SNC·LAVALIN	FUNCTIONAL REQUIREMENTS SPECIFICATION High Rate Clarification	Document Code: A-0102-AFRS-K001
		Revision 01
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APEGM Certificate of Authorization SNC-Lavalin Inc. No. 4489	PROVINCE OF MANITOBA P.D. CHICATUN Member 30307 REGISTERED PROFESSIONAL ENGINEER JULY 13/ 2017 REV. 01

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Table of Contents

Tables

1 OVERVIEW

1.1 Scope of Document

The logic specified in this document is intended to provide functional requirements for PLC-K800 in the HRC Building. Refer to document A-0102-AFRS-A001 for general requirements and standard equipment classes. Refer to PCN Alarm, Range and Settings List for operator setting ranges.

This Functional Requirement Specification (FRS) document is intended to provide an initial basis for development of the PLC and HMI application functionality for the specific process area described herein. The Contractor must provide further development of the PLC and HMI functionality described in this document for a complete and functional system. It is written from a technical perspective and is intended to be read in parallel with the Process Control Narratives (PCNs), the associated Process and Instrument Diagrams (P&IDs), the Instrument Loop Drawings (ILDs) and the other PLC related contract documents. In the event of any discrepancy or any ambiguity, the PCNs, P&IDs, ILDs and other contract documents take precedence (in no specific order of importance) over the FRS documents. Any significant discrepancy should be clarified with the Contract Administrator. All discrepancy resolutions should be documented and submitted as part of the as-built markups. If there are discrepancies from a scope of work perspective, the more stringent requirement shall apply. All scope of work discrepancies should be clarified with the Contract Administrator.

Control functions are described using pseudo code and encapsulated in classes (some of which are commonly applicable for similar or identical equipment systems). These classes may therefore be instantiated as necessary to control similar types of equipment throughout the facility. Each class defines a control interface whose inputs and outputs are interconnected to implement the overall process control strategy as defined by the PCNs, P&IDs, ILDs, etc. and the FRS document. The specific area FRS documents are supported by the General FRS document which provides common definitions for software development required throughout the entire facility.

While the FRS documents provide specific guidance with respect to software development, they should not be presumed to be comprehensive of all software development requirements. Ultimately the P&IDs, the PCNs and the ILDs will govern and take precedence. It is the responsibility of the Contractor to utilize its expertise to provide a fully functional set of developed software in accordance with the contract documents even if not described within the FRS document at no additional cost to the contract. It is the specific responsibility of the Contractor to identify, seek clarification and ultimately resolve any issues of ambiguity, interpretation, uncertainties or discrepancies between the FRS documents and the associated contract documents. This responsibility extends to the need for consultation, as necessary, with the process designers, process equipment vendors, the Engineer, the Owner and any other relevant stakeholders to resolve any issue in accordance with the Contractor's legal obligations for the delivery of the work.

1.2 Associated Documents

The documents associated with the functional requirements are listed below. Additional P&ID drawings may be referenced in this document.

Table 1.2-1 Associated Documents

Document Number	Description	
1-0102-AFRS-A001	FUNCTIONAL REQUIREMENTS SPECIFICATION	GENERAL CLASS DEFINITION
1-0102-PPID-K101	HIGH RATE CLARIFICATION	HRC INFLUENT
1-0102-PPID-K102	HIGH RATE CLARIFICATION	TK-K111 AND TK-K112

1-0102-PPID-K103	HIGH RATE CLARIFICATION	TK-K113 AND TK-K114
1-0102-PPID-K104	HIGH RATE CLARIFICATION	TK-K121 AND TK-K122
1-0102-PPID-K105	HIGH RATE CLARIFICATION	TK-K123 AND TK-K124
1-0102-PPID-K106	HIGH RATE CLARIFICATION	HRC EFFLUENT
1-0102-PPID-K107	POLYMER DISTRIBUTION PANELS	
1-0102-PPID-K108	HRC LAMELLA AIR SCOUR BLOWER	
1-0102-PPID-K201	HIGH RATE CLARIFICATION	RECYCLE PUMPS P-K211, P-K212 & P-K213
1-0102-PPID-K202	HIGH RATE CLARIFICATION	RECYCLE PUMPS P-K221, P-K222 & P-K223
1-0102-PPID-K203	HRC WASTE SLUDGE PUMPS	P-K251 & P-K252
1-0102-PPID-K301	HIGH RATE CLARIFICATION	BALLAST ADDITION
A-0102-PPCN-K001	PROCESS CONTROL NARRATIVE	HIGH RATE CLARIFICATION

2 GENERAL REQUIREMENTS

Refer to document A-0102-AFRS-A001 for general requirements and standard classes.

2.1 Graphic Displays

Create Area Overview, Process Graphic and Detail displays as per City of Winnipeg HMI Layout and Animation plan document (612620-0015-40ER-0001) and General Functional Requirements Specification A-0102-AFRS-A001.

The following tables provide guidance on the minimum anticipated groupings of process displays, however, these should not be considered as fully defined and modifications and additions may be required.

Note that only mayor or representative equipment and devices are explicitly shown in the graphic display tables, all others are also required.

Table 2.1-1 Level 2 Area Graphic Displays – High Rate Clarification Overview

Group	Content
General	YC-K1000_DS.EqmtLead Text (HRC Lead Train 1 Or 2) FIC-K1000 Plant Influent Flow Bar Graph and Text FI-K1001 HRCs Total Influent Flow Bar Graph and Text FI-K1001_SP HRCs Total Influent Flow Setpoint Bar Graph and Text AI-G3611 HRC Influent Turbidity Bar Graph and Text AI-G3611_TSS HRC Influent Total Suspended Solids Bar Graph and Text AI-G3612 HRC Influent PH Bar Graph and Text FI-K1511 HRCs Effluent Flow to Outfall Sewer Bar Graph and Text XV-K1513 HRCs Effluent Channel Gate To Bioreactors Status
HRC 1	XC-G3621 / XV-G3621 HRC 1 Influent Channel Gate Status YC-K1100_StartPerm / HRC 1 Auto Start Permissive Status Text Train 1 Auto starting / Running / Auto Stopping Status Text[1] Train 1 Main Sequences State Status FIC-K1102 / HRC 1 Influent Channel Flow Bar Graph, Text and Trend TK-K111 Coagulation Zone Mixer running YC-K1110 Status TK-K112 Injection Zone Mixer running YC-K1120 Status TK-K113 Maturation Zone Mixer running YC-K1130 Status TK-K114 Clarifier Sludge Collector YC-K1140 Status Recycle pumps P-K211/2 & 3 Status AI-K1151 Train 1 Effluent Turbidity Bar Graph and Text AI-K1151_TSS Train 1 Effluent Total Suspended Solids Bar Graph and Text AI-K1152 Train 1 Effluent pH Bar Graph and Text Wet Storage Sequences State Status
HRC 2	Similar to HRC 1
Waste Sludge Sump	TK-K250 HRC Waste Sludge Sump Level LIC-K2501 Bar Graph and Text P-K25(1/2) HRC Waste Sludge Sump Pump Speed YC-K25(1/2)0.Fbk_Out Bar Graph and Text HRC Waste Sludge Flow to Fermenters FI-K2542 Bar Graph and Text Primary Sludge Fermenter Level LC-D4100 Bar Graph and Text

[1] Repeat in the general group if the general group is in a different screen.

Group	Content
	HRC Waste Sludge Flow to Primary Clarifiers FI-K2541 Bar Graph and Text
Sump Pumps	P-K50(1/2) HRC Building Sump Pumps

Table 2.1-2 Level 3 and Level 4 Graphic Displays

Display Group	Level	Content
Overview Trends	4	(See Trends section below)
Influent / Effluent	3	HRC Influent and Effluent
Effluent	4	Effluent to BNR/outfall states and settings
HRC 1	3	TK-K111 Coagulation Zone TK-K112 Injection Zone TK-K113 Maturation Zone TK-K114 Clarifier
HRC 1 Main Sequence	4	Auto start and auto stop sequence details and settings
HRC 1 LTUP	4	Wet storage level top up sequence details and settings
HRC 1 WSR	4	Wet storage recirculation sequence details and settings
HRC 1 WSSC	4	Wet storage superchlorination details and settings
HRC 1 DF	4	Drain and refill details and settings
HRC 1 Recycle Pump	3	Recycle Pumps PK-20(1/2/3)
HRC 1 Chemical	4	Chemical Details
HRC 1 Auto Sand Addition	4	HRC 1 Auto Sand Addition Sequence details and settings
HRC 2		Similar to HRC 1
Air Scour Blower	3	HRC Lamella Air Scour Blower
Waste Sludge	3	Waste Sludge TK-250, Pumps P-K251 and P-K252, secondary clarifiers / fermenters redirection and P-K253 drain pump
Ballast Addition	3	Ballast addition system
Electrical	4	Area K Electrical Third Party Information

Display Group	Level	Content
PCS Status	4	PLC Status and Basic Diagnostics for - Main Controller Racks - Remote I/O Racks - Networking Components (Including switch diagnostic when available) - RIO, DIO, Modbus and Profibus devices - Other PLCs in the area (E.G. unit or vendor PLCs) - Power Supplies

2.2 Trends

Create, at minimum, the following trend displays, with the indicated pens. Create appropriate links from the various graphic screens to the trend displays.

Table 2.2-1 Trends

Trend Group	Content	
Inlet /Outlet Flows	FIC-K1000.Out	Plant Influent Flow
	FI-K1001.Out	HRCs Total Influent Flow
	FI-K1511.Out	HRCs Effluent Flow to Outfall Sewer
Inlet/Outlet TSS	AI-G3611_TSS.Out	HRC Influent Total Suspended Solids
	AI-K1(1/2)51_TSS.Out	HRC (1/2) Effluent Total Suspended Solids
Inlet/Outlet Turbidity	AI-G3611.Out	HRC Influent Turbidity
	AI-K1(1/2)51.Out	HRC (1/2) Effluent Turbidity
Inlet/Outlet PH	AI-G3612.Out	HRC Influent PH
	AI-K1(1/2)52.Out	HRC (1/2) Effluent PH
HRC 1	FIC-K1102.Out	Train 1 Influent Channel Flow
	YC-K1140.Fbk_Out	Clarifier Sludge Collector speed
	FQI-K3120_HRC1	HRC 1 Accumulated Sand Mass
	OI-K1140.Out	CM-K114 TK-K114 Clarifier Sludge Collector Torque
HRC 1 Sand Dosing	FQI-K3120_HRC1	HRC 1 Accumulated Sand Mass
	K3120_HRC(1/2)_PrevDay	Previous Day Previous Day Sand Mass
HRC 2	Similar to HRC 1	
HRC 2 Sand Dosing	Similar to HRC 1 Sand Dosing	
TK-K250 Waste Sludge Sump	LIC-K2501.Out	HRC Waste Sludge Sump Level
	YC-K2510.Fbk_Out	P-K251 HRC Waste Sludge Sump Pump Speed

Trend Group	Content	
	YC-K2520.Fbk_Out	P-K252 HRC Waste Sludge Sump Pump Speed
Waste Sludge	FI-K2542.Out	HRC Waste Sludge Flow to Fermenters
	FI-K2541.Out	Waste Sludge Flow to Primary Clarifiers

2.3 Inputs from Other PLCs

Some variables will be shared among different areas of the plant. They will be communicated via the Fibre Ethernet redundant ring connecting the PLCs. s are listed below, along with their default value in the event of a communications failure.

The following table provide guidance on the minimum anticipated variables that are read from other PLC along with their default value in the event of a communications failure, however, these should not be considered as fully defined and modifications and additions may be required.

Input	Description	Source PLC	Value On Communication Error
GBL_C800_Standby_Power_Run_Inhibit	Standby Power Generation Run Inhibit	PLC-C800	Last
GBL_C800_Standby_Power_State_Number	Standby Power Generation State Number	PLC-C800	Last
GBL_C800_Standby_Power_Manual_Enable	Standby Power Generation Manual Operation Enable	PLC-C800	Last
GBL_G800_FI-G1100_Out	Plant Influent Flow	PLC-G800	Last
GBL_G800_FI-G1100_AlmErr	Plant Influent Flow Bad Quality	PLC-G800	Last
GBL_G800_XC-G36(2/3)1_Rdy	XV-G3621 HRC Train (1/2) Influent Channel Gate Ready	PLC-G800	Last
GBL_G800_XC-G36(2/3)1_ConfOpn	XV-G3621 HRC Train (1/2) Influent Channel Gate Confirmed Open	PLC-G800	Last
GBL_G800_XC-G36(2/3)1_ConfCls	XV-G3621 HRC Train (1/2) Influent Channel Gate Confirmed Closed	PLC-G800	Last
GBL_G800_XC-G36(2/3)1_Fail	XV-G3621 HRC Train (1/2) Influent Channel Gate Fail	PLC-G800	Last

Input	Description	Source PLC	Value On Communication Error
	Summanry		
GBL_G800_XC-G36(2/3)1_AlmErr	XV-G3621 HRC Train (1/2) Influent Channel Gate Bad Quality	PLC-G800	True
GBL_G800_XC-G36(2/3)2_Rdy	XV-G3622 HRC Train (1/2) Influent Flushing Water Ready	PLC-G800	False
GBL_G800_XC-G36(2/3)2_ConfOpn	XV-G3622 HRC Train (1/2) Influent Flushing Water Confirmed Open	PLC-G800	False
GBL_G800_XC-G36(2/3)2_ConfCls	XV-G3622 HRC Train (1/2) Influent Flushing Water Confirmed Closed	PLC-G800	False
GBL_G800_XC-G36(2/3)2_Fail	XV-G3622 HRC Train (1/2) Influent Flushing Water Fail Summary	PLC-G800	True
GBL_G800_XC-G36(2/3)2_AlmErr	XV-G3622 HRC Train (1/2) Influent Flushing Water Bad Quality	PLC-G800	True
GBL_G800_AI-G3611_Out	HRC 1 & 2 Influent Turbidity Value	PLC-G800	Last
GBL_G800_AI-G3611_AlmErr	HRC 1 & 2 Influent Turbidity Bad Quality	PLC-G800	True
GBL_G800_AI-G3611_CtrlHi_Act	HRC 1 & 2 Influent Turbidity Value High Control Level and HRC Influent analyzer alarm deactivation delay has elapsed	PLC-G800	Last
GBL_G800_AI-G3611_CtrlLo	HRC 1 & 2 Influent Turbidity Value Low Control Level	PLC-G800	Last
GBL_G800_AI-G3612_Out	HRC 1 & 2 Influent pH Value	PLC-G800	Last
GBL_G800_AI-G3612_AlmErr	HRC 1 & 2 Influent pH Bad Quality	PLC-G800	True
GBL_G800_FAL-G3614_Alm	HRC 1 & 2 Influent Turbidity and pH Sensor Low Sample Flow	PLC-G800	Last

Input	Description	Source PLC	Value On Communication Error
GBL_G800_FAL-G3614_AlmErr	HRC 1 & 2 Influent Turbidity and pH Sensor Low Sample Flow Bad Quality	PLC-G800	True
GBL_D800_LI-D3041_AlmHi	Primary Sludge Fermenters Train 1 Cell 4 Level High	PLC-D800	Last
GBL_D800_LI-D3041_AlmHiHi	Primary Sludge Fermenters Train 1 Cell 4 Level HighHigh	PLC-D800	True after 60 seconds TBDC
GBL_D800_LI-D3041_AlmErr	Primary Sludge Fermenters Train 1 Cell 4 Level Bad Quality	PLC-D800	True
GBL_D800_LI-D3141_AlmHi	Primary Sludge Fermenters Train 2 Cell 4 Level High	PLC-D800	Last
GBL_D800_LI-D3141_AlmHiHi	Primary Sludge Fermenters Train 2 Cell 4 Level HighHigh	PLC-D800	True after 60 seconds TBDC
GBL_D800_LI-D3141_AlmErr	Primary Sludge Fermenters Train 2 Cell 4 Level Bad Quality	PLC-D800	True
GBL_C800_YC-C1241_NotAvail	HRC 1 Coagulant Not Available	PLC-C800	Last
GBL_C800_YC-C1341_NotAvail	HRC 2 Coagulant Not Available	PLC-C800	Last
GBL_C800_YC-C4529_PathANotAvail	HRC 1 Polymer Not Available	PLC-C800	Last
GBL_C800_YC- C4529_PathBNotAvail	HRC 2 Polymer Not Available	PLC-C800	Last
GBL_C800_YC-C2229_PathANotAvail	HRC 1 Sodium Hypochlorite Not Available	PLC-C800	Last
GBL_C800_YC-C2229_PathBNotAvail	HRC 2 Sodium Hypochlorite Not Available	PLC-C800	Last
GBL_C800_ YC-C224(1/2)_DropShaft_SH	HRC (1/2) Sodium Hypochlorite Flow Mode Drop Shaft Selected	PLC-C800	Last
GBL_C800_ YC-C224(1/2)_ Matur_SH	HRC (1/2) Sodium Hypochlorite Flow Mode Maturation Selected	PLC-C800	Last
GBL_C800_YC-C2312_NotAvail	HRC 1 Sodium Hydroxide	PLC-C800	Last

Input	Description	Source PLC	Value On Communication Error
	Not Available In Influent Mode		
GBL_C800_YC-C2322_NotAvail	HRC 2 Sodium Hydroxide Not Available In Influent Mode	PLC-C800	Last

2.4 Logic and variables for other PLCs

The following sections provide guidance on the minimum anticipated variables and logic required from this PLC for other PLCs, however, these should not be considered as fully defined and modifications and additions may be required.

Variable	Description	Source
GBL_K800_ XC-G36(2/3)1_OpenReq	HRC Train (1/2) Influent Channel Gate Open Request to G Area	YC-K1(1/2)00_GateOpen
GBL_K800_ HA-K1(1/2)06_Alm	HRC (1/2) Process Stop Hand Switch Summary	HA-K1(1/2)06.Alm
GBL_K800_ HA-K1(1/2)06_AlmErr	HRC (1/2) Process Stop Hand Switch Summary Bad Quality	HA-K1(1/2)06.AlmErr
GBL_K800_ XC-G36(2/3)2_OpenReq	HRC Train (1/2) Influent Flushing Water Open Request to G Area	(YC-K1(1/2)00_DF_FlushingVlvOpen OR YC-K1(1/2)00_LTUP_FlushingVlvOpen OR YC-K1(1/2)00_WSSC_FlushingVlvOpen) AND NOT LI-K1102.AlmHi
GBL_K800_FIC-K1(1/2)02_Out	HRC Train (1/2) Influent Channel Flow	FIC-K1(1/2)02.Out
GBL_K800_FIC-K1(1/2)02_AlmErr	HRC Train (1/2) Influent Channel Flow Bad Quality	FIC-K1(1/2)02.AlmErr
GBL_K800_YC-K1(1/2)00_CoagulatReq	HRC Train (1/2) Coagulant Dosing Request	YC-K1(1/2)00_ChemReq
GBL_K800_YC-K1(1/2)00_Poly_Req	HRC Train (1/2) Polymer Dosing Request	YC-K1(1/2)00_ChemReq
GBL_K800_YC-K1(1/2)00_SH_FlowReq	HRC Train (1/2) Sodium Hypochlorite Flow Based Dosing Request	YC-K1(1/2)00_ChemReq AND (GBL_C800_YC-C224(1/2)_DropShaft_SH AND XC-K1(1/2)03.ConfOpn OR GBL_C800_YC-C224(1/2)_Matur_SH

Variable	Description	Source
		AND XC-K1(1/2)34.ConfOpn OR NOT (GBL_C800_ YC-C224(1/2)_DropShaft_SH AND GBL_C800_ YC-C224(1/2)_Matur_SH)
GBL_K800_FIC-K1514_Out	HRC BNR Return Flow	FIC-K1514.Out
GBL_K800_FIC-K1514_AlmErr	HRC BNR Return Flow Bad Quality	FIC-K1514.AlmErr
GBL_K800_FIC-K1511_Out	HRC Effluent Channel to Outfall Sewer Flow	FIC-K1511.Out
GBL_K800_FIC-K1511_AlmErr	HRC Effluent Channel to Outfall Sewer Flow Bad Quality	FIC-K1511.AlmErr
GBL_K800_YC-K1(1/2)00_SN_Req	HRC Train (1/2) Sodium Hydroxide Dosing Request	YC-K1(1/2)00_ChemReq
GBL_K800_YC-K1(1/2)00_PolyFlushing_Req	HRC (1/2) Polymer Supply Line Flushing Request (Flushing interval defined in C FRS)	YC-K1(1/2)00_PolyFlushing_Req
GBL_K800_YC-K1(1/2)00_WSSC_SH_Req	HRC Train (1/2) Sodium Hypochlorite Superchlorination Request	YC-K1(1/2)00_WSSC_SH_Req
GBL_K800_YC-K1(1/2)00_SH_TR_Req	HRC Train (1/2) Sodium Hypochlorite Tank Refill Request	YC-K1(1/2)00_DF_SH_Req AND XC-K1(1/2)03.ConfOpn
GBL_K800_YC-K1000_Poly_MD_Req	HRC Polymer Make Down Request	YC-K1000_Poly_MD_Req
GBL_K800_YC-K1000_PrimarySludge	HRC Running and Waste Sludge Directed to Primary Clarifiers	(YC-K1100.Running OR YC-K1200.Running) AND XC-K2543.ConfOpn

3 IMPLEMENTATION

SEWPCC has two parallel HRC treatment trains (Train 1 and Train 2). The HRC system treats excess wet weather flow beyond the conventional primary clarifier capacity of 150 ML/d. Each HRC train can treat up to 135 ML/d for a total maximum high rate treatment capacity of 270 ML/d.

3.1 Simple Class Instances

The following tables show simple class instance implementations, other instances are shown in the rest of the document.

3.1.1 AnalogIAC (Analog Indication, Alarming and / or On Off Control)

Table 3.1-1 Simple AnalogIAC Instances

Instance	Source	Description	Alarms (Priority)	Notes
FI-K1001	FIC-K1102.Out + FIC-K1202.Out	HRC Total Influent Flow	N/A	P&ID: PPID-K101
LI-K1(1/2)02	LT-K1(1/2)02	HRC Train (1/2) Influent Channel Level	HiHi (1), Hi(2) & Err(2)	Read through FIT-K1(1/2)02 CtrlLoSP: LI-K1002_MinLevel_Setting (See Note 6) CtrlLoDly:TBDC P&ID: PPID-K101
LI-K1(1/2)32	LT-K1(1/2)32	TK-K1(1/2)3 Maturation Zone Level	HiHi (1), Hi(2) & Err(2)	CtrlLoSP: LIT-K1032_MinLevel_Setting (See Note 1) P&ID: PPID-K10(3/5)
OI-K1(1/2)40	OT-K(1/2)140	HRC (1/2) CM-K1(1/2)4 TK-K(1/2)14 Clarifier Sludge Collector Torque	Err(2)	P&ID: PPID-K10(3/5)
AI-K1(1/2)51	AIT-K1(1/2)51	HRC (1/2) Effluent Turbidity	HiHi(1), Hi(2), & Err(2)	Read through AIT-K1(1/2)53 CtrlHiSP: see note 4 CtrlLoSP: see note 5 CtrlLoDly:TBDC Enable AlmHi and AlmHiHi alarms when (NOT XC-K1(1/2)55.ConfCls) for more than AI-K1053_AlmDeact_Setting minutes. See note 3. AutoRst: TBDC P&ID: PPID-K106
AI-K1(1/2)51_TSS	AI-K1(1/2)51.Out x AIT-K1051_TSS_Ratio_Settting	HRC (1/2) Effluent Total Suspended Solids	N/A	P&ID: PPID-K106
AI-K1(1/2)52	AIT-K1(1/2)52	HRC (1/2) Effluent pH	HiHi(1), Hi(2), Lo(2), LoLo(1) &	Read through AIT-K1(1/2)53 Enable AlmHi/HiHi and

Instance	Source	Description	Alarms (Priority)	Notes
			Err(2)	AlmLo/LoLo alarms when (NOT XC-K1(1/2)55.ConfCls) for more than AI-K1053_AlmDeact_Setting minutes. See note 3.P&ID: AutoRst: TBDC PPID-K106
TI-K1603	TIT-K1603	HRC 1&2 Lamella Air Scour Blower Discharge Air Temperature	HiHi(1), Hi(2), & Err(2)	P&ID: PPID-K108
PI-K1604	PIT-K1604	HRC 1&2 Lamella Air Scour Blower Discharge Air Pressure	HiHi(1), Hi(2), Lo(2) & Err(2)	Enable AlmLo alarm if YC-K1600.Running for more than TBDC seconds P&ID: PPID-K108
PI-K21(1/2/3)2	PT-K21(1/2/3)2	HRC 1 Recycle Pump P-K21(1/2/3) Discharge Pressure	HiHi(1), Hi(2), Lo(2), LoLo(1) & Err(2)	Enable AlmLo and AlmLoLo if YC-K21(1/2/3)0.Running for more than **TBDC** seconds P&ID: PPID-K201
PI-K22(1/2/3)2	PT-K22(1/2/3)2	HRC 2 Recycle Pump P-K22(1/2/3) Discharge Pressure	HiHi(1), Hi(2), Lo(2), LoLo(1) & Err(2)	Enable AlmLo and AlmLoLo if YC-K22(1/2/3)0.Running for more than **TBDC** seconds P&ID: PPID-K202
FI-K2542	FIT-K2542	TK-K250 HRC Waste Sludge Flow to Fermenter	HiHi(1), Hi(2), Lo(2), LoLo(1) & Err(2)	Enable AlmLo and AlmLoLo if ((YC-K2510.Running OR YC-K2520.Running AND NOT XC-K2544.ConfCls) for more than **TBDC** seconds) P&ID: PPID-K203
FI-K2541	FIT-K2541	TK-K250 HRC Waste Sludge Flow to Primary Influent Channel	HiHi(1), Hi(2), Lo(2), LoLo(1) & Err(2)	Enable AlmLo and AlmLoLo if ((YC-K2510.Running OR YC-K2520.Running AND NOT XC-K2543.ConfCls) for more than **TBDC** seconds) P&ID: PPID-K203

Note 1: LIT-K1032_MinLevel_Setting is the operator configurable “Minimum Allowable Level to Enable Start Mixers Setting”.

Note 2: AIT-K1051_TSS_Ratio_Settting is the operator configurable “Effluent Turbidity to TSS Ratio Setting for HRC”.

Note 3: AI-K1053_AlmDeact_Setting in minutes is the “HRC Effluent analyzer alarm deactivation delay”

Note 4: AI-K1(1/2)51.CtrlHiSP := AI-K1051_CtrlHi_Setting. AI- AI-K1051_CtrlHi_Setting is “HRC Lag Pump Effluent Turbidity Start Value”. AI-K1051_CtrlHi_Setting can be modified by an operator with security level M or higher. The operator HMI settings should be range checked before being used.

Note 5: AI-K1(1/2)51.CtrlLoSP := AI- AI-K1051_CtrlLo_Setting. AI-K1051_CtrlLo_Setting is “HRC Lag Pump Effluent Turbidity Stop Value”. AI-K1051_CtrlLo_Setting can be modified by an operator with security level M or higher. The operator HMI settings should be range checked before being used.

Note 6: LI-K1002_MinLevel_Setting is the operator configurable “Minimum Influent Channel Level to Modulate Weir Influent Gate Setting”.

LIT-K1032_MinLevel_Setting, AIT-K1051_TSS_Ratio_Settting and AIT-K1053_AlmDeact_Setting can be modified by an operator with security level M or higher. The operator HMI settings should be range checked before being used.

3.1.2 DiscreteCS (indication and alarming for equipment controlled by the PLC with feedback)

Table 3.1-2 Simple DiscreteCS Instances

Instance	Destination	Description	RunAuto	Alarms (Priority)	Notes
YC-K1(1/2)10	MXR-K1(1/2)1	HRC (1/2) MXR-K1(1/2)1 TK-K1(1/2)1 Coagulation Zone Mixer	YC-K1(1/2)00_CoagMixerRun OR YC-K1(1/2)00_WSR_CoagMixerRun OR YC-K1(1/2)00_WSSC_CoagMixerRun	(2)	Intlk: HA-K1(1/2)06.Alm PathNotRunRdyIn: NOT YC-K1(1/2)00_LiqEnb.Out P&ID: PPID-K10(2/4)
YC-K1(1/2)20	MXR-K1(1/2)2	HRC (1/2) MXR-K1(1/2)2 TK-K1(1/2)2 Injection Zone Mixer	YC-K1(1/2)00_InjectionMixerRun OR YC-K1(1/2)00_WSR_InjectionMixerRun OR YC-K1(1/2)00_WSSC_InjectionMixerRun	(1)	Intlk: HA-K1(1/2)06.Alm PathNotRunRdyIn: NOT YC-K1(1/2)00_LiqEnb.Out P&ID: PPID-K10(2/4)
YC-K1600	B-K160	B-K160 HRC 1&2 Lamella Air Scour Blower	(YC-K1100_ScourBlower OR YC-K1200_ScourBlower) AND NOT (YC-K1100_IS_MajorFault.Alm OR YC-K1200_IS_MajorFault.Alm)	(2)	Intlk: HA-K1106.Alm OR HA-K1206.Alm OR TI-K1603.AlmHiHi OR PI-K1604.AlmHiHi P&ID: PPID-K108
YC-K21(1/2/3)0	P-K21(1/2/3)	HRC 1 P-K21(1/2/3) Recycle Pump	YC-K2100_DDS.Eqmt(1/2/3)_CmdRun	(2)	Intlk: HA-K1106.Alm OR (LI-K2501.AlmHiHi AND NOT YC-K2500_BackUpLvlCtrl.Alm) OR LAH-K2504.Alm OR PI-K21(1/2/3)2.AlmHiHi OR PI-K21(1/2/3)2.AlmLoLo P&ID: PPID-K201
YC-K22(1/2/3)0	P-K22(1/2/3)	HRC 2 P-K22(1/2/3) Recycle Pump	YC-K2200_DDS.Eqmt(1/2/3)_CmdRun	(2)	Intlk: HA-K1206.Alm OR (LI-K2501.AlmHiHi AND NOT YC-K2500_BackUpLvlCtrl.Alm) OR LAH-K2504.Alm OR PI-K22(1/2/3)2.AlmHiHi OR PI-K22(1/2/3)2.AlmLoLo P&ID: PPID-K202
YC-K2530	P-K253	P-K253 TK-K250 Waste Sludge Sump Drain Pump	(YC-K2500_DrainReq.Out AND (LI-K2501.Out > YC-K2500_DrainPmpStart AND NOT LI-K2501.AlmErr))) AND NOT LCL-K2502.Out	(2)	PathNotRunRdyIn: LCL-K2502.Out OR LCL-K2502.AlmErr P&ID: PPID-K203
YC-K3110	AG-K311	AG-K311 Ballast Addition System Agitator	YC-K3111_HRC1.CmdRun OR YC-K3111_HRC2.CmdRun	(2)	Intlk: HA-K3108.Alm OR HA-K3108.AlmErr OR LAL-K3101.Alm P&ID: PPID-K301

3.1.3 DiscreteCS_OnOff (indication and alarming for equipment controlled by the PLC with no feedback)

Table 3.1-3 Simple DiscreteCS_OnOff Instances

Instance	Destination	Description	OnAuto	Alarms (Priority)	Notes
YC-K0900	YS-K0900.Ntfy	Effluent Gates Closed To HVAC PLC	GBL_G800_XC-G3621_ConfCls AND GBL_G800_XC-G3631_ConfCls AND XC-K1513.ConfCls	Err(3)	EnbManual: False P&ID: PPID-K101
YC-K7(1/2)10_Pwr	PNL-K7(1/2)1	Panelboard PNL-K7(1/2)1 Power	True	(3)	EnbManual: True

01

3.1.4 DiscreteIA (Discrete Indication and / or Alarming)

Table 3.1-4 Simple DiscreteIA Instances

Instance	Source	Description	Alarms (Priority)	Notes
OAH-K1(1/2)40	OSH-K1(1/2)40	HRC (1/2) CM-K1(1/2)4 TK-K(1/2)14 Clarifier Sludge Collector Torque Hi	(2)	Read through CM-K1(1/2)4 VFD P&ID: PPID-K10(3/5)
OAHH-K1(1/2)40	OSHH-K1(1/2)40	HRC (1/2) CM-K1(1/2)4 TK-K(1/2)14 Clarifier Sludge Collector Torque HiHi	(1)	Read through CM-K1(1/2)4 VFD P&ID: PPID-K10(3/5)
HA-K1(1/2)06-(1/2)	HS-K1(1/2)06-(1/2)	HRC (1/2) Process Immediate Stop Hand Switch (Located in Clarifier / Pump Room)	(3)	P&ID: PPID-K10(3/5)
HA-K1(1/2)06-3	HMI HRC1 Immediate Stop	HRC (1/2) Process Immediate Stop PB from HMI	(3)	This DiscreteIA instance is activated by an HMI PB. HA-K1(1/2)99.In is set by the HMI and reset by the PLC. Operator needs to reset the instance from the HMI to clear the alarm (AutoRst is 0 and ExtRst always false) DisAlm is always False and Dly is 0.
HA-K1(1/2)06	HA-K1(1/2)06-1.Alm OR HA-K1(1/2)06-1.AlmErr OR HA-K1(1/2)06-2.Alm OR HA-K1(1/2)06-2.AlmErr OR HA-K1(1/2)06-3.Alm	HRC (1/2) Process Immediate Stop Hand Switch Summary	(1)	P&ID: PPID-K10(3/5)
LAH-K1(1/2)44	LSH-K1(1/2)44	HRC (1/2) TK-K1(1/2)4 Clarifier Level High	(1)	P&ID: PPID-K10(3/5)
FAL-K1(1/2)54	FSL-K1(1/2)54	AIT-K1(1/2)51/2 Analyzers Low Flow	(2)	DisAlm: NOT (XC-1155.ConfOpn OR XC-1156.CmdOpn) Dly: TBDC P&ID: PPID-K106
FAL-K1(1/2)54_Fail	NOT FAL-K1(1/2)54.Out AND (XC-1(1/2)55.ConfCls OR NOT XC-1(1/2)56.CmdOpn)	AIT-K1(1/2)51/2 Analyzers Low Flow Switch Fail	(2)	Dly: TBDC P&ID: PPID-K106
YA-K1(1/2)53_Fault	LIC-K1511.AlmErr OR LIC-K1511.CtrlLo OR	HRC Effluent Channel (1/2) Sampling System Fault	(2)	DisAlm: NOT YC-K1(1/2)00.Running

Instance	Source	Description	Alarms (Priority)	Notes
	NOT(XV-K1155.Rdy OR NOT XV-K1155.ConfOpn) OR FAL-K1(1/2)54.Alm			Dly: TBDC P&ID: PPID-K106
PDAH-K1601	PDSH-K1601	Lamella Air Scour Blower Inlet Filter High Differential Pressure	(2)	P&ID: PPID-K108
LALL-K2503	LSLL-K2503	TK-K250 HRC Waste Sludge Sump Level Low Low	(1)	AutoRst: TBDC Dly: TBDC (to allow for Backup Level Switch Control) DisAlm: TK-K250_Drained.Out P&ID: PPID-K203
LCL-K2502	LSL-K2502	TK-K250 HRC Waste Sludge Sump Drain Level Low	(3)	AutoRst: TBDC P&ID: PPID-K203
TK-K250_Drained	See Note 1	TK-K250 HRC Waste Sludge Sump Drain Status	N/A	TK-K250_Drained prevents the running of waste sludge pumps while inhibiting low/low low level alarms P&ID: PPID-K203
LAH-K2504	LSH-K2504	TK-K250 HRC Waste Sludge Sump Level High	Err(1) Alm(see Note 2)	AutoRst: TBDC Dly: TBDC (to allow for Backup Level Switch Control) P&ID: PPID-K203
TAH-K25(1/2)0	TSH-K25(1/2)0	P-K25(1/2) HRC Waste Sludge Sump Pump High Winding Temperature	(1)	P&ID: PPID-K203
HA-K3108	HS-K3108	Ballast System Stop	(1)	P&ID: PPID-K301
LAL-K3101	LSL-K3101	HRC Ballast Addition Hopper Low Level	(1)	P&ID: PPID-K301
LAH-K3102	LSH-K3102	HRC Ballast Addition Wetting Cone High Level	(1)	P&ID: PPID-K301
PAL-K3103	PSL-K3103	HRC Ballast Addition Service Water Pressure Low	(1)	P&ID: PPID-K301
LAH-K5011	LSH-K5011	Area K Building Sump Level High	(1)	P&ID: PPID-K501
FA-K5121	FA-K5121	Area K Clarifier Room Emergency Eyewash/Shower Station U-K512 In Use	(1)	P&ID: PPID-K502

Note 1: TK-K250_Drained.In := ((YC-K2500_DrainReq.Out AND LIC-K2501.CtrlLoSP) OR (LALL-K2503.Out AND LCL-K2502.Out) OR TK-K250_Drained.Out) AND NOT (LIT-K2501.PV > LIT-K2501.AlmLoLmt AND NOT YC-K2500_BackUpLvlCtrl.Alm OR AND NOT LALL-K2503.Out AND NOT LCL-K2502.Out AND YC-K2500_BackUpLvlCtrl.Alm)

Note 2: LAH-K2504.Alm is priority 1 if NOT YC-K2500_BackUpLvlCtrl.Alm and priority 3 otherwise

3.1.5 DiscreteIA PCS Status and Electrical (Discrete Indication and / or Alarming)

Table 3.1-5 DiscreteIA PCS Status and Electrical Instances

Instance	Source	Description	Alarms (Priority)	Notes
YL-K8200-(1/2/3)	PSP-K820_ES-(1/2/3)	PSP-K820 Redundancy Module RM0(1/2/3) Loss of Redundancy Alarm	(3)	
YL-K8000	PLC-K800_ES	PLC-K800 Power Supply Alarm	(1)	
YL-K8001	RIO-K800-1_ES	RIO-K800-1 Power Supply Alarm	(1)	
YL-K9100	NSW-K910_Flt	Supervisory Network Switch NSW-K910 Alarm	(3)	
YL-K9200	NSW-K920_Flt	Primary Control Network Switch NSW-K920 Alarm	(2)	
YL-K9210	NSW-K921_Flt	Secondary Control Network Switch NSW-K921 Alarm	(3)	
YL-K9201	YL-K9200.Alm AND YL-K9210.Alm	Primary And Secondary Control Network Switch Alarm	(1)	
YL-K9300	NSW-K930_Flt	Network Switch NSW-K930 Alarm	(1)	
YL-K9310	NSW-K931_Flt	Network Switch NSW-K931 Alarm	(1)	

3.1.6 EqmtStatus (indication and alarming for equipment not controlled by the PLC)

Table 3.1-6 Simple EqmtStatus Instances

Instance	Source	Description	Alarms (Priority)	Notes
YL-K50(1/2)0	P-K50(1/2)	Area K Building Sump Pump P-K50(1/2)	(3)	P&ID: PPID-K501

3.1.7 ValveD (indication and alarming for discrete valve or damper controlled by the PLC with open and close limits feedback)

Table 3.1-7 Simple ValveD Instances

Instance	Source	Description	OpnReq	Alarms (Priority)	Notes
XC-K1(1/2)03	XV-K1(1/2)03	HRC (1/2) drop shaft sodium hypochlorite valve XV-K1(1/2)03	((YC-K1(1/2)00_ChemReq AND GBL_C800_ YC-C224(1/2)_DropShaft_SH) OR YC-K1(1/2)00_DF_SH_Req) 10 sec (TBDC) Off delay OR YC-K1(1/2)00_WSSC_DropShaftSH	(2)	P&ID: PPID-K10(2/4)
XC-K1(1/2)34	XV-K1(1/2)34	HRC (1/2) maturation tank sodium hypochlorite valve XV-K1(1/2)03	(YC-K1(1/2)00_ChemReq AND GBL_C800_ YC-C224(1/2)_Matur_SH) 10 sec (TBDC) Off	(2)	P&ID: PPID-K10(3/5)

Instance	Source	Description	OpnReq	Alarms (Priority)	Notes
			delay OR YC-K1100_WSSC_MaturSH		
XC-K1(1/2)45	XV-K1(1/2)45	HRC (1/2) Clarifier Mid-Level Drain Valve XV-K1(1/2)45	YC-K1100_Lamella_MidLevelDrain Open	(2)	P&ID: PPID-K10(3/5)
XC-K1(1/2)31	XV-K1(1/2)31	HRC (1/2) Mud Valve XV-K1(1/2)31	YC-K1(1/2)00_DF_MudVlvOpen	(2)	P&ID: PPID-K10(3/5)
XC-K1(1/2)55	XV-K1(1/2)55	AE-K1(1/2)5(1&2) pH and Turbidity Sensors Inlet Valve XV-K1(1/2)55	(YC-K1(1/2)00.Running AND NOT LIC-K1511.CtrlLo) OR YC-K1(1/2)53_Drain	(3)	P&ID: PPID-K106 See note 1
XC-K112(3/4/5)	XV-K112(3/4/5)	TK-K112 HRC 1 CYC-K211 Underflow Polymer Injection Valve XV-K112(3/4/5)	(YC-21(1/2/3)1.Running 2 sec TBDC Off delay) AND NOT YC-K1100_IS_MajorFault.Alm	(3)	P&ID: PPID-K107
XC-K122(3/4/5)	XV-K122(3/4/5)	TK-K122 HRC 2 CYC-K221 Underflow Polymer Injection Valve XV-K122(3/4/5)	(YC-22(1/2/3)1.Running 2 sec TBDC Off delay) AND NOT YC-K1200_IS_MajorFault.Alm	(3)	P&ID: PPID-K107
XC-K1512	XV-K1512	Outfall Sewer Drop Shaft Flushing Water Spray Nozzle Valve XV-K1512	See Note 2	(3)	P&ID: PPID-K106
XC-K2544	XV-K2544	TK-K250 HRC Waste Sludge Stream to Fermenter Valve XV-K2544	See Note 3	(1)	P&ID: PPID-K203
XC-K2543	XV-K2543	TK-K250 HRC Waste Sludge Stream to Primary Influent Channel Valve XV-K2543	See Note 4	(1)	P&ID: PPID-K203
XC-K1(1/2)21	XV-K1(1/2)21	HRC (1/2) TK-K1(1/2)2 Ballast Addition XV-K1(1/2)21	(YC-K3111_HRC(1/2).CmdRun Off delay of 1 second (TBDC)) OR YC-K3112_HRC(1/2))	(1)	Intlk: (HA-K3108.Alm OR HA-K3108.AlmErr) P&ID: PPID-K301

Note 1:LIC-K1511.CtrlLo is set at AI-K1053_MinWtrLvl_Setting is the “Minimum Water Level for Effluent Analyzer Operation”.

