Set new CIP status	-	R	-	Out of Service	Out of Service	Dirty
3.	TIMER_SP	New setpoint for CIP timer	-	R	-	24	0	999
4.	TIMESTAMP	Record time stamp when timer start	-	-	L	-	-	-

Table 87 – CIP_STATUS phase parameter description

4.14 Phase logic PROMPT

Used to manage the issuing and response of prompts to operator via the HMI.

4.14.1 Sequential function chart

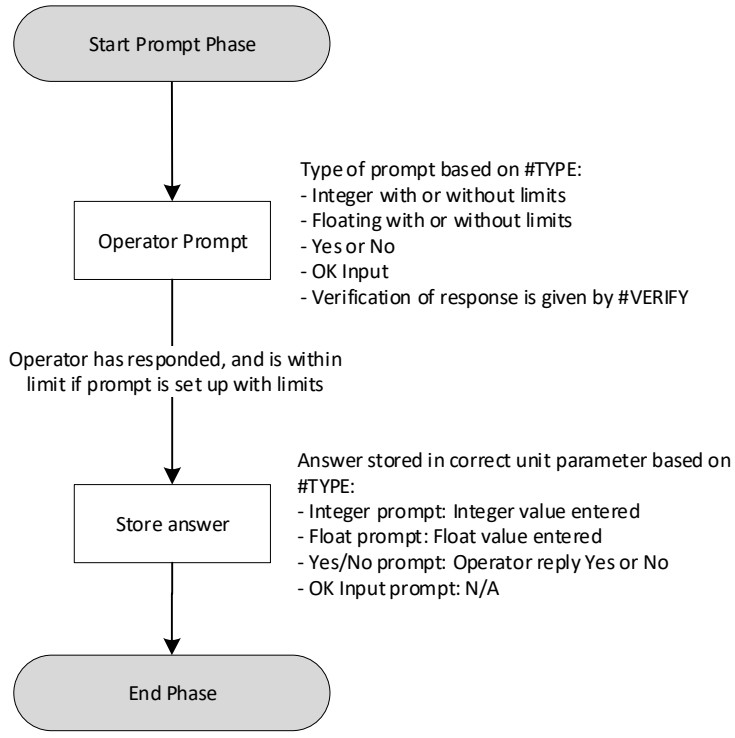


Table 88 – Prompt phase sequential function chart

4.14.2 Parameter description

Parameters and a description on how to use them are presented in the table below.

No.	Parameter name	Function	Unit	Input	Report	Nominal value		
						Default	MIN	MAX
1.	HI_LIM	Float parameter defining the maximum entry value for prompt types “Floating points with limits” and “Integer with limits”	-	R	-	100.0	-999999.0	999999.0
2.	LO_LIM	Float parameter defining the minimum entry value for prompt types “Floating points with limits” and “Integer with limits”	-	R	-	0.0	-999999.0	999999.0
3.	MESSAGE	Prompt message	-	R	-	Undefined	-	-
4.	TYPE	Named set parameter defining the prompt type • Integer with no limits • Integer with limits • Floating point with no limits • Floating point with limits • Yes or No • OK Input	-	R	-	None	-	-
5.	VERIFY	Named set parameter defining the verification level of the prompt • None • Confirmer • Verifier Depending upon the criticality of input to the process, confirmer or verifier can be configured. When VERIFY is set to 'Confirmer', authentication of prompt response is required from confirming authority before operator can acknowledge the prompt. When VERIFY is set to 'Verifier', authentication from both confirming authority and verifying authority is required.	-	R	-	None	-	-

Table 89 – PROMPT phase parameter description

4.15 Phase logic AXICHROM

AXICHROM phase is to be ran to perform methods on the AxiChrom column by interacting with an AxiChrom Master. These methods include:

- Priming
- Packing
- Unpacking

Further details are to be included in the next release of this document once the detailed design is formalized.