Note2: XC-K1512.OpenReq := (FK-K1511.Fbk_Out > 3% (TBDC)) OR (XC-K1512.ConfOpn AND (FK-K1511.Fbk_Out < 3% (TBDC) for less than XC-K1512_ClsDly_Setting)). XC-K1512_ClsDly_Setting in minutes is the “Outfall Sewer Drop Shaft Flushing Water Spray Nozzle Close Delay”

Note 3: XC-K2544.OpenReq := YC-K2549_ToRDT.SelOut AND NOT (GBL_D800_LI-D3141_AlmHi AND ((NOT GBL_D800_LI-D3141_AlmErr) for more than 180 seconds(TBDC))) OR NOT ((XC-K2543.ConfOpn AND NOT XC-K2543.AlmErr) for more than 60 seconds (TBDC))

Note 4: XC-K2543.OpenReq := NOT YC-K2549_ToRDT.SelOut OR GBL_D800_LI-D3141_AlmHi AND ((NOT GBL_D800_LI-D3141_AlmErr) for more than 180 seconds(TBDC)) OR NOT ((XC-K2544.ConfOpn AND NOT XC-K2544.AlmErr) for more than 60 seconds (TBDC))

AI-K1053_MinWtrLvl_Setting and XC-K1512_ClsDly_Setting can be modified by an operator with security level M or higher. The operator HMI settings should be range checked before being used.

3.1.8 ValveS (Discrete valve or damper without open and close limits feedback)

Table 3.1-8 Simple ValveS Instances

Instance	Source	Description	OpenReq	Alarms (Priority)	Intlk	Notes
XC-K114(1/2/3)	XV-K114(1/2/3)	HRC 1 TK-K114 Clarifier Lamella Air Scour Valve	YC-K1100_ScourValves AND NOT (YC-K1100_IS_MajorFault.Alm OR YC-K1200_IS_MajorFault.Alm)	(2)	HA-K1106.Alm	P&ID: PPID-K108
XC-K124(1/2/3)	XV-K124(1/2/3)	HRC 2 TK-K124 Clarifier Lamella Air Scour Valve	YC-K1200_ScourValves AND NOT (YC-K1100_IS_MajorFault.Alm OR YC-K1200_IS_MajorFault.Alm)	(2)	HA-K1206.Alm	P&ID: PPID-K108
XC-K1(1/2)56	XV-K1(1/2)56	AE-K1(1/2)5(1 and 2) Sensors Flushing Valve	YC-K1(1/2)53_Flush AND NOT (YC-K1100_IS_MajorFault.Alm OR YC-K1200_IS_MajorFault.Alm)	(3)		P&ID: PPID-K106
XC-K3105	XV-K3105	XV-K3105 S-K310 Ballast Addition System Service Water Valve	((YC-K3111_HRC1.CmdRun OR YC-K3111_HRC2.CmdRun) Off delay of 1 second (TBDC)) OR YC-K3112_HRC1 OR YC-K3112_HRC2	(1)	HA-K3108.Alm OR HA-K3108.AlmErr OR LAH-K3102.Alm OR NOT (XV-K1121.ConfOpn OR XC-K1221ConfOpn)	P&ID: PPID-K301
XC-K3106	XV-K3106	XV-K3106 Ballast Addition System Output Valve	YC-K3111_HRC1.CmdRun OR YC-K3111_HRC2.CmdRun	(1)	HA-K3108.Alm OR HA-K3108.AlmErr OR LAH-K3102.Alm OR NOT (XV-K1121.ConfOpn OR XC-K1221ConfOpn)	P&ID: PPID-K301

3.1.9 VFDBasic (VFD controlled by the PLC)

Table 3.1-9 Simple VFDBasic Instances

Instance	Source	Description	RunAuto	Alarms (Priority)	Notes
YC-K1(1/2)30	MXR-K1(1/2)3	HRC (1/2) MXR-K1(1/2)3 TK-K1(1/2)3 Maturation Zone Mixer	YC-K1(1/2)00_MaturMixerRun OR YC-K1(1/2)00_WSR_MaturMixerRun OR YC-K1(1/2)00_WSSC_MaturMixerRun	(1)	CV_In: See Note 1 Intlk: HA-K1(1/2)06.Alm PathNotRunRdyIn: See note 2 P&ID: PPID-K10(3/5)
YC-K1(1/2)40	CM-K114	HRC (1/2) CM-K1(1/2)4 TK-K1(1/2)4 Clarifier	YC-K1(1/2)00_ClarifierRun OR YC-K1(1/2)00_WSR_Clarifier	(1)	CV_In: YC-K1(1/2)40_ S_ SP (See 3.2.2.4 YC-K1140_ S_ SP / CM-K114 TK-K114 Clarifier)

Instance	Source	Description	RunAuto	Alarms (Priority)	Notes
		Sludge Collector	Run OR YC-K1(1/2)00_WSSC_ClarifierRun		Intlk: HA-K1(1/2)06.Alm OR OAHH-K1(1/2)40.Alm PathNotRunRdyIn: See note 3 P&ID: PPID-K10(3/5)

Note 1: In Auto, Mixer MXR-K1(1/2)3 runs at a constant speed (CV_In) determined during commissioning.

Note 2: YC-K1(1/2)30.PathNotRunRdyIn := NOT YC-K1(1/2)00_LiqEnb.Out OR (NOT (YC-K2(1/2)11.Running OR YC-K2(1/2)21.Running OR YC-K2(1/2)31.Running) for more than 37 sec)

Note 3: YC-K1(1/2)40.PathNotRunRdyIn:= NOT YC-K1(1/2)00_LiqEnb.Out OR (NOT (YC-K2(1/2)11.Running OR YC-K2(1/2)21.Running OR YC-K2(1/2)31.Running) for more than 37 sec)

3.2 K1 – Tanks and Mixing

3.2.1 HRC 1&2 Influent

P&ID Drawing: PPID-K101

Alarm if there is no HRC ready to start in Auto.

Table 3.2-1 YC-K1000_NoStartPerm / HRC 1&2 No Auto Start Permissive

Instance	YC-K1000_NoStartPerm		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	NOT (YC-K1100_StartPerm.Out OR YC-K1200_StartPerm.Out)	Link
	AutoRst	5 seconds	Const
Alarms	Alm(2) – Medium Priority		

3.2.1.1 HRC Auto start conditions

During dry weather flows, or wet weather flows less than 150 ML/d (operator adjustable), screened and degritted wastewater flows by gravity to the primary clarifiers and downstream activated sludge secondary treatment process, through secondary clarification and to UV disinfection. When the plant influent flow exceeds 150 ML/d (YC-K1000_StrtLead_Setting by operator) for greater than an operator defined time (YC-K1000_Lead_RunDly_Setting by operator), as measured using electromagnetic flow meters on the influent pump discharge pipes, the lead HRC train will be started in Auto.

When the plant influent flow exceeds an operator defined flow (YC-K1000_StrtLag_Setting by operator) for greater than an operator defined time (YC-K1000_Lag_RunDly_Setting by operator) the lag HRC train will be started in auto.

The lag unit (if running) is stopped when the plant influent flow is below an operator defined flow (YC-K1000_StpLag_Setting by operator) for an operator defined time (YC-K1000_Lag_StopDly_Setting by operator).

The lead unit is stopped when the plant influent flow is below an operator defined flow (YC-K1000_StpLead_Setting by operator) for an operator defined time (YC-K1000_Lead_StopDly_Setting by operator).

The minimum train run time for the Lead Train is 4 hours (setpoint YC-K1000_MinRunTime_Setting in minutes). The operator may opt to stop the train before minimum run time is up.

YC-K1000_Lead_RunDly_Setting, YC-K1000_Lag_RunDly_Setting, YC-K1000_Lead_StopDly_Setting, YC-K1000_Lag_StopDly_Setting and YC-K1000_MinRunTime_Setting are real numbers in minutes and can be modified by the operator with security level M or higher.
YC-K1000_(StrtLag/StrtLead/StpLag/StpLead)_Setting in Ml/d can be modified by the operator with security level M or higher. The values should be checked so that YC-K1000_StrtLag_Setting > YC-K1000_StrtLead_Setting> YC-K1000_StpLag_Setting > YC-K1000_StpLead_Setting.
As always, the operator HMI setpoints should be range checked before being used.

Table 3.2-2 FIC-K1000 Plant Influent Flow HRC Auto Start/Stop

Instance	FIC-K1000		
Class	AnalogIAC		
Inputs	Parameter	Source	Type
	PV	GBL_G800_FI-G1100_Out	Link
	CtrlHiHiSP	YC-K1000_StrtLag_Setting	Link
	CtrlHiSP	YC-K1000_StrtLead_Setting	Link
	CtrlLoSP	YC-K1000_StpLag_Setting	Link
	CtrlLoLoSP	YC-K1000_StpLead_Setting	Link
	CtrlHiHiDly	YC-K1000_Lag_RunDly_Setting * 60 000 [ms/minutes]	Link
	CtrlHiDly	YC-K1000_Lead_RunDly_Setting * 60 000 [ms/minutes]	Link
	CtrlLoDly	YC-K1000_Lag_StopDly_Setting * 60 000 [ms/minutes]	Link
	CtrlLoLoDly	YC-K1000_Lead_StopDly_Setting * 60 000 [ms/minutes]	Link
Alarms	N/A		

3.2.1.2 FIC-K1000_Poly_MD / HRC Polymer Makedown Auto Start / Stop

The polymer make-down request (YC-K1000_Poly_MD_Req) must be activated by the HRC control system in order to allow the polymer system in the chemical building to made-down a batch of dry polymer into polymer solution. In AUTO mode, when total plant influent flow exceeds the “Start Polymer Makedown Flow” (FIC-K1000_Poly_MD_Strt_Setting) setting the polymer make-down request is activated. Conversely, when total plant flow drops below the “Stop Polymer Makedown Flow” (FIC-K1000_Poly_MD_Stp_Setting) setting the request is deactivated.

YC-K1000_Poly_MD_Req := (FIC-K1003_PolyMakedown.CtrlHi OR YC-K1000_Poly_MD_Req) AND NOT FIC-K1003_PolyMakedown.CtrlLo

Table 3.2-3 FIC-K1000_Poly_MD / Plant Influent Flow HRC Polymer Makedown Auto Start/Stop

Instance	FIC-K1000_Poly_MD		
Class	AnalogIAC		
Inputs	Parameter	Source	Type
	PV	GBL_G800_FI-G1100_Out	Link
	CtrlHiSP	FIC-K1000_Poly_MD_Strt_Setting	Link
	CtrlLoSP	FIC-K1000_Poly_MD_Stp_Setting	Link
	CtrlHiDly	TBDC	Const
	CtrlLoDly	TBDC	Const
Alarms	N/A		

3.2.1.3 FI-K1001_SP / HRC total influent flow setpoint

The flow required to be handled by the HRCs trains is defined as the difference between Plant Influent flow minus the maximum flow to primary clarifiers (FIC-K1000_P_MaxFlowLmt).

The maximum flow to primary clarifiers (FIC-K1000_P_MaxFlowLmt) can be modified by the operator with security level M or higher. The operator HMI setpoints should be range checked before being used.

FI-K1001_SP := FIC-K1000.Out-FIC-K1000_P_MaxFlowLmt

FI-K1001_SP should be range limited to 0 to 270 ML/d (Two HRC trains maximum flow).

3.2.1.4 FI-K1001_HRC1_SP / HRC 1 Auto influent flow setpoint

In Auto mode, the HRC1 influent flow PID uses a setpoint calculated to limit the flow to the primary clarifiers to a maximum flow.
If HRC 2 train flow mode is not in Auto (Local, Manual or Operator), the setpoint for the train 1 in auto will adjust to compensate for the flow passing through the other train. To avoid inlet flow controller interactions, instead of the flow measured, the operator set point will be used to compensate when in operator mode.

When two trains are in AUTO flow mode, the gate control can be selected by the operator as either “Individual” or “Common” ((YC-K1001_CommFlowGateMode OnOffSel instance – On for “Common”, Off for “Individual”). These two modes provide flexibility for optimizing the gate flow control and flow balancing during commissioning.

In Individual gate control mode, each HRC train flow controller calculates a control value for the modulating weir gate using the train’s flow setpoint and measured flow. This mode is anticipated to provide good control and balancing of flows between the two trains. However, the two PID loops are not independent because a change in the gate position and corresponding flow in one channel affects the other, therefore there is a potential the gates could “hunt” excessively.

The Common gate control mode is provided to avoid excessive hunting by the gates. The gate control value for the lag train is set to be equal to the control value calculated by the lead train’s PID. In Common mode, an operator-adjustable gate position linear offset (YC-K1001_CommFlowGateHRC1_K) is also available for each

train to address potential non-equal flow distribution between the two channels. However, this control mode is not expected to be as good as individual mode at balancing the flows between the two trains.

When the HRC is in “Individual” mode or the HRC 1 is lead in “Common” mode and the HRC1 influent flow PID is in auto, the HRC 1 PID takes its setpoint from FI-K1001_HRC1_SP and controls HRC 1 modulating weir gate. If HRC 2 influent gate is not confirmed open, FI-K1001_HRC1_SP is the same as the HRC total setpoint (FI-K1001_SP). If HRC 2 influent gate is open but the HRC 2 modulating weir gate is not in auto or the HRC 2 influent flow PID is in operator mode, the setpoint to HRC 1 is total flow setpoint less the current setpoint to HRC 2 to comply (if possible) with the total required flow to HRC. Otherwise, the flow setpoint for Train 1 (FI-K1001_HRC1_SP) is half of the total setpoint.

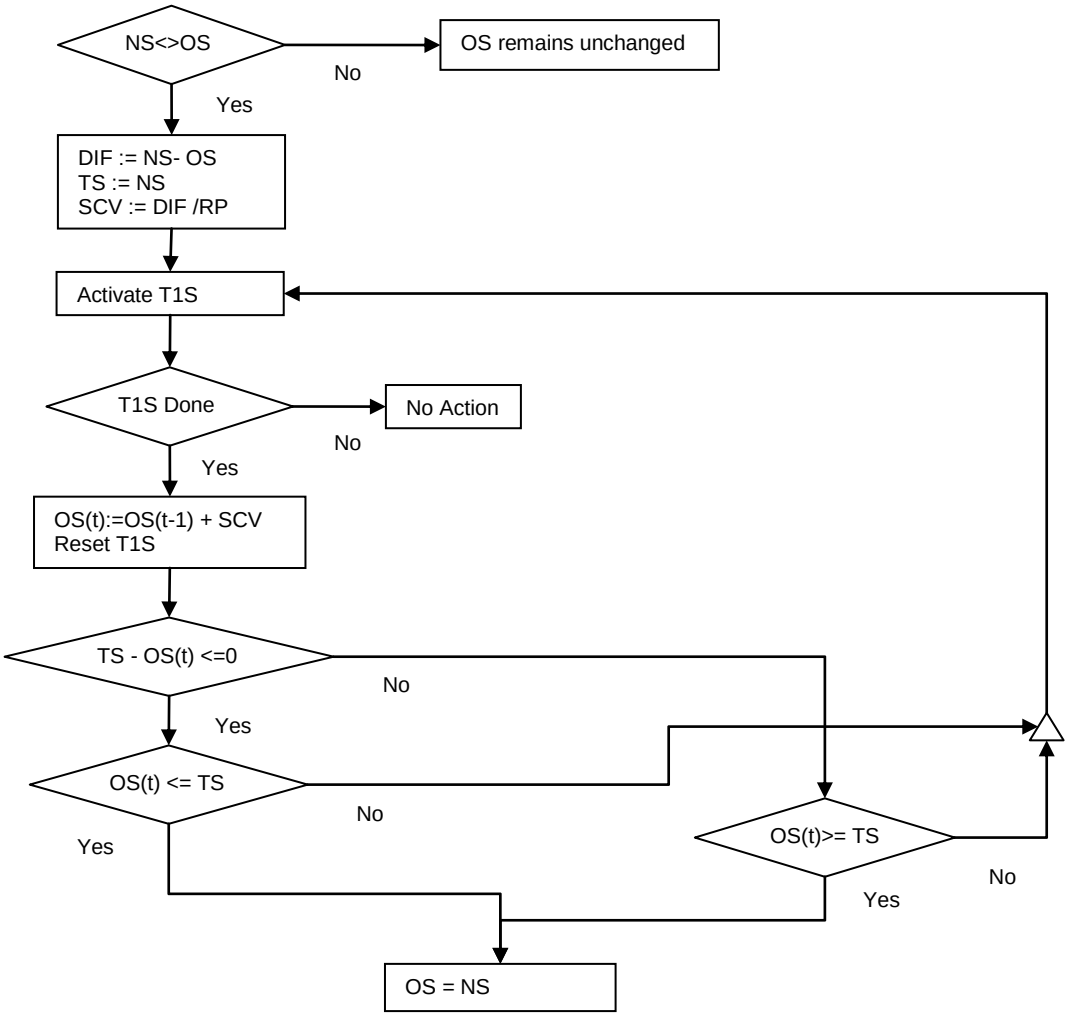
When the HRC is in “Common” mode and HRC 1 is not lead, HRC 1 PID will be executed in tracking mode (for bumpless transfer) and HRC 1 modulating weir gate is controlled from HRC 2 PID plus a flow setpoint dependant linear offset (YC-K1001_CommFlowGateHRC1_K).

The common mode linear offset setting (YC-K1001_CM1_K_Setting) can be modified by the operator with security level M or higher. The operator HMI setpoints should be range checked before being used.

```
If XC-G3621.ConfOpn Then

        If NOT XC-G3631.ConfOpn Then
                FI-K1001_HRC1_SP := FI-K1001_SP
        Elseif (NOT FK-1202.CtrlAuto OR FIC-K1202.CtrlOper) Then
                FI-K1001_HRC1_SP := FI-K1001_SP- FIC-K1202.SP
        Else
                FI-K1001_HRC1_SP := FI-K1001_SP/2
        Endif
Else
        FI-K1001_HRC1_SP := 0
Endif
```

As per equipment vendor request the influent flow setpoint will be smoothed as follows:



Where:

NS is the new setpoint FI-K1001_HRC1_SP
OS is the output setpoint FI-K1001_HRC1_SP_Smooth
TS is a temporary setpoint
RP is the adjustable ramping period FI-K1001_HRC1_SP_Ramp_Setting (Default 5 seconds)
DIF is the difference between the new the output setpoint
SCV is the step change value
T1S is a one second timer

FI-K1001_HRC1_SP_Smooth should be range limited to 20 to 135 ML/d (one HRC train maximum flow).

The adjustable ramping period FI-K1001_HRC1_SP_Ramp_Setting can be modified by an operator with security level M or higher. The operator HMI setpoints should be range checked before being used.

If YC-K1001_CommFlowGateMode.SelOut AND NOT YC-K1000_DS. Eqmt1_SelLead Then
FK-K1102_FollowHRC2 := True
FK-K1102_CM_Ofst := YC-K1001_CM1_K_Setting * FIC-K1202.SP

Else
FK-K1102_FollowHRC2 := False
FK-K1102_CM_Ofst := 0
Endif

3.2.1.5 FI-K1001_HRC2_SP / HRC 2 Auto influent flow setpoint

Similar to HRC 1

3.2.1.6 Lead HRC Train Selection

Table 3.2-4 YC-K1000_DS HRC Train Duty Selector – Train 1 / 2

Instance	YC-K1000_DS		
Class	DutyDS		
Inputs	Parameter	Source	Type
	Eqmt1_Fail	YC-K1100.Fail	Link
	Eqmt1_Rdy	YC-K1100_StartPerm.Out AND NOT(FIC-K1102.CtrlOper OR (FIC-K1102.CtrlErr AND NOT(FIC-K1202.CtrlAuto AND YC-K1200.Running))) OR YC-K1100_AutoStarting OR YC-K1100.Running	Link
	Eqmt1_Running	YC-K1100.Running	Link
	Eqmt1_Auto	YC-K1100.CtrlAuto	Link
	Eqmt1_PerfDeg	See Logic below	
	Eqmt2_Fail	YC-K1200.Fail	Link
	Eqmt2_Rdy	YC-K1200_StartPerm.Out AND NOT(FIC-K1202.CtrlOper OR (FIC-K1202.CtrlErr AND NOT(FIC-K1102.CtrlAuto AND YC-K1100.Running))) OR YC-K1200_AutoStarting OR YC-K1200.Running	Link
	Eqmt2_Running	YC-K1200.Running	Link
	Eqmt2_Auto	YC-K1200.CtrlAuto	Link
	Eqmt2_PerfDeg	See Logic below	
	RunReq	FIC-K1000.CtrlHi OR ((YC-K1100_AutoStarting OR YC-K1100.Running OR YC-K1200_AutoStarting OR YC-K1200.Running) AND NOT FIC-K1000.CtrlLoLo)	Link
	RunLagReq	FIC-K1000.CtrlHiHi OR (((YC-K1100_AutoStarting OR YC-K1100.Running) AND (YC-K1200_AutoStarting OR YC-K1200.Running)) AND NOT FIC-K1000.CtrlLo) OR	Link

		(YC-K1000_DS.RunReq AND (YC-K1100.Running AND (LI-K1132.AlmHiHi OR LAH-K1144.Alm)) OR (YC-K1200.Running AND (LI-K1232.AlmHiHi OR LAH-K1144.Alm)))	
	RunLagEn	True	Const
	StopMode	True	Const
Alarms	AlmEqmtNotAvail(1) – Emergency / Call Out Priority AlmLagEqmtNotAvail(1) – Emergency / Call Out Priority		

The DutyDS performance degraded is used to force, if the other train is ready and its performance is not degraded, an automatic lead train switch. When the performance degraded is set, an alarm is generated and it requires operator reset to return to normal (performance not degraded).

YC-K1000_DS.Eqmt1_PerfDeg is True in any of the following conditions:

- If requested by the operator and HRC 1 Lamella Cleaning Required {NOT YC-K1140_Cleaning_Mode.SelOut AND KQI-K1140.AlmHi}
- HRC 1 coagulant not available, HRC 1 requested to run as lead and HRC 2 coagulant available.{ YC-K1000_DS.Eqmt1_CmdRun AND YC-K1000_DS.Eqmt1_SelLead AND ((GBL_C800_YC-C1241_NotAvail AND NOT GBL_C800_YC-C1341_NotAvail) On delay of 60 sec (TBDC))}
- HRC 1 polymer not available , HRC 1 requested to run as lead and HRC 2 polymer available.{ YC-K1000_DS.Eqmt1_CmdRun AND YC-K1000_DS.Eqmt1_SelLead AND ((GBL_C800_YC-C4529_PathANotAvail AND NOT GBL_C800_YC-C4529_PathBNotAvail) On delay of 60 sec (TBDC))}
- If requested by operator, HRC 1 sodium hypochlorite not available (if required, hypochlorite valves not ready or open) , HRC 1 requested to run as lead and HRC 2 sodium hypochlorite available (and if required, hypochlorite valves not ready or open) {NOT YC-K1000_DS_H_FailMode.SelOut AND YC-K1000_DS.Eqmt1_CmdRun AND YC-K1000_DS.Eqmt1_SelLead AND

  (((GBL_C800_YC-C2229_PathANotAvail AND (GBL_C800_ YC-C2241_DropShaft_SH AND (XC-K1103.ConfOpn OR XC-K1103.Rdy) OR GBL_C800_ YC-C2241_Matur_SH AND (XC-K1134.ConfOpn OR XC-K1134.Rdy) OR NOT (GBL_C800_ YC-C2241_DropShaft_SH AND GBL_C800_ YC-C2241_Matur_SH)

  AND

  NOT (GBL_C800_YC-C2229_PathBNotAvail AND (GBL_C800_ YC-C2242_DropShaft_SH AND (XC-K1203.ConfOpn OR XC-K1203.Rdy) OR GBL_C800_ YC-C2242_Matur_SH AND (XC-K1234.ConfOpn OR XC-K1234.Rdy) OR NOT (GBL_C800_ YC-C2242_DropShaft_SH AND GBL_C800_ YC-C2242_Matur_SH)))

  On delay of 60 sec (TBDC))}
- If requested by operator, HRC 1 sodium hydroxide not available, HRC 1 sodium hydroxide in Influent Mode, HRC 1 requested to run as lead and HRC 2 sodium hydroxide available {NOT YC-K1000_DS_N_FailMode.SelOut AND YC-K1000_DS.Eqmt1_CmdRun AND YC-K1000_DS.Eqmt1_SelLead AND ((GBL_C800_YC-C2312_NotAvail AND NOT GBL_C800_YC-C2322_NotAvail) On delay of 60 sec (TBDC))}
- HRC 1 inlet flow is HiHi or there is an error or deviation, HRC 1 requested to run as lead and HRC 2 Inlet flow is not HiHi or in error. { YC-K1000_DS.Eqmt1_CmdRun AND YC-K1000_DS.Eqmt1_SelLead AND

(FIC-K1102.AlmHiHi AND NOT FIC-K1202.AlmHiHi OR FIC-K1102.AlmErr OR FIC-K1102.DevAlm) AND NOT FIC-K1202.AlmErr)}

- HRC 1 maturation zone level error, HRC 1 requested to run as lead and HRC 2 maturation zone level is not in error { YC-K1000_DS.Eqmt1_CmdRun AND YC-K1000_DS.Eqmt1_SelLead AND (LI-K1132.AlmErr AND NOT LI-K1232.AlmErr)}
- HRC 1 Effluent Turbidity HiHi, HRC 1 requested to run as lead and HRC 2 Effluent Turbidity is not HiHi { YC-K1000_DS.Eqmt1_CmdRun AND YC-K1000_DS.Eqmt1_SelLead AND (AI-K1151.AlmHiHi AND NOT AI-K1251.AlmHiHi)}

YC-K1000_DS.Eqmt2_PerfDeg is similar to YC-K1000_DS.Eqmt1_PerfDeg.

Table 3.2-5 YC-K1000_DS_SH_FailMode / HRC Performance Degraded On Sodium Hypochlorite Failure Mode

Instance	YC-K1000_DS_H_FailMode		
Class	OnOffSel		
Inputs	**Parameter**	**Source**	**Type**
	SelOffText	“Set HRC train to Degraded Performance On HRC train Sodium Hypochlorite Failure”	Const
	SelOnText	“HRC train Sodium Hypochlorite Failure Alarm Only”	Const

Table 3.2-6 YC-K1000_DS_N_FailMode / HRC Performance Degraded On Sodium Hydroxide Failure Mode

Instance	YC-K1000_DS_N_FailMode		
Class	OnOffSel		
Inputs	**Parameter**	**Source**	**Type**
	SelOffText	“Set HRC train to Degraded Performance On HRC train Sodium Hydroxide Failure”	Const
	SelOnText	“HRC train Sodium Hydroxide Failure Alarm Only”	Const

3.2.2 HRC 1

A maximum current off time value alarm warns the operator that a unit has been out of service for duration higher than a preset value. The maximum current off time is 168hrs (setpoint YC-K1100_OffTime in hours) can be modified by the operator with security level M or higher.

As always, the operator HMI setpoints should be range checked before being used.

Table 3.2-7 YC-K1100_OffTime / HRC 1 Off Time Alarm

Instance	YC-K1100_OffTime		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	YC-K1100.KQ_CurrRunStop > (YC-K1100_ OffTime * 60)	Link
Alarms	Alm(4) - Abnormal Condition		

Note: Disable alarm if HRC is dry (LCL-K2502.Out and LALL-K2503.Out)

3.2.2.1 YC-K1100 / HRC 1 Auto Start / Stop

This instance controls the auto sequence HRC train start and stop. In manual mode the command to start the sequence is manual from the HMI. In Auto mode the command to start the sequence comes from the duty selector and plant influent flows.

Table 3.2-8 YC-K1100 / HRC 1 Start/Stop

Instance	YC-K1100		
Class	DiscreteCS		
Inputs	Parameter	Source	Type
	RunFbkDly	TBDC	Const
	CtrlRem	N/A	Link
	Flt	YC-K1100_StartFail.Alm OR YC-K1100_StartMajorFault.Alm OR YC-K1100_RunFail.Alm OR YC-K1100_MajorFault.Alm	Link
	Run	YC-K1100_AutoRunning	Link
	Intlk	YC-K1100.Flt	Link
	RunAuto	YC-K1000_DS.Eqmt1_CmdRun OR YC-K1100.CmdRun AND NOT (YC-K1100.KQ_CurrRun > YC-K1000_MinRunTime_Setting OR GBL_C800_YC-C4529_PathANotAvail)	Link
	StartInh	NOT YC-K1100_StartPerm.Out	Link
	ExtAutoStopEnb	True	Const
Alarms	Priority as per class		

3.2.2.2 HRC 1 Influent Channel

P&ID Drawing: PPID-K101

Table 3.2-9 FIC-K1102 / HRC 1 Influent Channel Flow Control

Instance	FIC-K1102		
Class	PID_Controller		
Inputs	Parameter	Source	Type
	PV	FIT-K1102	Link
	Auto_SP	FI-K1001_HRC1_SP _Smooth	Link
	SP_Max	135 [ML/d]	Const
	SP_Min	20 [ML/d]	Const
	AlmHiDly, AlmLoDly & AlmLoLoDly	TBDC	Const
	AutoRst	TBDC	Const
	Tracking	FK-K1102.NotRdy OR NOT FK-K1102_FlowEnable OR FK-K1102_FollowHRC2	Link
	TrackingCV	FK-K1102.CV	Link
	DisDevAlmDB	FIC-K1102.CtrlTr	Link
	ReverseAct	1 (Reverse)	Const
Alarms	LoLo(1),Lo(2), Hi(2), HiHi(1), DevAlm (2) & Err(1)		

Notes: Enable AlmLo and AlmLoLo alarms if ((FK-K1102.Fbk_Out > 1% (TBDC) AND GBL_G800_XV-G3621_ConfOpn)

Table 3.2-10 FK-K1102 / FV-K1102 HRC 1 Influent Channel Flow Control Weir Gate

Instance	FK-K1102		
Class	AnalogCS		
Inputs	Parameter	Source	Type
	CV_In	See Notes	Link
	CtrlRem	FV-K1102.Rem	I/O
	Fbk	FV-K1102.Z	I/O
	Flt	FV-K1102.Flt	I/O
	Intlk	HA-K1106.Alm	Link
	PowerFail	TBD	I/O
Outputs	Parameter	Destination	Type
	CV	FV-K1102.CmdZ	I/O
Alarms	Priority as per class		

Notes:

FK-K1102_FlowEnable := GBL_G800_XC-G3621_ConfOpn AND YC-K1100_EnableFlow

```
FK-K1102.CV_In:
    If FK-K1102_FlowEnable Then

        If FK-K1102_FollowHRC2 Then          //Follow HRC 2 FIC
            FK-K1102.CV_In := FIC-K1202.CV + FK-K1102_CM_Ofst
        Else                                 //Follow HRC 1 FIC
            FK-K1102.CV_In := FIC-K1102.CV
        Endif

    ElseIf YC-K1100_DF_ModWeirOpen OR YC-K1100_LTUP_ModWeirOpen OR YC-
        K1100_WSSC_ModWeirOpen
            //Wet Storage

        FK-K1102.CV_In := 100%

    ElseIf (GBL_G800_XC-G3622_Fail OR LI-K1102.AlmHi ) AND NOT GBL_G800_XC-
        G3622_ConfCls AND GBL_G800_XC-G3621_ConfCls AND NOT YC-K1100.CmdRun

        //Flushing valve failed not closed or level in inlet channel is high, open weir TBDC% to
        mitigate channel fill and overflow out the top of the conduit

        FK-K1102.CV_In := TBDC %

    Else

        FK-K1102.CV_In := 0%

    EndIf
```

Table 3.2-11 FQI-K1102_Total / HRC 1 Total Influent Volume

Instance	FQI-K1102_Total		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	FIC-K1102.Out	Link
	TimeFactor	86400 (Ml/d assumed)	Const
	UnitConv	1 (Ml assumed)	Const
Alarms	-		

Table 3.2-12 FQI-K1102 / HRC 1 Volume (Operator Resettable)

Instance	FQI-K1102		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	FIC-K1102.Out	Link
	TimeFactor	86400 (Ml/d assumed)	Const
	UnitConv	1 (Ml assumed)	Const
	AccumRstEnable	1 (Enabled)	Const
Alarms	-		

Table 3.2-13 FQI-K1102_CurrDay / HRC 1 Current Day Influent Volume

Instance	FQI-K1102_CurrDay		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	FIC-K1102.Out	Link
	TimeFactor	86400 (Ml/d assumed)	Const
	UnitConv	1 (Ml assumed)	Const
	AccumAutoRst	At 8 A.M	Link
Alarms	-		

Table 3.2-14 FQI-K1102_PrevDay / HRC 1 Previous Day Influent Volume

Instance	FQI-K1102_PrevDay		
Class	AnalogIAC		
Inputs	Parameter	Source	Type
	PV	Move FQI-K1102_CurrDay.Out before it is reset	Link
Alarms	-		

Table 3.2-15 FQI-K1102_CurrHour / HRC 1 Current Hour Influent Volume

Instance	FQI-K1102_CurrHour		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	FIC-K1102.Out	Link
	TimeFactor	86400 (Ml/d assumed)	Const
	UnitConv	1 (Ml assumed)	Const

	AccumAutoRst	Beginning of hour	Link
Alarms	-		

Table 3.2-16 FQI-K1102_PrevHour / HRC 1 Previous Hour Influent Volume

Instance	FQI-K1102_PrevHour		
Class	AnalogIAC		
Inputs	Parameter	Source	Type
	PV	Move FQI-K1102_CurrHour.Out before it is reset	Link
Alarms	-		

3.2.2.3 YC-K1100_LiqEnb / Minimum Level or Influent Volume Reached

A minimum liquid level in the HRC train is required to enable running of equipment (mixers, scraper, etc.). The minimum level will be determined with the maturation level transmitter LIT-K1132. If the level transmitter has errors, a minimum influent volume will be used.

An influent volume running total of the preceding 60 minutes is accumulated in 10 minutes intervals.

Table 3.2-17 FQI-K1102_Curr10min / HRC 1 Current 10 minutes Influent Volume

Instance	FQI-K1102_Curr10min		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	If(NOT FIC-K1102.AlmErr, FIC-K1102.Out,0)	Link
	TimeFactor	86400 (Ml/d assumed)	Const
	UnitConv	1 (Ml assumed)	Const
	AccumAutoRst	10,20,30,40,50,60 minutes every hour	Link
Alarms	-		

The preceding five 10 minutes accumulated values are stored in FQI-K1102_Prev10min_(1/2/3/4/5). FQI-K1102_Prev10min_(1/2/3/4/5) are reset if the maturation zone drain valve is not confirmed closed and HRC 1 is not running (NOT XC-K1131.ConfCls AND NOT YC-K1100.Running).

Table 3.2-18 FQI-K1102_60minRT_10minInt / HRC 1 60 minute Running Total in 10 minute intervals

Instance	FQI-K1102_60minRT_10minInt		
Class	AnalogIAC		
Inputs	Parameter	Source	Type
	PV	FQI-K1102_Curr10min + FQI-K1102_Prev10min_1 +	Link

		FQI-K1102_Prev10min_2 + FQI-K1102_Prev10min_3 + FQI-K1102_Prev10min_4 + FQI-K1102_Prev10min_5	
	CtrlLoSP	FQI-K1002_MinVolume_Setting	Link
Alarms	-		

FQI-K1002_MinVolume_Setting is the operator configurable “Minimum Allowable Influent Volume Enable Start Mixers Setting In Case Of Level Transmitter Failure”.
FQI-K1002_MinVolume_Setting can be modified by an operator with security level M or higher. The operator HMI settings should be range checked before being used.

Table 3.2-19 YC-K1100_LiqEnb / Minimum Level or Influent Volume Reached

Instance	YC-K1100_LiqEnb		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	Dly	TBDC	Const.
	In	NOT LI-K1132.CtrlLo OR (LI-K1132.AlmErr AND NOT FQI-K1102_60minRT_10minInt.CtrlLo)	Link
Alarms	-		

3.2.2.4 YC-K1140_ S_ SP / CM-K114 TK-K114 Clarifier Speed Setpoint

P&ID Drawing: PPID-K103

The clarifier drive is equipped with a variable frequency drive (VFD). In auto mode, the clarifier rotation speed is proportional to the raw water flow rate.

The speed is determined with the following table:

Table 3.2-20 HRC Clarifier rotation speed

HRC Influent Flow (FIC-K1102.PV)	Clarifier rotation speed % (YC-K1140.CV_In)
20 ML/d	YC-K1140_ S_A
53 ML/d	YC-K1140_ S_B
135 ML/d	YC-K1140_ S_C

The settings YC-K1140_ S_A/B/C (clarifier rotation speed in %) can be modified by the operator with security level M or higher. The values should be checked so that YC-K1140_ S_A + 1% < YC-K1140_ S_B +1% < YC-K1140_ S_C. The operator HMI setpoints should be range checked before being used. YC-K1140_ S_A/B&C have no effect in manual mode.

The scraper speed setpoint is calculated using the measured influent flow for the corresponding train as follows:

If FIC-K1102.Out < 20 [ML/d] Then

YC-K1140_S_SP : = YC-K1140_ S_A [%]

Elseif FIC-K1102.Out < 53 [ML/d] Then

$$\text{YC - K1140\_ S\_ SP} := \frac{(\text{YC - K1140\_ S\_B - YC - K1140\_ S\_A})}{(53 - 20)} \times (\text{FIC - K1102.Out - 20}) + \text{YC - K1140\_ S\_A [\%]}$$

Elseif FIC-K1102.Out < 53 [ML/d] AND FIC-K1102,Out =< 135 [ML/d] Then

$$\text{YC - K1140\_ S\_ SP} := \frac{(\text{YC - K1140\_ S\_C - YC - K1140\_ S\_B})}{(135 - 53)} \times (\text{FIC - K1102.Out - 53}) + \text{YC - K1140\_ S\_B [\%]}$$

Else

YC-K1140_S_SP : = YC-K1140_ S_C [%]

EndIf

3.2.2.5 HRC 1 Lamella Air Scour Cleaning

The air scour system for both trains consists of one blower (B-K160) and three solenoid valves per clarifier to direct air to one unit at a time. The air scour blower is provided for assisting in cleaning the lamella tubes on an intermittent basis. The lamella air scour cleaning is called as part of the auto shutdown sequence. The clarifier mid-level drain valve will be automatically open and closed by the HRC train stopping sequence.

A retentive timer dedicated to lamellas cleaning accumulates the runtime of HRC 1 (KQI-K1140). If the accumulator reaches the lamellas cleaning due to “Runtime Lamellas Cleaning Required” (KQI-K1140_CleanReq_Setting) setting an alarm is generated. When the “Runtime Lamellas Cleaning Required “ alarm is generated, the system will change HRC 1 to lag (which will eventually stop the train) if the operator selects to “Set HRC 1 to Lag on HRC 1 Lamella Cleaning Required Alarm”.

Table 3.2-21 YC-K1140_Cleaning_Mode / HRC 1 Lamella Cleaning Alarm Mode

Instance	YC-K1140_Cleaning_Mode		
Class	OnOffSel		
Inputs	**Parameter**	**Source**	**Type**
	SelOffText	“Set HRC 1 to Degraded Performance When HRC 1 Lamella Cleaning Required”	Const
	SelOnText	“HRC 1 Lamella Cleaning Required Alarm Only”	Const

The lamellas will then be air scoured as part of the auto shutdown sequence. The timer is reset if the lamellas cleaning step of the stop sequencer is completed or by operator command.

Table 3.2-22 KQI-K1140 / HRC 1 Runtime for Lamella Cleaning [Hrs] (Operator Resettable)

Instance	KQI-K1140		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	If(YC-K1100.Running,1,0)	Link
	TimeFactor	3600 (Accumulates hours)	Const

	UnitConv	1	Const
	AlmHiLmt	KQI-K1140_CleanReq_Setting	Link
	AccumRstEnable	1 (Operator reset enabled)	Const
	ExtRst	YC-K1100_ScourDone	Link
Alarms	Hi(2)		

3.2.3 HRC 1 Main Sequence

3.2.3.1 Start Permissive

Table 3.2-23 YC-K1100_StartPerm / HRC 1 Start Permissive

Instance	YC-K1100_StartPerm		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	See Table 3.2-25 HRC 1 Start Permissive List	Link

Table 3.2-24 YC-K1100_StartNotPerm / HRC 1 Start Not Permissive

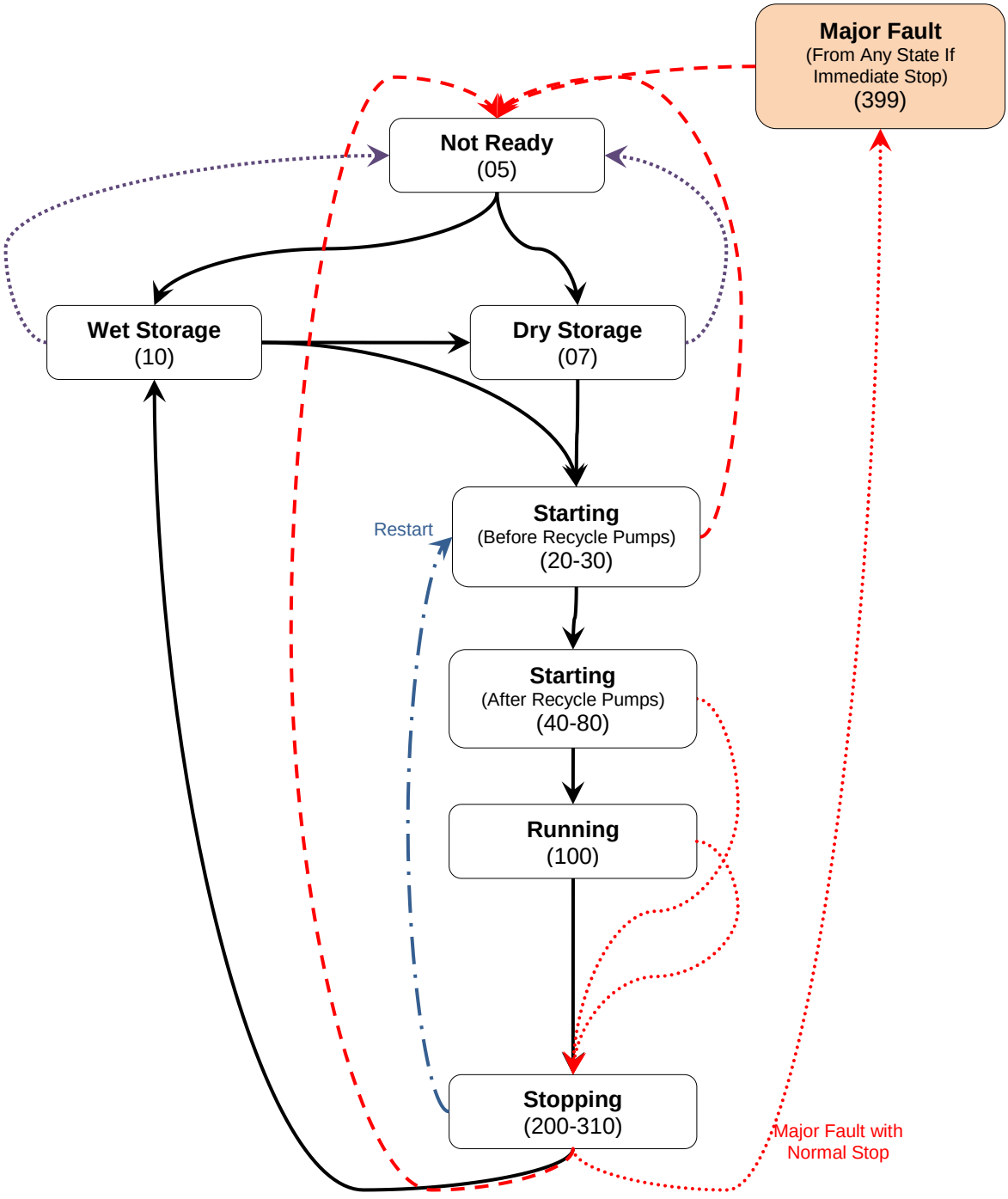
Instance	YC-K1100_StartNotPerm		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	Dly	2 000 msec	Const
	AutoRst	5 seconds	Const
	In	NOT (YC-K1100_StartPerm.Out OR YC-K1100_AutoStarting OR YC-K1100.Running)	Link
Alarms	Alm(3) - Low Priority		

Table 3.2-25 HRC 1 Start Permissive List

Permissive (AND)	Description
NOT YC-K1100.Fail	Not HRC 1 Fail Summary
XC-G3621.Rdy	XV-G3621 Influent Isolation Gate Ready
FK-K1102.Rdy	FV-K1102 Influent Modulating Weir Gate Ready
YC-K1120.Rdy	MXR-K112 Injection Mixer Ready
YC-K1130.Rdy	MXR-K113 Maturation Mixer Ready

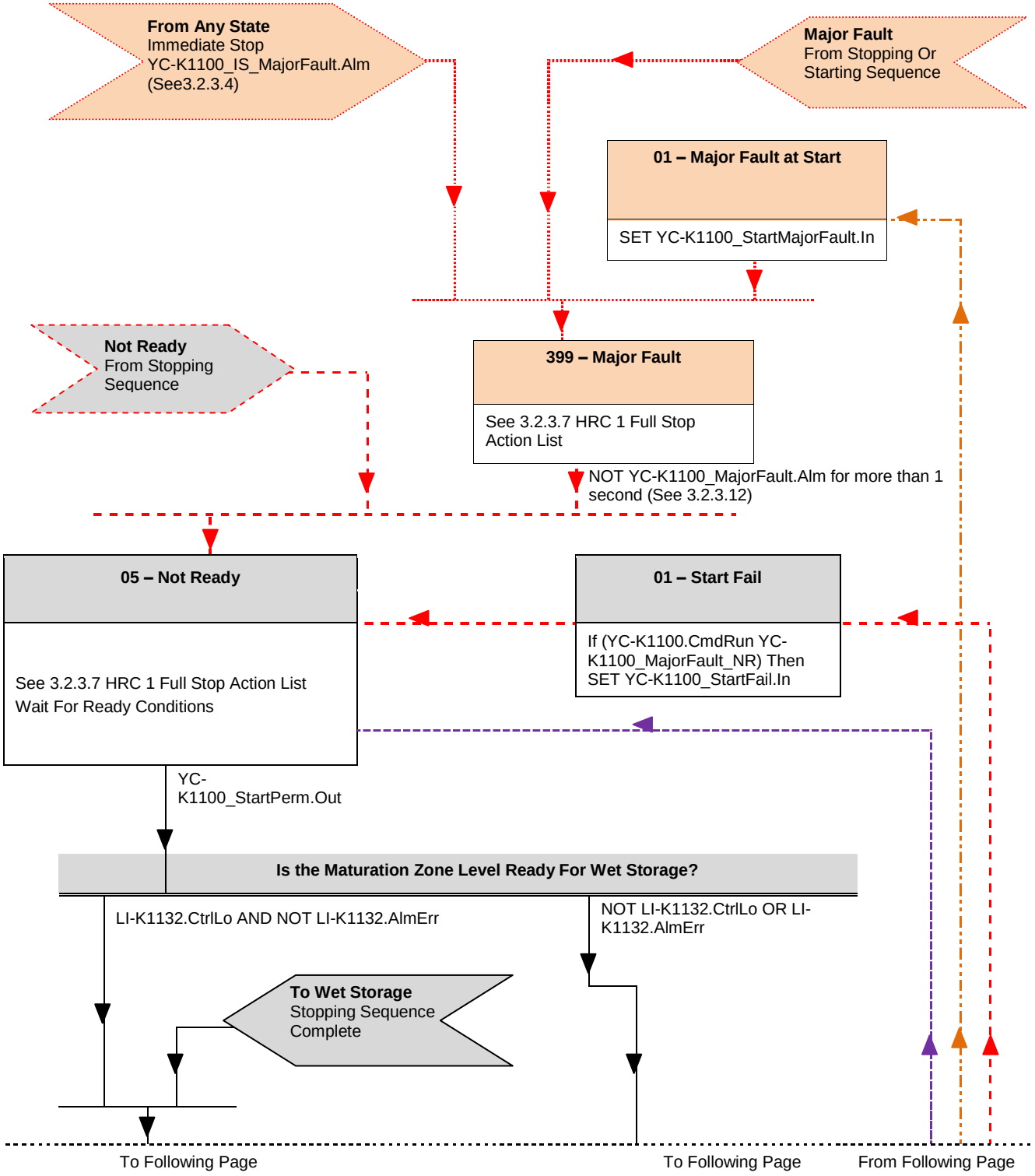
Permissive (AND)	Description
YC-K1140.Rdy	CM-K114 Sludge Scraper Ready
YC-K2110.Rdy OR YC-K2120.Rdy OR YC-K2130.Rdy	At least one Recycle Pump P-K211, P-K212 or P-K213 Ready
NOT GBL_C800_YC-C1241_NotAvail	HRC 1 Coagulant Available
NOT GBL_C800_YC-C4529_PathANotAvail	HRC 1 Polymer Available
FK-K1511.Rdy OR ((FK-K1511.FbkOut <= (AI-K1053_MinWtrLvl_GateOpn + %(TBDC)) AND XV-K1513.ConfCls)	HRC Effluent Weir Gate Ready or HRC Effluent Weir Gate Position Near or Below the Minimum Water Level with the HRC Effluent Channel to BNR Isolation Gate Closed
NOT (FIC-K1511.CtrlOper OR FIC-K1511.CtrlErr) OR ((FK-K1511.FbkOut <= (AI-K1053_MinWtrLvl_GateOpn + %(TBDC)) AND XV-K1513.ConfCls)	HRC Effluent Channel to Outfall Sewer Flow Control Not in Operator or Error mode or HRC Effluent Weir Gate Position Near or Below the Minimum Water Level with the HRC Effluent Channel to BNR Isolation Gate Closed
YC-K2510.Rdy OR YC-K2520.Rdy	At least one Waste Sludge Pumps P-K251 or P-K252 Ready
NOT (LIC-K2501.CtrlOper OR LIC-K2501.CtrlErr) OR YC-K2500_BackUpLvlCtrl.Alm	Waste Sludge Sump Level Control Not in Operator or Error mode or Backup Level Switch Control Mode
XC-K2543.ConfOpn OR XV-K2544.ConfOpn	Waste Sludge Valve XV-K2543 or XV-K2544 open

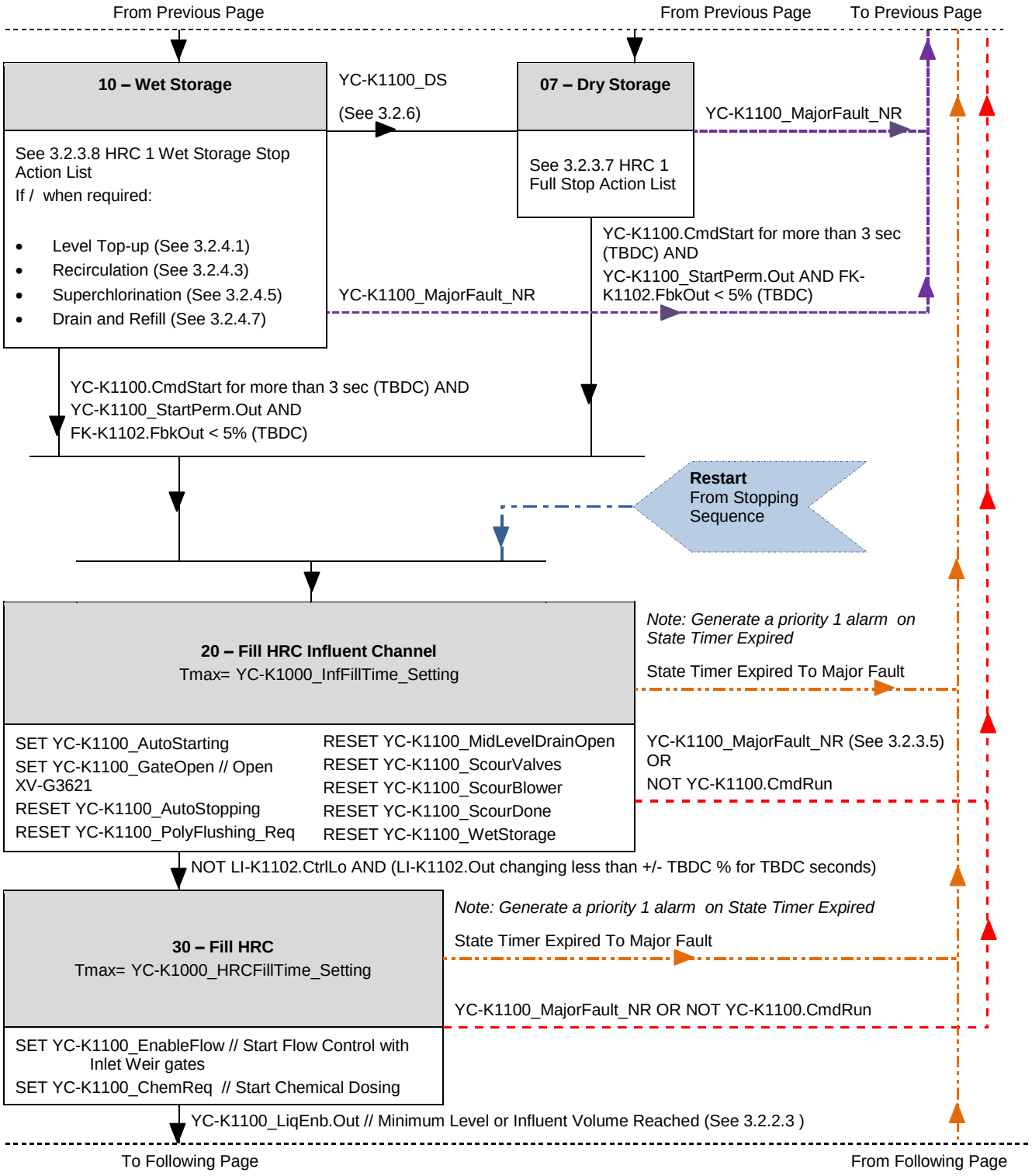
3.2.3.2 HRC 1 High Level Sequence



3.2-1 HRC High Level Sequence

3.2.3.3 YC-K1100_Sequence / HRC 1 Detailed Sequence




From Previous Page
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To Previous Page
10 – Wet Storage
YC-K1100_DS
(See 3.2.6)
07 – Dry Storage
YC-K1100_MajorFault_NR
See 3.2.3.8 HRC 1 Wet Storage Stop Action List
If / when required:
Level Top-up (See 3.2.4.1)
Recirculation (See 3.2.4.3)
Superchlorination (See 3.2.4.5)
Drain and Refill (See 3.2.4.7)
See 3.2.3.7 HRC 1 Full Stop Action List
YC-K1100.CmdStart for more than 3 sec (TBDC) AND
YC-K1100_StartPerm.Out AND FK-K1102.FbkOut < 5% (TBDC)
YC-K1100_MajorFault_NR
YC-K1100.CmdStart for more than 3 sec (TBDC) AND
YC-K1100_StartPerm.Out AND
FK-K1102.FbkOut < 5% (TBDC)
Restart
From Stopping Sequence
20 – Fill HRC Influent Channel
Tmax= YC-K1000_InfFillTime_Setting
Note: Generate a priority 1 alarm on State Timer Expired
State Timer Expired To Major Fault
SET YC-K1100_AutoStarting
SET YC-K1100_GateOpen // Open XV-G3621
RESET YC-K1100_AutoStopping
RESET YC-K1100_PolyFlushing_Req
RESET YC-K1100_MidLevelDrainOpen
RESET YC-K1100_ScourValves
RESET YC-K1100_ScourBlower
RESET YC-K1100_ScourDone
RESET YC-K1100_WetStorage
YC-K1100_MajorFault_NR (See 3.2.3.5)
OR
NOT YC-K1100.CmdRun
NOT LI-K1102.CtrlLo AND (LI-K1102.Out changing less than +/- TBDC % for TBDC seconds)
30 – Fill HRC
Tmax= YC-K1000_HRCFillTime_Setting
Note: Generate a priority 1 alarm on State Timer Expired
State Timer Expired To Major Fault
YC-K1100_MajorFault_NR OR NOT YC-K1100.CmdRun
SET YC-K1100_EnableFlow // Start Flow Control with Inlet Weir gates
SET YC-K1100_ChemReq // Start Chemical Dosing
YC-K1100_LiqEnb.Out // Minimum Level or Influent Volume Reached (See 3.2.2.3)
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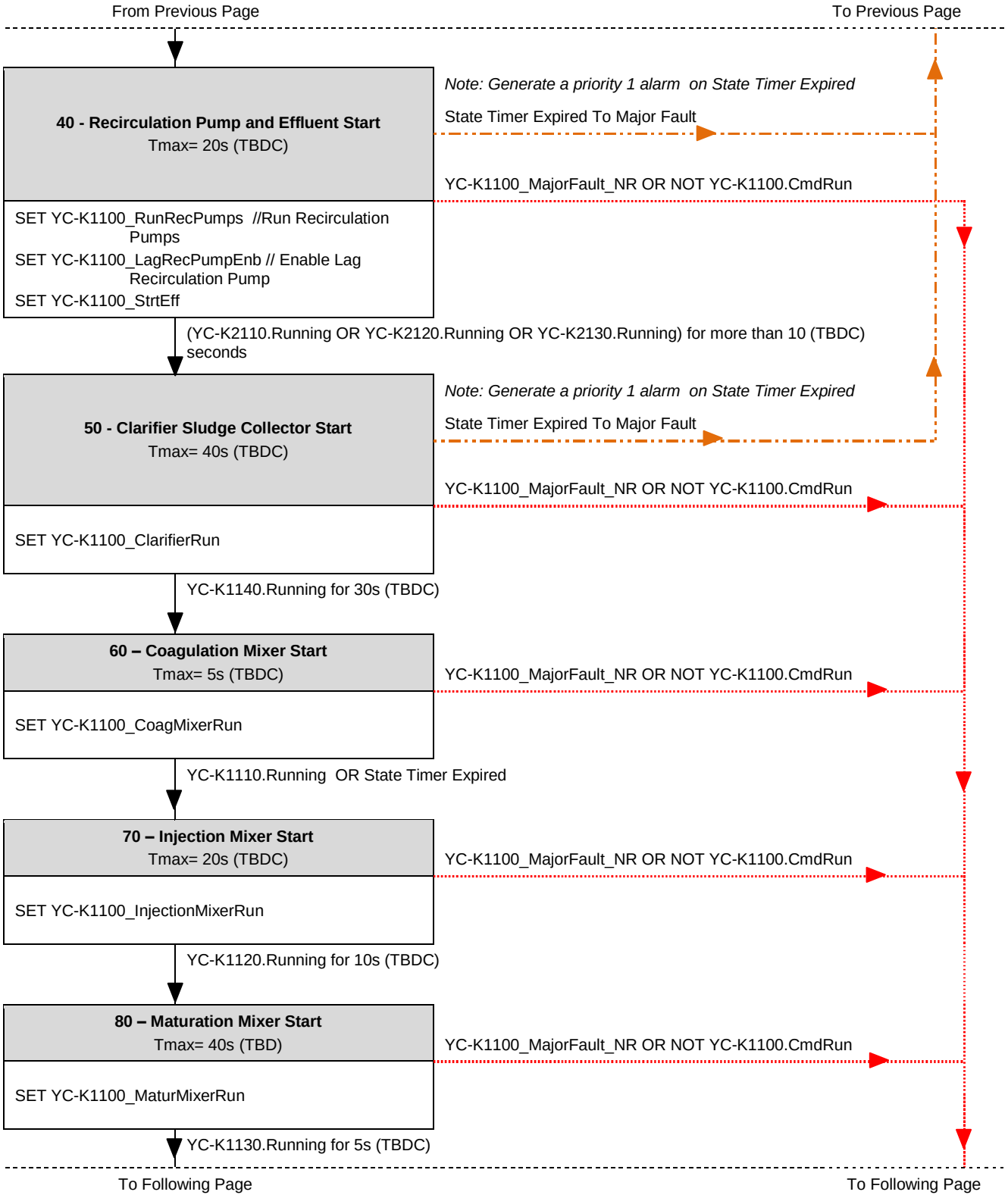
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40 - Recirculation Pump and Effluent Start
Tmax= 20s (TBDC)
Note: Generate a priority 1 alarm on State Timer Expired
State Timer Expired To Major Fault
YC-K1100_MajorFault_NR OR NOT YC-K1100.CmdRun
SET YC-K1100_RunRecPumps //Run Recirculation Pumps
SET YC-K1100_LagRecPumpEnb // Enable Lag Recirculation Pump
SET YC-K1100_StrtEff
(YC-K2110.Running OR YC-K2120.Running OR YC-K2130.Running) for more than 10 (TBDC) seconds
50 - Clarifier Sludge Collector Start
Tmax= 40s (TBDC)
Note: Generate a priority 1 alarm on State Timer Expired
State Timer Expired To Major Fault
YC-K1100_MajorFault_NR OR NOT YC-K1100.CmdRun
SET YC-K1100_ClarifierRun
YC-K1140.Running for 30s (TBDC)
60 – Coagulation Mixer Start
Tmax= 5s (TBDC)
YC-K1100_MajorFault_NR OR NOT YC-K1100.CmdRun
SET YC-K1100_CoagMixerRun
YC-K1110.Running OR State Timer Expired
70 – Injection Mixer Start
Tmax= 20s (TBDC)
YC-K1100_MajorFault_NR OR NOT YC-K1100.CmdRun
SET YC-K1100_InjectionMixerRun
YC-K1120.Running for 10s (TBDC)
80 – Maturation Mixer Start
Tmax= 40s (TBD)
YC-K1100_MajorFault_NR OR NOT YC-K1100.CmdRun
SET YC-K1100_MaturMixerRun
YC-K1130.Running for 5s (TBDC)
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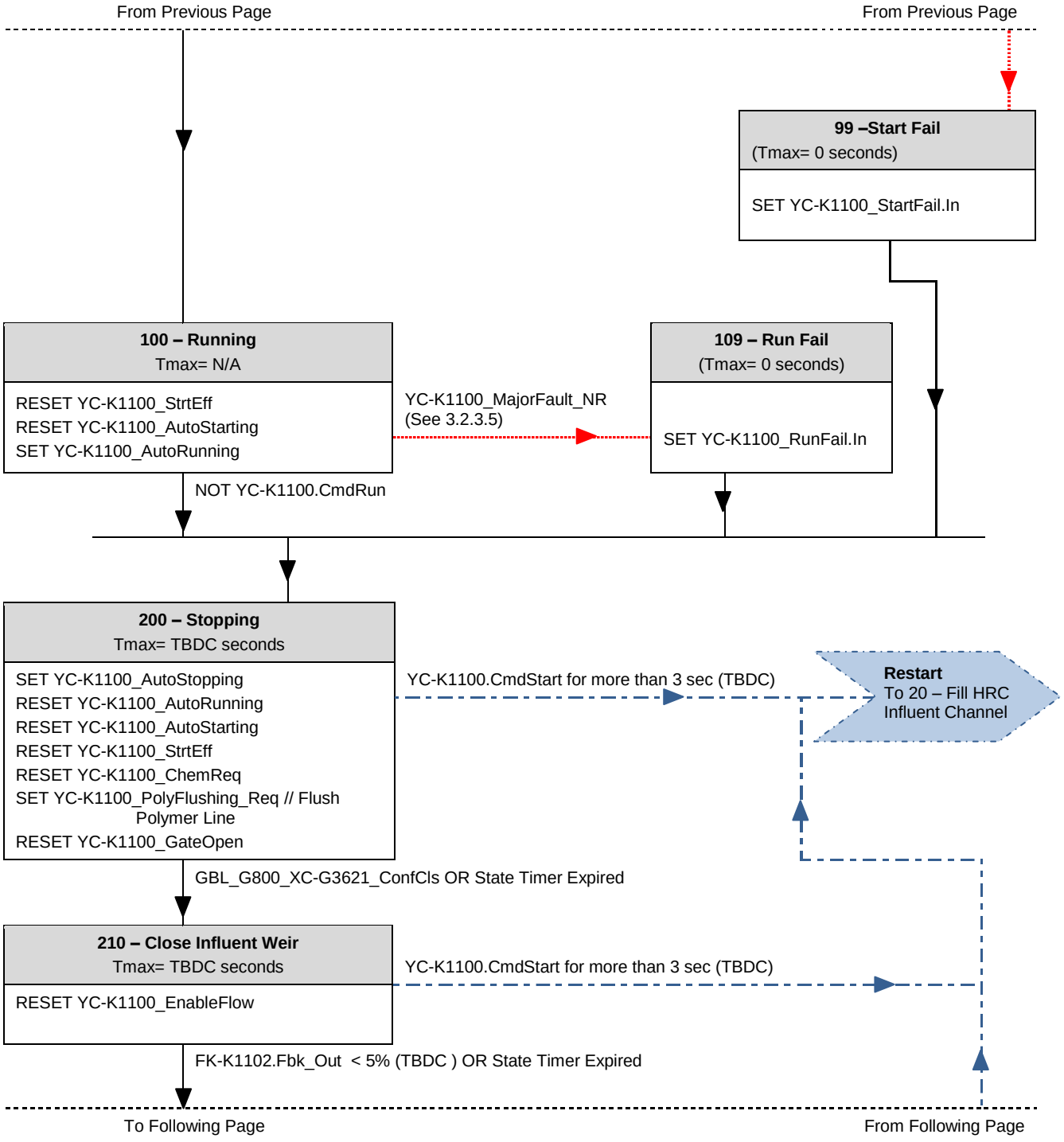
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99 –Start Fail
(Tmax= 0 seconds)
SET YC-K1100_StartFail.In
100 – Running
Tmax= N/A
RESET YC-K1100_StrtEff
RESET YC-K1100_AutoStarting
SET YC-K1100_AutoRunning
YC-K1100_MajorFault_NR
(See 3.2.3.5)
109 – Run Fail
(Tmax= 0 seconds)
SET YC-K1100_RunFail.In
NOT YC-K1100.CmdRun
200 – Stopping
Tmax= TBDC seconds
SET YC-K1100_AutoStopping
RESET YC-K1100_AutoRunning
RESET YC-K1100_AutoStarting
RESET YC-K1100_StrtEff
RESET YC-K1100_ChemReq
SET YC-K1100_PolyFlushing_Req // Flush Polymer Line
RESET YC-K1100_GateOpen
YC-K1100.CmdStart for more than 3 sec (TBDC)
Restart
To 20 – Fill HRC Influent Channel
GBL_G800_XC-G3621_ConfCls OR State Timer Expired
210 – Close Influent Weir
Tmax= TBDC seconds
RESET YC-K1100_EnableFlow
YC-K1100.CmdStart for more than 3 sec (TBDC)
FK-K1102.Fbk_Out < 5% (TBDC) OR State Timer Expired
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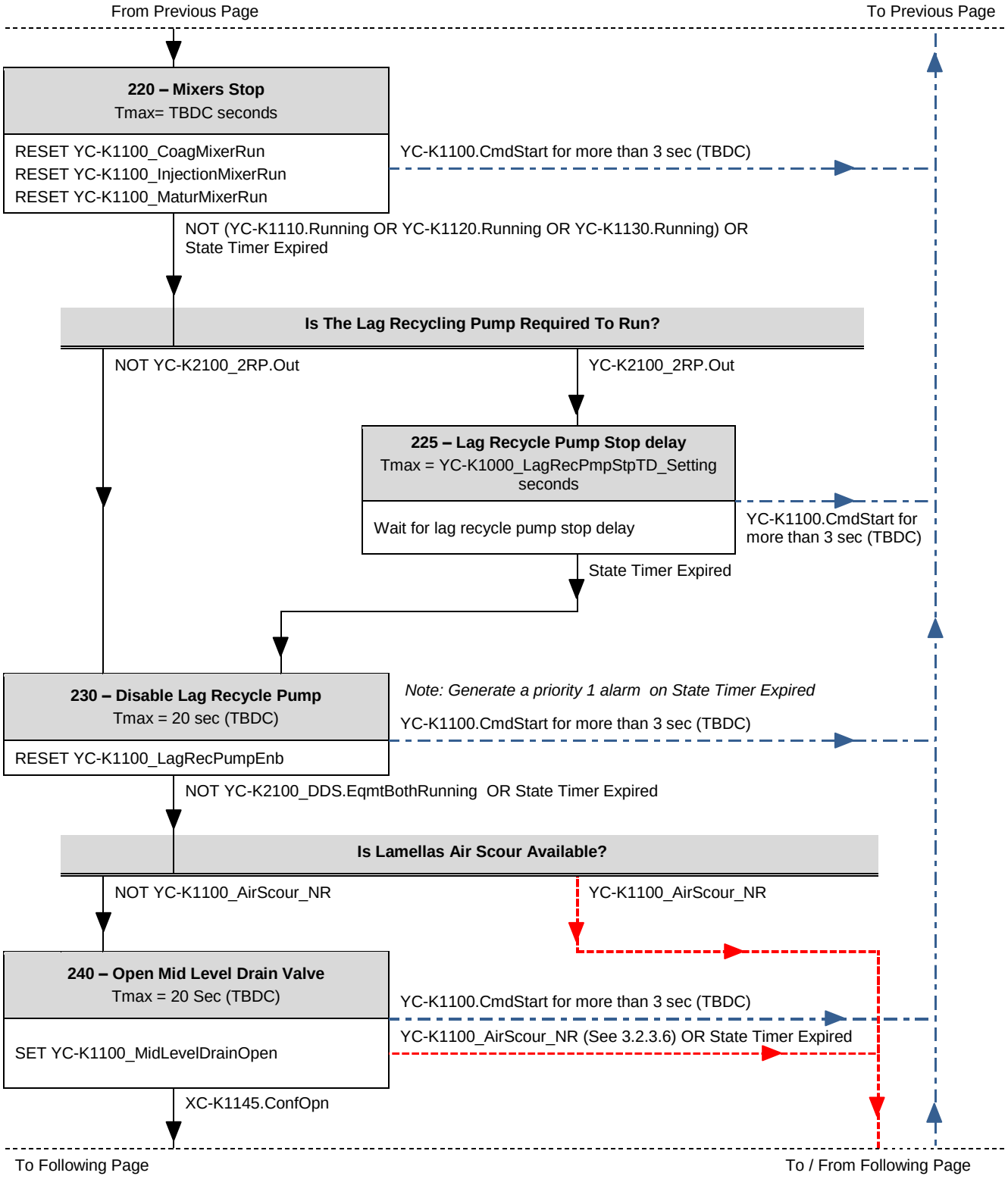
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To Previous Page
220 – Mixers Stop
Tmax= TBDC seconds
RESET YC-K1100_CoagMixerRun
RESET YC-K1100_InjectionMixerRun
RESET YC-K1100_MaturMixerRun
YC-K1100.CmdStart for more than 3 sec (TBDC)
NOT (YC-K1110.Running OR YC-K1120.Running OR YC-K1130.Running) OR State Timer Expired
Is The Lag Recycling Pump Required To Run?
NOT YC-K2100_2RP.Out
YC-K2100_2RP.Out
225 – Lag Recycle Pump Stop delay
Tmax = YC-K1000_LagRecPmpStpTD_Setting seconds
Wait for lag recycle pump stop delay
YC-K1100.CmdStart for more than 3 sec (TBDC)
State Timer Expired
230 – Disable Lag Recycle Pump
Tmax = 20 sec (TBDC)
RESET YC-K1100_LagRecPumpEnb
Note: Generate a priority 1 alarm on State Timer Expired
YC-K1100.CmdStart for more than 3 sec (TBDC)
NOT YC-K2100_DDS.EqmtBothRunning OR State Timer Expired
Is Lamellas Air Scour Available?
NOT YC-K1100_AirScour_NR
YC-K1100_AirScour_NR
240 – Open Mid Level Drain Valve
Tmax = 20 Sec (TBDC)
SET YC-K1100_MidLevelDrainOpen
YC-K1100.CmdStart for more than 3 sec (TBDC)
YC-K1100_AirScour_NR (See 3.2.3.6) OR State Timer Expired
XC-K1145.ConfOpn
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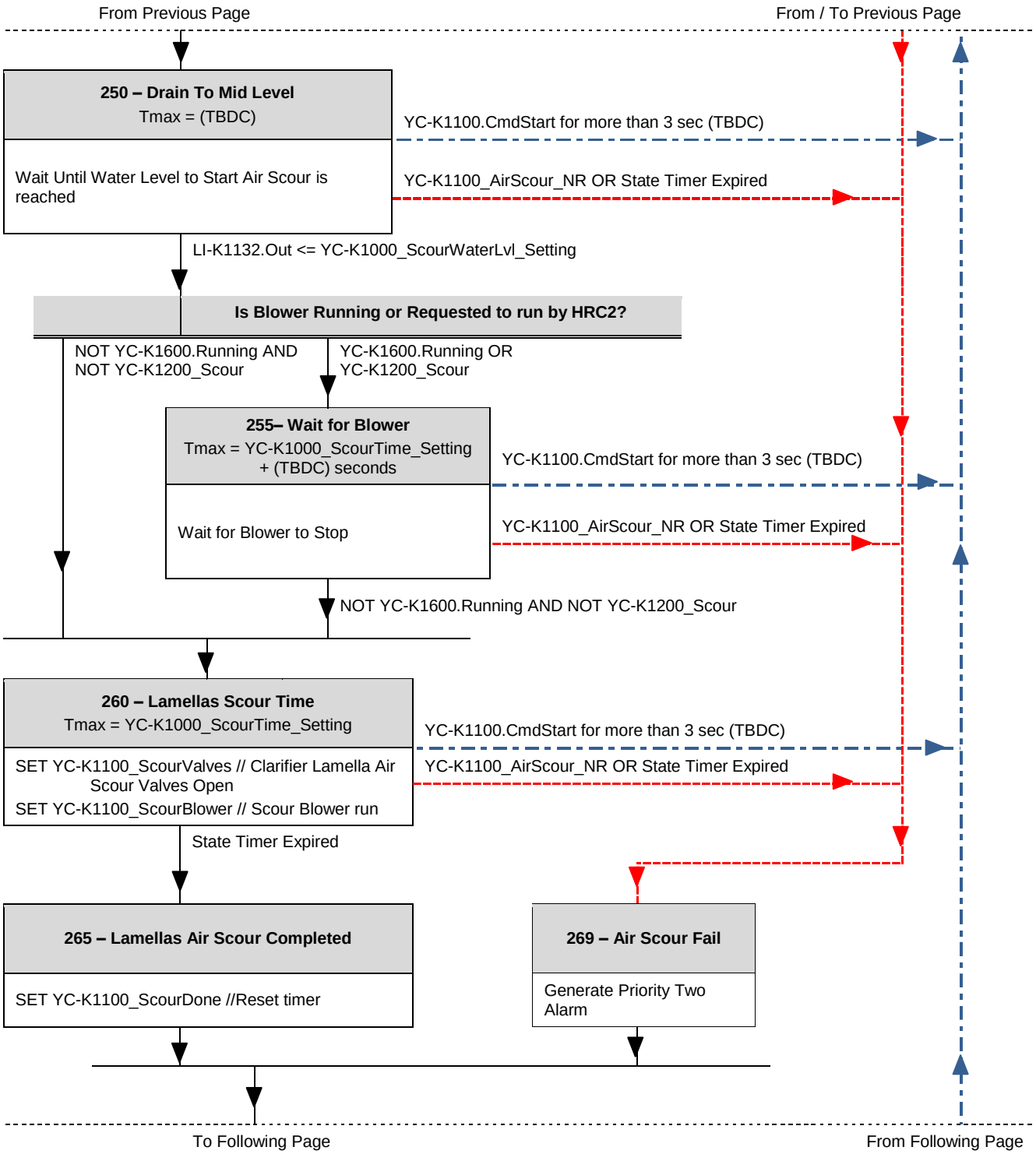
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250 – Drain To Mid Level
Tmax = (TBDC)
Wait Until Water Level to Start Air Scour is reached
YC-K1100.CmdStart for more than 3 sec (TBDC)
YC-K1100_AirScour_NR OR State Timer Expired
LI-K1132.Out <= YC-K1000_ScourWaterLvl_Setting
Is Blower Running or Requested to run by HRC2?
NOT YC-K1600.Running AND NOT YC-K1200_Scour
YC-K1600.Running OR YC-K1200_Scour
255– Wait for Blower
Tmax = YC-K1000_ScourTime_Setting + (TBDC) seconds
Wait for Blower to Stop
YC-K1100.CmdStart for more than 3 sec (TBDC)
YC-K1100_AirScour_NR OR State Timer Expired
NOT YC-K1600.Running AND NOT YC-K1200_Scour
260 – Lamellas Scour Time
Tmax = YC-K1000_ScourTime_Setting
SET YC-K1100_ScourValves // Clarifier Lamella Air Scour Valves Open
SET YC-K1100_ScourBlower // Scour Blower run
YC-K1100.CmdStart for more than 3 sec (TBDC)
YC-K1100_AirScour_NR OR State Timer Expired
State Timer Expired
265 – Lamellas Air Scour Completed
SET YC-K1100_ScourDone //Reset timer
269 – Air Scour Fail
Generate Priority Two Alarm
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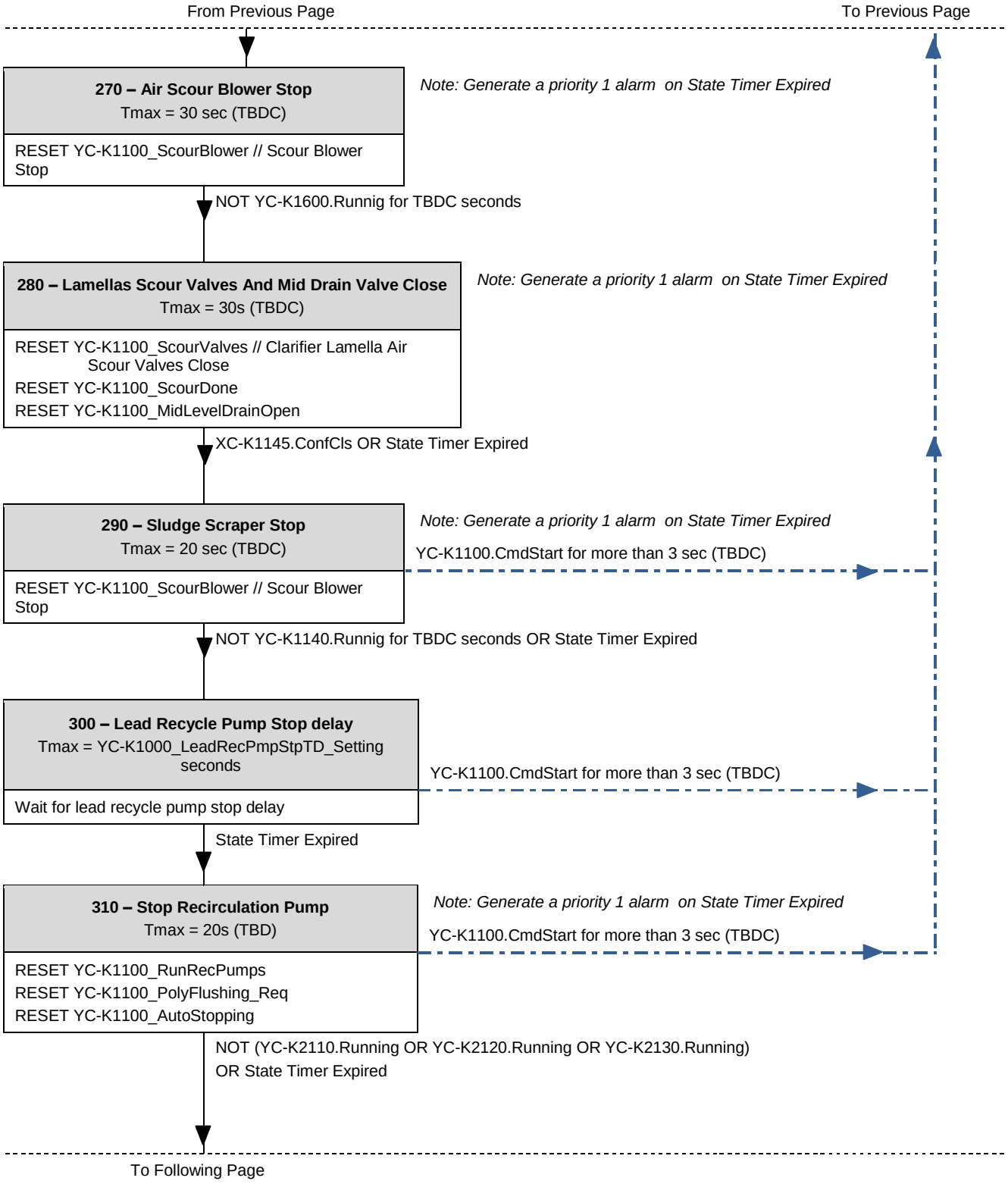
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270 – Air Scour Blower Stop
Tmax = 30 sec (TBDC)
RESET YC-K1100_ScourBlower // Scour Blower Stop
Note: Generate a priority 1 alarm on State Timer Expired
NOT YC-K1600.Runnig for TBDC seconds
280 – Lamellas Scour Valves And Mid Drain Valve Close
Tmax = 30s (TBDC)
RESET YC-K1100_ScourValves // Clarifier Lamella Air Scour Valves Close
RESET YC-K1100_ScourDone
RESET YC-K1100_MidLevelDrainOpen
Note: Generate a priority 1 alarm on State Timer Expired
XC-K1145.ConfCls OR State Timer Expired
290 – Sludge Scraper Stop
Tmax = 20 sec (TBDC)
RESET YC-K1100_ScourBlower // Scour Blower Stop
Note: Generate a priority 1 alarm on State Timer Expired
YC-K1100.CmdStart for more than 3 sec (TBDC)
NOT YC-K1140.Runnig for TBDC seconds OR State Timer Expired
300 – Lead Recycle Pump Stop delay
Tmax = YC-K1000_LeadRecPmpStpTD_Setting seconds
Wait for lead recycle pump stop delay
YC-K1100.CmdStart for more than 3 sec (TBDC)
State Timer Expired
310 – Stop Recirculation Pump
Tmax = 20s (TBD)
RESET YC-K1100_RunRecPumps
RESET YC-K1100_PolyFlushing_Req
RESET YC-K1100_AutoStopping
Note: Generate a priority 1 alarm on State Timer Expired
YC-K1100.CmdStart for more than 3 sec (TBDC)
NOT (YC-K2110.Running OR YC-K2120.Running OR YC-K2130.Running)
OR State Timer Expired
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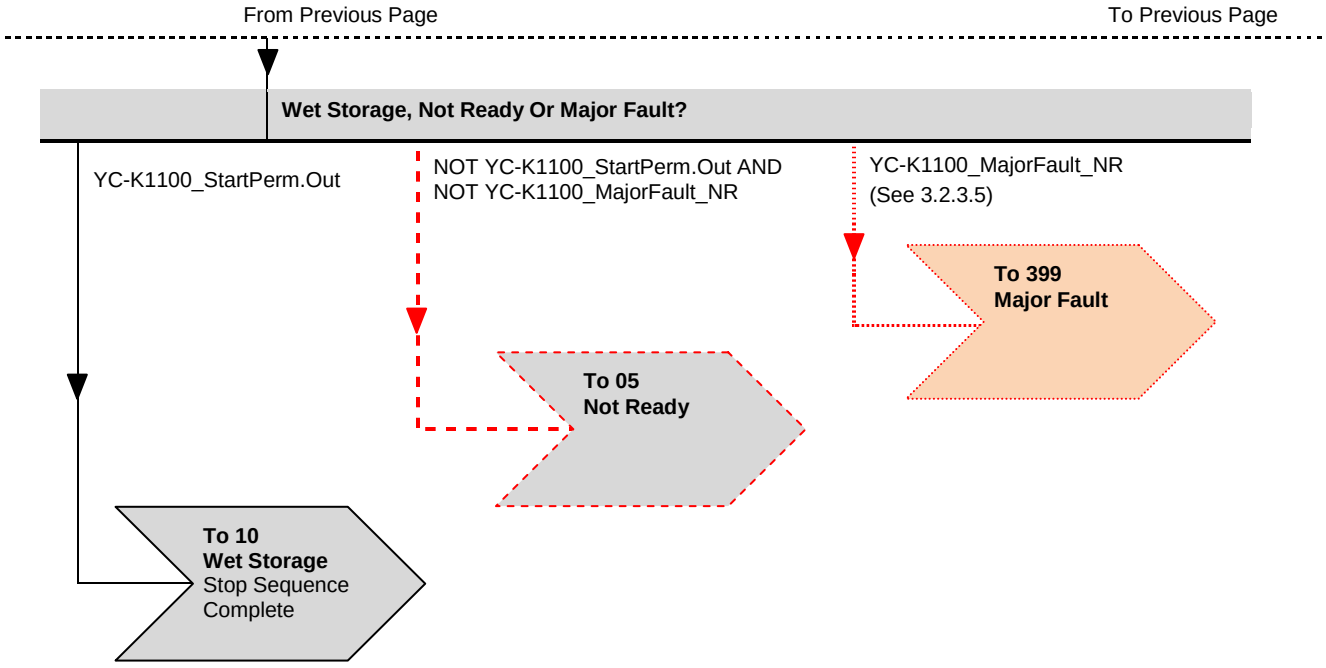