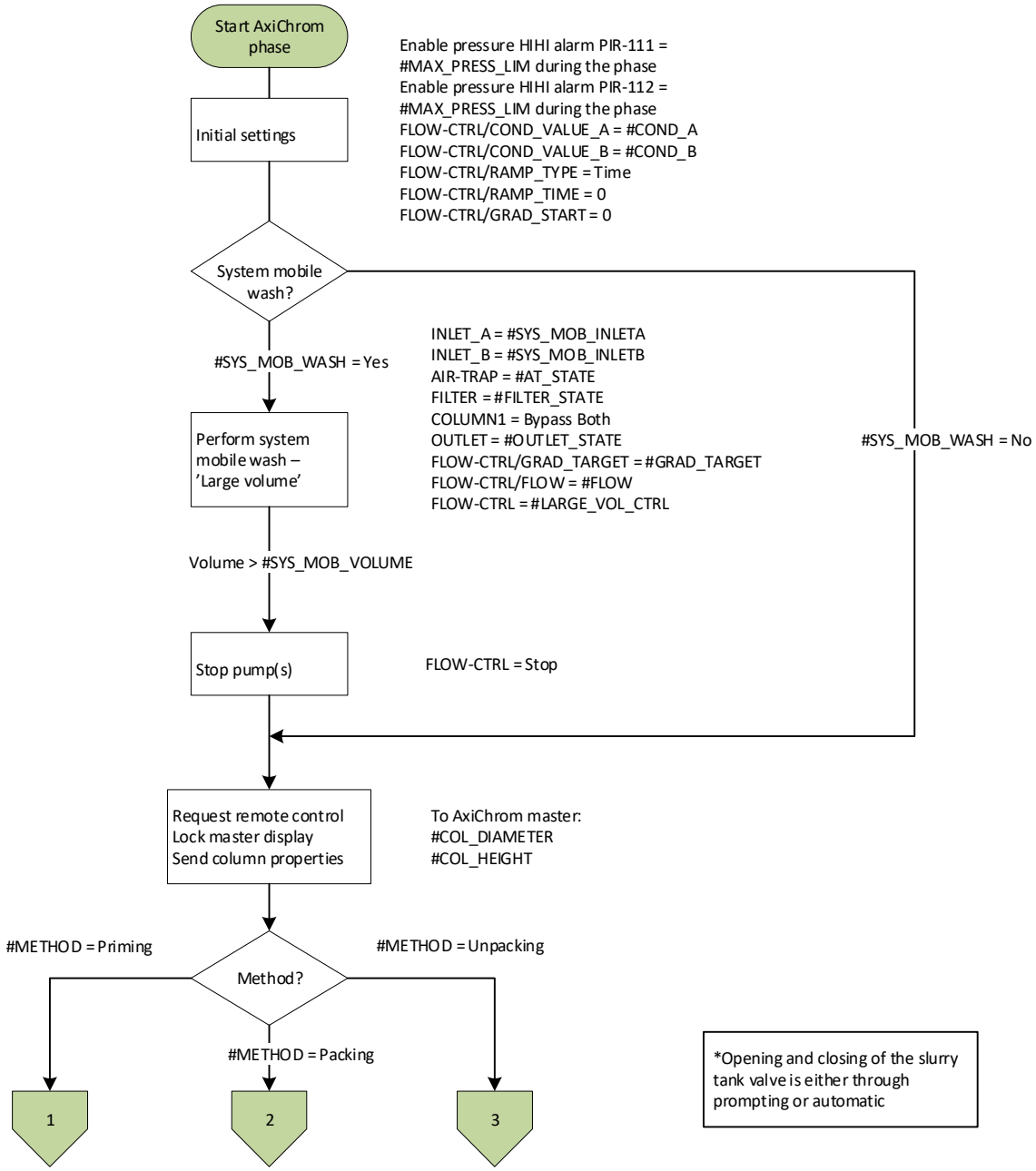
4.15.1 Aliases

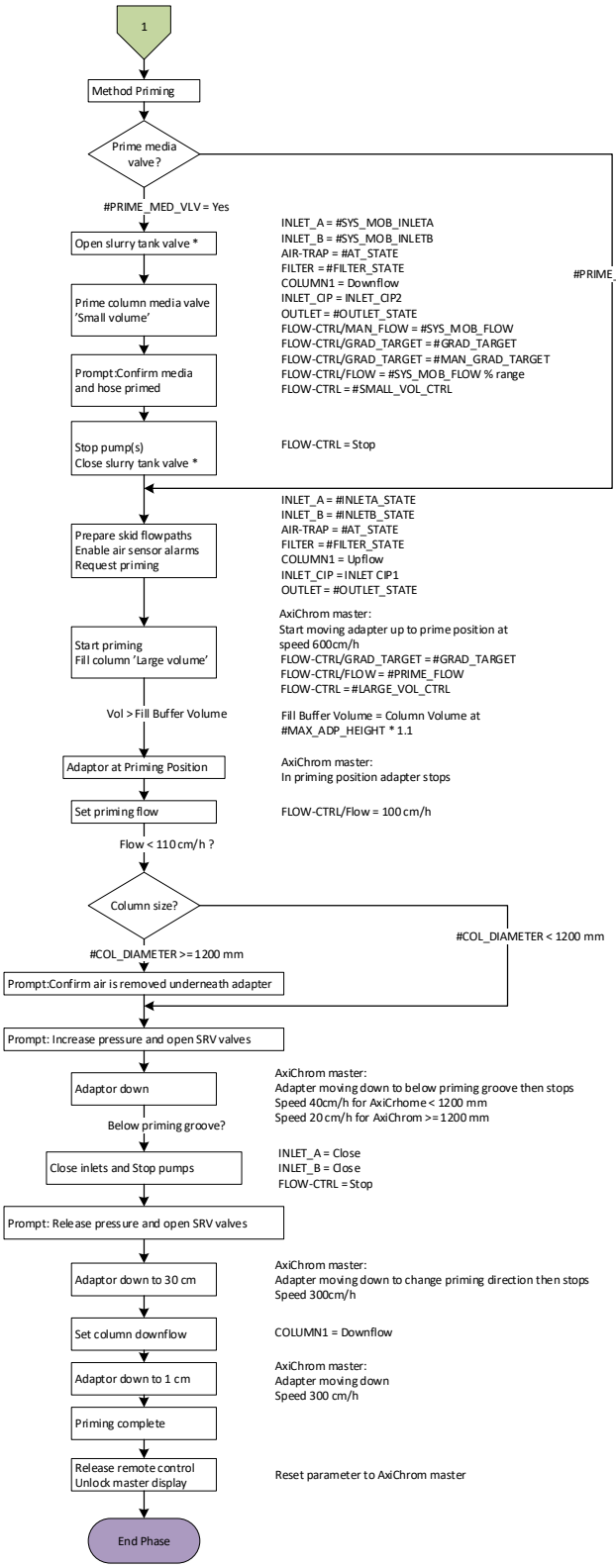
The following aliases is specified in FAIL_MONITOR for acquiring of Equipment Modules.

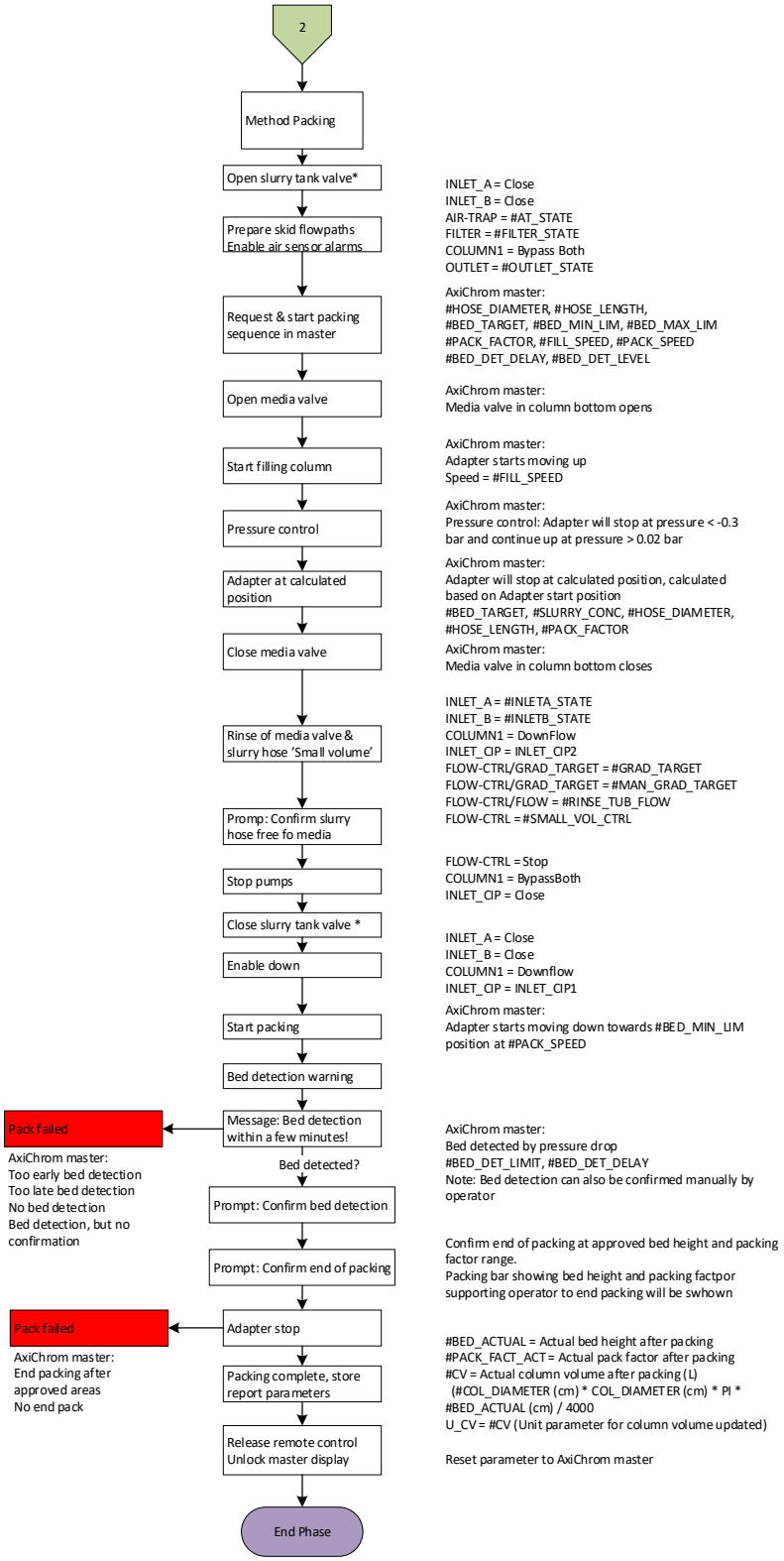
DeltaV Alias	EQxx	EQxx_PRIVATE	EQxx_HOLD_TIME	EQxx_RESTART_1ST	EQxx_HOLD
FLOW-CTRL	EQ01	True	10	False	True
INLET_A	EQ02	True	10	True	True
INLET_B	EQ03	True	10	True	True
INLET_CIP	EQ04	True	10	True	True
AIR-TRAP	EQ05	True	10	True	False
FILTER	EQ06	True	10	True	False
COLUMN1	EQ07	True	10	True	False
OUTLET	EQ08	True	10	True	True