The following settings are real numbers that can be modified by an operator with security level M or higher:

- YC-K1000_ScourWaterLvl_Setting is the “HRC Water Level to Start Air Scour” in meters.
- YC-K1000_ScourTime_Setting is the “HRC Train Air Scouring ON Time” in seconds.
- YC-K1000_InfFillTime_Setting is the “HRC Influent Channel Maximum Fill Time” in seconds.
- YC-K1000_HRCFillTime_Setting is the “HRC Maximum Fill Time” in seconds.
- YC-K1000_LagRecPmpStpTD_Setting is the “Lag Recycle Pump Stop Delay” in seconds.
- YC-K1000_LeadRecPmpStpTD_Setting is the “Lead Recycle Pump Stop Delay” in seconds.

3.2.3.4 YC-K1100_IS_MajorFault / HRC 1 Immediate Stop Major Fault

Table 3.2-26 YC-K1100_IS_MajorFault / HRC 1 Immediate Stop Major Fault

Instance	YC-K1100_IS_MajorFault		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	See Table 3.2-27 YC-K1100_IS_MajorFault / HRC 1 Immediate Stop Major Fault Conditions List below	Link

	AutoRst	5 sec (TBDC)	Const
Alarms	Alm(1) – Emergency / High Priority		

The following conditions trigger an Immediate Stop by changing immediately from any state to Major Fault state:

Table 3.2-27 YC-K1100_IS_MajorFault / HRC 1 Immediate Stop Major Fault Conditions List

Conditions (OR)	Description
Area K PLC First Scan	Area K PLC is restarting
YC-K1140.Fail	CM-K114 Scraper Failure (Includes Interlocks)
(YC-K1100_ClarifierRun AND NOT YC-K1140.Running) for more than 41 seconds (TBDC)	CM-K114 Scraper Not Running When Required by the Sequence
YC-K2110.Fail AND YC-K2120.Fail AND YC-K2130.Fail	All Recirculation Pumps Failed
YC-K1100_RunRecPumps AND (NOT (YC-K2110.Running OR YC-K2120.Running OR YC-K2130.Running) for more than 21 seconds(TBDC))	Recirculation pumps Not Running When Required by the Sequence
HA-K1106.Alm	HRC 1 Process Immediate Stop Hand Switch (Clarifier, Pump Room or HMI)

3.2.3.5 YC-K1100_MajorFault_NR / HRC 1 Major Fault Not Ready Conditions

The following conditions generate a major fault after stop and prevent the major fault reset:

Table 3.2-28 YC-K1100_MajorFault_NR / HRC 1 Major Fault Not Ready Conditions List

Conditions (OR)	Description
YC-K1100_IS_MajorFault.Alm	HRC 1 Immediate Stop Conditions (for completeness)
YC-K1120.Fail	MXR-K112 Injection Mixer Failure
(YC-K1100_InjectionMixerRun AND NOT YC-K1120.Running) for more than 21 seconds (TBDC)	MXR-K112 Injection Mixer Not Running When Required by the Sequence
YC-K1130.Fail	MXR-K113 Maturation Mixer Failure
(YC-K1100_MaturationMixerRun AND NOT YC-K1130.Running) for more than 41 seconds (TBDC)	MXR-K113 Maturation Mixer Not Running When Required by the Sequence
GBL_G800_XC-G3621_Fail	XV-G3621 Inlet Isolation Gate Failure
FK-K1102.Fail	HRC 1 Influent Channel Flow Control Gate Failure
FIC-K1102.AlmLoLo	HRC 1 Influent Channel Flow Low Low

Conditions (OR)	Description
YC-K1100_StartMajorFault.Alm	HRC 1 Auto Start Major Fault (Operator Reset Required)
YC-K1100_RunFail.Alm	HRC 1 Auto Run Fail (Operator Reset Required)

3.2.3.6 YC-K1100_AirScour_NR / HRC 1 Lamellas Air Scour Not Ready Conditions

The following conditions prevent the execution of lamellas air scour:

Table 3.2-29 YC-K1100_AirScour_NR / HRC 1 Lamellas Air Scour Not Ready Conditions List

Conditions (OR)	Description
YC-K1100_IS_MajorFault.Alm	HRC 1 Immediate Stop Conditions (for completeness)
YC-K1200_IS_MajorFault.Alm	HRC 2 Immediate Stop Conditions
NOT XC-K1145.Rdy	XV-K1145 Mid Level Drain Valve Not Ready
LIT-K1132.AlmErr	Maturation Zone Level Transmitter Bad Quality
NOT YC-K1600.Rdy	B-K160 Air Scour Blower Not Ready
NOT(XC-K1141.Rdy AND XC-K1142.Rdy AND XC-K1143.Rdy)	Any Clarifier Lamella Air Scour Valves (XV-K1141, XV-K1142 and XV-K1143) Not Ready

3.2.3.7 HRC 1 Full Stop Action List

The following actions will be performed continuously when Full Stop is required:

Table 3.2-30 HRC 1 Full Stop Action List

Action	Description
YC-K1100_WetStorage := False	Not In Wet Storage Mode
YC-K1100_DS := False	Wet Storage To Dry Storage Transfer Done (see 3.2.6)
YC-K1100_GateOpen := False	Influent Channel Isolation Gate Close
YC-K1100_ChemReq := False	Stop Chemical Dosing
YC-K1100_PolyFlushing_Req := False	Stop Flush Polymer Line
YC-K1100_RunRecPumps := False	Stop Recycle Pumps
YC-K1100_LagRecPumpEnb := False	Disable Lag Recycle Pump
YC-K1100_CoagMixerRun := False	Stop MXR-K111 TK-K111 Coagulation Zone Mixer
YC-K1100_InjectionMixerRun := False	Stop MXR-K112 TK-K112 Injection Zone Mixer
YC-K1100_MaturMixerRun := False	Stop MXR-K113 TK-K113 Maturation Zone Mixer
YC-K1100_ClarifierRun := False	Stop CM-K114 TK-K114 Clarifier Sludge Collector
YC-K1100_MidLevelDrainOpen :=False	Close TK-K114 Clarifier Lamella Drain Valve
YC-K1100_ScourValves := False	Close TK-K114 Clarifier Lamella Air Scour Valves

Action	Description
YC-K1100_ScourBlower := False	Stop Lamella Air Scour Blower
FIC-K1102.Auto_SP := 0	Influent Channel Flow Control Setpoint to 0 Flow
YC-K1100_EnableFlow := False	Close Influent Modulating Weir
YC-K1100_AutoStarting := False	HRC 1 Not Starting
YC-K1100_AutoStopping := False	HRC 1 Not Stopping
YC-K1100_AutoRunning := False	HRC 1 Not Running
YC-K1100_ScourDone:=False	Lamella scour not done
Reset YC-K1100_StartFail.In after 1 sec in state	Enable reset (if required) of Start Fail
Reset YC-K1100_StartMajorFault.In after 1 sec in state	Enable reset (if required) of HRC 1 Auto Start Major Fault
Reset YC-K1100_RunFail.In after 1 sec in state	Enable reset (if required) of Run Fail

3.2.3.8 HRC 1 Wet Storage Stop Action List

The following actions will be performed continuously when Wet Storage is required:

Table 3.2-31 HRC 1 Wet Storage Stop Action List

Action	Description
YC-K1100_WetStorage := True	In Wet Storage Mode
YC-K1100_GateOpen := False	Influent Channel Sluice Gate Close
YC-K1100_ChemReq := False	Stop Chemical Dosing
YC-K1100_PolyFlushing_Req := False	Stop Flush Polymer Line
YC-K1100_RunRecPumps := False	Stop Recycle Pumps
YC-K1100_LagRecPumpEnb := False	Disable Lag Recycle Pump
YC-K1100_CoagMixerRun := False	Stop MXR-K111 TK-K111 Coagulation Zone Mixer
YC-K1100_InjectionMixerRun := False	Stop MXR-K112 TK-K112 Injection Zone Mixer
YC-K1100_MaturMixerRun := False	Stop MXR-K113 TK-K113 Maturation Zone Mixer
YC-K1100_ClarifierRun := False	Stop CM-K114 TK-K114 Clarifier Sludge Collector
YC-K1100_MidLevelDrainOpen :=False	Close TK-K114 Clarifier Lamella Drain Valve
YC-K1100_ScourValves := False	Close TK-K114 Clarifier Lamella Air Scour Valves
YC-K1100_ScourBlower := False	Stop Lamella Air Scour Blower
FIC-K1102.Auto_SP := 0	Influent Channel Flow Control Setpoint to 0 Flow

Action	Description
YC-K1100_EnableFlow := False	Influent Modulating Weir Not Flow Controlling

3.2.3.9 YC-K1100_StartFail / HRC 1 Start Fail

Table 3.2-32 YC-K1100_StartFail / HRC 1 Start Fail

Instance	YC-K1100_StartFail		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	See YC-K1100_Sequence (0)	Link
	ExtRst	YC-K1100.RstDevAlms	Link
Alarms	Alm(2) - Medium Priority		

Note: Alarm text to include name and description of the failed sequence state

3.2.3.10 YC-K1100_StartMajorFault / HRC 1 Start Major Fault

Table 3.2-33 YC-K1100_StartMajorFault / HRC 1 Auto Start Major Fault

Instance	YC-K1100_StartMajorFault		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	See YC-K1100_Sequence (0)	Link
	ExtRst	YC-K1100. RstDevAlms	Link
Alarms	Alm(2) - Medium Priority		

Notes: Alarm text to include name and description of the failed sequence state

3.2.3.11 YC-K1100_RunFail / HRC 1 Run Fail

Table 3.2-34 YC-K1100_RunFail / HRC 1 Auto Run Fail

Instance	YC-K1100_RunFail		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	See YC-K1100_Sequence (0)	Link
	ExtRst	YC-K1100. RstDevAlms	Link
Alarms	Alm(2) – Medium Priority		

3.2.3.12 YC-K1100_MajorFault / HRC 1 Major Fault

Table 3.2-35 YC-K1100_MajorFault / HRC 1 Major Fault

Instance	YC-K1100_MajorFault		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	(Entering to State 399 - Major Fault) OR YC-K1100_MajorFault_NR OR YC-K1100_IS_MajorFault.Alm	Link
	ExtRst	YC-K1100. RstDevAlms	Link
Alarms	Alm(1) – Emergency / High Priority		

3.2.4 HRC 1 Wet Storage Sequences

P&ID Drawing: PPID-K101, PPID-K102 & PPID-K103

In Wet Storage mode, the train is maintained in a wet condition for an adjustable amount of time before automatically being drained and optionally refilled. During wet storage the tank contents are periodically recirculated to keep the contents fresh, and also periodically superchlorinated to mitigate odours and fouling

The following operator settings are use in the Wet Storage Sequences:

- YC-K1000_WS_ClarifierStpTD_Setting [sec] is the “Wet Storage Clarifier Stop Delay”
- YC-K1000_WS_LeadRecPmpStpTD_Setting [sec] is the “Wet Storage Lead Recycle Pump Stop Delay”
- YC-K1000_WSR_Recirc_Setting [sec] is the “Wet Storage Recirculation Duration”
- YC-K1000_WSSC_SH_IM_Setting [sec] is the “Wet Storage Superchlorination Inlet and Maturation Duration”
- YC-K1000_WSSC_SH_M_Setting [sec] is the “Wet Storage Superchlorination Maturation Only Duration”

All the previous settings are real numbers and can be modified by the operator with security level M or higher. The operator HMI settings should be range checked before being used.

3.2.4.1 YC-K1100_LTUP / HRC 1 Wet Storage Level Top Up Control Station

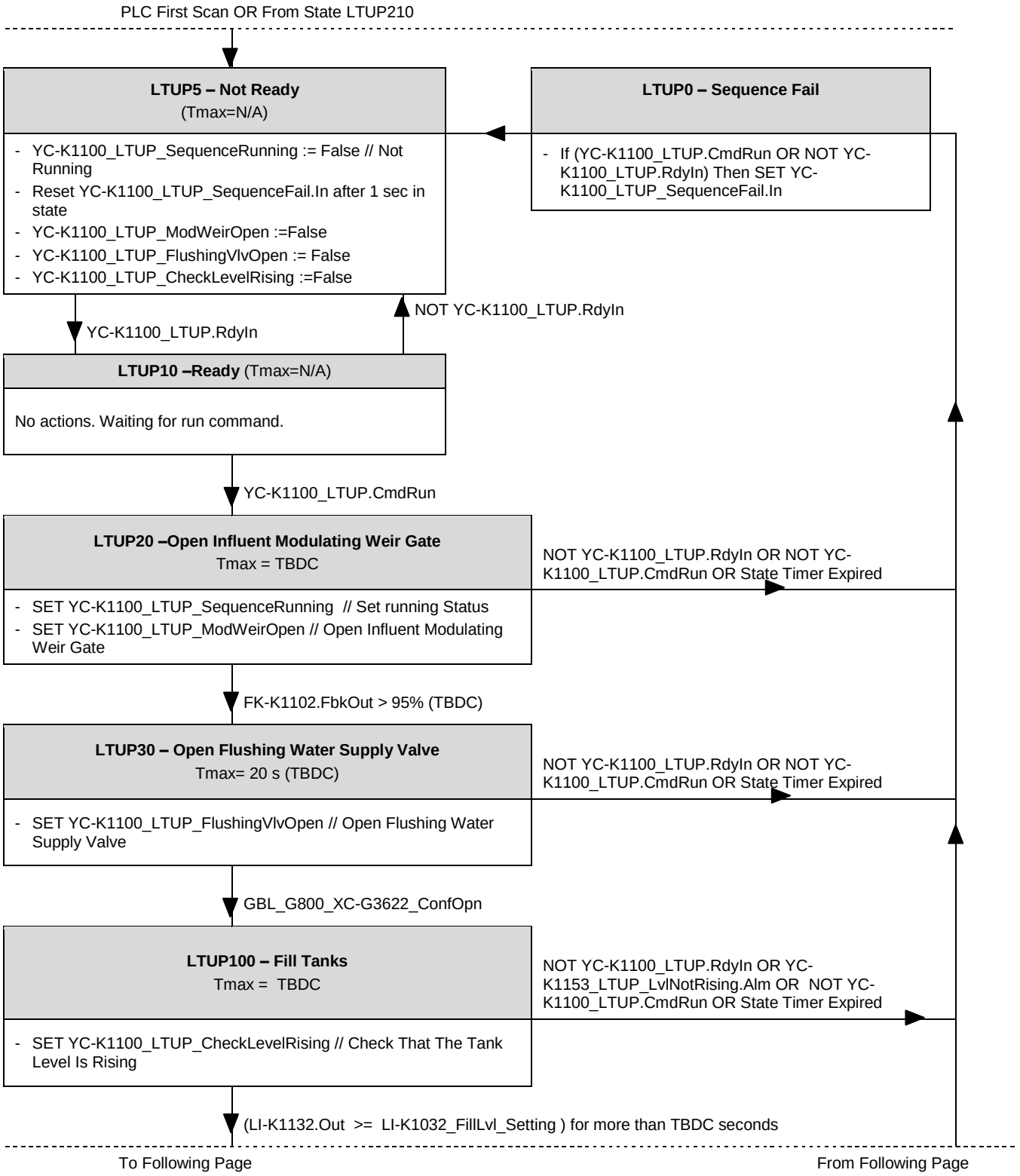
When in auto, if the level measured in the maturation tank is less than a level adjustable by the operator (LI-K1032_LTUP_Str_Setting – higher than the required level to start the train), then the tank will be filled with flushing water to a level adjustable by the operator (LI-K1032_FillLvl_Setting). This is required to allow the equipment to run as part of the other wet storage sequences.

LI-K1032_LTUP_Str_Setting and LI-K1032_FillLvl_Setting are real numbers in meters that can be modified by an operator with security level M or higher. The operator HMI settings should be range checked before being used so that LI-K1032_FillLvl_Setting > LI-K1032_LTUP_Str_Setting > LI-K1132.CtrLo.

Table 3.2-36 YC-K1100_LTUP / HRC 1 Wet Storage Level Top Up Sequence Control Station

Instance	YC-K1100_LTUP		
Class	DiscreteCS		
Inputs	**Parameter**	**Source**	**Type**
	CtrlRem	N/A	Link
	Flt	YC-K1153_LTUP_SequenceFail.Alm	Link
	RdyIn	YC-K1100_WetStorage AND GBL_G800_XC-G3621_ConfCls AND NOT LI-K1132.AlmErr AND FV-K1102.Rdy AND GBL_G800_XC-G3622_Rdy AND NOT (YC-K1100_WSSC.Running OR YC-K1100_DF.Running)	Link
	Run	YC-K1153_LTUP_SequenceRunning	Link
	ExtAutoStopEnb	True	Const
	RunAuto	YC-K1100_WetStorage AND (LI-K1132.Out < LI-K1032_LTUP_Str_Setting) OR YC-K1153_LTUP_SequenceRunning	Link
Alarms	N/A		

3.2.4.2 YC-K1100_LTUP_Sequence / HRC 1 Wet Storage Level Top Up Sequence



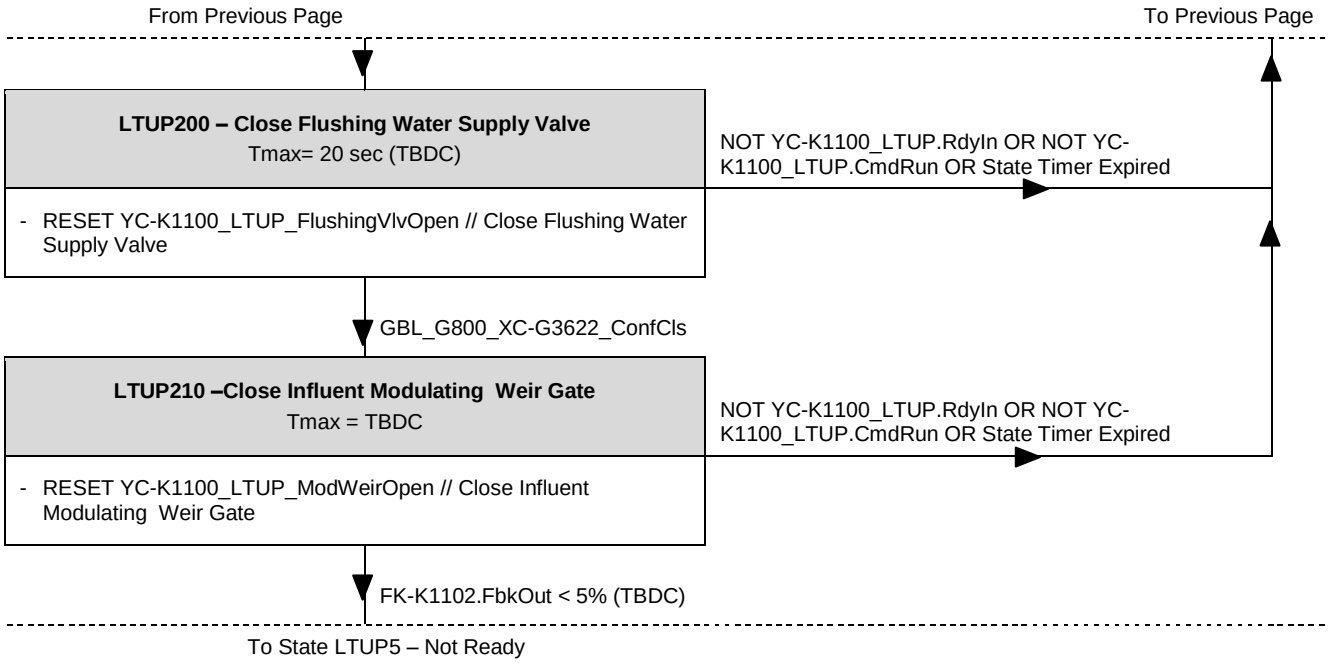


Table 3.2-37 YC-K1100_LTUP_Req_NR / HRC 1 Wet Storage Level Top Up Required and Not Ready

Instance	YC-K1100_LTUP_Req_NR		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	YC-K1100_WetStorage AND LI-K1132.CtrLo AND NOT (YC-K1100_LTUP.Rdy OR YC-K1100_LTUP.Running)	Link
	ExtRst	YC-K1100_LTUP. RstDevAlms	Link
Alarms	Alm(3) - Low Priority		

Table 3.2-38 YC-K1100_LTUP_SequenceFail / HRC 1 Wet Storage Level Top Up Sequence Fail

Instance	YC-K1100_LTUP_SequenceFail		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	See YC-K1100_LTUP_Sequence above	Link
	ExtRst	YC-K1100_LTUP. RstDevAlms	Link
Alarms	Alm(3) - Low Priority		

Note: Alarm text to include name and description of the failed sequence state

Table 3.2-39 YC-K1153_LTUP_LvlNotRising / HRC 1 Wet Storage Level Top Up Level Not Rising

Instance	YC-K1153_LTUP_LvlNotRising		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	Check every minute that new measurement increase is greater than TBDC	Link
	DisAlm	NOT YC-K1100_LTUP_CheckLevelRising	Link
	ExtRst	YC-K1100_LTUP. RstDevAlms	Link
Alarms	Alm(3) - Low Priority		

3.2.4.3 YC-K1100_WSR / HRC 1 Wet Storage Recirculation Control Station

When in auto, every 24 hours (YC-K1100_WSR_Tmr_Setting) the mixers, sludge collector and lead recycle pump will run in order to mix and freshen the stagnant water.

YC-K1100_WSR_Tmr_Setting is the operator configurable “Wet Storage Recirculation Frequency” in hours. YC-K1100_WSR_Tmr_Setting can be modified by an operator with security level M or higher. The operator HMI settings should be range checked before being used.

Table 3.2-40 YC-K1100_WSR_Tmr / HRC 1 Wet Storage Recirculation Timer

Instance	YC-K1100_WSR_Tmr		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	1	Link
	CrtlHiSP	YC-K1100_WSR_Tmr_Setting	Link
	TimeFactor	3600 (Hrs assumed)	Const
	UnitConv	1	Const
	AccumAutoRst	YC-K1100.Running OR (NOT YC-K1100_WetStorage AND LIT-K132.CtrlLo) OR (YC-K1100_WSR_RecircDone rising edge)	Link
	AccumRstEnable	True	Const
Alarms	-		

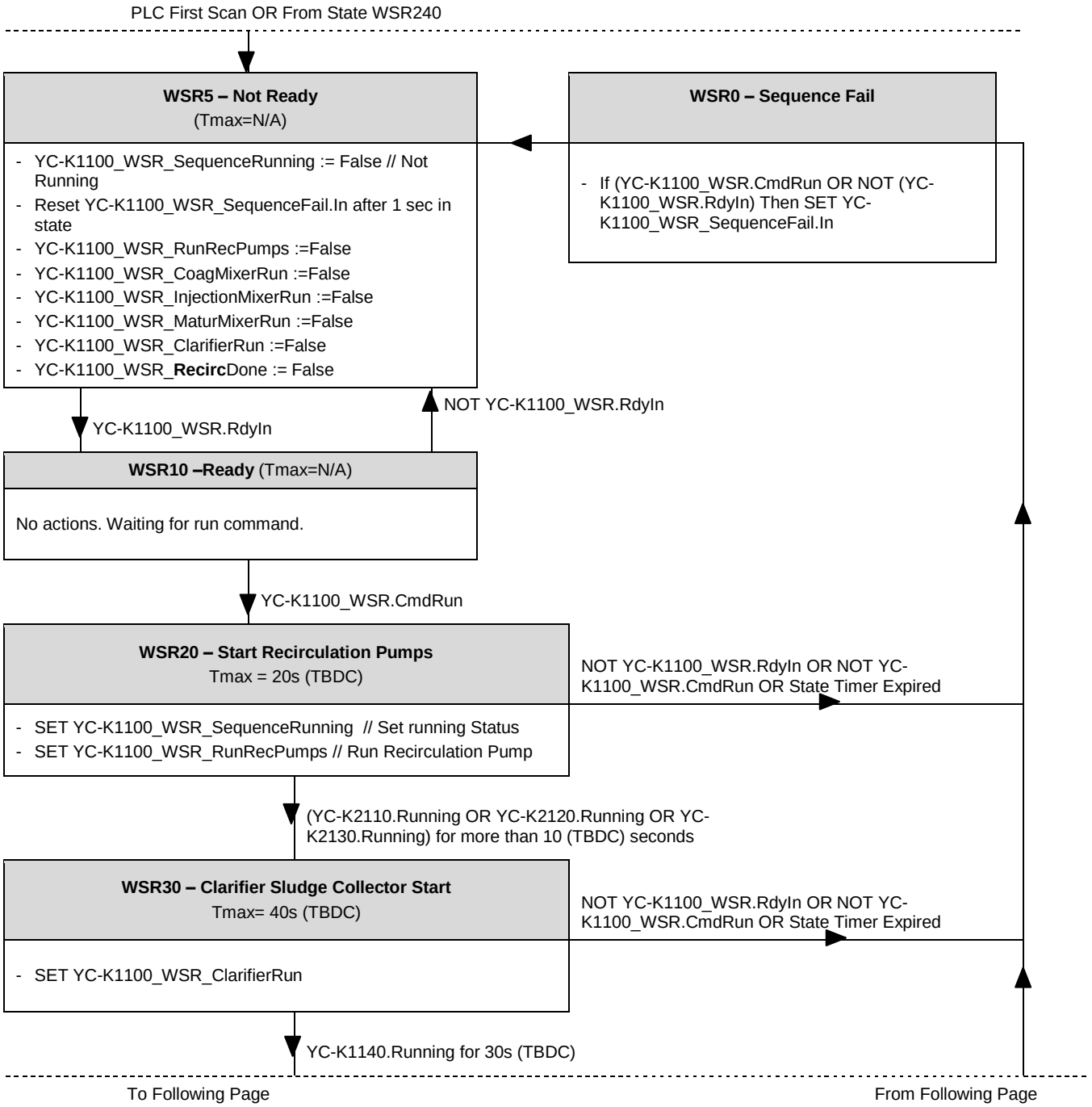
Table 3.2-41 YC-K1100_WSR / HRC 1 Wet Storage Recirculation Sequence Control Station

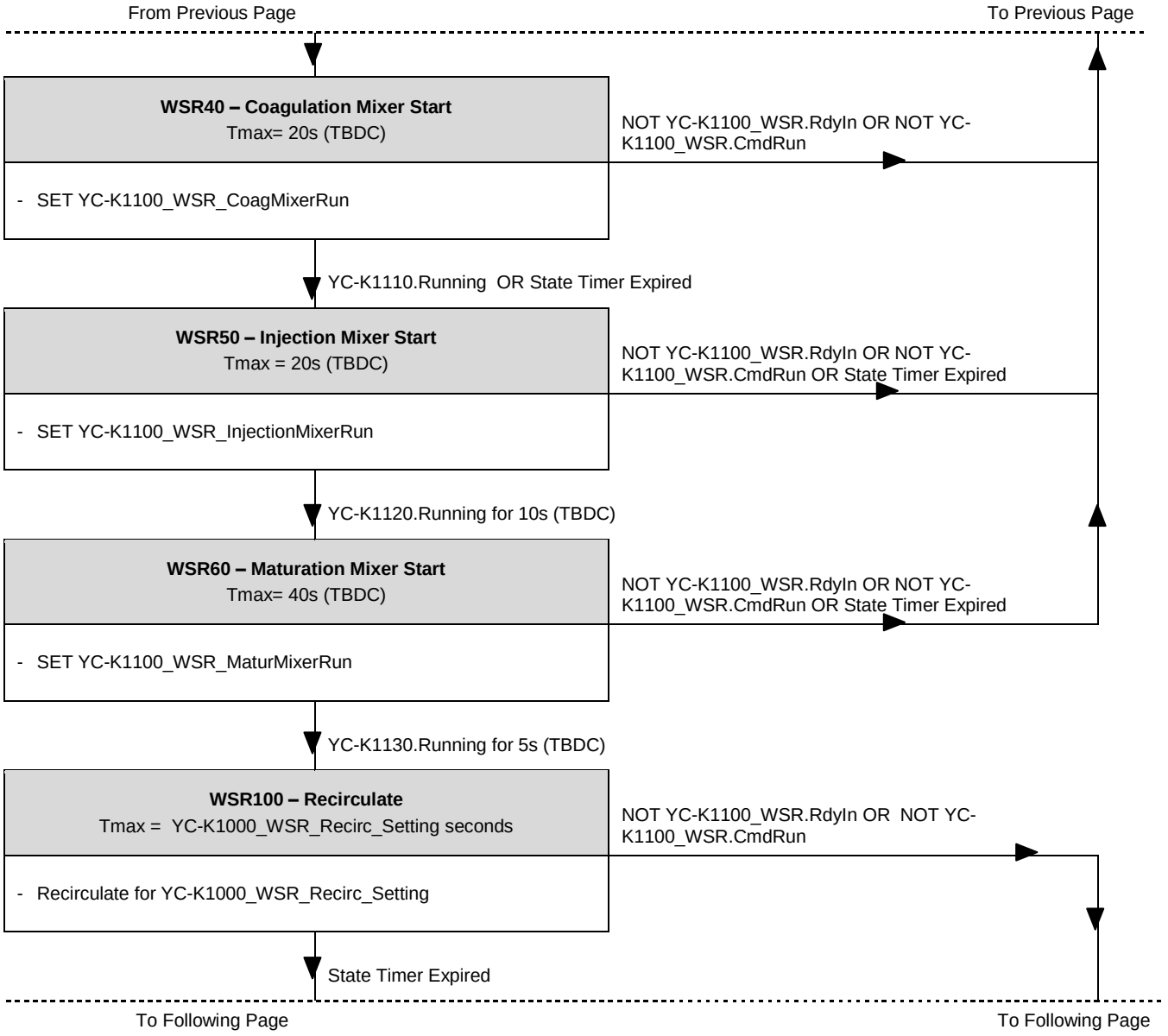
Instance	YC-K1100_WSR		
Class	DiscreteCS		
Inputs	**Parameter**	**Source**	**Type**
	CtrlRem	N/A	Link
	Flt	YC-K1100_WSR_SequenceFail.Alm	Link
	RdyIn	See Table 3.2-42 HRC 1 Wet Storage Recirculation Sequence Ready List	Link
	Run	YC-K1100_WSR_SequenceRunning	Link
	ExtAutoStopEnb	True	Const
	RunAuto	YC-K1100_WetStorage AND YC-K1100_WSR_Tmr.CtrHi	Link
Alarms	N/A		

Table 3.2-42 HRC 1 Wet Storage Recirculation Sequence Ready List

Ready (AND)	Description
YC-K1100_WetStorage	In Wet Storage mode
GBL_G800_XC-G3621_ConfCls	XV-G3621 Influent Isolation Gate Confirmed Closed
YC-K1120.Rdy	MXR-K112 Injection Mixer Ready
YC-K1130.Rdy	MXR-K113 Maturation Mixer Ready
YC-K1140.Rdy	CM-K114 Sludge Scraper Ready
YC-K2110.Rdy OR YC-K2120.Rdy OR YC-K2130.Rdy	At least one Recycle Pump P-K211, P-K212 or P-K213 Ready
YC-K2510.Rdy OR YC-K2520.Rdy	At least one Waste Sludge Pumps P-K251 or P-K252 Ready
NOT (LIC-K2501.CtrlOper OR LIC-K2501.CtrlErr) OR YC-K2500_BackUpLvlCtrl.Alm	Waste Sludge Sump Level Control Not in Operator or Error mode or Backup Level Switch Control Mode
XC-K2543.ConfOpn OR XV-K2544.ConfOpn	Waste Sludge Valve XV-K2543 or XV-K2544 open
NOT (LIT-K132.CtrlLo OR LIT-K132.AlmErr)	Maturation Tank Level Not Low or Bad Quality
NOT YC-K1100_DF.Running	Drain and Refill Sequence Not Running
NOT YC-K1100_WSSC.Running	Superchlorination Sequence Not Running

3.2.4.4 YC-K1100_WSR_Sequence / HRC 1 Wet Storage Recirculation Sequence

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WSR40 – Coagulation Mixer Start
Tmax= 20s (TBDC)
NOT YC-K1100_WSR.RdyIn OR NOT YC-K1100_WSR.CmdRun
- SET YC-K1100_WSR_CoagMixerRun
YC-K1110.Running OR State Timer Expired
WSR50 – Injection Mixer Start
Tmax = 20s (TBDC)
NOT YC-K1100_WSR.RdyIn OR NOT YC-K1100_WSR.CmdRun OR State Timer Expired
- SET YC-K1100_WSR_InjectionMixerRun
YC-K1120.Running for 10s (TBDC)
WSR60 – Maturation Mixer Start
Tmax= 40s (TBDC)
NOT YC-K1100_WSR.RdyIn OR NOT YC-K1100_WSR.CmdRun OR State Timer Expired
- SET YC-K1100_WSR_MaturMixerRun
YC-K1130.Running for 5s (TBDC)
WSR100 – Recirculate
Tmax = YC-K1000_WSR_Recirc_Setting seconds
NOT YC-K1100_WSR.RdyIn OR NOT YC-K1100_WSR.CmdRun
- Recirculate for YC-K1000_WSR_Recirc_Setting
State Timer Expired
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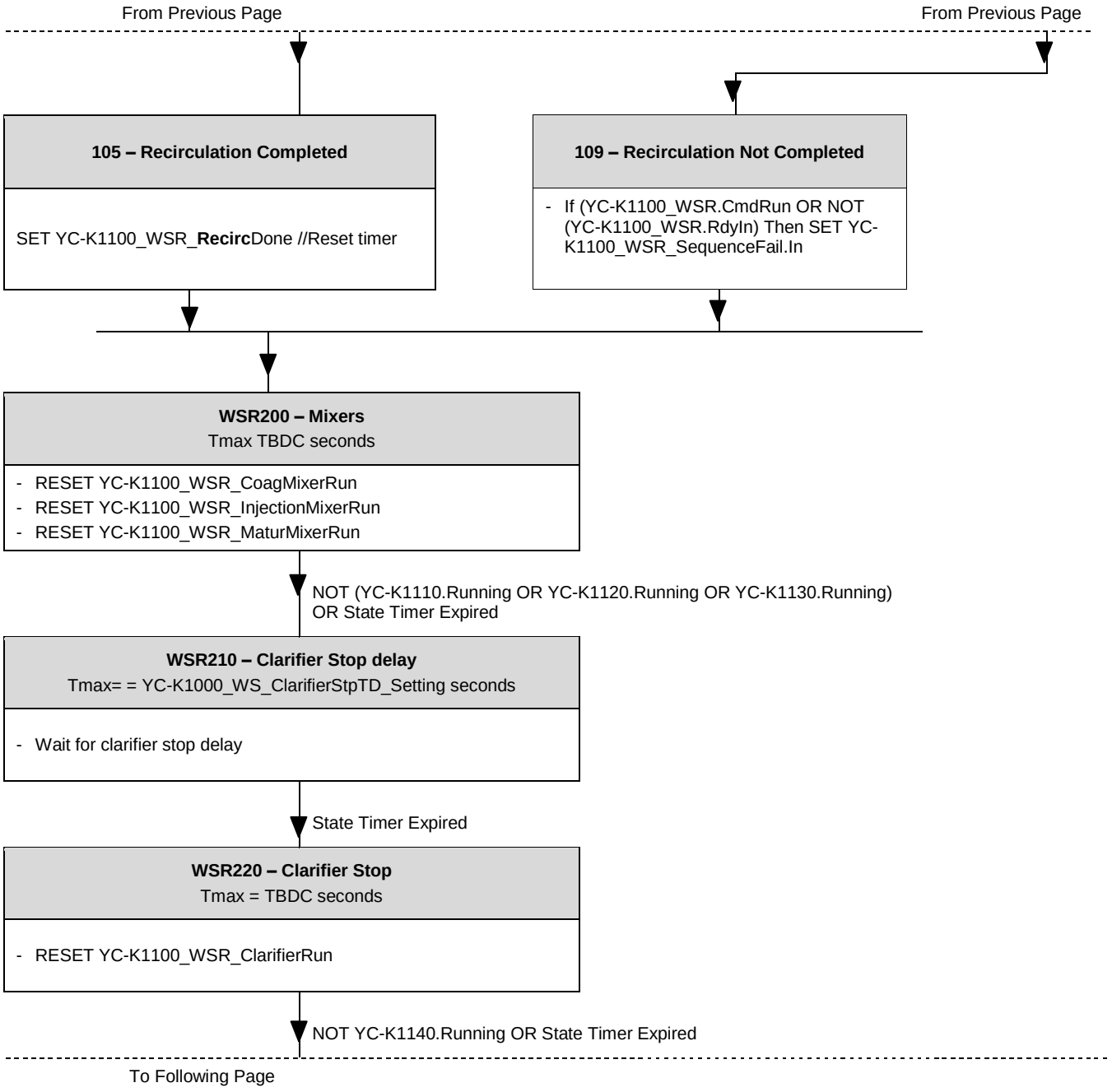
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105 – Recirculation Completed
SET YC-K1100_WSR_Recirc Done //Reset timer
109 – Recirculation Not Completed
- If (YC-K1100_WSR.CmdRun OR NOT (YC-K1100_WSR.RdyIn) Then SET YC-K1100_WSR_SequenceFail.In
WSR200 – Mixers
Tmax TBDC seconds
- RESET YC-K1100_WSR_CoagMixerRun
- RESET YC-K1100_WSR_InjectionMixerRun
- RESET YC-K1100_WSR_MaturMixerRun
NOT (YC-K1110.Running OR YC-K1120.Running OR YC-K1130.Running)
OR State Timer Expired
WSR210 – Clarifier Stop delay
Tmax= = YC-K1000_WS_ClarifierStpTD_Setting seconds
- Wait for clarifier stop delay
State Timer Expired
WSR220 – Clarifier Stop
Tmax = TBDC seconds
- RESET YC-K1100_WSR_ClarifierRun
NOT YC-K1140.Running OR State Timer Expired
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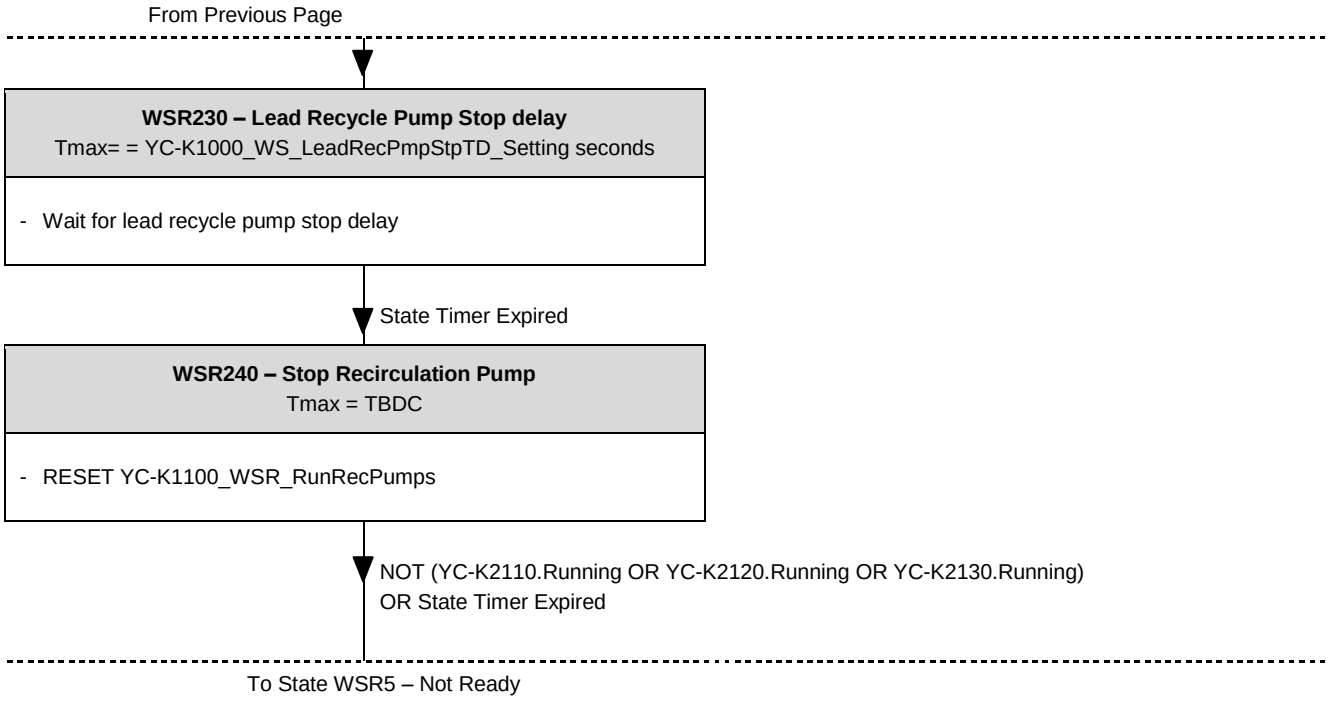


Table 3.2-43 YC-K1100_WSR_Req_NR / HRC 1 Wet Storage Recirculation Required and Not Ready

Instance	YC-K1100_WSR_Req_NR		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	YC-K1100_WetStorage AND YC-K1100_WSR_Tmr.CtrHi AND NOT (YC-K1100_WSR.Rdy OR YC-K1100_WSR.Running)	Link
	ExtRst	YC-K1100_WSR.RstDevAlms	Link
Alarms	Alm(3) - Low Priority		

Table 3.2-44 YC-K1100_WSR_SequenceFail / HRC 1 Wet Storage Recirculation Sequence Fail

Instance	YC-K1100_WSR_SequenceFail		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	See YC-K1100_WSR_Sequence above	Link
	ExtRst	YC-K1100_WSR.RstDevAlms	Link
Alarms	Alm(3) - Low Priority		

Note: Alarm text to include name and description of the failed sequence state

3.2.4.5 YC-K1100_WSSC / HRC 1 Wet Storage Superchlorination Control Station

When in auto and there is more than 24 hours until tank draining, every 96 hours (YC-K1100_WSSC_Tmr_Setting) hypochlorite is dosed into the tanks and mixed by running the mixers, sludge collector and lead recycle pump. Hypochlorite is injected at the inlet drop shaft as well as the maturation tank while also running FSW from the inlet channel to facilitate thorough contact of hypochlorite with the entire tank contents

YC-K1100_WSSC_Tmr_Setting is the operator configurable “Wet Storage Superchlorination Frequency” in hours.
YC-K1100_WSSC_Tmr_Setting can be modified by an operator with security level M or higher. The operator HMI settings should be range checked before being used.

Table 3.2-45 YC-K1100_WSSC_Tmr / HRC 1 Wet Storage Superchlorination Timer

Instance	YC-K1100_WSSC_Tmr		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	1	Link
	CrtlHiSP	YC-K1100_WSSC_Tmr_Setting	Link
	TimeFactor	3600 (Hrs assumed)	Const
	UnitConv	1	Const
	AccumAutoRst	YC-K1100.Running OR (NOT YC-K1100_WetStorage AND LIT-K132.CtrlLo) OR YC-K1100_DF_Drained OR (YC-K1100_WSSC_Done rising edge)	Link
	AccumRstEnable	True	Const
Alarms	-		

Table 3.2-46 YC-K1100_WSSC / HRC 1 Wet Storage Superchlorination Sequence Control Station

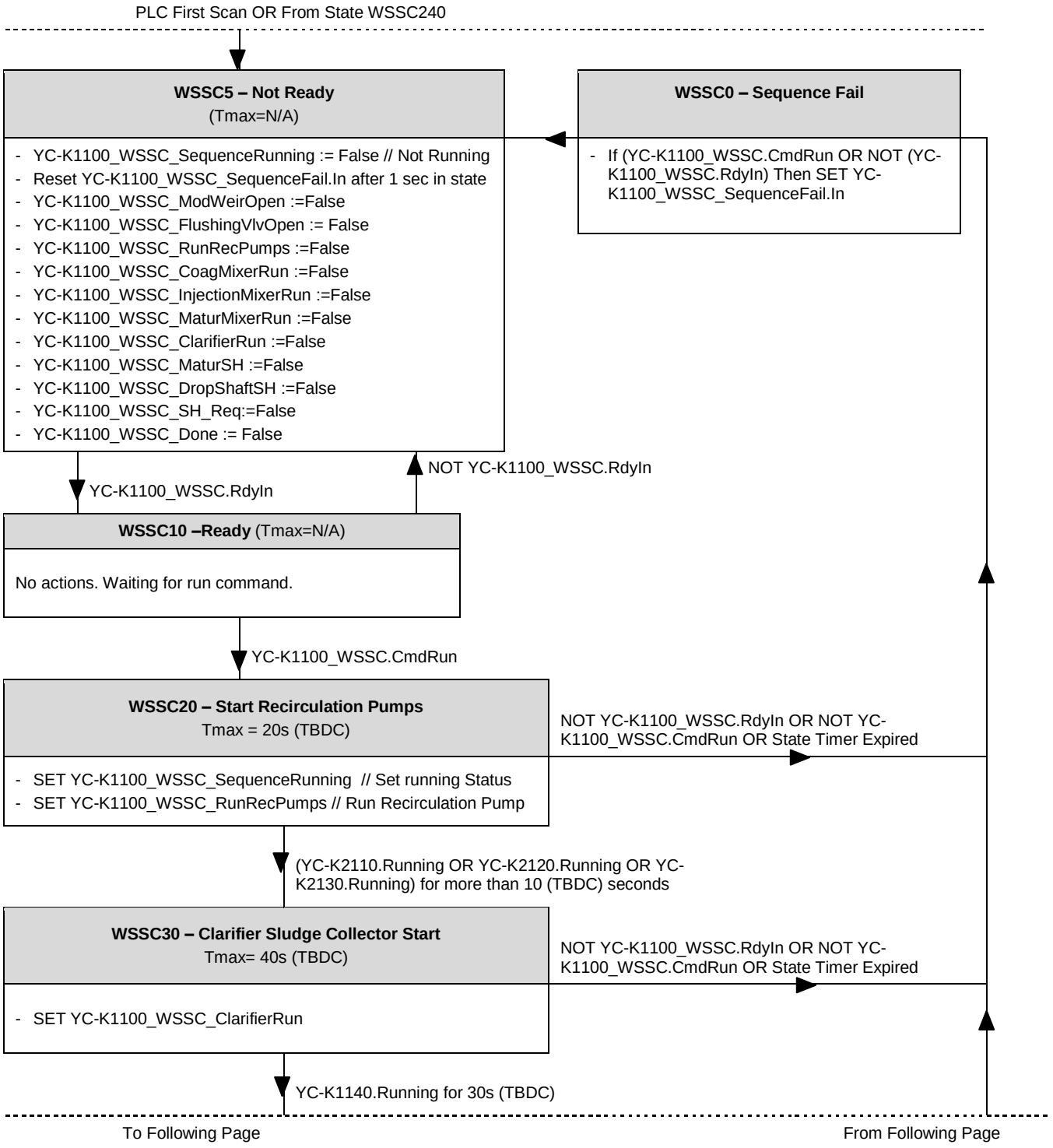
Instance	YC-K1100_WSSC		
Class	DiscreteCS		
Inputs	**Parameter**	**Source**	**Type**
	CtrlRem	N/A	Link
	Flt	YC-K1100_WSSC_SequenceFail.Alm	Link
	RdyIn	See Table 3.2-47 HRC 1 Wet Storage Superchlorination Sequence Ready List	Link
	Run	YC-K1100_WSSC_SequenceRunning	Link
	ExtAutoStopEnb	True	Const
	RunAuto	YC-K1100_WetStorage AND YC-K1100_WSSC_Tmr.CtrHi AND ((YC-K1100_WSDF_Tmr.CtrlHiSP - YC-K1100_WSDF_Tmr.Out) > 24 hrs)	Link
Alarms	N/A		

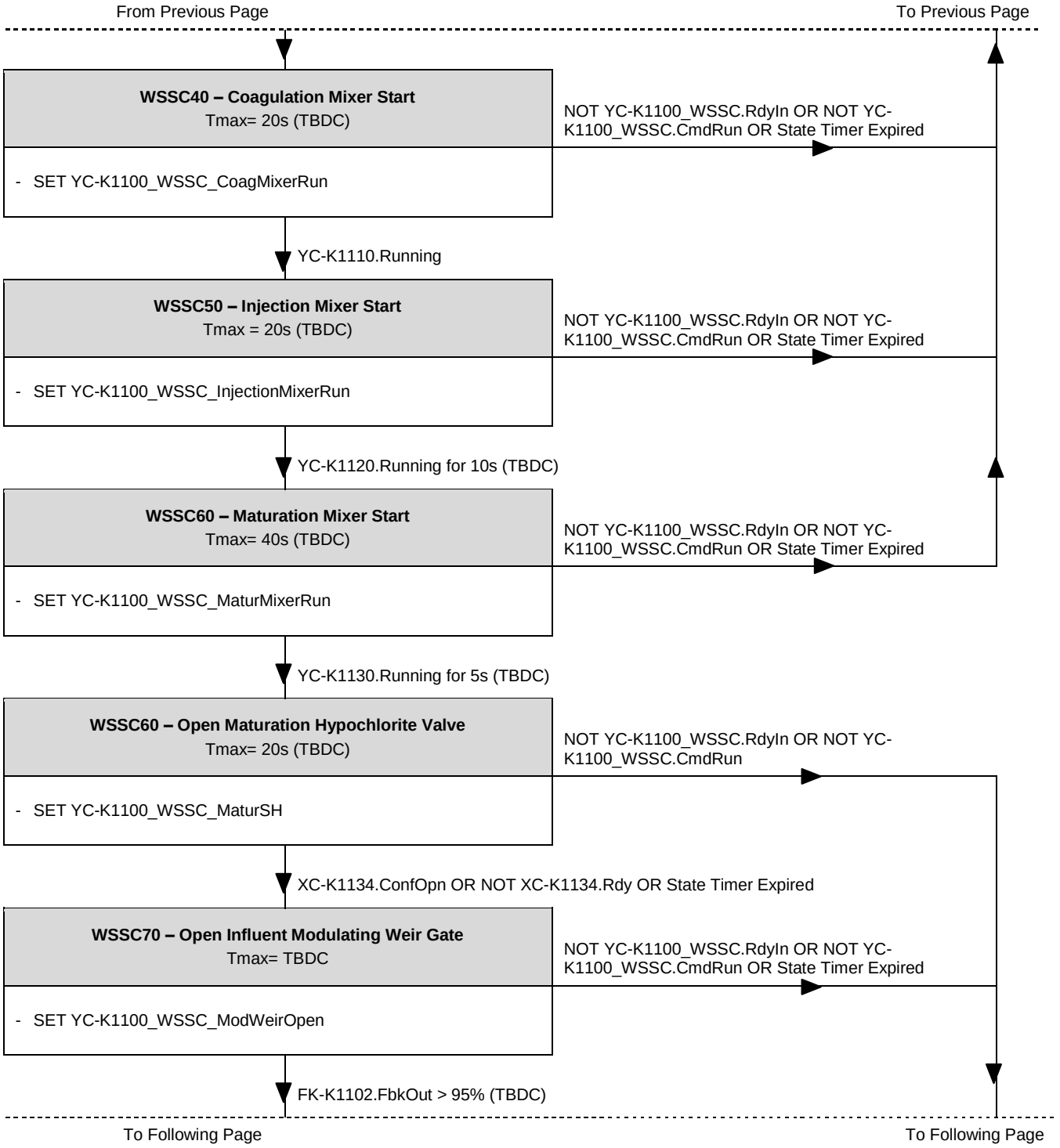
Table 3.2-47 HRC 1 Wet Storage Superchlorination Sequence Ready List

Ready (AND)	Description
YC-K1100_WetStorage	In Wet Storage mode
NOT GBL_C800_YC-C2229_PathANotAvail	HRC 1 Sodium Hypochlorite Available
GBL_G800_XC-G3621_ConfCls	XV-G3621 Influent Isolation Gate Confirmed Closed
FV-K1102.Rdy	FV-K1102 Influent Channel Modulating Weir Gate
YC-K1110.Rdy	MXR-K111 Coagulation Mixer Ready
YC-K1120.Rdy	MXR-K112 Injection Mixer Ready
YC-K1130.Rdy	MXR-K113 Maturation Mixer Ready
YC-K1140.Rdy	CM-K114 Sludge Scraper Ready
YC-K2110.Rdy OR YC-K2120.Rdy OR YC-K2130.Rdy	At least one Recycle Pump P-K211, P-K212 or P-K213 Ready
YC-K2510.Rdy OR YC-K2520.Rdy	At least one Waste Sludge Pumps P-K251 or P-K252 Ready
NOT (LIC-K2501.CtrlOper OR LIC-K2501.CtrlErr) OR YC-K2500_BackUpLvlCtrl.Alm	Waste Sludge Sump Level Control Not in Operator or Error mode or Backup Level Switch Control Mode
XC-K2543.ConfOpn OR XV-K2544.ConfOpn	Waste Sludge Valve XV-K2543 or XV-K2544 open
NOT (LIT-K132.CtrlLo OR LIT-K132.AlmErr)	Maturation Tank Level Not Low or Bad Quality
(XC-K1103.Rdy OR XC-K1103.ConfOpn) OR	Drop Shaft Or Maturation Hypochlorite Valves Ready or

Ready (AND)	Description
(XC-K1134.Rdy OR XC-K1134.ConfOpn)	Open
NOT YC-K1100_DF.Running	Drain and Refill Sequence Not Running
NOT YC-K1100_WSR.Running	Recirculation Sequence Not Running

3.2.4.6 YC-K1100_WSSC_Sequence / HRC 1 Wet Storage Superchlorination Sequence

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WSSC40 – Coagulation Mixer Start
Tmax= 20s (TBDC)
NOT YC-K1100_WSSC.RdyIn OR NOT YC-K1100_WSSC.CmdRun OR State Timer Expired
- SET YC-K1100_WSSC_CoagMixerRun
YC-K1110.Running
WSSC50 – Injection Mixer Start
Tmax = 20s (TBDC)
NOT YC-K1100_WSSC.RdyIn OR NOT YC-K1100_WSSC.CmdRun OR State Timer Expired
- SET YC-K1100_WSSC_InjectionMixerRun
YC-K1120.Running for 10s (TBDC)
WSSC60 – Maturation Mixer Start
Tmax= 40s (TBDC)
NOT YC-K1100_WSSC.RdyIn OR NOT YC-K1100_WSSC.CmdRun OR State Timer Expired
- SET YC-K1100_WSSC_MaturMixerRun
YC-K1130.Running for 5s (TBDC)
WSSC60 – Open Maturation Hypochlorite Valve
Tmax= 20s (TBDC)
NOT YC-K1100_WSSC.RdyIn OR NOT YC-K1100_WSSC.CmdRun
- SET YC-K1100_WSSC_MaturSH
XC-K1134.ConfOpn OR NOT XC-K1134.Rdy OR State Timer Expired
WSSC70 – Open Influent Modulating Weir Gate
Tmax= TBDC
NOT YC-K1100_WSSC.RdyIn OR NOT YC-K1100_WSSC.CmdRun OR State Timer Expired
- SET YC-K1100_WSSC_ModWeirOpen
FK-K1102.FbkOut > 95% (TBDC)
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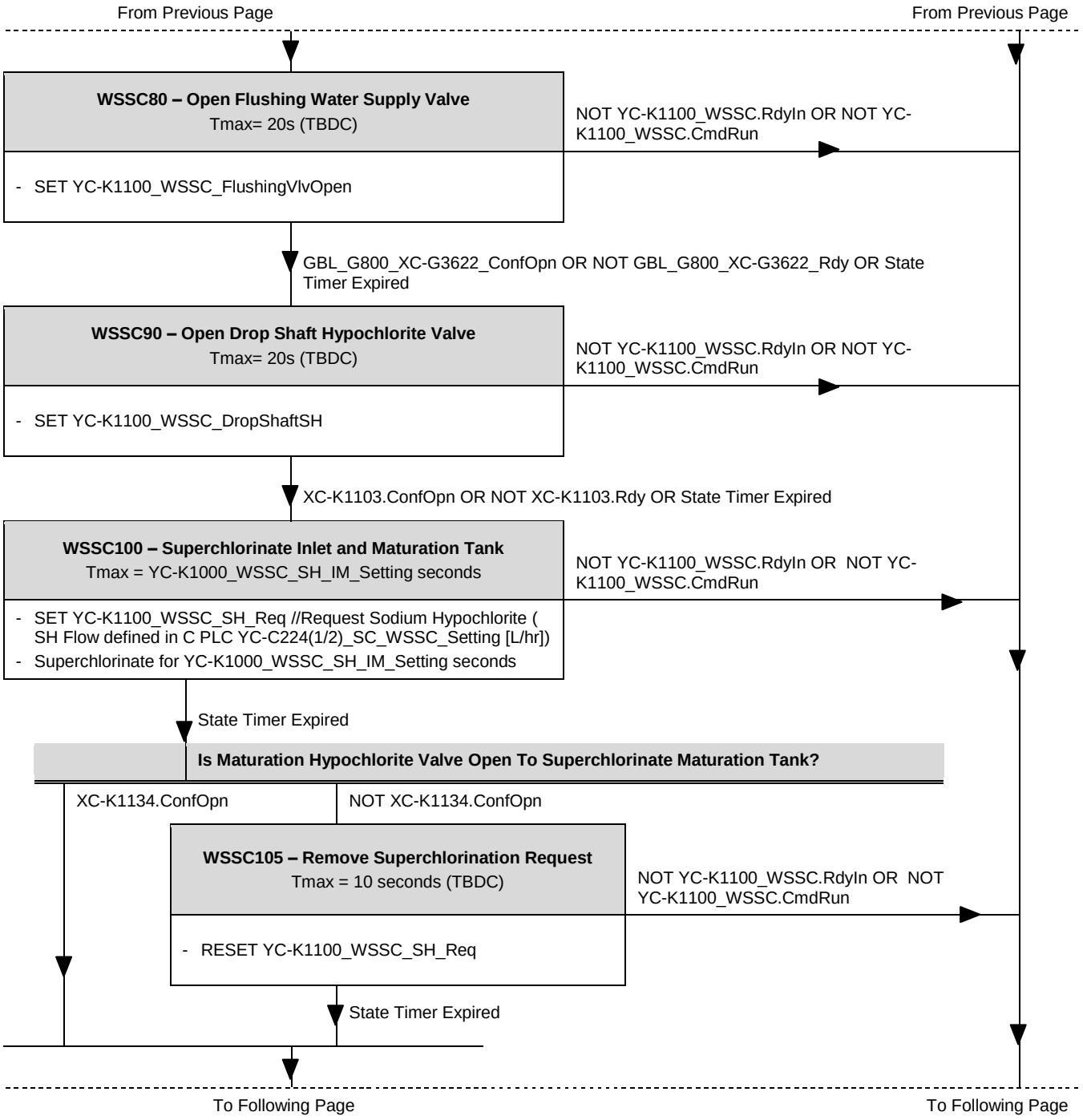
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WSSC80 – Open Flushing Water Supply Valve
Tmax= 20s (TBDC)
NOT YC-K1100_WSSC.RdyIn OR NOT YC-K1100_WSSC.CmdRun
- SET YC-K1100_WSSC_FlushingVlvOpen
GBL_G800_XC-G3622_ConfOpn OR NOT GBL_G800_XC-G3622_Rdy OR State Timer Expired
WSSC90 – Open Drop Shaft Hypochlorite Valve
Tmax= 20s (TBDC)
NOT YC-K1100_WSSC.RdyIn OR NOT YC-K1100_WSSC.CmdRun
- SET YC-K1100_WSSC_DropShaftSH
XC-K1103.ConfOpn OR NOT XC-K1103.Rdy OR State Timer Expired
WSSC100 – Superchlorinate Inlet and Maturation Tank
Tmax = YC-K1000_WSSC_SH_IM_Setting seconds
NOT YC-K1100_WSSC.RdyIn OR NOT YC-K1100_WSSC.CmdRun
- SET YC-K1100_WSSC_SH_Req //Request Sodium Hypochlorite (SH Flow defined in C PLC YC-C224(1/2)_SC_WSSC_Setting [L/hr])
- Superchlorinate for YC-K1000_WSSC_SH_IM_Setting seconds
State Timer Expired
Is Maturation Hypochlorite Valve Open To Superchlorinate Maturation Tank?
XC-K1134.ConfOpn
NOT XC-K1134.ConfOpn
WSSC105 – Remove Superchlorination Request
Tmax = 10 seconds (TBDC)
NOT YC-K1100_WSSC.RdyIn OR NOT YC-K1100_WSSC.CmdRun
- RESET YC-K1100_WSSC_SH_Req
State Timer Expired
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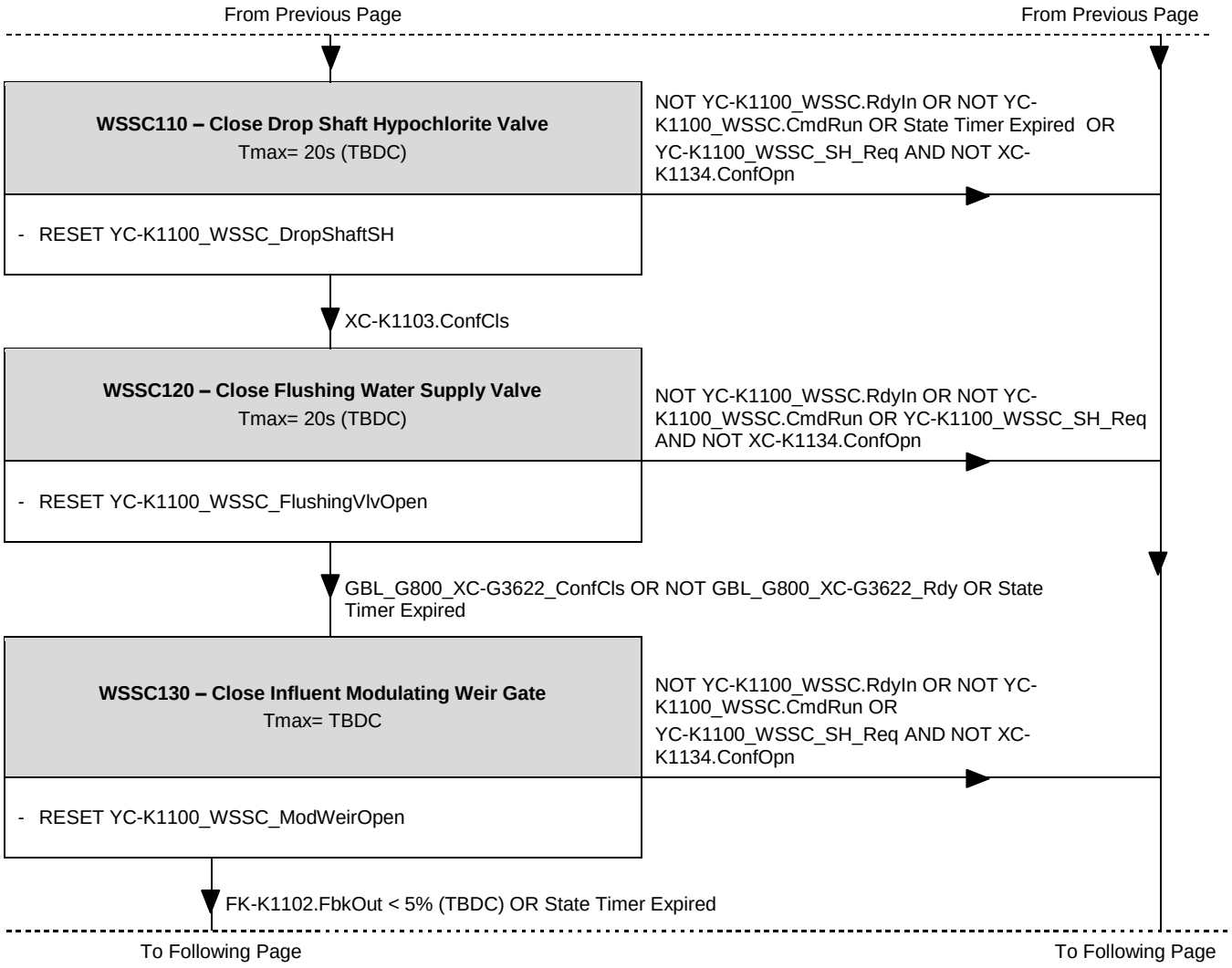
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WSSC110 – Close Drop Shaft Hypochlorite Valve
Tmax= 20s (TBDC)
NOT YC-K1100_WSSC.RdyIn OR NOT YC-K1100_WSSC.CmdRun OR State Timer Expired OR YC-K1100_WSSC_SH_Req AND NOT XC-K1134.ConfOpn
- RESET YC-K1100_WSSC_DropShaftSH
XC-K1103.ConfCls
WSSC120 – Close Flushing Water Supply Valve
Tmax= 20s (TBDC)
NOT YC-K1100_WSSC.RdyIn OR NOT YC-K1100_WSSC.CmdRun OR YC-K1100_WSSC_SH_Req AND NOT XC-K1134.ConfOpn
- RESET YC-K1100_WSSC_FlushingVlvOpen
GBL_G800_XC-G3622_ConfCls OR NOT GBL_G800_XC-G3622_Rdy OR State Timer Expired
WSSC130 – Close Influent Modulating Weir Gate
Tmax= TBDC
NOT YC-K1100_WSSC.RdyIn OR NOT YC-K1100_WSSC.CmdRun OR YC-K1100_WSSC_SH_Req AND NOT XC-K1134.ConfOpn
- RESET YC-K1100_WSSC_ModWeirOpen
FK-K1102.FbkOut < 5% (TBDC) OR State Timer Expired
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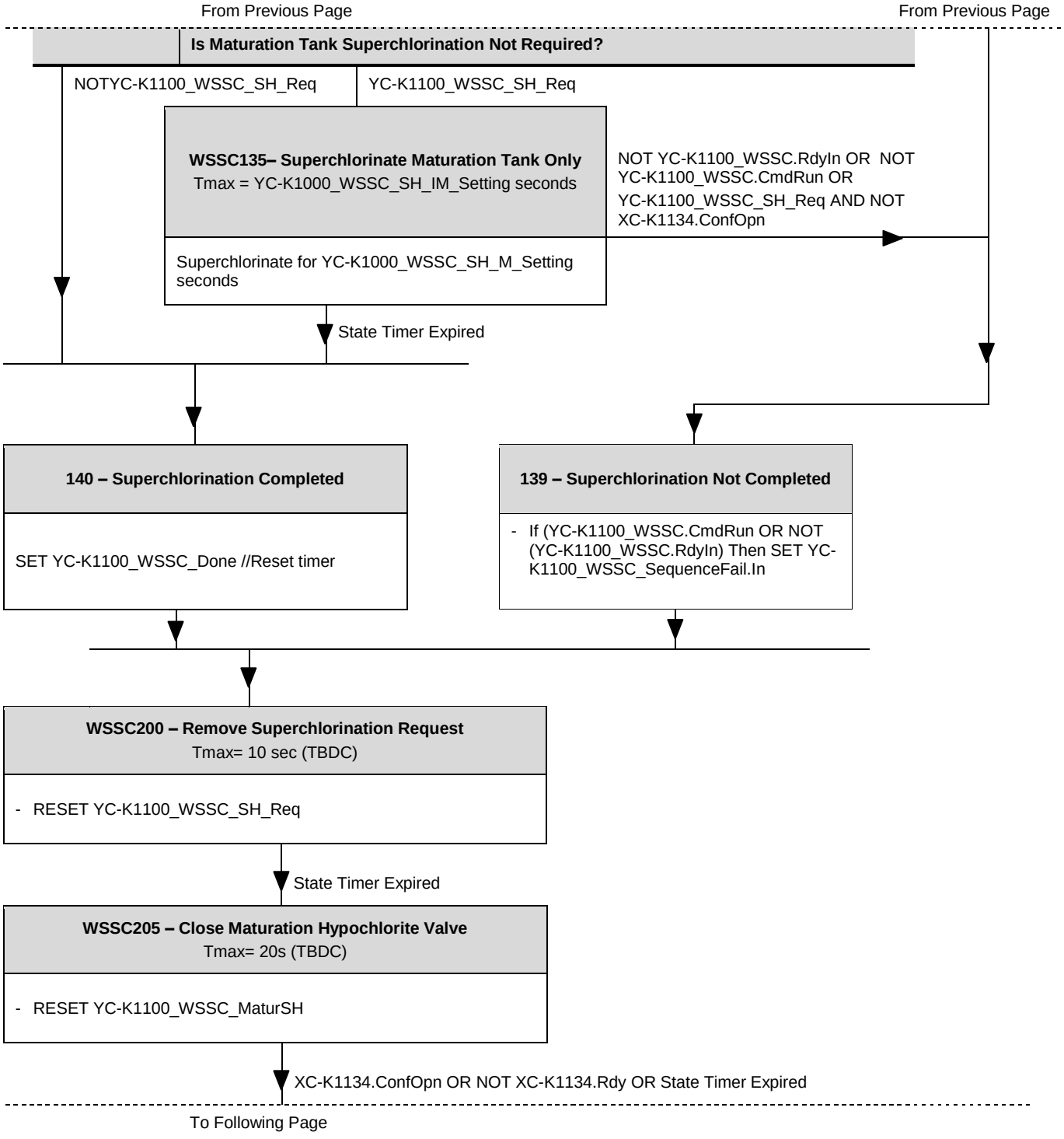
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Is Maturation Tank Superchlorination Not Required?
NOTYC-K1100_WSSC_SH_Req
YC-K1100_WSSC_SH_Req
WSSC135– Superchlorinate Maturation Tank Only
Tmax = YC-K1000_WSSC_SH_IM_Setting seconds
NOT YC-K1100_WSSC.RdyIn OR NOT YC-K1100_WSSC.CmdRun OR YC-K1100_WSSC_SH_Req AND NOT XC-K1134.ConfOpn
Superchlorinate for YC-K1000_WSSC_SH_M_Setting seconds
State Timer Expired
140 – Superchlorination Completed
SET YC-K1100_WSSC_Done //Reset timer
139 – Superchlorination Not Completed
- If (YC-K1100_WSSC.CmdRun OR NOT (YC-K1100_WSSC.RdyIn) Then SET YC-K1100_WSSC_SequenceFail.In
WSSC200 – Remove Superchlorination Request
Tmax= 10 sec (TBDC)
- RESET YC-K1100_WSSC_SH_Req
State Timer Expired
WSSC205 – Close Maturation Hypochlorite Valve
Tmax= 20s (TBDC)
- RESET YC-K1100_WSSC_MaturSH
XC-K1134.ConfOpn OR NOT XC-K1134.Rdy OR State Timer Expired
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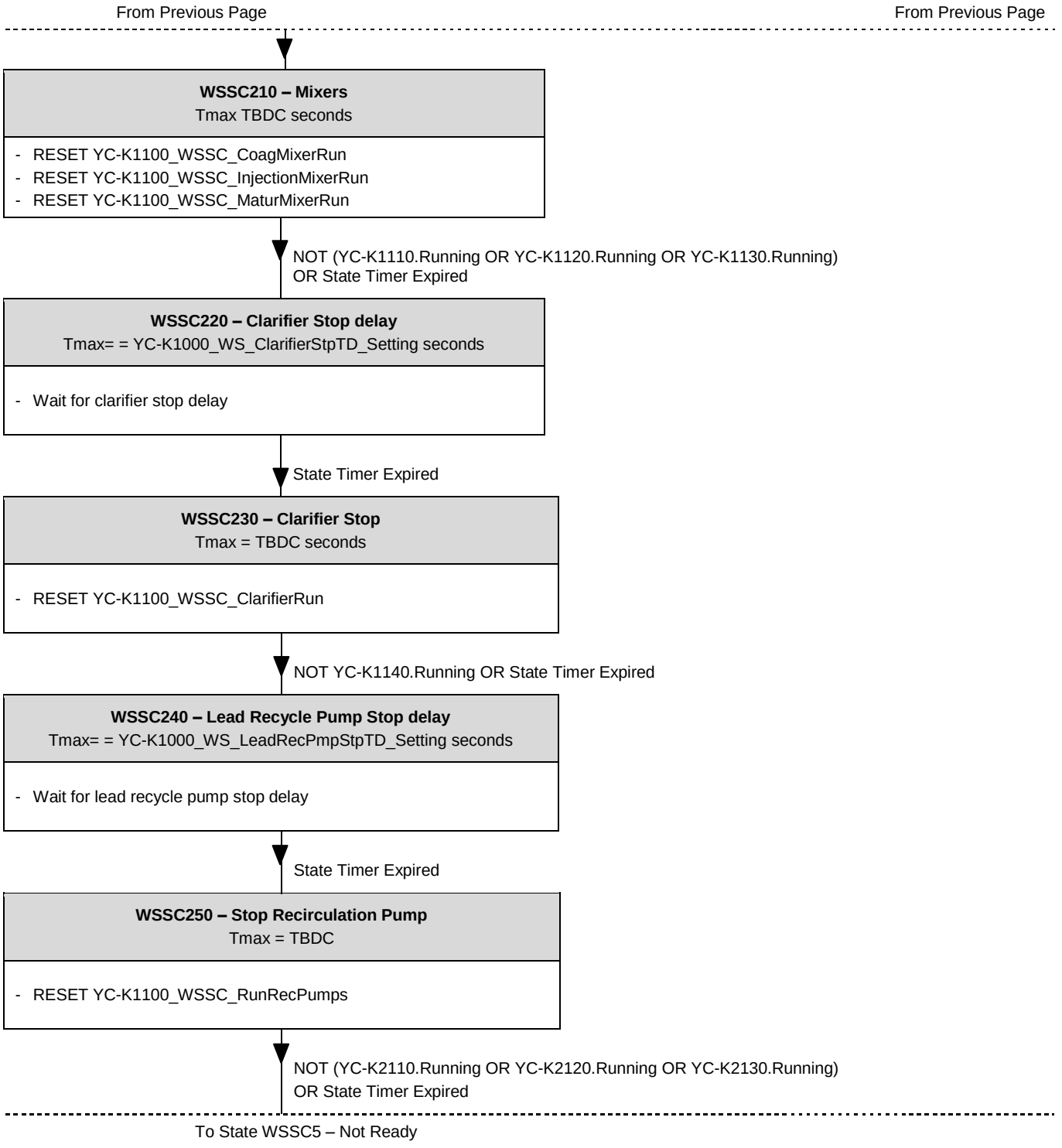
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WSSC210 – Mixers
Tmax TBDC seconds
- RESET YC-K1100_WSSC_CoagMixerRun
- RESET YC-K1100_WSSC_InjectionMixerRun
- RESET YC-K1100_WSSC_MaturMixerRun
NOT (YC-K1110.Running OR YC-K1120.Running OR YC-K1130.Running)
OR State Timer Expired
WSSC220 – Clarifier Stop delay
Tmax= = YC-K1000_WS_ClarifierStpTD_Setting seconds
- Wait for clarifier stop delay
State Timer Expired
WSSC230 – Clarifier Stop
Tmax = TBDC seconds
- RESET YC-K1100_WSSC_ClarifierRun
NOT YC-K1140.Running OR State Timer Expired
WSSC240 – Lead Recycle Pump Stop delay
Tmax= = YC-K1000_WS_LeadRecPmpStpTD_Setting seconds
- Wait for lead recycle pump stop delay
State Timer Expired
WSSC250 – Stop Recirculation Pump
Tmax = TBDC
- RESET YC-K1100_WSSC_RunRecPumps
NOT (YC-K2110.Running OR YC-K2120.Running OR YC-K2130.Running)
OR State Timer Expired
To State WSSC5 – Not Ready

Table 3.2-48 YC-K1100_WSSC_Req_NR / HRC 1 Wet Storage Superchlorination Required and Not Ready

Instance	YC-K1100_WSSC_Req_NR		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	YC-K1100_WetStorage AND YC-K1100_WSSC_Tmr.CtrHi AND NOT (YC-K1100_WSSC.Rdy OR YC-K1100_WSSC.Running)	Link
	ExtRst	YC-K1100_WSSC.RstDevAlms	Link
Alarms	Alm(3) - Low Priority		

Table 3.2-49 YC-K1100_WSSC_SequenceFail / HRC 1 Wet Storage Superchlorination Sequence Fail

Instance	YC-K1100_WSSC_SequenceFail		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	See YC-K1100_WSSC_Sequence above	Link
	ExtRst	YC-K1100_WSSC.RstDevAlms	Link
Alarms	Alm(3) - Low Priority		

Note: Alarm text to include name and description of the failed sequence state

Table 3.2-50 YC-K1100_WSSC_MaturSH_NA / HRC 1 Wet Storage Superchlorination Running With Maturation Tank Hypocrite Valve Not Available

Instance	YC-K1100_WSSC_MaturSH_NA		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	YC-K1100_WSSC_MaturSH AND NOT (XC-K1134.Rdy OR XC-K1134.ConfOpn)	Link
	ExtRst	YC-K1100_WSSC.RstDevAlms	Link
Alarms	Alm(3) - Low Priority		

Table 3.2-51 YC-K1100_WSSC_MaturSH_NA / HRC 1 Wet Storage Superchlorination Running With Drop Shaft Hypocrite Valve Not Available

Instance	YC-K1100_WSSC_DropShaftSH_NA		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	YC-K1100_WSSC_DropShaftSH AND NOT (XC-K1103.Rdy OR XC-K1103.ConfOpn)	Link

	ExtRst	YC-K1100_WSSC.RstDevAlms	Link
Alarms	Alm(3) - Low Priority		

3.2.4.7 HRC 1 Wet Storage Drain and Optional Refill Timer

When Drain and Refill is in auto, after 240 hours (YC-K1100_WSDF_Tmr_Setting) from the time the wet storage sequence was initiated the tank is drained automatically or a notification is annunciated on the HMI requesting the operators to confirm (initiate) tank draining (operator selection of auto vs manual initiation). Upon completion of tank draining, if enabled, the HRC is refilled with flushing water.