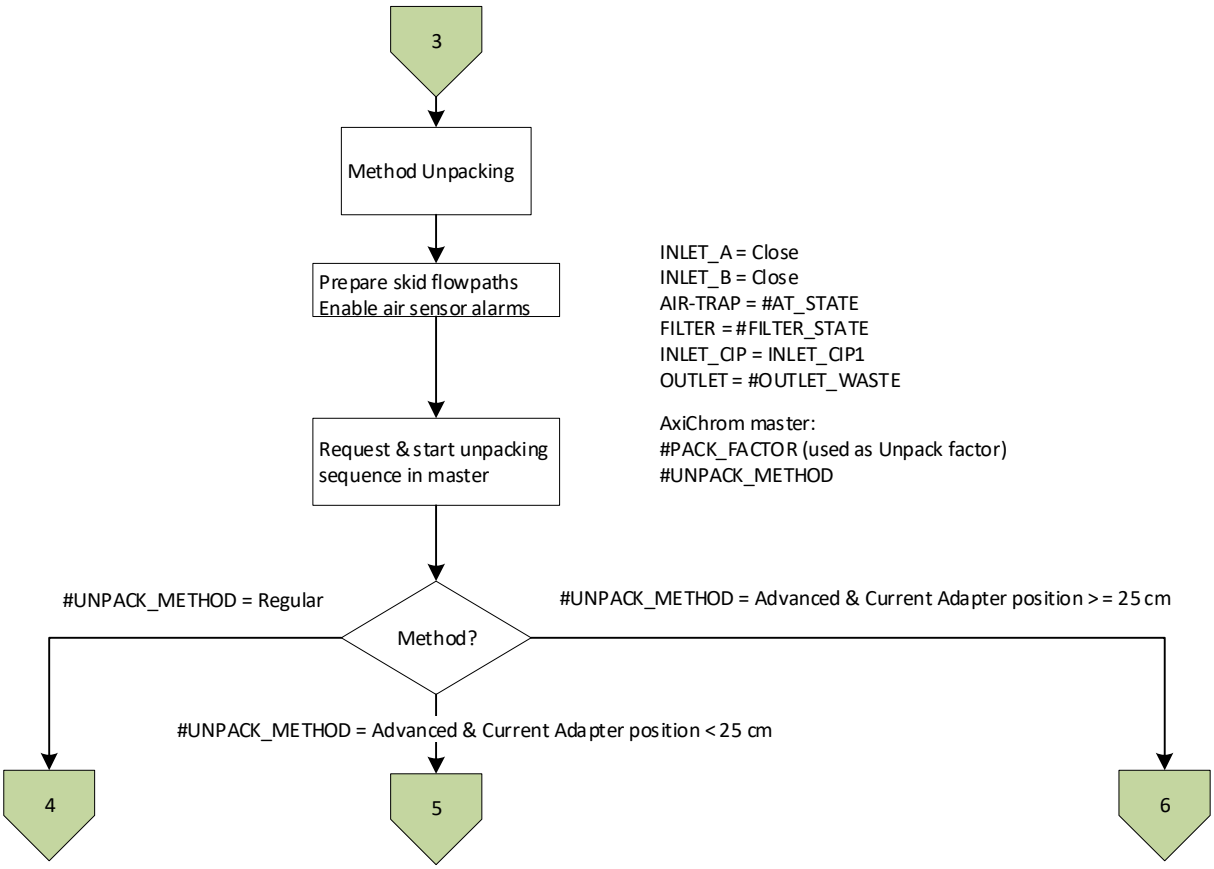
Table 90 – AXICHROM phase aliases

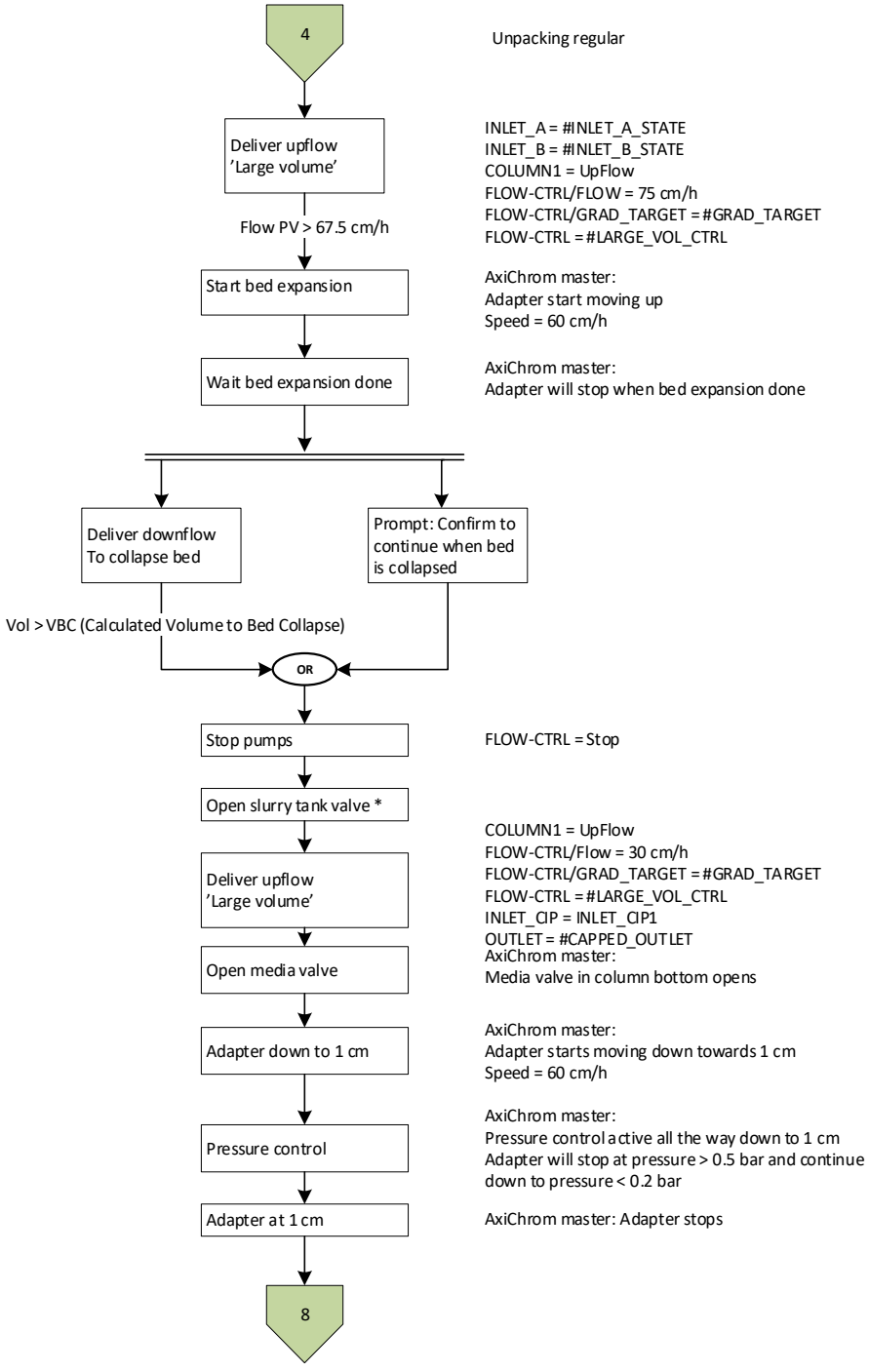
4.15.2 Sequential function chart

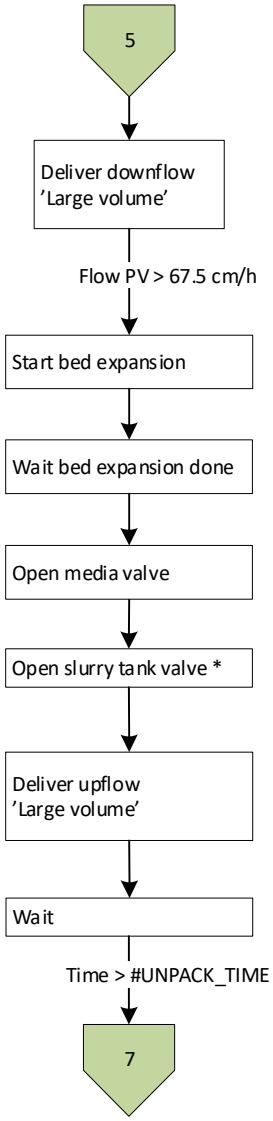












Unpacking advanced And
Current Adapter position < 25 cm

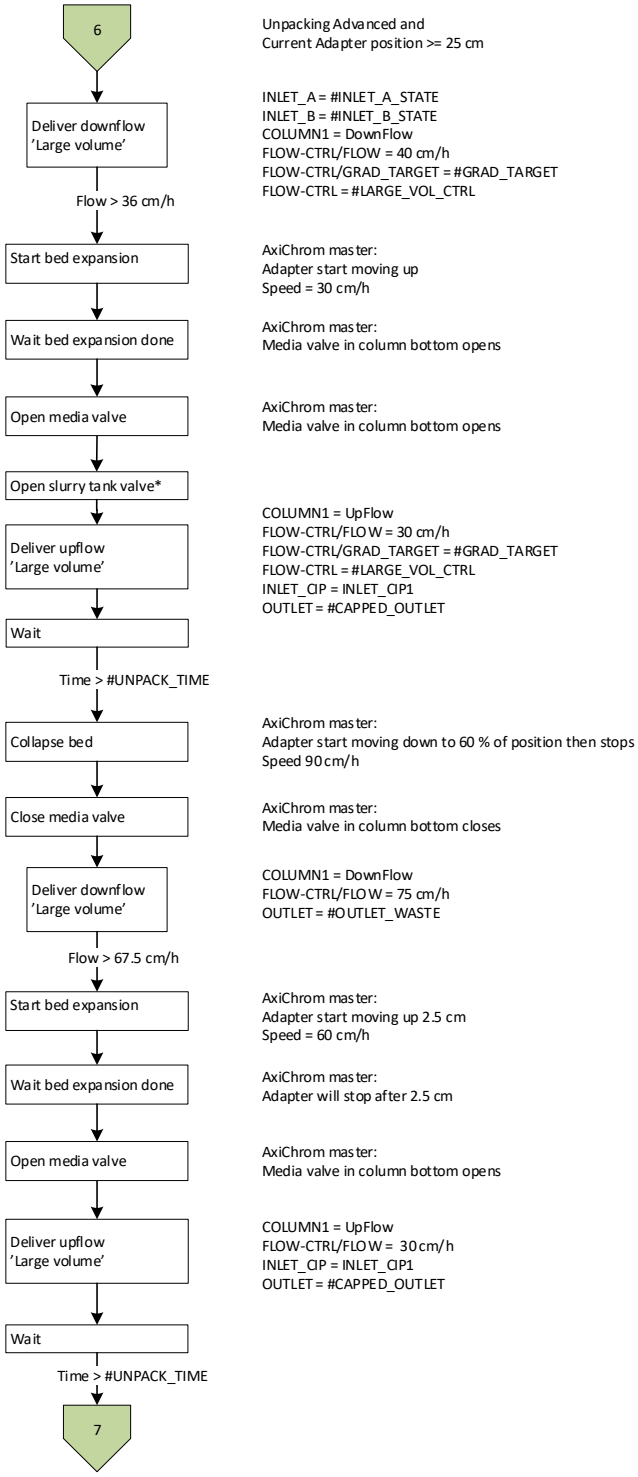
INLET_A = #INLET_A_STATE
INLET_B = #INLET_B_STATE
COLUMN1 = DownFlow
FLOW-CTRL/FLOW = 75 cm/h
FLOW-CTRL/GRAD_TARGET = #GRAD_TARGET
FLOW-CTRL = #LARGE_VOL_CTRL

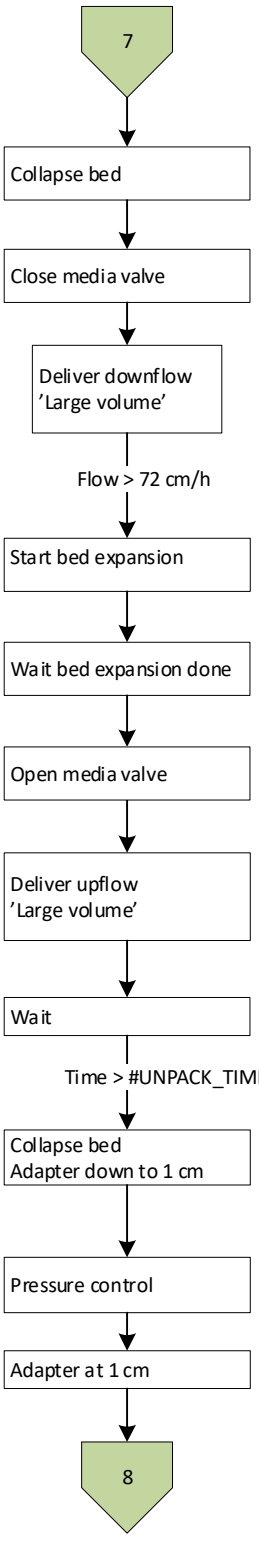
AxiChrom master:
Adapter start moving up
Speed = 60 cm/h

AxiChrom master:
Adapter will stop when bed expansion done

AxiChrom master:
Media valve in column bottom opens

COLUMN1 = UpFlow
FLOW-CTRL/FLOW = 30 cm/h
FLOW-CTRL/GRAD_TARGET = #GRAD_TARGET
FLOW-CTRL = #LARGE_VOL_CTRL
INLET_CIP = INLET_CIP1
OUTLET = #CAPPED_OUTLET





AxiChrom master:
Adapter start moving down to 45 % of position then stops
Speed 90 cm/h

AxiChrom master:
Media valve in column bottom closes

COLUMN1 = DownFlow
FLOW-CTRL/FLOW = 80 cm/h
OUTLET = #OUTLET_WASTE

AxiChrom master:
Adapter start moving up 4 cm
Speed = 60 cm/h

AxiChrom master:
Adapter will stop after 4 cm

AxiChrom master:
Media valve in column bottom opens

COLUMN1 = UpFlow
FLOW-CTRL/FLOW = 30 cm/h
INLET_CIP = INLET_CIP1
OUTLET = #CAPPED_OUTLET

AxiChrom master:
Adapter starts moving down towards 1 cm
Speed = 30 cm/h
Adjust speed after 1 cm to 60 cm/h
Adjust speed after 4 cm to 90 cm/h
Adjust speed after 7 cm to 120 cm/h