YC-K1100_WSDF_Tmr_Setting is the operator configurable “Wet Storage Drain and Optional Refill Frequency” in hours.
YC-K1100_WSDF_Tmr_Setting can be modified by an operator with security level M or higher. The operator HMI settings should be range checked before being used.

Table 3.2-52 YC-K1100_WSDF_Tmr / HRC 1 Wet Storage Drain and Optional Refill Timer

Instance	YC-K1100_WSDF_Tmr		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	1	Link
	CrtlHiSP	YC-K1100_WSDF_Tmr_Setting	Link
	TimeFactor	3600 (Hrs assumed)	Const
	UnitConv	1	Const
	AccumAutoRst	YC-K1100.Running OR (NOT YC-K1100_WetStorage AND LIT-K132.CtrlLo) OR (YC-K1100_DF_Done rising edge)	Link
	AccumRstEnable	True	Const
Alarms	-		

Table 3.2-53 YC-K1100_WSDF_Req_NR / HRC 1 Drain and Refill Required and Not Ready

Instance	YC-K1100_WSDF_Req_NR		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	YC-K1100_WetStorage AND YC-K1100_WSDF_Tmr.CtrHi AND NOT (YC-K1100_DF.Rdy OR YC-K1100_DF.Running)	Link
	ExtRst	YC-K1100_WSDF.RstDevAlms	Link
Alarms	Alm(3) - Low Priority		

Refer to section 3.2.6 YC-K1100_DF / HRC 1 Drain and Refill for control station and sequence details.

3.2.5 HRC 1 Effluent Channel Analyzer Clean-Up

P&ID Drawing: PPID-K106

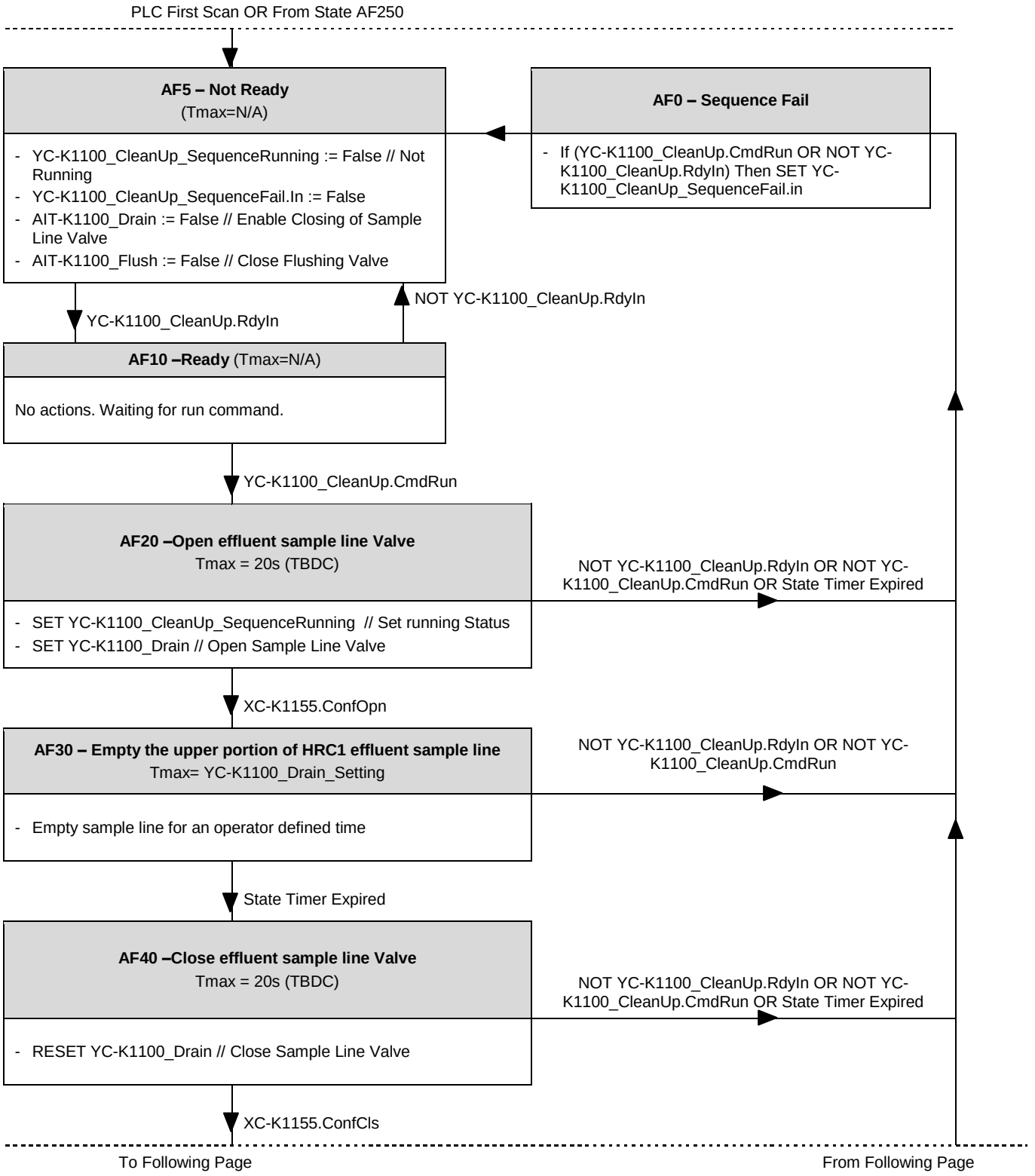
The effluent channel analyzer sample line is drained and flushed with non-potable water whenever FV-K1511 HRC Effluent to Outfall Weir Gate is requested to drain (100% open).

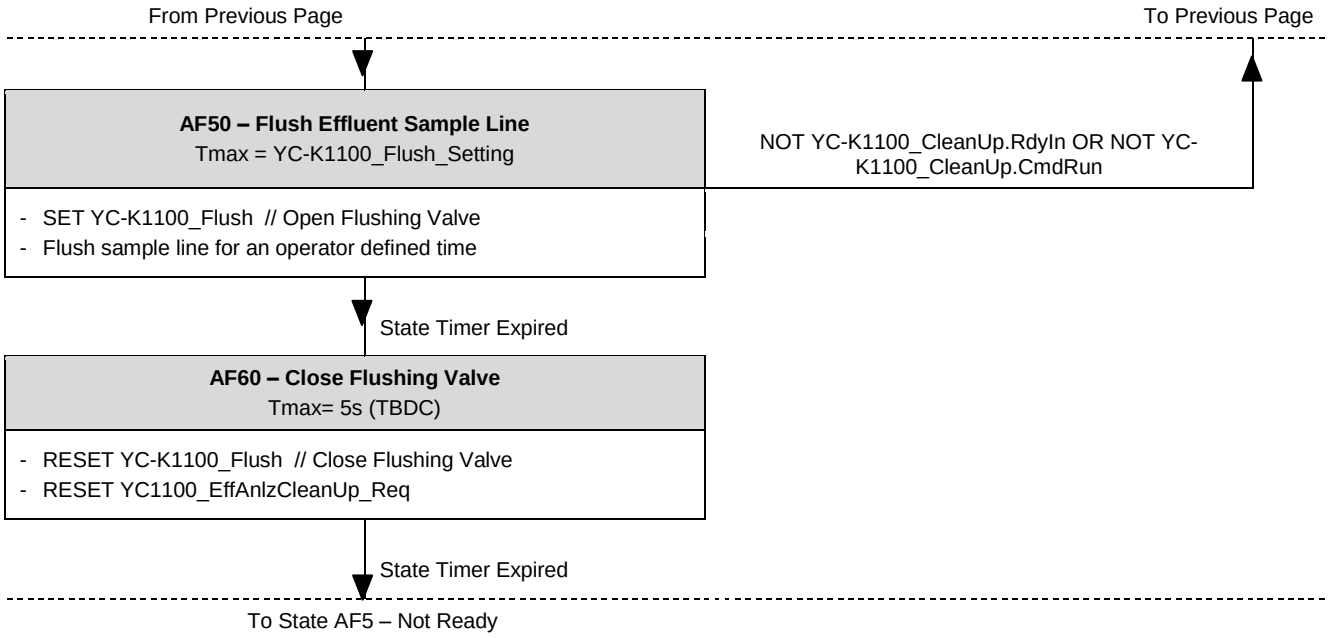
Set YC1100_EffAnlzCleanUp_Req on (YC-K1511_State == 3) rising edge.

Table 3.2-54 YC-K1100_CleanUp / HRC 1 Effluent Channel Analyzer Clean-Up Sequence Control Station

Instance	YC-K1100_CleanUp		
Class	DiscreteCS		
Inputs	**Parameter**	**Source**	**Type**
	CtrlRem	N/A	Link
	Flt	YC-K1100_CleanUp_SequenceFail.Alm	Link
	RdyIn	XV-K1155.Rdy AND XV-K1156.Rdy	Link
	Run	YC-K1100_CleanUp_SequenceRunning	Link
	ExtAutoStopEnb	True	Const
	RunAuto	YC1100_EffAnlzCleanUp_Req AND NOT (YC-K1100_IS_MajorFault.Alm OR YC-K1200_IS_MajorFault.Alm)	Link
Alarms	N/A		

3.2.5.1 YC-K1100_CleanUp_Sequence / HRC 1 Effluent Channel Analyzer Clean-Up





Notes:

YC-K1100 Analyzers sample line will be drained for an operator defined time (YC-K1100_Drain_Setting [sec]).

YC-K1100 Analyzers sample line will be flushed (YC-K1100_Flush) for an operator defined time (YC-K1100_Flush_Setting [sec]).

YC-K1100_Drain_Setting and YC-K1100_Flush_Setting are real numbers and can be modified by the operator with security level M or higher. The operator HMI settings should be range checked before being used.

Table 3.2-55 YC-K1153_CleanUp_SequenceFail / HRC 1 Effluent Channel Analyzer Clean-Up Sequence Fail

Instance	YC-K1153_CleanUp_SequenceFail		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	See YC-K1100_CleanUp_Sequence above	Link
	AutoRst	5 seconds (TBDC)	Const
Alarms	Alm(3) - Low Priority		

Note: Alarm text to include name and description of the failed sequence state

3.2.6 YC-K1100_DF / HRC 1 Drain and Refill

The drain and refill sequence facilitates automatic draining and optional refilling of one HRC tank.

Note that the tank drain sequence requires the waste sludge pumping system to go into “train drain” mode and therefore both trains must be stopped (i.e. cannot have one train running and one train draining). If a train is required to start, the draining sequence will stop.

The operator can select the “Number of Influent Channel Flashes on Tank Drain” (YC-K1100_DF_Flushes_Setting). YC-K1100_DF_Flushes_Setting can be modified by the operator with security level M or higher. As always, the operator HMI setpoints should be range checked before being used.

The operator can select if chlorination during tank refill is required.

Table 3.2-56 YC-K1100_DF_SH / HRC 1 Chlorinate During Tank Refill

Instance	YC-K1100_DF_SH		
Class	OnOffSel		
Inputs	**Parameter**	**Source**	**Type**
	SelOffText	“Disable”	Const
	SelOnText	“Enable”	Const
Alarms	N/A		

The operator can select if the tank will be refilled after drain.

Table 3.2-57 YC-K1100_DF_Refill / HRC 1 Refill Tank After Drain

Instance	YC-K1100_DF_Refill		
Class	OnOffSel		
Inputs	**Parameter**	**Source**	**Type**
	SelOffText	“Disable”	Const
	SelOnText	“Enable”	Const
Alarms	N/A		

YC-K1100_DS is used in the main HRC sequence to transfer from Wet Storage to Dry Storage state. YC-K1100_DS is set in the Drain and Refill sequence if Drain is successfully completed with no Refill.

Table 3.2-58 YC-K1100_DF / HRC 1 Drain and Refill Sequence Control Station

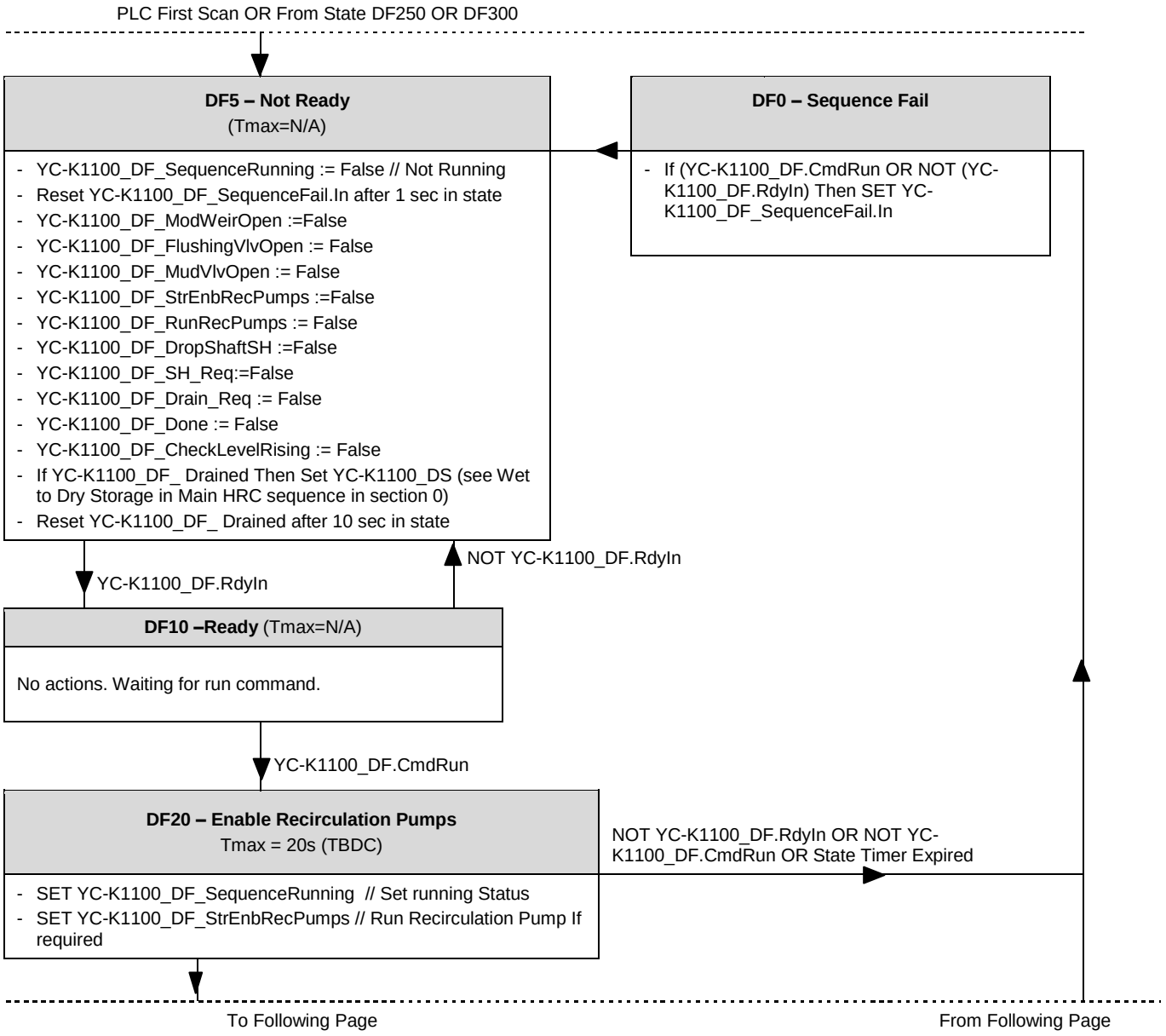
Instance	YC-K1100_DF		
Class	DiscreteCS		
Inputs	**Parameter**	**Source**	**Type**
	CtrlRem	N/A	Link
	Flt	YC-K1100_DF_SequenceFail.Alm	Link
	RdyIn	See Table 3.2-59 HRC 1 Drain and Refill Sequence Ready List	Link
	Run	YC-K1100_DF_SequenceRunning	Link
	ExtAutoStopEnb	True	Const
	RunAuto	YC-K1100_WetStorage AND YC-K1100_WSDF_Tmr.CtrHi AND NOT (YC-K1100.CmdStart OR YC-K1100_AutoStarting OR YC-K1100.Running OR YC-K1100_AutoStopping) AND NOT (YC-K1200.CmdStart OR YC-K1200_AutoStarting OR YC-K1200.Running OR YC-K1200_AutoStopping)	Link
Alarms	N/A		

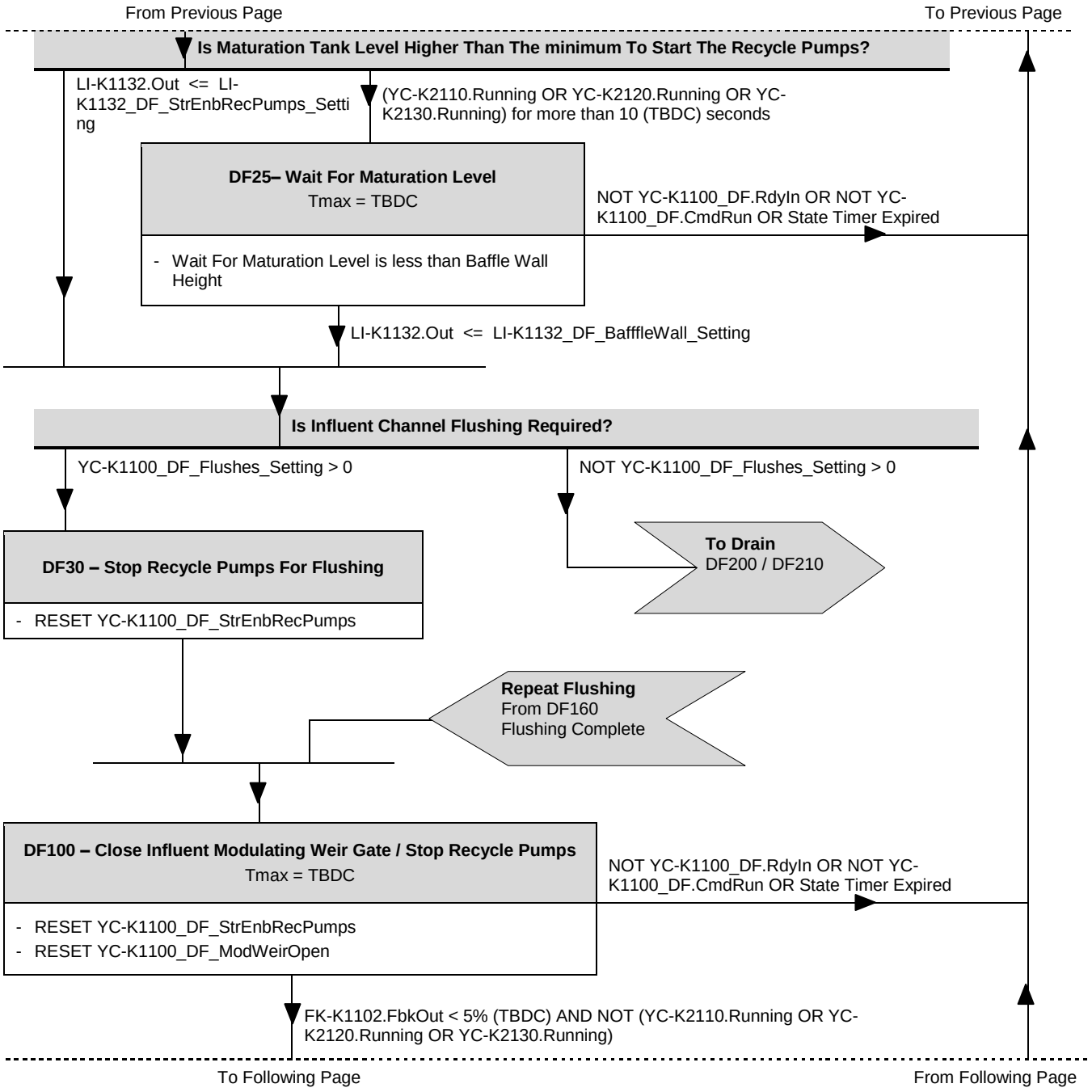
Table 3.2-59 HRC 1 Drain and Refill Sequence Ready List

Ready (AND)	Description
NOT (YC-K1100.CmdStart OR YC-K1100_AutoStarting OR YC-K1100.Running OR YC-K1100_AutoStopping)	HRC 1 Not starting, Running or Stopping
NOT (YC-K1200.CmdStart OR YC-K1200_AutoStarting OR YC-K1200.Running OR YC-K1200_AutoStopping)	HRC 2 Not starting, Running or Stopping
GBL_G800_XC-G3621_ConfCls	XV-G3621 Influent Isolation Gate Confirmed Closed
NOT YC-K1100_DF_SH.SelOut OR NOT GBL_C800_YC-C2229_PathANotAvail	HRC 1 Sodium Hypochlorite Available If Required
NOT YC-K1100_DF_SH.SelOut XC-K1103.Rdy	Drop Shaft Hypochlorite Valve Ready If Required
NOT (YC-K1100_DF_Flushes_Setting > 0) OR FV-K1102.Rdy	FV-K1102 Influent Channel Modulating Weir Gate If Required
NOT (YC-K1100_DF_Flushes_Setting > 0) OR GBL_G800_XC-G3622_Rdy	XV-G3622 HRC 1 Influent Flushing Water Ready If Required
YC-K2110.Rdy OR YC-K2120.Rdy OR YC-K2130.Rdy	At least one Recycle Pump P-K211, P-K212 or P-K213 Ready
XC-K1131.Rdy	Maturation Tank Drain Mud Valve Ready
YC-K2510.Rdy OR YC-K2520.Rdy	At least one Waste Sludge Pumps P-K251 or P-K252 Ready

Ready (AND)	Description
NOT (LIC-K2501.CtrlOper OR LIC-K2501.CtrlErr) OR YC-K2500_BackUpLvlCtrl.Alm	Waste Sludge Sump Level Control Not in Operator or Error mode or Backup Level Switch Control Mode
XC-K2543.ConfOpn OR XV-K2544.ConfOpn	Waste Sludge Valve XV-K2543 or XV-K2544 open
NOT LIT-K132.AlmErr	Maturation Tank Level Not Bad Quality