AxiChrom master:
Pressure control active all the way down to 1 cm
Adapter will stop at pressure > 1.0 bar and continue down to pressure < 0.5 bar

AxiChrom master: Adapter stops

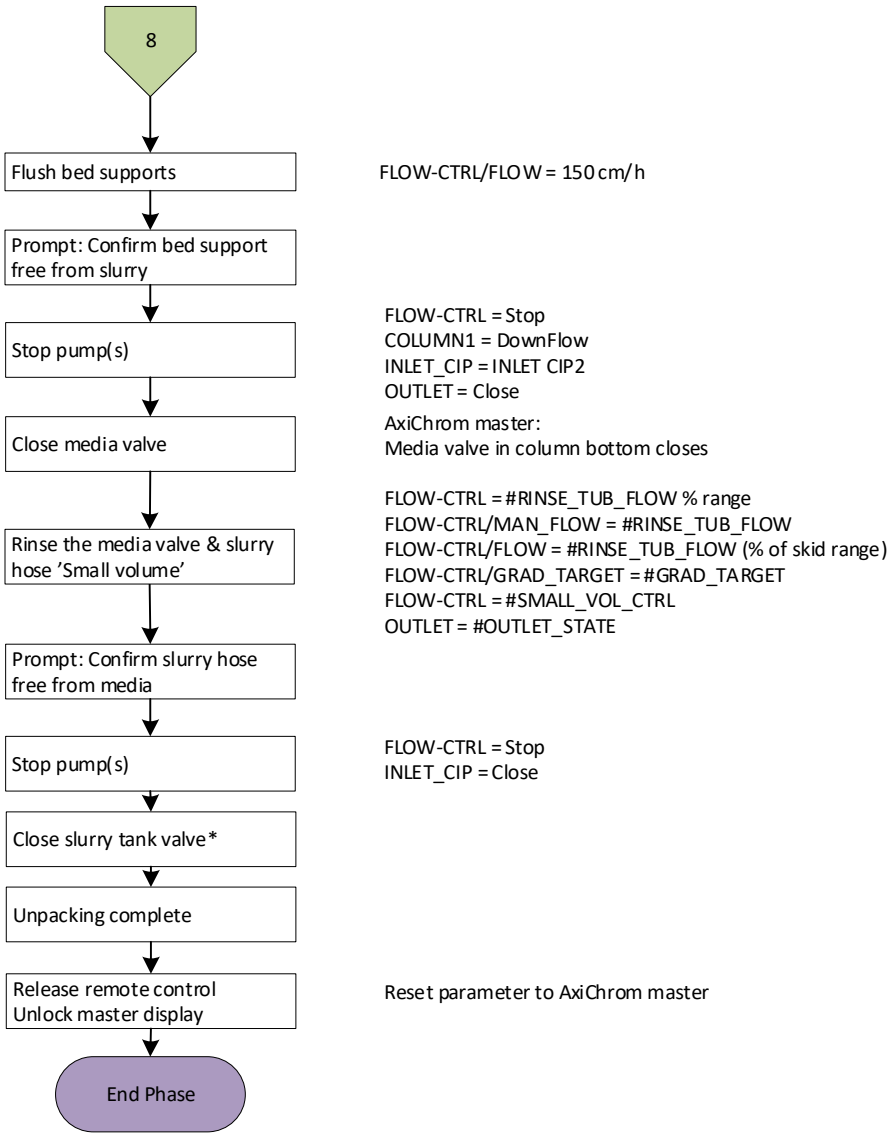


Figure 24 - AXICHROM phase sequential function chart

4.15.3 Hold logic

This section specifies changes in Hold logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S1	A2	0	If AxiChrom master in remote control, then Pause AxiChrom master
S200 (Hold)	A6	1	EQ05: AIR-TRAP
	A7	2	EQ06: FILTER
	A8	3	EQ07: COLUMN1
	A9	4	EQ08: OUTLET

Table 91 – AXICHROM phase hold logic

4.15.4 Restart logic

This section specifies changes in Restart logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S9999	A8	0	If AxiChrom master in remote control, then Resume AxiChrom master

Table 92 – AXICHROM phase restart logic

4.15.5 Stop and Abort logic

This section specifies changes in Stop- and Abort logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S1	A2	0	End AxiChrom master
	A3	0	Reset parameters to AxiChrom master
S100 (Stop / Abort)	A5	1	EQ04: INLET-CIP
	A6	2	EQ05: AIR-TRAP
	A7	3	EQ06: FILTER
	A8	4	EQ07: COLUMN1
	A9	5	EQ08: OUTLET

Table 93 – AXICHROM phase stop and abort logic

4.15.6 Parameter description

Parameters and a description on how to use them are presented in the table below.

No.	Parameter name	Function	Unit	Input / Report	Used in method			Nominal value		
					Prime	Packing	Unpacking	Default	MIN	MAX
1.	AT_STATE [10)]	Air Trap state	-	R	X	X	X	Bypass	Bypass	Inline
2.	BED_DET_DELAY	Bed detection delay	sec	R		X		2	1	60
3.	BED_DET_LEVEL	Bed detection level	mbar	R		X		10	1	1000

No.	Parameter name	Function	Unit	Input / Report	Used in method			Nominal value		
					Prime	Packing	Unpacking	Default	MIN	MAX
4.	BED_MAX_LIM	Maximum bed height	cm	R		X		10.5	1.0	55.0
5.	BED_MIN_LIM	Minimum bed height	cm	R		X		9.5	1.0	55.0
6.	BED_ACTUAL	Actual bed height after packing	cm	L		X		N/A	N/A	N/A
7.	BED_TARGET	Target bed height	cm	R		X		10.0	1.0	55.0
8.	CAPPED_OUTLET	Unpacking capped Outlet state	-	R			X	Outlet 2	Close	Outlet 3
9.	COL_DIAMETER	Column diameter D-300mm *, D-400mm, D-450mm, D-600mm, D-800mm, D-1000mm, D-1200mm, D-1400mm, D-1600mm. D-1800mm, D-2000mm	mm	R	X	X	X	D-300mm	D-300mm	D-2000mm
10.	COL_HEIGHT	Column height H-300mm *, H-500mm	mm	R	X	X	X	H-300	H-300	H-500
11.	COND_A	Inlet A Conductivity	mS/cm	R	X [1)]	X [1)]	X [1)]	0	0	200
12.	COND_B	Inlet B Conductivity	mS/cm	R	X [1)]	X [1)]	X [1)]	0	0	200
13.	CV	Actual column volume after packing	L	L		X		N/A	N/A	N/A
14.	FILL_SPEED	Packing fill speed	cm/h	R		X		300	10	300
15.	FILTER_STATE [10)]	Filter state	-	R	X	X	X	Bypass	Bypass	Inline
16.	GRAD_TARGET	Gradient target in %B	%	R	X [6)]	X [6)]	X [6)]	0	0	100
17.	HOSE_DIAMETER	Hose inner diameter	mm	R		X		14	1	100
18.	HOSE_LENGTH	Hose length	m	R		X		2	0.01	10.00
19.	INLETA_STATE	Inlet A state	-	R	X	X	X	Inlet A1	Close	Inlet A2
20.	INLETB_STATE	Inlet B state	-	R	X	X	X	Close	Close	Inlet B2

No.	Parameter name	Function	Unit	Input / Report	Used in method			Nominal value		
					Prime	Packing	Unpacking	Default	MIN	MAX
21.	LARGE_VOL_CTRL	Gradient type for large volume control Flow Grad*, Cond Grad All flows except 'Priming of the media valve' and 'Rinsing of the slurry hose' are defined as large volumes	-	R	X [4)]	X [4)]	X	Flow Grad	Flow Grad	Cond Grad
22.	MAN_GRAD_TARG	Man gradient target (%B) for small volume control	%	R	X [2)]	X [2)]	X [2)]	0	0	100
23.	MAX_ADP_HEIGHT	Maximum adapter height In Prime used to calculate priming volume. In Packing used to calculate minimum slurry concentration. If to diluted warning message is given	cm	R	X	X	X [3)]	62	20	120
24.	MAX_PRESS_LIM	Maximum column pressure limit	bar	R	X	X	X	4	0	11
25.	METHOD	AxiChrom method Priming*, Packing, Unpacking	-	R	X	X	X	Priming	Priming	Unpacking
26.	OUTLET_STATE	Outlet state	-	R	X	X	X	Outlet 1	Close	Outlet 3
27.	OUTLET_WASTE	Unpack outlet waste state	-	R			X	Outlet 1	Close	Outlet 3
28.	PACK_FACTOR	Packing / unpacking factor	-	R		X	X	1.15	1.00	1.50
29.	PACK_FACT_ACT	Actual pack factor	-	L		X		N/A	N/A	N/A
30.	PACK_SPEED	Packing speed	cm/h	R		X		60	10	600
31.	PRIME_FLOW	Priming flow	cm/h	R	X			180	30	600

No.	Parameter name	Function	Unit	Input / Report	Used in method			Nominal value		
					Prime	Packing	Unpacking	Default	MIN	MAX
32.	PRIME_MED_VLV	Prime media valve selection Close, Yes – to tank, Yes -to drain	-	R	X			Yes – to tank	No	Yes – to drain
33.	RINSE_TUB_FLOW	Rinse tubing (hose) flow / manual pump speed If SMALL_VOLUME is 'Flow Grad' then 25 %* of system flow range (Range 1.0 – 100.0 %) If SMALL_VOLUME is 'Man Flow' then 30 %* total pump speed (Range 1.0 – 100.0 %)	-	R		X	X	30	1	100
34.	SLURRY_CONC	Slurry concentration. Used to calculate minimum concentration. 70 % * (Range 20 – 80%)	%	R		X		70	20	80
35.	SMALL_VOL_CTRL	Flow type for small volume control Only 'Priming of the media valve' and 'Rinsing of the slurry hose' are defined as small volumes Man Flow *, Flow Grad		R	X [5)]	X	X	Man Flow	Man Flow	Flow Grad

No.	Parameter name	Function	Unit	Input / Report	Used in method			Nominal value		
					Prime	Packing	Unpacking	Default	MIN	MAX
36.	SYS_MOB_FLOW [8]	System mobile flow / manual pump speed If SMALL_VOLUME is 'Flow Grad' then 40 %* of system flow range (Range 1.0 – 100.0 %) If SMALL_VOLUME is 'Man Flow' then 40 %* total pump speed (Range 1.0 – 100.0 %)	%	R	X [7]	X [4]	X [4]	40	1	100
37.	SYS_MOB_INLET A [8]	System mobile inlet A state	-	R	X [7]	X [4]	X [4]	Inlet A1	Close	Inlet A2
38.	SYS_MOB_INLETB [8]	System mobile inlet B state	-	R	X [7]	X [4]	X [4]	Close	Close	Inlet B2
39.	SYS_MOB_VOLUME	System mobile volume	L	R	X [4]	X [4]	X [4]	12	1	1000
40.	SYS_MOB_WASH	System mobile wash selection	-	R	X	X	X	Yes	No	Yes
41.	UNPACK_METHOD	Unpacking method Depending on type of media (Regular or advanced)	-	R			X	Regular Media	Regular Media	Advanced Media
42.	UNPACK_TIME	Unpacking wait time after bed expansion	min	R			X [9]	5	1	60

Table 94 – AXICHROM phase parameter description

1) Only used if LARGE_VOL_CTRL is set to 'Cond Grad'
2) Only used if SMALL_VOL_CTRL is set to 'Man Flow'
3) Not used in any calculation – only for graphic animation of adapter position
4) Only used if SYS_MOB_WASH is 'Yes'
5) Only used if PRIME_MED_VLV is 'Yes'
6) Only used in 'Flow Grad' and 'Cond Grad'
7) Only used if SYS_MOB_WASH is 'Yes' or PRIME_MED_VLV is 'Yes'
8) Also used for priming of column media valve in Prime
9) Used in Advanced media unpacking
10) Only Inline or Bypass

4.15.7 Interlocks

Condition	Description	Expression	Delay (sec)
1.	Critical alarm detected	#ALARM#/FAULT_LATCH	0

Table 95 - AXICHROM phase interlocks

4.16 Phase logic COL_PER

HETP phase is to run a column performance test. The phase sequence is equilibration, injection and wash. The phase can end either by stopping the pump(s) and closing the flow path or keeping the pump(s) running and the flow path open. There is an option to disable alarms or keep them enabled when the phase ends.

If the calculations for some reason isn't done when the pump stops a prompt with calculation failed will be presented. When acknowledged the phase ends.

When calculations complete as expected there are three options in the end of phase:

- The phase completes without presenting the results in the operator view
- Plates per meter, asymmetry and reduced plate height is presented in a prompt. When acknowledged the phase ends. (Reduced plate height if particle size is defined)
- As item above but with an option to do another calculation on the same data. If acknowledged 'No' the phase ends. If acknowledged 'Yes' another prompt is presented where the user shall define the baseline to be used for the recalculation. The prompt will show the previous baseline used, and the maximum peak value.