3.2.6.1 YC-K1100_DF_Sequence / HRC 1 Drain and Refill Sequence




From Previous Page
To Previous Page
Is Maturation Tank Level Higher Than The minimum To Start The Recycle Pumps?
LI-K1132.Out <= LI-K1132_DF_StrEnbRecPumps_Setting
(YC-K2110.Running OR YC-K2120.Running OR YC-K2130.Running) for more than 10 (TBDC) seconds
DF25– Wait For Maturation Level
Tmax = TBDC
- Wait For Maturation Level is less than Baffle Wall Height
NOT YC-K1100_DF.RdyIn OR NOT YC-K1100_DF.CmdRun OR State Timer Expired
LI-K1132.Out <= LI-K1132_DF_BafffleWall_Setting
Is Influent Channel Flushing Required?
YC-K1100_DF_Flushes_Setting > 0
NOT YC-K1100_DF_Flushes_Setting > 0
To Drain
DF200 / DF210
DF30 – Stop Recycle Pumps For Flushing
- RESET YC-K1100_DF_StrEnbRecPumps
Repeat Flushing
From DF160
Flushing Complete
DF100 – Close Influent Modulating Weir Gate / Stop Recycle Pumps
Tmax = TBDC
- RESET YC-K1100_DF_StrEnbRecPumps
- RESET YC-K1100_DF_ModWeirOpen
NOT YC-K1100_DF.RdyIn OR NOT YC-K1100_DF.CmdRun OR State Timer Expired
FK-K1102.FbkOut < 5% (TBDC) AND NOT (YC-K2110.Running OR YC-K2120.Running OR YC-K2130.Running)
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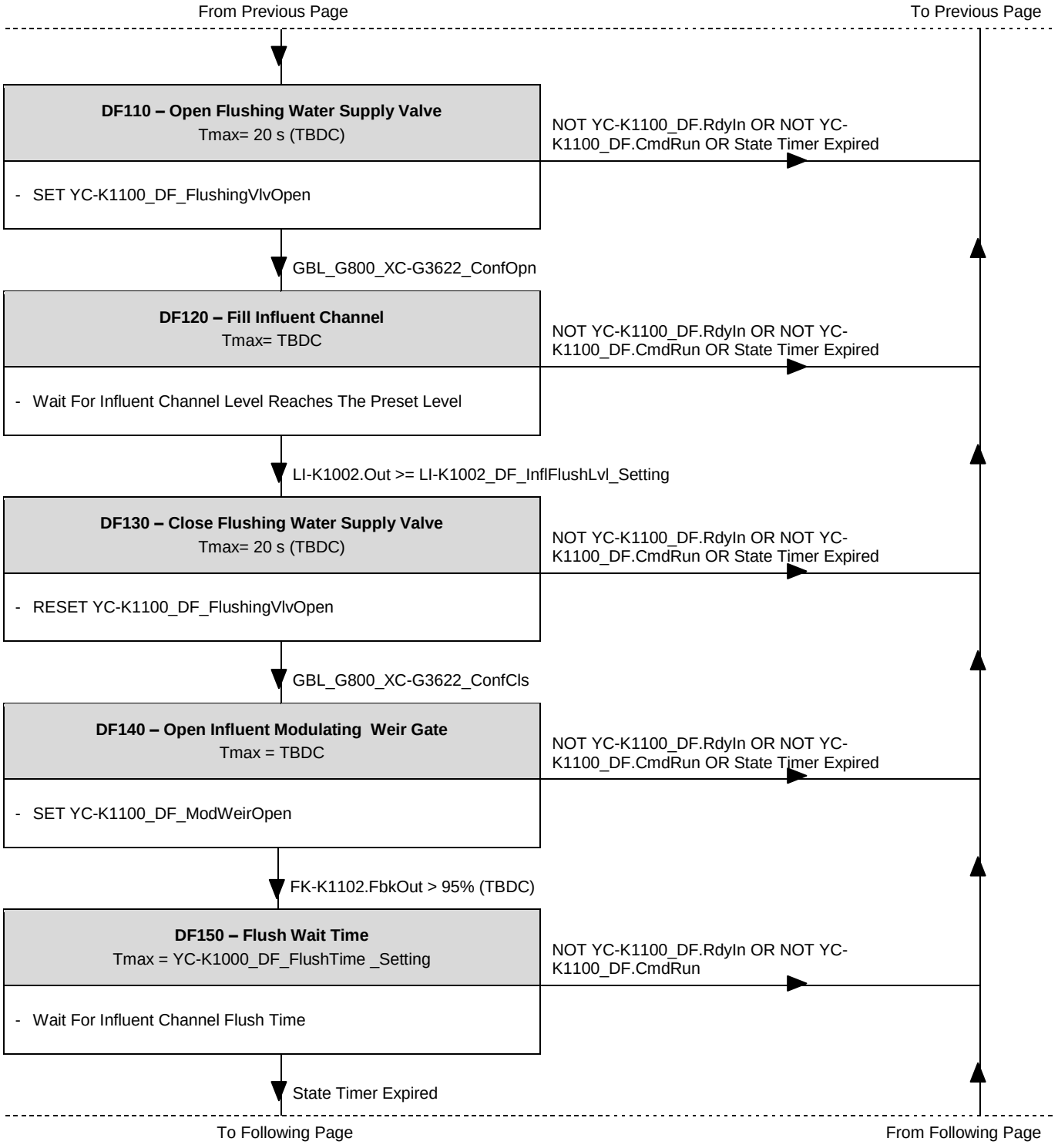
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DF110 – Open Flushing Water Supply Valve
Tmax= 20 s (TBDC)
- SET YC-K1100_DF_FlushingVlvOpen
NOT YC-K1100_DF.RdyIn OR NOT YC-K1100_DF.CmdRun OR State Timer Expired
GBL_G800_XC-G3622_ConfOpn
DF120 – Fill Influent Channel
Tmax= TBDC
- Wait For Influent Channel Level Reaches The Preset Level
NOT YC-K1100_DF.RdyIn OR NOT YC-K1100_DF.CmdRun OR State Timer Expired
LI-K1002.Out >= LI-K1002_DF_InflFlushLvl_Setting
DF130 – Close Flushing Water Supply Valve
Tmax= 20 s (TBDC)
- RESET YC-K1100_DF_FlushingVlvOpen
NOT YC-K1100_DF.RdyIn OR NOT YC-K1100_DF.CmdRun OR State Timer Expired
GBL_G800_XC-G3622_ConfCls
DF140 – Open Influent Modulating Weir Gate
Tmax = TBDC
- SET YC-K1100_DF_ModWeirOpen
NOT YC-K1100_DF.RdyIn OR NOT YC-K1100_DF.CmdRun OR State Timer Expired
FK-K1102.FbkOut > 95% (TBDC)
DF150 – Flush Wait Time
Tmax = YC-K1000_DF_FlushTime _Setting
- Wait For Influent Channel Flush Time
NOT YC-K1100_DF.RdyIn OR NOT YC-K1100_DF.CmdRun
State Timer Expired
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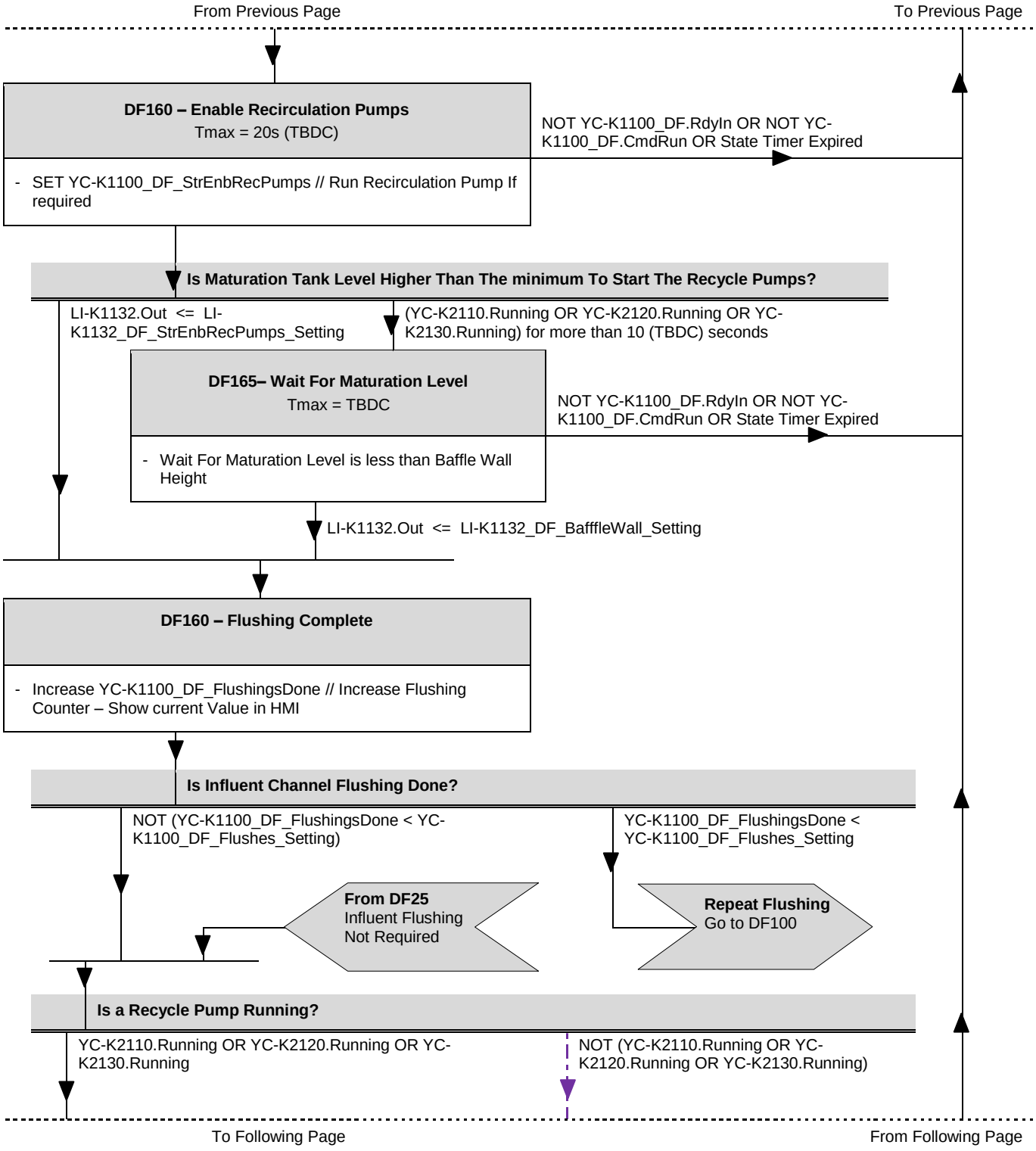
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DF160 – Enable Recirculation Pumps
Tmax = 20s (TBDC)
NOT YC-K1100_DF.RdyIn OR NOT YC-K1100_DF.CmdRun OR State Timer Expired
- SET YC-K1100_DF_StrEnbRecPumps // Run Recirculation Pump If required
Is Maturation Tank Level Higher Than The minimum To Start The Recycle Pumps?
LI-K1132.Out <= LI-K1132_DF_StrEnbRecPumps_Setting
(YC-K2110.Running OR YC-K2120.Running OR YC-K2130.Running) for more than 10 (TBDC) seconds
DF165– Wait For Maturation Level
Tmax = TBDC
NOT YC-K1100_DF.RdyIn OR NOT YC-K1100_DF.CmdRun OR State Timer Expired
- Wait For Maturation Level is less than Baffle Wall Height
LI-K1132.Out <= LI-K1132_DF_BafffleWall_Setting
DF160 – Flushing Complete
- Increase YC-K1100_DF_FlushingsDone // Increase Flushing Counter – Show current Value in HMI
Is Influent Channel Flushing Done?
NOT (YC-K1100_DF_FlushingsDone < YC-K1100_DF_Flushes_Setting)
YC-K1100_DF_FlushingsDone < YC-K1100_DF_Flushes_Setting
From DF25
Influent Flushing Not Required
Repeat Flushing
Go to DF100
Is a Recycle Pump Running?
YC-K2110.Running OR YC-K2120.Running OR YC-K2130.Running
NOT (YC-K2110.Running OR YC-K2120.Running OR YC-K2130.Running)
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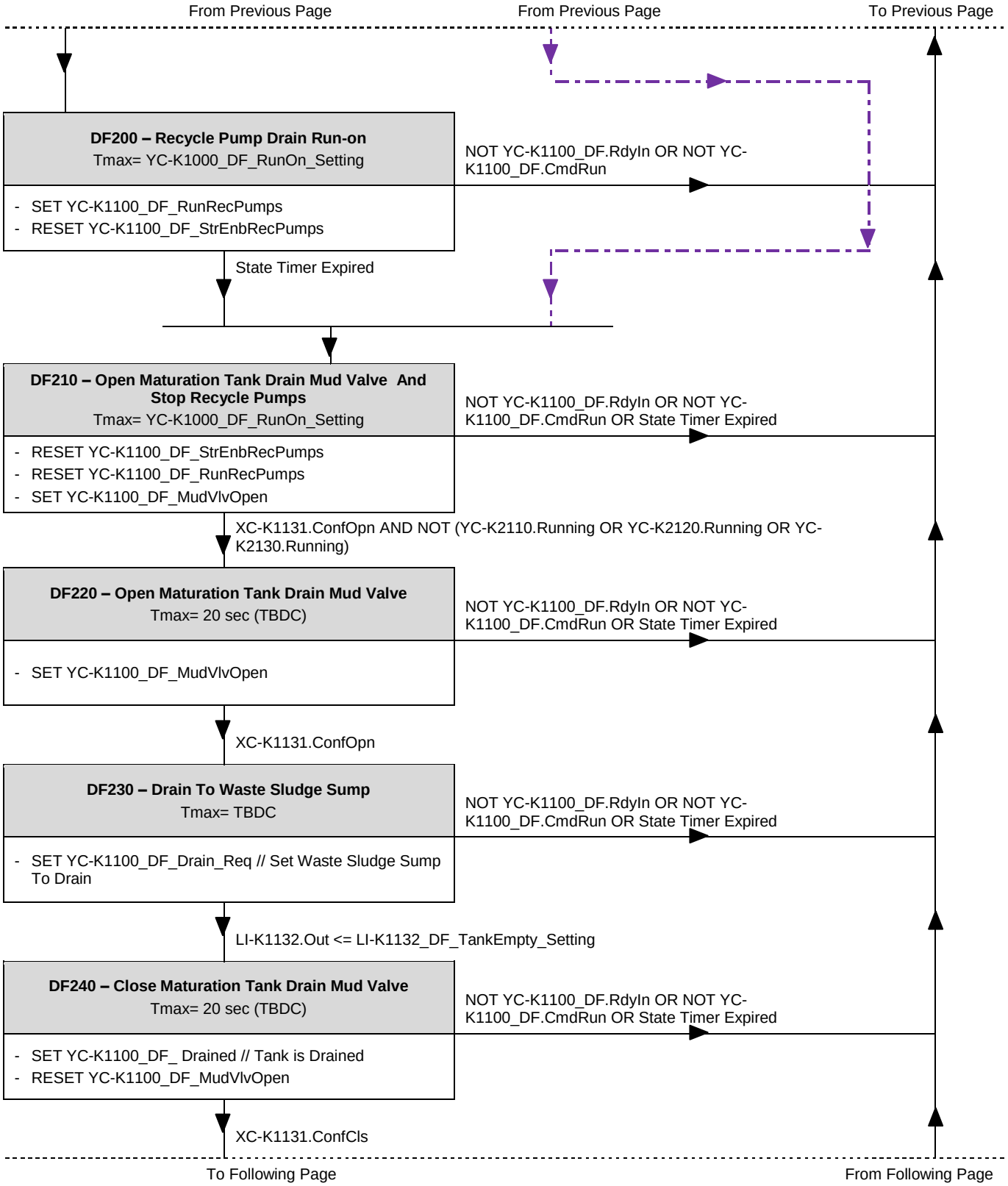
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To Previous Page
DF200 – Recycle Pump Drain Run-on
Tmax= YC-K1000_DF_RunOn_Setting
- SET YC-K1100_DF_RunRecPumps
- RESET YC-K1100_DF_StrEnbRecPumps
NOT YC-K1100_DF.RdyIn OR NOT YC-K1100_DF.CmdRun
State Timer Expired
DF210 – Open Maturation Tank Drain Mud Valve And Stop Recycle Pumps
Tmax= YC-K1000_DF_RunOn_Setting
- RESET YC-K1100_DF_StrEnbRecPumps
- RESET YC-K1100_DF_RunRecPumps
- SET YC-K1100_DF_MudVlvOpen
NOT YC-K1100_DF.RdyIn OR NOT YC-K1100_DF.CmdRun OR State Timer Expired
XC-K1131.ConfOpn AND NOT (YC-K2110.Running OR YC-K2120.Running OR YC-K2130.Running)
DF220 – Open Maturation Tank Drain Mud Valve
Tmax= 20 sec (TBDC)
- SET YC-K1100_DF_MudVlvOpen
NOT YC-K1100_DF.RdyIn OR NOT YC-K1100_DF.CmdRun OR State Timer Expired
XC-K1131.ConfOpn
DF230 – Drain To Waste Sludge Sump
Tmax= TBDC
- SET YC-K1100_DF_Drain_Req // Set Waste Sludge Sump To Drain
NOT YC-K1100_DF.RdyIn OR NOT YC-K1100_DF.CmdRun OR State Timer Expired
LI-K1132.Out <= LI-K1132_DF_TankEmpty_Setting
DF240 – Close Maturation Tank Drain Mud Valve
Tmax= 20 sec (TBDC)
- SET YC-K1100_DF_ Drained // Tank is Drained
- RESET YC-K1100_DF_MudVlvOpen
NOT YC-K1100_DF.RdyIn OR NOT YC-K1100_DF.CmdRun OR State Timer Expired
XC-K1131.ConfCls
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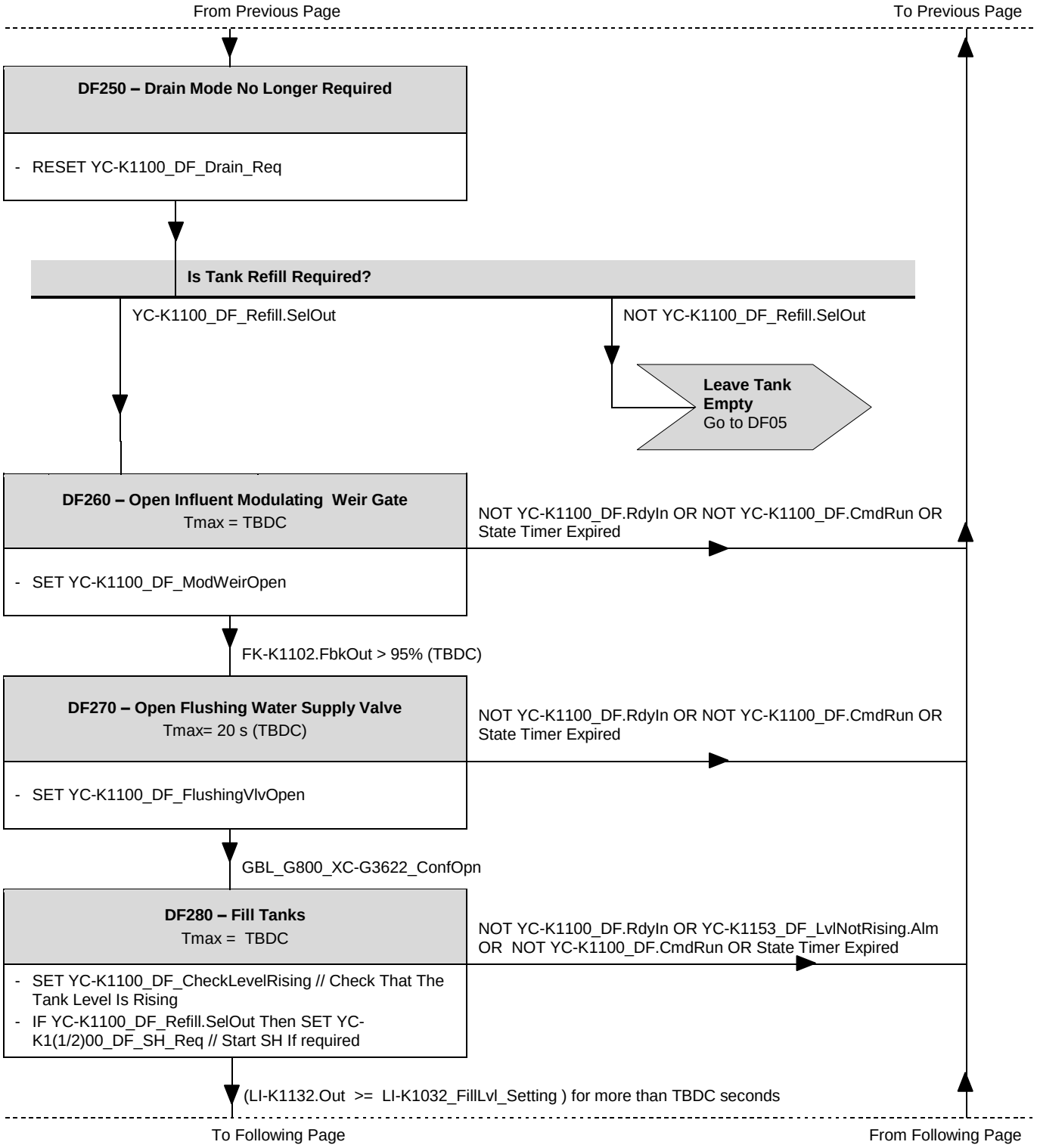
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To Previous Page
DF250 – Drain Mode No Longer Required
- RESET YC-K1100_DF_Drain_Req
Is Tank Refill Required?
YC-K1100_DF_Refill.SelOut
NOT YC-K1100_DF_Refill.SelOut
Leave Tank Empty
Go to DF05
DF260 – Open Influent Modulating Weir Gate
Tmax = TBDC
NOT YC-K1100_DF.RdyIn OR NOT YC-K1100_DF.CmdRun OR State Timer Expired
- SET YC-K1100_DF_ModWeirOpen
FK-K1102.FbkOut > 95% (TBDC)
DF270 – Open Flushing Water Supply Valve
Tmax= 20 s (TBDC)
NOT YC-K1100_DF.RdyIn OR NOT YC-K1100_DF.CmdRun OR State Timer Expired
- SET YC-K1100_DF_FlushingVlvOpen
GBL_G800_XC-G3622_ConfOpn
DF280 – Fill Tanks
Tmax = TBDC
NOT YC-K1100_DF.RdyIn OR YC-K1153_DF_LvlNotRising.Alm OR NOT YC-K1100_DF.CmdRun OR State Timer Expired
- SET YC-K1100_DF_CheckLevelRising // Check That The Tank Level Is Rising
- IF YC-K1100_DF_Refill.SelOut Then SET YC-K1(1/2)00_DF_SH_Req // Start SH If required
(LI-K1132.Out >= LI-K1032_FillLvl_Setting) for more than TBDC seconds
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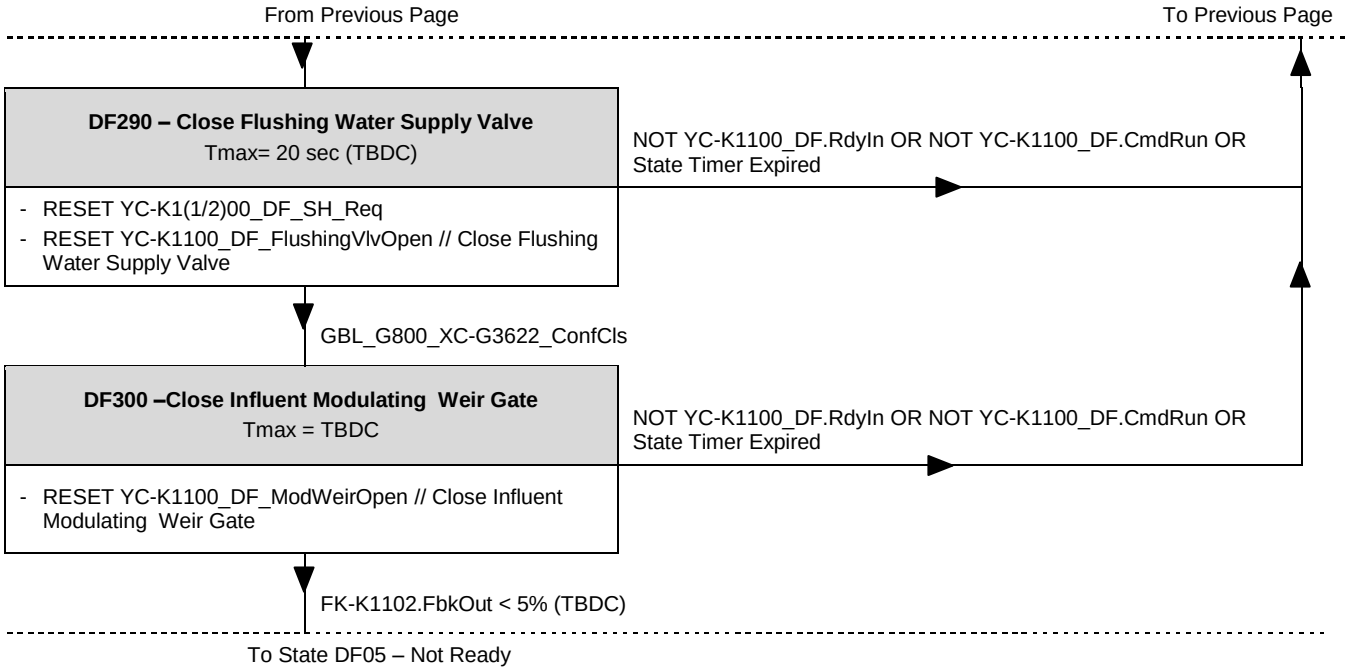


The following settings are real numbers that can be modified by an operator with security level M or higher:

- LI-K1132_DF_StrEnbRecPumps_Setting [m] is the “Drain and Refill Minimum Maturation Tank Level To Start Recycle Pumps”
- LI-K1132_DF_BafffleWall_Setting [m] is the “Baffle Wall Height”
- LI-K1132_DF_TankEmpty_Setting [m] is the “Tank Drain Empty Level”
- LI-K1002_DF_InflFlushLvl_Setting [m] is the “Water Level for Influent Channel Flushing”
- YC-K1000_DF_FlushTime _Setting [s] is the “Influent Channel Flush Time”
- YC-K1000_DF_RunOn_Setting [s] is the “Recycle Pump Drain Run-on Time”

LI-K1132_DF_StrEnbRecPumps_Setting should be coordinated with LI-K1132_DF_BafffleWall_Setting.

Table 3.2-60 YC-K1100_DF_SequenceFail / HRC 1 Drain and Refill Sequence Fail

Instance	YC-K1100_DF_SequenceFail		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	See YC-K1100_DF_Sequence above	Link
	ExtRst	YC-K1100_DF.RstDevAlms	Link
Alarms	Alm(3) - Low Priority		

Note: Alarm text to include name and description of the failed sequence state

Table 3.2-61 YC-K1153_DF_LvlNotRising / HRC 1 Drain and Refill Level Not Rising

Instance	YC-K1153_DF_LvlNotRising		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	Check every minute that new measurement increase is greater than TBDC	Link
	DisAlm	NOT YC-K1100_DF_CheckLevelRising	Link
	ExtRst	YC-K1100_DF.RstDevAlms	Link
Alarms	Alm(3) - Low Priority		

3.2.7 HRC 2

Similar to High Rate Clarifier Train 1

3.2.8 HRC 2 Main Sequence

Similar to High Rate Clarifier Train 1

3.2.9 HRC 2 Wet Storage Sequences

Similar to High Rate Clarifier Train 1

3.2.10 HRC 2 Effluent Channel Analyzer Clean-Up

Similar to High Rate Clarifier Train 1

3.2.11 HRC Effluent

The HRC effluent system is comprised of one effluent channel for each HRC train. These channels then combine into a common HRC effluent channel that connects to the bypass sewer (outfall) and the primary effluent channel.

3.2.11.1 XC-K1513 / XV-K1513 HRC Effluent Channel to BNR Isolation Gate

The required position for XV-K1513 depends on the BNR flow requirement and HRC running status.

If the BNR isolation gate is in auto and is closed but required to open, it will be kept closed until the level in the effluent channel is higher than the “Isolation Gate Open Level Setting” (XC-K1513_OpenMinWtrLvl_Setting [m]).

```
If XC-K1513.Rdy Then
        If XC-K1513.ConfCls AND YC-K1513_BNR_Req AND LIC-K1511.Out > XC-
                K1513_OpenMinWtrLvl_Setting Then
                XC-K1513.OpnReq := True                 //Give an open command
        Elseif XC-K1513.ConfOpn AND NOT YC-K1513_BNR_Req AND FK-K1511.FbkOut <= (XC-
                K1513_Closing_WtrLvl_GateOpn + 1%(TBDC)) OR
                (YC-K1100_IS_MajorFault.Alm AND NOT (YC-K1200.Running OR YC-K1200_StrtEff) OR
                (YC-K1200_IS_MajorFault.Alm AND NOT (YC-K1100.Running OR YC-K1100_StrtEff) Then
                XC-K1513.OpnReq := False                //Give a close command
        Else
                //Keep last open/close request
        Endif
Else // if not ready set command same as current confirmed position
        If XC-K1513.ConfOpn Then
                XC-K1513.OpnReq := True
        Else XC-K1513.ConfCls Then
                XC-K1513.OpnReq := False
        Else
                //Keep last open/close request
        Endif
Endif
```

YC-K1513_BNR_Req defines if the effluent is required to go to BNR (limited to the maximum flow).

YC-K1513_BNR_Req := (YC-K1100.Running OR YC-K1100_StrtEff OR YC-K1200.Running OR YC-K1200_StrtEff) AND ((YC-K1513_BNR_Mode == 1) OR ((YC-K1513_BNR_Mode == 2) AND NOT FQI-K1002_LeadVol.CrtlHi))

Table 3.2-62 XC-K1513 / XV-K1513 HRC Effluent Channel to BNR Isolation Gate

Instance	**XC-K1513**		
Class	ValveD		
Inputs	**Parameter**	**Source**	**Type**
	Flt	XV-K1513.Flt	I/O
	CtrlRem	XV-K1513.Rem	I/O
	ZSO	XV-K1513.ZSO	I/O
	ZSC	XV-K1513.ZSC	I/O
	OpenReq	See above	Link
Outputs	**Parameter**	**Destination**	**Type**
	CmdOpn	XV-K1513.CmdOpn	I/O
	CmdCls	XV-K1513.CmdCls	I/O
Alarms	(2) Medium Priority		

3.2.11.2 FI-K1511 / HRC Effluent Channel to Outfall Sewer Flow Calculation

Table 3.2-63 FI-K1511 / HRC Effluent Channel to Outfall Sewer Flow

Instance	FI-K1511		
Class	AnalogIAC		
Inputs	Parameter	Source	Type
	PV	See Calculation Below	Link
Alarms	N/A		

The flow over the modulating weir gate is calculated by the PCS using the Kindsvater and Carter (1959) method. When applied to the HRC effluent modulating weir it results in the following equation:

$$\text{FI-K1511.PV} := \left(0.2888 \times \frac{\text{FI-K1511\_H}}{\text{FK-K1511\_P.Out}} + 3.533\right) \times \left(\text{FI-K1511\_H} + 0.0009\right)^{3/2} \times 86.4 \text{ [ML/d]}$$

Where FI-K1511_H := LIC-K1511.Out - FK-K1511_P.Out [m] is the calculated head on the weir.

Table 3.2-64 FK-K1511_P / FV-K1511 HRC Effluent Channel to Outfall Sewer Weir Gate Position Relative to Channel Invert

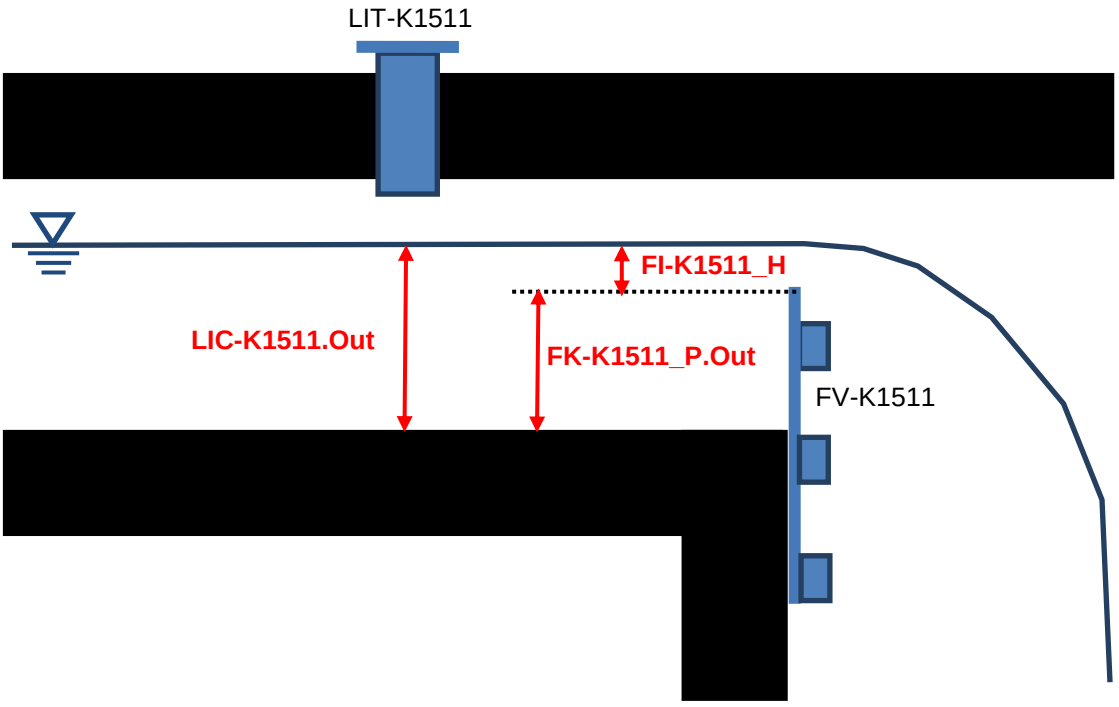
Instance	FK-K1511_P		
Class	AnalogIAC		
Inputs	Parameter	Source	Type

	PV	FK-K1511_K x (100 - FK-K1511.Fbk_Out) [m]	Link
Alarms	N/A		

Notes:

FK-K1511.Fbk_Out is the modulating weir gate % Open position feedback.
FK-K1511_K is factor to be determined by the contractor.

Water level (LIC-K1511) and gate position (FK-K1511_P) must both be in the same engineering units of meters above upstream channel invert. LIT-K1511 must be calibrated with its 0 at channel invert level.



3.2.11.3 HRC Effluent to BNR Modes

Part or all HRC Effluent can be directed to the bioreactor secondary treating system via HRC effluent channel to primary effluent channel XV-K1513 gate valve. The maximum flow directed to the primary effluent channel is operator adjustable (FIC-K1514_MaxFlow_Setting).

From the HMI, the operator can select one of the available HRC Effluent to BNR Modes (YC-K1513_BNR_Mode) for the HRC effluent system:

- “Disabled” (YC-K1513_BNR_Mode := 0). No HRC effluent is conveyed to the primary effluent channel at any point in the operating sequence.
- “All Base Flow” (YC-K1513_BNR_Mode := 1). In this mode, HRC effluent flow up to a maximum limit equal to the “HRC Effluent to BNR Maximum Allowable Flow” is conveyed to the BNR process, while any HRC effluent in excess of this is discharged to the bypass sewer (outfall).

- "On Lead Train Start" (YC-K1513_BNR_Mode := 2). This mode may be selected by the operators to divert "off-spec" HRC effluent during the initial start-up of the system when effluent quality is not anticipated to meet performance guarantee requirements. In this mode, HRC effluent is diverted in the same manner as the ALL BASE FLOW mode above except that conveying HRC effluent to the primary effluent channel is stopped after the HRC influent volume totalizer exceeds the "HRC Effluent to BNR on Lead Start Maximum Allowable Volume" (FQI-K1002_LeadVol_MaxToBNR_Setting) value. This mode is provided with respect to start-up of the lead train only.

The control system may override the operator selection for HRC Effluent to BNR Mode in the following circumstances:

- HRC effluent channel level alarms (LIC-K1511):
  - HiHi level in HRC effluent channel (LIC-K1511.AlmHiHi) changes mode to "Disabled" (YC-K1513_BNR_Mode := 0). To prevent flooding within the plant, the automatic control will attempt to maximize the amount of flow to the outfall. Alarm priority 1 on mode change.
  - Level instrument error (LIC-K1511.AlmErr (for more than 20 seconds TBDC)) changes mode to "Disabled" (YC-K1513_BNR_Mode := 0). A LI with errors prevents the control of the modulating gate and the proper control of flow between BNR and the outfall. Alarm priority 1 on mode change.
- HRC maturation zone and clarifier level alarms (LI-K1132 & LAH-1144 / LI-K1232 & LAH-1244):
  - HiHi level in a running HRC maturation zone or clarifier ((LI-K1132.AlmHiHi OR LAH-1144.Alm) AND YC-K1100.Running OR (LI-K1232.AlmHiHi OR LAH-1144.Alm) AND YC-K1200.Running) changes mode to "Disabled" (YC-K1513_BNR_Mode := 0). To prevent flooding within the plant, the automatic control will attempt to maximize the amount of flow to the outfall. Alarm priority 1 on mode change.
- HRC effluent channel to BNR isolation gate alarms (XV-1513):
  - Isolation gate un-commanded open or fail to close (NOT XC-K1513.OpnReq AND XC-K1513.ZA AND XC-K1513.ConfOpn) changes mode to "All Base Flow" (YC-K1513_BNR_Mode := 1). Alarm priority 2 on mode change.
  - Isolation gate un-commanded close or fail to open (XC-K1513.OpnReq AND XC-K1513.ZA AND XC-K1513.ConfCls) changes mode to "Disabled" (YC-K1513_BNR_Mode := 0). Alarm priority 2 on mode change.
  - Isolation gate fault when gate is closed (XC-K1513.AlmFlt AND XC-K1513.ConfCls) changes mode to "Disabled" (YC-K1513_BNR_Mode := 0). Alarm priority 2 on mode change.
  - Isolation gate fault when gate is open (XC-K1513.AlmFlt AND XC-K1513.ConfOpn) changes mode to "All Base Flow" (YC-K1513_BNR_Mode := 1). Alarm priority 2 on mode change.
  - Isolation gate fault when gate is in transit ((XC-K1513.AlmFlt OR XC-K1513.ZA) AND NOT (XC-K1513.ConfCls OR XC-K1513.ConfOpn)) changes mode to "All Base Flow" (YC-K1513_BNR_Mode := 1). Alarm priority 2 on mode change.
- HRC effluent to outfall modulating weir gate (FV-K1511):
  - Weir gate un-commanded open or fail to close ((FK-K1511.FbkOut < (AI-K1053_MinWtrLvl_GateOpn + 2%(TBDC)) AND (YC-K1511_State == 0 OR YC-K1511_State == 1)) for more than 30 seconds (TBDC)) changes mode to "Disabled" (YC-K1513_BNR_Mode := 0). Alarm priority 1 on mode change.
  - Weir gate un-commanded close or fail to open ((FK-K1511.FbkOut < (AI-K1053_MinWtrLvl_GateOpn + 2%(TBDC)) AND (YC-K1511_State == 0 OR YC-K1511_State == 1)) for more than 30 seconds (TBDC)) changes mode to "All Base Flow" (YC-K1513_BNR_Mode := 1). Alarm priority 1 on mode change.

- Weir gate fault or error ((FK-K1511.AlmFlt OR FK-K1511.AlmErr) for more than 30 seconds (TBDC)) changes mode to “Disabled” (YC-K1513_BNR_Mode := 0). Alarm priority 1 on mode change.

An alarm must be generated whenever the mode is changed automatically by the system. The alarm message will have the following format “HRC BNR Mode Change - ” plus the reason of the change (e.g. “LIC-K1511 error”.

FIC-K1514_MaxFlow_Setting is the “HRC Effluent to BNR Maximum Allowable Flow” [ML/d] and FQI-K1002_LeadVol_MaxToBNR_Setting “HRC Effluent to BNR on Lead Start Maximum Allowable Volume” [ML]. FIC-K1514_MaxFlow_Setting and FQI-K1002_LeadVol_MaxToBNR_Setting are real numbers that can be modified by the operator with security level M or higher. The operator HMI settings should be range checked before being used.

The lead HRC train influent volume is calculated to determine when to close the isolation gate to primary effluent channel.

Table 3.2-65 FQI-K1002_LeadVol / HRC Lead Train Influent Volume

Instance	FQI-K1002_LeadVol		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	If(YC-K1000_DS.Eqmt1_SelLead,FIC-K1102.Out, FIC-K1202.Out)	Link
	CrtlHiSP	FQI-K1002_LeadVol_MaxToBNR_Setting	Link
	TimeFactor	86400 (ML/d assumed)	Const
	UnitConv	1 (ML assumed)	Const
	AccumAutoRst	NOT (YC-K1100.Running OR YC-K1100_StrtEff OR YC-K1200.Running OR YC-K1200_StrtEff)	Link
Alarms	-		

3.2.11.4 FK-K1511 / FV-K1511 HRC Effluent Channel to Outfall Sewer Weir Gate

The required position for FV-K1511 depends on the isolation gate to primary effluent.

When isolation gate to primary effluent XV-K1513 is open (and not required to close) the weir gate is controlling flow to outfall or maintaining the weir gate close to the water level when the maximum flow to BNR is not exceed (see FK-K1511_FlowContEnb). See 3.2.11.5 HRC to BNR Maximum Flow Control for details.

If the primary effluent isolation gate is closing (or required to close), the HRC effluent gates needs to be controlled in such a manner as to prevent backflow of primary effluent into the HRC effluent channel while also preventing excessive rise in the water level. See 3.2.11.6 LIC-K1511 / HRC Effluent Channel Level Control for details.

When the primary effluent isolation gate is closed the weir gate can be at a minimum level (AI-K1053_MinWtrLvl_GateOpn) for analyzer operation, fully open for draining or fully closed depending on if the is HRC running status and if flow to BNR is required.

If the primary effluent isolation gate is opening (or required to open), the HRC effluent weir and isolation gate need to be closed until the level in the effluent channel level is higher than the “Isolation Gate Open Level Setting” (XC-K1513_OpenMinWtrLvl_Setting [m]) to prevent significant sloshing and backflow from the primary effluent channel while the isolating gate is being opened.

XC-K1513_OpenMinWtrLvl_Setting is a real number that can be modified by the operator with security level M or higher. The operator HMI settings should be range checked before being used.

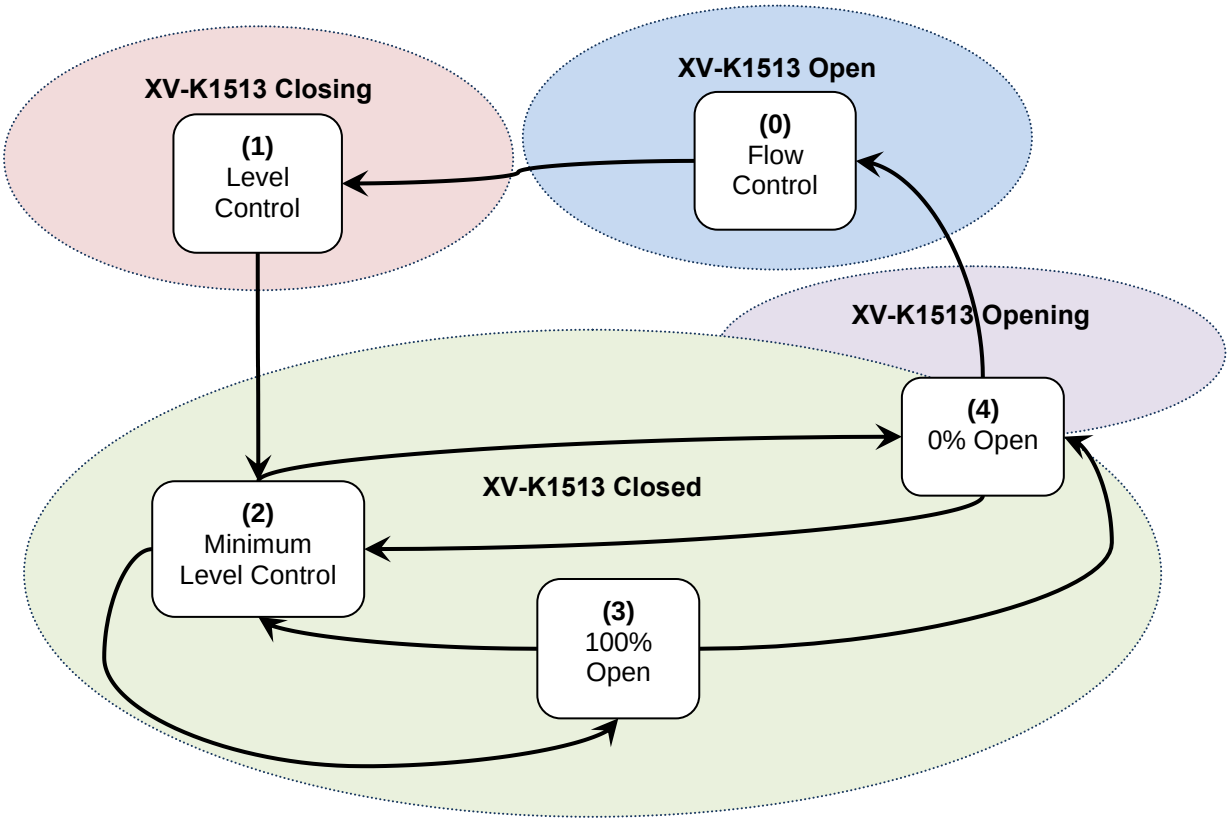


Figure 3.2-2 YC-K1511_State - FV-K1511 HRC Effluent to Outfall Weir Gate Possible Request States

State selection based on XV-K1513

```
If XV-K1513.ConfOpn AND (NOT XV-K1513_Closing OR NOT XV-K1513.Rdy) Then       //Flow to BNR
        YC-K1511_State := 0                                                   //Flow Control or 0 flow to Outfall
Elseif XV-K1513_Closing Then                                                  //Valve Closing
        YC-K1511_State := 1                                                   //Level Control
        FK-K1511.CV_In := LIC-K1511.CV
Else if XV-K1513.ConfCls
        If YC-K1511_State <> 3 AND YC-K1511_State <> 4 Then //Default state - minimum level required
                YC-K1511_State := 2
        Endif
Else            //Not open, closed or closing set default as opening
        YC-K1511_State := 4             // Weir Gate Closed Required
```

Endif

XV-K1513_Opening := NOT (XV-K1513_Closing OR XV-K1513.ConfOpn OR XV-K1513.ConfCls)

State 0 / Flow control or no flow to outfall required
If YC-K1511_State == 0 Then

IF FK-K1511_FlowContEnb Then //Flow Control

FK-K1511.CV_In := FIC-K1514.CV

Else //Maintain gate 0.1m (TBDC) over water level

$$\text{FK-K1511.CV\_In} := 100 - \frac{\text{LIC-K1511.Out} + 0.1\text{[m] (TBDC)}}{\text{FK-K1511\_K}} \text{ [\%]}$$

Endif

Endif

State 1 / Level control required
If YC-K1511_State == 1 Then

FK-K1511.CV_In := LIC-K1511.CV
Endif

State 2 / Minimum level required
If YC-K1511_State == 2 Then

FK-K1511.CV_In := AI-K1053_MinWtrLvl_GateOpn // Open to min water level

IF NOT (YC-K1100.Running OR YC-K1100_StrtEff OR YC-K1200.Running OR YC-K1200_StrtEff)

AND ((FI-K1001.Out < 1ML/d (TBDC)) for more than TBDC seconds) AND (FK-K1511.FbkOut <= (AI-K1053_MinWtrLvl_GateOpn + %(TBDC))) Then

YC-K1511_State := 3 // Go to Drain when not running, no flow and gate is at minimum

Elseif YC-K1513_BNR_Req Then // Flow to BNR required

YC-K1511_State := 4 // Go to 0% Open to rise level to open XV-K1513

Elseif NOT (YC-K1100.Running OR YC-K1100_StrtEff OR YC-K1200.Running OR YC-K1200_StrtEff)

AND (NOT (XC-G3621.ConCls OR FK-K1102.FbkOut < 5% (TBDC)) OR NOT (XC-G3631.ConCls OR FK-K1202.FbkOut < 5% (TBDC))) Then

// Untreated wastewater going to the outfall over the effluent weir gate
YC-K1511_State := 4 //Change state to close weir

Endif
Endif

State 3 / 100% Open Draining required
If YC-K1511_State == 3 Then

FK-K1511.CV_In := 100% // Open fully to drain and wait 5 minutes with no liquid level

If (LIC-K1511.Out < 10 mm (TBDC Drained Level) for more than 5 minutes) Then

YC-K1511_State := 4 //Change state to close weir

Elseif NOT (YC-K1100.Running OR YC-K1100_StrtEff OR YC-K1200.Running OR YC-K1200_StrtEff)

AND (NOT (XC-G3621.ConCls OR FK-K1102.FbkOut < 5% (TBDC)) OR NOT (XC-G3631.ConCls OR FK-K1202.FbkOut < 5% (TBDC))) Then

// Untreated wastewater going to the outfall over the effluent weir gate

YC-K1511_State := 4 //Change state to close weir

Elseif (YC-K1100.Running OR YC-K1100_StrtEff OR YC-K1200.Running OR

YC-K1200_StrtEff) OR ((FI-K1001.Out > 1ML/d (TBDC)) for more than TBDC seconds)

Then

YC-K1511_State := 2 //Change state to start closing weir

Endif

Endif

State 4 / 0% Open required
If YC-K1511_State == 4 Then

FK-K1511.CV_In := 0% // Close FV-K1511

If (YC-K1100.Running OR YC-K1100_StrtEff OR YC-K1200.Running OR YC-K1200_StrtEff)

AND (NOT YC-K1513_BNR_Req OR NOT XV-K1513.Rdy) Then

YC-K1511_State := 2 //Change to minimum level if no flow to BNR required

Endif

Endif

Table 3.2-66 FK-K1511 / FV-K1511 HRC 1&2 Effluent Channel to Outfall Sewer Weir Gate Control Station

Instance	FK-K1511		
Class	AnalogCS		
Inputs	Parameter	Source	Type
	CV_In	See above	Link

	CtrlRem	FV-K1511.Rem	I/O
	Fbk	FV-K1511.Z	I/O
	Flt	FV-K1511.Flt	I/O
	CV_DevBand	TBDC	Const
	PowerFail	TBD	Link
Outputs	Parameter	Destination	Type
	CV	FV-K1511.CmdZ	I/O
Alarms	Err(1), Flt(1),DevAlm(2)		

3.2.11.5 HRC to BNR Maximum Flow Control

There are two possible modulation modes for the effluent weir gate FV-K1511 when flow is being directed to the BNR (XV-K1513.ConfOpn), depending on the flow required to the outfall sewer. When FK-K1511_FlowContEnb is true flow needs to be redirected toward outfall sewer, when is false, no flow is required.

If the total influent flow (FI-K1001.Out) is less than the maximun flow to BNR (FIC-K1514.SP) then no flow is required to the outfall sewer and the weir gate is manteined higher (100 mm TBDC) than the water level. The weir gate is maintened near the water level to prevent controller windup when flow control is reactivated and the weir gate moves down towards the water level.

If the total influent flow (FI-K1001.Out) is more than the the maximun flow to BNR (FIC-K1514.SP) then flow is required to the outfall sewer and weir gate is modulated to maintain the maximun flow to BNR while maintainig a minimun weir head of flow to outfall of FK-K1511_MinHead_Setting (0.06 m initial value).

FIC-K1514_MinFlow in [ML/d] is the “HRC Effluent Weir Gate Minimum Flow” and is calculated as follows (see 3.2.11.2 FI-K1511 / HRC Effluent Channel to Outfall Sewer Flow for formula details):

If (LIC-K1511 - FK-K1511_MinHead_Setting) > 0.04 m Then

FIC-K1514_MinFlow :=

$$\left(0.2888\times\frac{\text{FK-K1511\_MinHead\_Setting}}{\text{LIC-K1511.Out}-\text{FK-FK-K1511\_MinHead\_Setting}}+3.533\right)\times\left(\text{FK-K1511\_MinHead\_Setting}+0.0009\right)^{3/2}\times 86.4$$

Else //Fixed value below a minimum level to prevent calculation overflows

FIC-K1514_MinFlow := 5 ML/d

Endif

A hysteresis around the maximun flow to BNR of FIC-K1514_MinFlow divided by 2 is implemented to prevent excessive mode changes when the influent flow is close to the requested maximum.