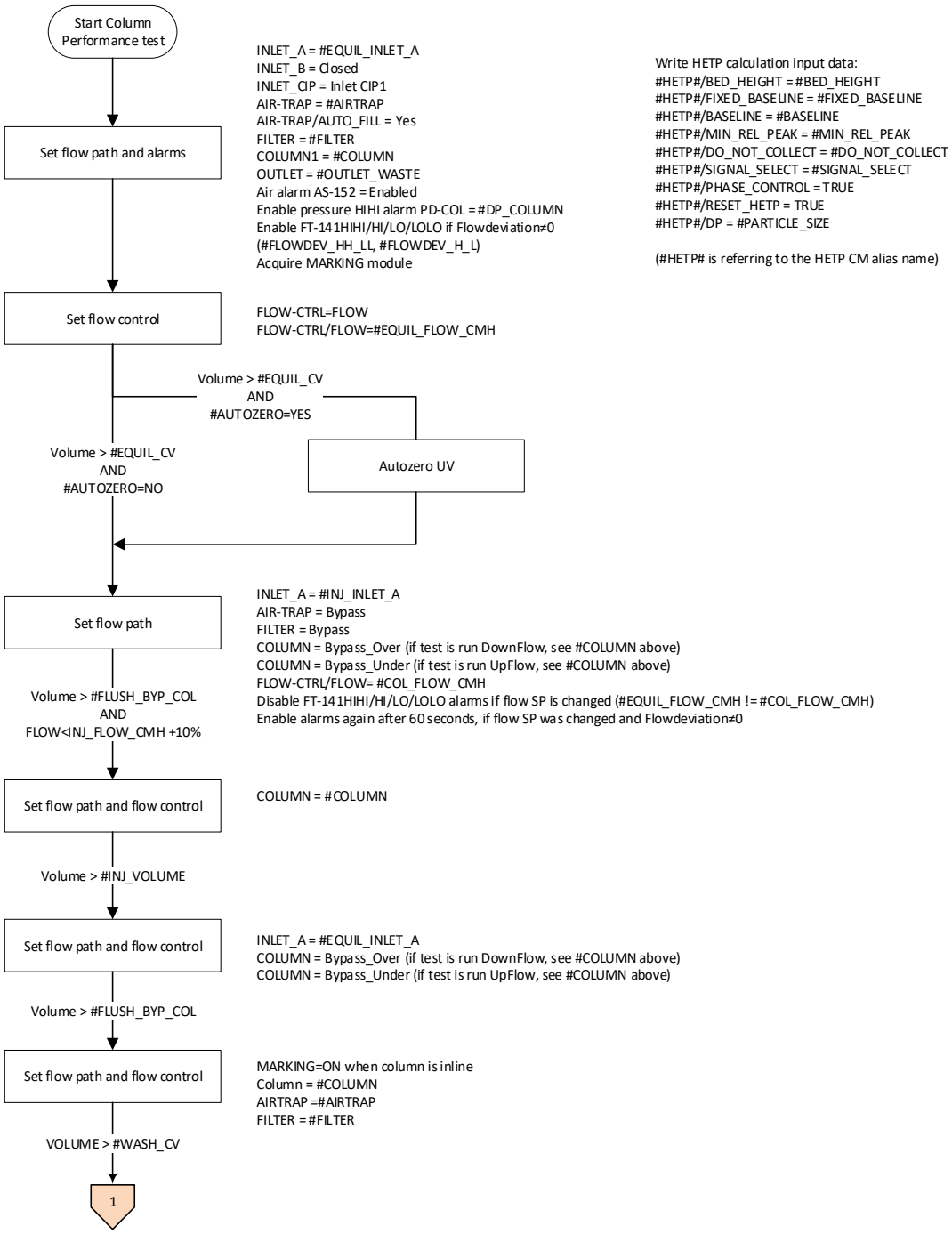
4.16.1 Aliases

The following aliases is specified in FAIL_MONITOR for acquiring of Equipment Modules.

DeltaV Alias	EQxx	EQxx_PRIVATE	EQxx_HOLD_TIME	EQxx_RESTART_1ST	EQxx_HOLD
FLOW-CTRL	EQ01	True	10	False	True
INLET_A	EQ02	True	10	True	True
INLET_B	EQ03	True	10	True	True
INLET_CIP	EQ04	True	10	True	True
AIR-TRAP	EQ05	True	10	True	False
FILTER	EQ06	True	10	True	False
COLUMN1	EQ07	True	10	True	False
OUTLET	EQ08	True	10	True	True

Table 96 – COL_PER (HETP) phase aliases

4.16.2 Sequential function chart



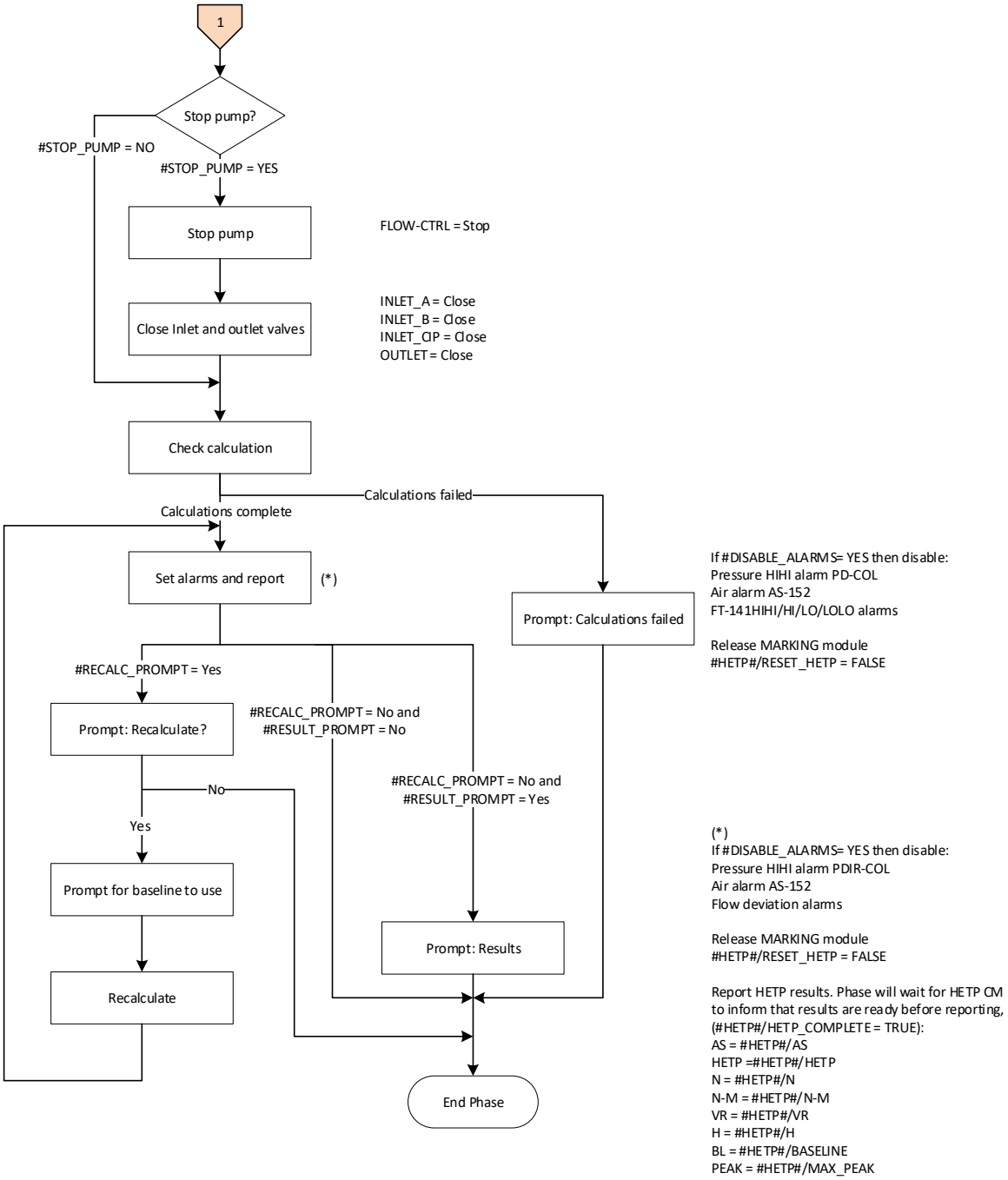


Figure 25 – COL_PER (HETP) phase flow chart

4.16.3 Hold logic

This section specifies changes in Hold logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S200 (Hold)	A6	1	EQ05: AIR-TRAP
	A7	2	EQ06: FILTER
	A8	3	EQ07: COLUMN1
	A9	4	EQ08: OUTLET

Table 97 – COL_PER (HETP) phase hold logic

4.16.4 Restart logic

This section specifies changes in Restart logic compared to the standard Phase Shell: None

4.16.5 Stop and Abort logic

This section specifies changes in Stop- and Abort logic compared to the standard Phase Shell:

Step	Action	Time delay	EQ number / Alias / Description
S100 (Stop / Abort)	A5	1	EQ04: INLET-CIP
	A6	2	EQ05: AIR-TRAP
	A7	3	EQ06: FILTER
	A8	4	EQ07: COLUMN1
	A9	5	EQ08: OUTLET
S9999	A6	0	Disable PD-COL HIHI alarm
	A7	0	Disable AS-152 alarm
	A8	0	Release MARKING module
	A9	0	Reset HETP module phase control
	A10	0	Disable FT-141 HIHI, HI, LO and LOLO alarm

Table 98 – COL_PER (HETP) phase stop and abort logic

4.16.6 Parameter description

Parameters and a description on how to use them are presented in the table below.

No.	Parameter name	Function	Unit	Input	Report	Nominal value		
						Default	MIN	MAX
1.	AS	Asymmetry	-	-	L	-	-	-
2.	BL	Fixed or calculated baseline [UV or Conductivity]	-	-	L	-	-	-
3.	H	Reduced plate height	-	-	L	-	-	-
4.	HETP	Plate height [cm]	cm	-	L	-	-	-

No.	Parameter name	Function	Unit	Input	Report	Nominal value		
						Default	MIN	MAX
5.	N	Number of plates	-	-	L	-	-	-
6.	N-M	Plates per meter	-	-	L	-	-	-
7.	PEAK	Maximum recorded value [UV or Conductivity]	-	-	L	-	-	-
8.	RECALCULATE	Defines number of times recalculation was done	-	-	L	-	-	-
9.	VR	Retention volume	L	-	L			
10.	AIRTRAP	AirTrap position	-	R	-	Inline[1)]	Inline	Bypass
11.	AUTOZERO	Autozero of UV after equilibration	-	R	-	Yes	No	Yes
12.	BASELINE	If fixed baseline selected set the baseline value (UV or Conductivity)	-	R	-	0	0	999
13.	BED_HEIGHT	Packed bed height in cm	cm	R	-	0	0	50
14.	COL_FLOW_CMH	Total flow for column injection and wash	cm/h	R	-	100.0	0	3000.0
15.	COLUMN	Column position	-	R	-	DownFlow[2)]	UpFlow	DownFlow
16.	DISABLE_ALARMS	Disables alarms enabled in phase at phase end	-	R	-	NO	NO	YES
17.	DO_NOT_COLLECT	Percentage of relative peak height where data will not be stored and are not needed for calculation	%	R	-	0	0	5
18.	DP_COLUMN	Max. diff. pressure column	bar	R	-	6.0	0	6.0
19.	EQUIL_CV	Equilibration amount as column volume	CV	R	-	3.0	0	10.0
20.	EQUIL_FLOW_CMH	Total flow for column equilibration	cm/h	R	-	100.0	0	3000.0
21.	EQUIL_INLET_A	Inlet A for column equilibration	-	R	-	Close	Close	Inlet A6
22.	FILTER	Filter position	-	R	-	Bypass[1)]	Bypass	Inline
23.	FIXED_BASELINE	If no the baseline will be calculated by the module	-	R	-	NO	NO	YES
24.	FLOWDEV_H_L[3)]	Hi/Lo flow deviation alarm	%	R	-	5	0	100
25.	FLOWDEV_HH_LL[3)]	HiHi/LoLo flow deviation alarm	%	R	-	10	0	100
26.	FLUSH_BYP_COL	Flush line up to column before and after injection	L	R	-	5.0	0.0	20.0
27.	INJ_INLET_A	Inlet A for column injection	-	R	-	Close	Close	Inlet A6
28.	INJ_VOLUME	Injection amount as percentage of column volume	%	R	-	1	0	3
29.	MIN_REL_PEAK	Define 50% of minimum expected peak value relative to baseline (UV or Conductivity)	-	R	-	0.05	0	999

No.	Parameter name	Function	Unit	Input	Report	Nominal value		
						Default	MIN	MAX
30.	OUTLET_WASTE	Outlet waste valve	-	R	-	Outlet 1	Close	Outlet 8
31.	PARTICLE_SIZE	Particle diameter for reduced plate height calculation (0 if not know)	µm	R	-	0	0	1000
32.	RECALC_PROMPT	Enable prompt with recalculate option	-	R	-	NO	NO	YES
33.	RESULT_PROMPT	Prompt HETP and asymmetry results	-	R	-	NO	NO	YES
34.	SIGNAL_SELECT	Transmitter to be used for HETP	-	R	-	UV	UV	Conductivity
35.	STOP_PUMP	Stop pump or keep running after phase ends	-	R	-	YES	NO	YES
36.	WASH_CV	Total wash volume when running injection sample over column	CV	R	-	2.0	1.0	10.0
37.								
38.								

Table 99 – COL_PER (HETP) phase parameter description

1) Note 1: Inline or Bypass option only
2) Note 2: Upflow and Downflow options only
3) Note 3: Flow deviation alarm is disable for 60s if the flowrate is changed, i.e. R_COL_FLOW_CMH and R_EQUIL_FLOW_CMH has different settings

4.17 Phase logic Start, Stop and INIT

The Start and Stop phase is only there for structural reason and works together with the Init phase. The Start phase only waits until the Init phase has done what is necessary (see below) when starting the skid and setting the unit parameter U_UNITOWNER = TRUE. When the process is complete the stop phase will set the unit parameter U_UNITOWNER back to FALSE and the Init phase will close the system and disable alarms. The two phases have no other logic built in apart from this.

The Start and stop phases can be used in Operation-, Unit Procedure- and/or the Procedure level. The sketch below shows how they are intended to be set up:

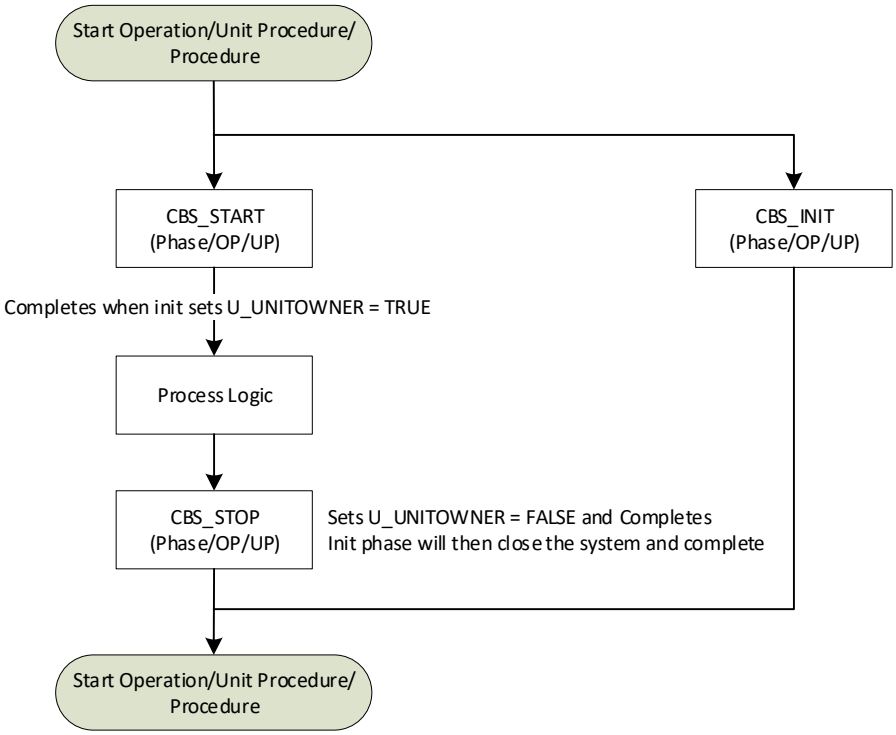


Figure 26 - Start, Stop and Init phase flow chart