FK-K1511_FlowContEnb := ((FI-K1001.Out - FIC-K1514.SP) > FV-K1511_MinFlow / 2) OR (FK-K1511__FlowContEnb AND NOT ((FI-K1001.Out - FIC-K1514.SP) > FV-K1511_MinFlow / 2))

FK-K1511_MinHead_Setting is the “HRC Effluent Weir Gate Minimum Head”. FK-K1511_MinHead_Setting is a real number in meters that can be modified by the operator with security level M or higher. The operator HMI settings should be range checked before being used.

Table 3.2-67 FIC-K1514 / HRC Effluent Channel to BNR Max Flow Control

Instance	FIC-K1514		
Class	PID_Controller		
Inputs	Parameter	Source	Type
	PV	FI-K1001.Out - FI-K1511.Out	I/O
	Auto_SP	FIC-K1514_MaxFlow_Setting	Link
	CV_Max	AI-K1053_MinWtrLvl_GateOpn	Link
	CV_Min	$100-\frac{\text{LIC-K1511.Out}-\text{FK-K1511\_MinHead\_Setting}}{\text{FK-K1511\_K}}$ [%]	Link
	Tracking	FK-K1511.NotRdy OR (YC-K1511_State <> 0)	Link
	TrackingCV	FK-K1511.CV	Link
	DisDevAlmDB	FIC-K1514.CtrlTr	Link
	DevBand	TBDC	Const
	ReverseAct	0 (Direct)	Const
Alarms	DevAlm(2)		

The flow set point for FIC-K1514 is the maximum flow to primary effluent channel. The controller is direct acting; if the total HRC influent flow is less than FIC-K1514.SP, FV-K1511 will be modulated to close sending all the flow to the primary effluent channel; if the total HRC flow is more than FIC-K1514.SP, the controller will maintain a maximum flow of FIC-K1514.SP by modulating outfall sewer weir gate.

3.2.11.6 LIC-K1511 / HRC Effluent Channel Level Control

If FV-K1511 is in auto, the level control will be activated whenever the flow to BNR is not required or when XV-K1513 starts to close (XV-K1513_Closing) regardless of XV-K1513 valve mode. If FV-K1511 is not in auto, the level control will not be activated.

When the primary effluent isolation gate starts to close, the effluent channel level control will modulate the weir gate to maintain the recorded initial water level. The minimum opening permitted for the valve will be set so that the weir gate position is not higher than the recorded initial water level.

Note that when the closure of XV-K1513 (in auto) is required by a sequence, and weir gate position FK-K1511_P.Out is higher than LIT-K1511.Out (no flow), the sequence controlling XV-K1513 will activate the level control and wait until the weir gate FV-K1511 position is equal to(with 2% tolerance TBDC), or less than, the current water level as measured by LIT-K1511.Out before commanding the close of the primary effluent isolation gate.

When the closure of XV-K1513 is not initiated by a sequence (E.G. XV-K1513 in manual or local), the level control with minimum opening (the recorded initial water level) will be activated simultaneously (i.e. XV-K1513 will move towards close while FV-K1511 modulates to maintain the level if its position was bellow the water level or moves toward the recorded initial water level if its position was above the water level).

XV-K1513_Closing := (NOT YC-K1513_BNR_Req AND NOT XV-K1513.ConfCls) OR (XV-K1513.ConfOpn ON to OFF transition) OR (XV-K1513_Closing AND NOT (XV-K1513.ConfOpn Or XV-K1513.ConfCls))

The recorded water level is updated only while XV-K1513 is open:
If XC-K1513.ConfOpn Then XC-K1513_Closing_WtrLvl_GateOpn := LIT-K1511.Out

The weir gate [%] open that corresponds to the recorded water level is calculated as follows:

$$\text{XC - K1513\_Closing\_WtrLvl\_GateOpn} := 100 - \frac{\text{XC - K1513\_Closing\_WtrLvl}}{\text{FK - K1511\_K}} \text{ [\%]}$$

After XV-K1513 is confirmed closed the modulating weir gate FV-K1511 will be opened to its effluent sampling minimum water Level (AI-K1053_MinWtrLvl_Setting [m]). The effluent sampling minimum water level is used to calculate the minimum weir gate [%] open as follows:

$$\text{AI - K1053\_MinWtrLvl\_GateOpn} := 100 - \frac{\text{AI - K1053\_MinWtrLvl\_Setting}}{\text{FK - K1511\_K}} \text{ [\%]}$$

Table 3.2-68 LIC-K1511 / HRC Effluent Channel Level Control

Instance	LIC-K1511		
Class	PID_Controller		
Inputs	Parameter	Source	Type
	PV	LIT-K1511	I/O
	Auto_SP	XC-K1513_Closing_WtrLvl_GateOpn	Link
	Max_CV	AI-K1053_MinWtrLvl_GateOpn	Link
	Min_CV	XC-K1513_Closing_WtrLvl_GateOpn	Link
	CtrlLoSP	AI-K1053_MinWtrLvl_Setting	Link
	Tracking	FK-K1511.NotRdy OR (YC-K1511_State <> 1)	Link
	TrackingCV	FK-K1511.CV	Link
	DisDevAlmDB	LIC-K1511.CtrlTr	Link
	DevBand	TBDC	Const
	ReverseAct	0 (Direct)	Const
Alarms	HiHi(1), Hi(2), Err(1) & DevAlm(2)		

3.3 K2 – Sludge and Scum

3.3.1 Recycle Pumps HRC 1

P&ID Drawing: PPID-K201

3.3.1.1 YC-K2100 / Recycle Pumps Control

The ballasted sludge is withdrawn from the clarifier sludge hopper by the recycle pumps and pumped to the hydrocyclones which recover the sand ballast for return into the injection zone. The waste sludge is discharged from the top of the cyclone and flows by gravity to the HRC Waste Sludge Sump. Each train has three independent recycle pump lines. Depending on the turbidity characteristics, one or two recycle pump(s) will be operated. The third line is a full backup.

The operator can select which turbidity measurement is used for recirculation pump control ("HRC 1 Lag Pump Turbidity Location for Control"). The operator can select either "Influent" or "Influent and Effluent" mode.
The HRC 1 Lag Pump Turbidity Location for Control will automatically switch to Influent only if there is an error associated with the effluent turbidimeter. A priority 3 alarm must be generated whenever the mode is changed automatically by the system. The alarm message will be as follows "HRC 1 Lag Pump Turbidity Location for Control Changed to Influent Only".

Table 3.3-1 YC-K2100_TurbMode / HRC 1 Lag Pump Turbidity Location for Control

Instance	YC-K2100_TurbMode		
Class	OnOffSel		
Inputs	**Parameter**	**Source**	**Type**
	IntlkOff	(AI-K1151.AlmErr OR OR YA-K1100_Fault.Alm) for more than TBDC seconds	Link
	SelOffText	"Influent Mode"	Const
	SelOnText	"Influent and Effluent Mode"	Const
	SelOnNotPerm	AI-K1151.AlmErr OR YA-K1100_Fault.Alm	Link
Alarms	N/A		

At least one pump is required to run the HRC, YC-K1100_RunRecPumps is set by the starting sequence of "HRC 1 Auto Sequence" (YC-K1100_Sequence) and reset when it is stopping. YC-K1100_LagRecPumpEnb is set and reset by the sequence to enable / disable running of lag recirculation pump.

Table 3.3-2 YC-K2100_2RP Recycle Two Pump Required State

Instance	YC-K2100_2RP		
Class	DiscreteIA		
Inputs	Parameter	Source	Type

	In	YC-K1100_RunRecPumps AND YC-K1100_LagRecPumpEnb AND (GBL_G800_AI-G3611_CtrlHi_Act OR GBL_G800_AI-G3611_AlmErr OR YC-K2100_TurbMode.SelOut AND AI-K1151.CtrlHi AND ((NOT XC-K1155.ConfCls) for more than AI-K1053_AlmDeact_Setting minutes)) OR YC-K2100_2RP AND (NOT GBL_G800_AI-G3611_CtrlLo OR (YC-K2100_TurbMode.SelOut AND NOT AI-K1151.CtrlLo)	Link
Alarms	-		

3.3.1.2 Recycle Pumps Duty Selector

Table 3.3-3 YC-K2100_DDS HRC 1 Recycle Pump Duty Selector – P-K211 / P-K212 / P-K213

Instance	YC-K2100_DDS		
Class	DutyDDS		
Inputs	Parameter	Source	Type
	Eqmt1_Fail	YC-K2110.Fail	Link
	Eqmt1_Rdy	YC-K2110.Rdy	Link
	Eqmt1_Running	YC-K2110.Running	Link
	Eqmt1_Auto	YC-K2110.CtrlAuto	Link
	Eqmt2_Fail	YC-K2120.Fail	Link
	Eqmt2_Rdy	YC-K2120.Rdy	Link
	Eqmt2_Running	YC-K2120.Running	Link
	Eqmt2_Auto	YC-K2120.CtrlAuto	Link
	Eqmt3_Fail	YC-K2130.Fail	Link
	Eqmt3_Rdy	YC-K2130.Rdy	Link
	Eqmt3_Running	YC-K2130.Running	Link
	Eqmt3_Auto	YC-K2130.CtrlAuto	Link
	RunReq	YC-K1100_RunRecPumps OR YC-K1100_WSR_RunRecPumps OR YC-K1100_WSSC_RunRecPumps OR YC-K1100_DF_StrEnbRecPumps AND ((LI-K1132.Out > LI-K1132_DF_StrEnbRecPumps_Setting) for more than 60 seconds (TBDC)) OR YC-K1100_DF_RunRecPumps	Link
	RunLagReq	YC-K2100_2RP.Out	Link
Alarms	AlmEqmtNotAvail(1) /AlmLagEqmtNotAvail(1) – Emergency / Call Out Priority		

3.3.2 TK-K250 Waste Sludge Sump

P&ID Drawing: PPID-K203

When in auto the TK-K250 waste sludge sump pump will try to maintain a level in the sump by changing speed and stopping/starting the pump when the incoming flow is less than the pumped flow at minimum VFD speed. The level setpoints are different depending whether the waste sludge sump level control is in “Normal Control” or “Drain Control” state.

Waste sludge sump mode can be selected by the operator as “Automatic Mode” or “Drain Only Mode”. In automatic mode the PCS changes between “Normal Control” (YC-K2500_DrainReq.Out is False) and “Drain Control” (YC-K2500_DrainReq.Out is True) as required by the sequence controlling the sump. The drain only mode keeps the sump in “Drain Control” and can be selected by the operator to keep the sump empty during the off season. The PCS will automatically change the waste sludge sump mode from “Drain Only Mode” to “Automatic Mode” if any of the trains are running.

Table 3.3-4 YC-K2500_SumpMode / HRC Waste Sludge Sump Mode

Instance	YC-K2500_SumpMode		
Class	OnOffSel		
Inputs	**Parameter**	**Source**	**Type**
	IntlkOff	YC-K1100.Running OR YC-K1200.Running	Link
	SelOffText	“Automatic Mode”	Const
	SelOnText	“Drain Only Mode”	Const
	SelOnNotPerm	YC-K1100.Running OR YC-K1200.Running	Link
Alarms	N/A		

Table 3.3-5 YC-K2500_DrainReq HRC Waste Sludge Sump Drain Required State

Instance	YC-K2500_DrainReq		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	(YC-K2500_SumpMode.SelOut OR YC-K1100_DF_Drain_Req OR YC-K1200_DF_Drain_Req) AND NOT (YC-K1100.Running OR YC-K1200.Running)	Link
Alarms	-		

3.3.2.1 Waste Sludge Sump Normal Level Control

In “Normal Control” state, the waste sludge sump is operated on a constant level principle, with the duty waste sludge pump run at the speed required to maintain a constant liquid level in the sump. Waste sludge is conveyed

from the hydrocyclones at a constant rate until the number of operating recycle pumps changes. The drain pump does not operate in this mode.

When the HRC is in normal sump control state (E.G. in operation, not flushing and draining), the setpoint will be YC-K2500_NormalSp. The pump will stop if it reaches YC-K2500_NormalCtrlLo level and the pump will start if it reaches YC-K2500_NormalCtrlHiSp level. YC-K2500_NormalSp, YC-K2500_NormalCtrlLo and YC-K2500_NormalCtrlHiSp are real numbers in meters that can be modified by the operator with security level M or higher. The operator HMI setpoints should be range checked before being used. YC-K2500_NormalCtrlHiSp should be higher than YC-K2500_NormalSp while YC-K2500_NormalCtrlLo should be lower than YC-K2500_NormalSp.

3.3.2.2 Waste Sludge Sump Drain Level Control

In “Drain Control” state, the duty waste sludge pump operates on a constant level principle but with a different (lower) level setpoint compared to normal level control state. In “Drain Control” state also limits the maximum waste sludge sump pump speed to an operator adjustable value (YC-K2500_DrainMaxS [%]).YC-K2500_DrainMaxS is a real number that can be modified by the operator with security level M or higher. The operator HMI setpoints should be range checked before being used.

In addition, the drain pump will operate automatically when the level measured by the LI-K2501 is an adjustable level setting (YC-K2500_DrainPmpStart) and stop by the low level drain control (LCL-K2502).

When the HRC is in drain sump control state the sump level setpoints will be changed to YC-K2500_DrainSp, YC-K2500_DrainCtrlHiSp level and YC-K2500_DrainCtrlLoSp level. YC-K2500_DrainSp, YC-K2500_DrainCtrlHiSp, YC-K2500_DrainCtrlLoSp and YC-K2500_DrainPmpStart are real numbers in meters that can be modified by the operator with security level M or higher. The operator HMI setpoints should be range checked before being used. YC-K2500_DrainCtrlHiSp should be higher than YC-K2500_DrainSp while YC-K2500_DrainCtrlLoSp should be lower than YC-K2500_DrainSp.

3.3.2.3 LIC-K2501 / TK-K250 HRC Waste Sludge Sump Level Control

Table 3.3-6 LIC-K2501 / TK-K250 HRC Waste Sludge Sump Level Control

Instance	LIC-K2501		
Class	PID_Controller		
Inputs	Parameter	Source	Type
	PV	LIT-K2501	I/O
	Auto_SP	If(YC-K2500_DrainReq.Out, YC-K2500_DrainSp ,YC-K2500_NormalSp)	Link
	AutoRst	TBDC	Const
	CV_Max	If(YC-K2500_DrainReq.Out, YC-K2500_DrainMaxS, 100% (TBDC))	Link
	CtrlHiSP	If(YC-K2500_DrainReq.Out, YC-K2500_DrainCtrlHiSp ,YC-K2500_NormalCtrlHiSp)	Link
	CtrlLoSP	If(YC-K2500_DrainReq.Out, YC-K2500_DrainCtrlLoSp ,YC-K2500_NormalCtrlLoSp)	Link
	Tracking	(YC-K2510.NotRdy AND YC-K2520.NotRdy) for more than 20 seconds OR TK-K250_Drained.Out OR YC-K2500_BackUpLvlCtrl.Alm	Link

	TrackingCV	YC-K2510.CV + YC-K2520.CV	Link
	ReverseAct	0 (Direct)	Const
Alarms	Err(1) - High Priority / Call Out. HiHi(2)/LoLo(2) Medium priority. Hi(3)/Lo(3) Low priority Disable Lo and LoLo alarms when TK-K250_Drained.Out		

Note: LIC-K2501 is direct acting. As Sump level increases, YC-K25(1/2)0 speed increases.

Table 3.3-7 LA-K2500 / TK-K250 HRC Waste Sludge Sump Level Measurement Discrepancy

Instance	LA-K2500		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	Dly	10 000 msec	Const
	In	(LIC-K2501.AlmHiHi AND NOT LAH-K2504.Out) OR (LSH-K2504.Out AND NOT LIC-K2501.AlmHi) OR (LALL-K2503.Out AND NOT LIC-K2501.CtrlLo) OR (LCL-K2502.Out AND NOT LALL-K2503.Out)	Link
Alarms	Alm(1) - High Priority / Call Out		

Notes: AlmHiHiLmt assumed higher than LSHH-K2501 level (TBDC). LSHH-K2501 assumed higher than AlmHiLmt (TBDC).

3.3.2.4 TK-K250 HRC Backup Level Switch Control Mode

Backup level switch control will operate in drain and level control. If LIC-K2501 has bad quality, then the waste sludge pumping control will change to backup level switch control. The change is alarmed and operator reset is required to return to normal LIC-K2501 level control. The waste sludge pumps speed will set at maximum speed when they are required to run in backup level control mode.

The duty waste sludge pump will start when LAH-K2504.Out is activated. The duty waste sludge pump will stop when LALL-K2503.Out is activated. The LAH-K2504 and LALL-K2503 alarm delay should be set so that if the pump starts when required, in general, the level decreases/increases below/above the switch level before an alarm is generated. LAH-K2504 and LALL-K2503 alarms will have autoreset (TBDC) for the cases when the level decreases/increases slower than normal and that the alarm delay is insufficient. Note that although the level alarm is reset automatically, the alarm will be shown in the HMI until it is acknowledged by the operator.

Table 3.3-8 YC-K2500_BackUpLvlCtrl 3.3.2.4 TK-K250 HRC Backup Level Switch Control Mode

Instance	YC-K2500_BackUpLvlCtrl		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	LIC-K2501.AlmErr	Link
Alarms	(3) Low priority		

3.3.2.5 P-K251 HRC Waste Sludge Sump Pump

Table 3.3-9 YC-K2510 / P-K251 HRC Waste Sludge Sump Pump

Instance	YC-K2510		
Class	PumpVFD (with DiscreteCS)		
Inputs	Parameter	Source	Type
	RunFbkDly	2 000 ms	Const
	CtrlRem	P-K251.Rem	I/O
	Run	P-K251.Run	I/O
	Flt	P-K251.Flt	I/O
	RdyIn	P-K251.StarterRdy	I/O
	PowerFail	TBD	I/O
	PathNotRunRdyIn	TK-K250_Drained.Out	Link
	FSL	(FI-K2542.Out < FI-K2542.AlmLoLoLmt AND XC-K2544.ConfOpn AND NOT FI-K2542.AlmErr) OR (FI-K2541.Out < FI-K2541.AlmLoLoLmt AND XC-K2543.ConfOpn AND NOT FI-K2541.AlmErr)	Link
	Intlk	LALL-K2503.Alm OR (LIT-K2501.AlmLoLo AND NOT YC-K2500_BackUpLvlCtrl.Alm) OR (LCL-K2502.AlmErr AND LIT-K2501.AlmErr) OR NOT (XC-K2543.ConfOpn OR XC-K2544.ConfOpn) OR (GBL_D800_LI-D3141_AlmHiHi AND NOT XC-K2544.ConfCls) OR TAH-K2510.Alm	Link
	CV_Max	If(YC-K2500_DrainReq, YC-K2500_DrainMaxS, 100% (TBDC))	Link
	CV_Min	TBD	Const
	RunAuto	YC-K2500_DS.Eqmt1_CmdRun	Link
	CV_In	If(YC-K2500_BackUpLvlCtrl.Alm, CV_Max, LIC-K2501.CV)	Link
	Fbk	P-K251.S	I/O
Outputs	Parameter	Destination	Type
	CmdRun	P-K251.CmdRun	I/O
	CV	P-K251.CmdS	I/O
Alarms	(1) High Priority – Call Out		

3.3.2.6 P-K252 HRC Waste Sludge Sump Pump

Similar to P-K252. See above.

3.3.2.7 YC-K2500_DS HRC Waste Sludge Sump Pump Duty Selector – P-K251 / P-K252

Table 3.3-10 YC-K2500_DS / HRC Waste Sludge Sump Pump Duty Selector – P-K251 / P-K252

Instance	YC-K2500_DS		
Class	DutyDS		
Inputs	Parameter	Source	Type
	Eqmt1_Fail	YC-K2510.Fail	Link
	Eqmt1_Rdy	YC-K2510.Rdy	Link
	Eqmt1_Running	YC-K2510.Running	Link
	Eqmt1_Auto	YC-K2510.CtrlAuto	Link
	Eqmt1_PerfDeg	(YC-K2510.Running AND LIC-K2501.Out > LIC-K2501.AlmHiHiLmt AND NOT YC-K2500_BackUpLvlCtrl.Alm) for more than 60 seconds (TBDC)	Link
	Eqmt2_Fail	YC-K2520.Fail	Link
	Eqmt2_Rdy	YC-K2520.Rdy	Link
	Eqmt2_Running	YC-K2520.Running	Link
	Eqmt2_Auto	YC-K2520.CtrlAuto	Link
	Eqmt2_PerfDeg	(YC-K2520.Running AND LIC-K2501.Out > LIC-K2501.AlmHiHiLmt AND NOT YC-K2500_BackUpLvlCtrl.Alm) for more than 60 seconds (TBDC)	Link
	RunReq	(LIC-K2501.CtrlHi AND NOT YC-K2500_BackUpLvlCtrl.Alm OR LAH-K2504.Out AND YC-K2500_BackUpLvlCtrl.Alm OR YC-K2500.EqmtRunning) AND (NOT LIC-K2501.CtrlLo AND NOT YC-K2500_BackUpLvlCtrl.Alm OR NOT LALL-K2503.Out AND YC-K2500_BackUpLvlCtrl.Alm)	Link
Alarms	Priority as per class		

3.3.2.8 TK-K250 HRC Waste Sludge Discharge

HRC waste sludge discharge will be directed to RDT or Primaries as per operator selection (YC-K2549_ToRDT).

If either RDT cell has a Hi alarm, while in RDT discharge mode, the HRC waste sludge will be automatically directed to the primaries (the operator selection does not change automatically) until the alarm is reset. Once the alarm is reset, the discharge will return to the operator selection.

Valve movements will be performed such that there is always at least one valve open i.e. a closed valve will open first and its open feedback status confirmed prior to closing the other valve.

If either RDT cell has a HiHi alarm and XV-K2544 is not closed, HRC waste sludge pumps will be interlocked.

Table 3.3-11 YC-K2549_ToRDT / HRC Waste Sludge Discharge

Instance	YC-K2549_ToRDT		
Class	OnOffSel		
Inputs	**Parameter**	**Source**	**Type**
	SelOffText	"To Primaries"	Const
	SelOnText	"To RDT"	Const
Alarms	N/A		

3.3.2.9 FQI-K2541 / HRC Waste Sludge Flow to Primary Influent Channel Totalizers

Table 3.3-12 FQI-K2541_Total / HRC Waste Sludge Flow to Primary Influent Channel Total Volume

Instance	FQI-K2541		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	FIC-K2541.Out	Link
	TimeFactor	60 (L/min assumed)	Const
	UnitConv	1 (L assumed)	Const
Alarms	-		

Table 3.3-13 FQI-K2541 / HRC Waste Sludge Flow to Primary Influent Channel Volume (Operator Resettable)

Instance	FQI-K2541		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	FIC-K2541.Out	Link
	TimeFactor	60 (L/min assumed)	Const
	UnitConv	1 (L assumed)	Const
	AccumRstEnable	1 (Enabled)	Const
Alarms	-		

Table 3.3-14 FQI-K2541_CurrDay / HRC Waste Sludge Flow to Primary Influent Channel Current Day Volume

Instance	FQI-K2541_CurrDay		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type

	PV_In	FIC-K2541.Out	Link
	TimeFactor	60 (L/min assumed)	Const
	UnitConv	1 (L assumed)	Const
	AccumAutoRst	At 8 A.M.	Link
Alarms	-		

Table 3.3-15 FQI-K2541_PrevDay / HRC Waste Sludge Flow to Primary Influent Channel Previous Day Volume

Instance	FQI-K2541_PrevDay		
Class	AnalogIAC		
Inputs	Parameter	Source	Type
	PV	Move FQI-K2541_CurrDay.Out before it is reset	Link
Alarms	-		

Table 3.3-16 FQI-K2541_CurrHour / HRC Waste Sludge Flow to Primary Influent Channel Current Hour Volume

Instance	FQI-K2541_CurrHour		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	FIC-K2541.Out	Link
	TimeFactor	60 (L/min assumed)	Const
	UnitConv	1 (L assumed)	Const
	AccumAutoRst	Beginning of hour	Link
Alarms	-		

Table 3.3-17 FQI-K2541_PrevHour / HRC Waste Sludge Flow to Primary Influent Channel Previous Hour Influent Volume

Instance	FQI-K2541_PrevHour		
Class	AnalogIAC		
Inputs	Parameter	Source	Type
	PV	Move FQI-K2541_CurrHour.Out before it is reset	Link
Alarms	-		

3.3.2.10 FQI-K2542 / HRC Waste Sludge Flow to Fermenters Totalizers

Similar to FQI-K2541. See above.

3.4 K3 – Ballast

P&ID Drawing: PPID-K301

3.4.1 S-K310 Ballast Addition System

P&ID Drawing: PPID-K301

The sand addition system uses a flow of water to entrain sand as a slurry which is then conveyed to the injection zone. The sand addition system consists of a bulk bag of sand located above a hopper and screw feeder. The sand discharges out the bottom of the bulk bag into a hopper with agitator. At the base of the hopper is a variable-speed volumetric screw feeder. The hopper has a low level switch which indicates when the hopper and bulk bag are empty. Sand is discharged from the screw feeder to the wetting cone equipped with a high level switch to alert for potential overflows. The wetted sand then flow into a venturi eductor. High pressure water passes through the eductor and entrains wetted sand to create a slurry for transport to the injection zone.

Via the HMI, the operator can select the microsand system auto mode for each HRC as either BATCH or FLOW PACED.

Sand Addition Mode

Table 3.4-1 YC-K3110_SM_HRC(1/2) / HRC (1/2) Sand Addition Mode

Instance	YC-K3110_SM_HRC(1/2)		
Class	OnOffSel		
Inputs	**Parameter**	**Source**	**Type**
	SelOffText	“Flow Paced”	Const
	SelOnText	“Batch”	Const

When an HRC is in Batch mode, the operator can request a single batch of sand to be added. The sand request is latched until the batch is executed. The execution of a batch will start as soon as the ballast addition system is available for the selected HRC (e.g. may have to wait if other train is running a cycle).

Table 3.4-2 YC-K3110_ASB_HRC(1/2) / Add Sand Batch to HRC (1/2) (Batch Mode)

Instance	YC-K3110_ASB_HRC(1/2)		
Class	OnOffSel		
Inputs	**Parameter**	**Source**	**Type**
	SelOffText	“Batch addition disabled”	Const
	SelOnText	“Add Batch of Sand to HRC(1/2)”	
	IntlkOff	NOT YC-K3110_SM_HRC(1/2).SelOut OR KQI-K3111_HRC(1/2).CtrlHi	Const

In Flow Paced mode, the PCS will automatically execute the required number of sand addition cycles to the required trains based on the operator-entered settings (see below) and the amount of water treated by each HRC train.

Table 3.4-3 YC-K3110_ASD_HRC(1/2) Add Sand Dose to HRC (1/2) (Flow Paced Mode)

Instance	YC-K3110_ASD_HRC(1/2)		
Class	DiscreteIA		
Inputs	Parameter	Source	Type
	In	(FQI-K1(1/2)02_SandDosing.CtrlHi OR YC-K3110_ASD_HRC(1/2).Out) AND NOT YC-K3110_SM_HRC(1/2).SelOut AND NOT KQI-K3111_HRC(1/2).CtrlHi	Link
Alarms	N/A		

Table 3.4-4 FQI-K1(1/2)02_SandDosing / HRC (1/2) Total Influent Volume for Sand Dosing

Instance	FQI-K1(1/2)02_SandDosing		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	FIC-K1(1/2)02.Out	Link
	CtrlHiSP	YC-K3111_ASD_HRC(1/2)_VT_Setting	Link
	TimeFactor	86400 (Ml/d assumed)	Const
	UnitConv	1 (Ml assumed)	Const
	AccumRstEnable	1 (Operator reset enabled)	Const
	ExtRst	YC-K3110_ASD_HRC(1/2) Rising edge	Link
Alarms	-		

The ballast addition system for HRC1 will run for YC-K3111_HRC1_TD [minutes] at YC-K3111_HRC1_Cm [kg/hr] mass flow. YC-K3111_HRC1_TD and YC-K3111_HRC1_Cm values will change when the Batch / Flow Paced mode is changed.

If YC-K3110_SM_HRC(1/2).SelOut Then //Batch mode

$$\text{YC-K3111\_HRC(1/2)\_Cm} := \frac{\text{YC-K3110\_ASB\_HRC(1/2)\_Mass\_Setting}}{\text{YC-K3110\_ASB\_HRC(1/2)\_TD\_Setting}} \times 60 \text{ [Kg/hr]}$$

$$\text{YC-K3111\_HRC(1/2)\_TD} := \text{YC-K3110\_ASB\_HRC(1/2)\_TD\_Setting [min]}$$

Else //Flow Paced Mode

$$\text{YC-K3111\_HRC(1/2)\_Cm} := \frac{\text{YC-K3110\_ASD\_HRC(1/2)\_DO\_Setting} \times \text{YC-K3110\_ASD\_HRC(1/2)\_VT\_Setting}}{\text{YC-K3110\_ASD\_HRC(1/2)\_TD\_Setting}} \times 60$$

[Kg/hr]

$$\text{YC-K3111\_HRC(1/2)\_TD} := \text{YC-K3110\_ASD\_HRC(1/2)\_TD\_Setting [min]}$$

Endif

YC-K3111_ASB_HRC(1/2)_Mass_Setting in Kg is the batch mass to deliver in YC-K3111_ASB_HRC(1/2)_TD_Setting in minutes.

YC-K3111_ASD_HRC(1/2)_DO_Setting in g/m^3 is the dosing to be delivered in flow passed mode. The sand addition cycle is initiated every YC-K3111_ASD_HRC(1/2)_VT_Setting in Ml of treated water. The calculated sand mass is delivered in YC-K3111_ASD_HRC(1/2)_TD_Setting in minutes.

All the previous settings are real numbers that can be modified by the operator with security level M or higher. As always, the operator HMI setpoints should be range checked before being used.

YC-K3111_ASB_HRC(1/2)_TD_Setting should be continually High limited in the PLC to the minimum dosing screw speed (5% (TBDC)):

Maximum Batch Time:

$$\frac{\text{YC-K3111\_ASB\_HRC(1/2)\_Mass\_Setting}}{\frac{(5-20)\times(\text{YC-K3120.Q80}-\text{YC-K3120.Q20})}{60}+\text{YC-K3120.Q20}}\times 60\ [\text{min}]$$

YC-K3111_ASB_HRC(1/2)_TD_Setting should be continually low limited in the PLC to the maximum dosing screw speed (100% (TBDC)):

Minimum Batch Time:

$$\frac{\text{YC-K3111\_ASB\_HRC(1/2)\_Mass\_Setting}}{\frac{(100-20)\times(\text{YC-K3120.Q80}-\text{YC-K3120.Q20})}{60}+\text{YC-K3120.Q20}}\times 60\ [\text{min}]$$

YC-K3111_ASD_HRC(1/2)_TD_Setting should be continually High limited in the PLC to the minimum dosing screw speed (5% (TBDC)):

Maximum Flow Paced Time:

$$\frac{\text{YC-K3110\_ASD\_HRC(1/2)\_DO\_Setting}\times\text{YC-K3110\_ASD\_HRC(1/2)\_VT\_Setting}}{\frac{(5-20)\times(\text{YC-K3120.Q80}-\text{YC-K3120.Q20})}{60}+\text{YC-K3120.Q20}}\times 60\ [\text{min}]$$

YC-K3111_ASD_HRC(1/2)_TD_Setting should be continually low limited in the PLC to the maximum dosing screw speed (100% (TBDC)):

Minimum Flow Paced Time:

$$\frac{\text{YC-K3110\_ASD\_HRC(1/2)\_DO\_Setting}\times\text{YC-K3110\_ASD\_HRC(1/2)\_VT\_Setting}}{\frac{(100-20)\times(\text{YC-K3120.Q80}-\text{YC-K3120.Q20})}{60}+\text{YC-K3120.Q20}}\times 60\ [\text{min}]$$

If the low or high limits are exceed in the PLC, YC-K3111_ASB_HRC(1/2)_TD_Setting or YC-K3111_ASD_HRC(1/2)_TD_Setting should be automatically changed and alarm priority 3 should be generated in the HMI.

The HMI should not let the operator enter a YC-K3111_ASB_HRC(1/2)_TD_Setting or YC-K3111_ASD_HRC(1/2)_TD_Setting value outside the current limits defined above.

Table 3.4-5 FQI-K3120_HRC(1/2) / HRC (1/2) Accumulated Sand Mass (Operator Resettable)

Instance	FQI-K3120_HRC(1/2)		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	If(YC-K3111_HRC(1/2).Running,YC-K3120.Q_Fbk,0)	Link
	TimeFactor	3600 ([kg/hr] assumed)	Const
	UnitConv	1 (Kg assumed)	Const
	AccumRstEnable	True (Operator reset enabled)	Const
Alarms	N/A		

Table 3.4-6 FQI-K3120_HRC(1/2)_CurrDay / HRC (1/2) Current Day Sand Mass

Instance	FQI-K3120_HRC(1/2)_CurrDay		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	If(YC-K3111_HRC(1/2).Running,YC-K3120.Q_Fbk,0)	Link
	TimeFactor	3600 ([kg/hr] assumed)	Const
	UnitConv	1 (Kg assumed)	Const
	ExtRst	8 A.M.	Const
Alarms	N/A		

Table 3.4-7 FQI-K3120_HRC(1/2)_PrevDay / HRC (1/2) Previous Day Sand Mass

Instance	FQI-K3120_HRC(1/2)_PrevDay		
Class	AnalogIAC		
Inputs	Parameter	Source	Type
	PV	Move FQI-K3120_HRC(1/2)_CurrDay.Out before it is reset	I/O
Alarms	N/A		

3.4.1.1 YC-K3111_HRC1 / Ballast Addition to HRC 1

YC-K3111_HRC1 runs the motors and valves of the ballast addition system to add sand to HRC 1. To run the ballast addition system:

- Except for the agitator, all its components need to be ready in auto with no errors
- no pressure or level alarms present or with errors,

- One HRC sand slurry valve should be ready or open with no error. The other HRC sand slurry valve should be closed.

In auto, the ballast addition system for HRC1 will run for YC-K3111_HRC1_TD [minutes] at YC-K3111_HRC1_Cm [kg/hr] mass flow. YC-K3111_HRC1_TD and YC-K3111_HRC1_Cm values will change when the Batch / Flow Paced mode is changed.

Table 3.4-8 KQI-K3111_HRC1 / HRC 1 Ballast Addition Time [min] (Operator Resettable)

Instance	KQI-K3111_HRC1		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	If(YC-K3111_HRC1.Running,1,0)	Link
	TimeFactor	60 (Accumulates minutes)	Const
	UnitConv	1	Const
	CtrlHiSP	YC-K3111_HRC1_FD	Const
	AccumRstEnable	1 (Operator reset enabled)	Const
	ExtRst	NOT (YC-K3110_ASB_HRC1.SelOut OR YC-K3110_ASD_HRC1.Out)	Link
Alarms	N/A		

Table 3.4-9 YC-K3111_HRC1 / Ballast Addition to HRC 1

Instance	YC-K3111_HRC1		
Class	DiscreteCS		
Inputs	Parameter	Source	Type
	RunFbkDly	2 000 ms	Const
	Flt	YC-K3120.AlmFlt OR YC-K3120.AlmErr OR XC-K3105.AlmFlt OR XC-K3105.AlmErr OR XC-K3106.AlmFlt OR XC-K3106.AlmErr OR XC-K1121.AlmErr OR XC-K1221.AlmErr OR LAL-K3101.AlmErr OR LAH-K3102.AlmErr OR PAL-K3103.AlmErr OR HA-K3108.AlmErr	Link
	RdyIn	YC-K3120.Rdy AND XC-K3105.Rdy AND XC-K3106.Rdy AND (XC-K1121.Rdy OR XC-K1121.ConfOpn) AND XC-K1221.ConfCls	Link
	PathNotRunRdyIn	NOT (XC-K1121.ConfOpn AND XC-K1221.ConfCls)	Link
	Run	YC-K3120.Running AND XC-K3105.CmdOpn AND XC-K3106.CmdOpn AND XC-K1121.ConfOpn	Link
	Intlk	LAL-K3101.Alm OR LAH-K3102.Alm OR	Link

		PAL-K3103.Alm OR HA-K3108.Alm	
	RunAuto	(YC-K3110_ASB_HRC1 OR YC-K3110_ASD_HRC1) AND NOT ((YC-K3111_HRC2.CmdRun) Off delay of 1 second (TBDC)) AND NOT YC-K3112_HRC2.CmdRun	Link
Alarms	Priority as per class		

3.4.1.2 YC-K3111_HRC2 / Ballast Addition to HRC 2

Similar to HRC1

3.4.1.3 Ballast Addition System Dosing Screw

Table 3.4-10 YC-K3120 / FDR-K312 S-K312 Ballast Addition System Dosing Screw

Instance	YC-K3120		
Class	DosingPump		
Inputs	Parameter	Source	Type
	CtrlRem	FDR-K312.Rem	I/O
	Run	FDR-K312.Run	I/O
	Flt	FDR-K312.Flt	I/O
	RdyIn	FDR-K312.StarterRdy	I/O
	Intlk	HA-K3108.Alm OR HA-K3108.AlmErr OR LAL-K3101.Alm OR LAH-K3102.Alm OR PAL-K3103	Link
	PathNotRunRdyIn	NOT (XV-K1121.ConfOpn OR XC-K1221ConfOpn) OR NOT XC-K3105.CmdOpn OR NOT XC-K3106.CmdOpn	Link
	RunAuto	YC-K3111_HRC1.CmdRun OR YC-K3111_HRC2.CmdRun	Link
	Q_AutoReq	If(XC-K1121.ConfOpn, YC-K3111_HRC1_Cm, If(XC-K1221.ConfOpn, YC-K3111_HRC2_Cm, 0))	Link
	Fbk	FDR-K310.S	I/O
	CV_Min	5% (TBDC)	Const
	CV_Max	100%	Const
	Q20	YC-K3120_Q20_Setting [kg/h]	Const
	Q80	YC-K3120_Q80_Setting [kg/h]	Const
	FQ_K	1/(60*60) [for Q in kg/hr and FQ in kg]	Const
Outputs	Parameter	Destination	Type

	CmdRun	FDR-K310.CmdRun	I/O
	CV	FDR-K310.CmdS	I/O
Alarms	(1) – Emergency / Call Out Priority		

YC-K3120_Q20_Setting and YC-K3120_Q80_Setting are real numbers in kg/h can be modified by the operator with security level M or higher. As always, the operator HMI setpoints should be range checked before being used.

3.4.2 Ballast Addition System Flushing

The ballast addition system is flushed running clean water through the sand slurry piping in order to flush the line of any residual sand to prevent blockages. To flush the ballast addition system:

- output valve should not have an open command,
- no wetting cone high level or with errors,
- no service water low pressure or with errors,
- One HRC sand slurry valve should be ready or open with no error. The other HRC sand slurry valve should be closed.

In Auto, the flushing required bit is latched when the ballast addition system is running. The flushing starts after ballast addition stops and runs for YC-K3112_FD_Setting [minutes] (retentive timer).

YC-K3112_FD_Setting can be modified by the operator with security level M or higher. As always, the operator HMI setpoints should be range checked before being used.

YC-K3112_HRC(1/2)_Req is set by YC-K3111_HRC(1/2).Running and reset by KQI-K3112_HRC1.CtrlHi

3.4.2.1 Ballast Addition to HRC 1 Flushing

Table 3.4-11 KQI-K3112_HRC1 / HRC 1 Ballast Addition line Flushing Time [min] (Operator Resettable)

Instance	KQI-K3112_HRC1		
Class	AccumulatorIAC		
Inputs	Parameter	Source	Type
	PV_In	If(YC-K3112_HRC1.Running,1,0)	Link
	TimeFactor	60 (Accumulates minutes)	Const
	UnitConv	1	Const
	CtrlHiSP	YC-K3112_FD_Setting	Const
	AccumRstEnable	1 (Operator reset enabled)	Const
	ExtRst	YC-K3111_HRC1.Running OR NOT YC-K3112_HRC1_Req	Link
Alarms	N/A		

Table 3.4-12 YC-K3112_HRC1 / S-K310 Ballast Addition To HRC 1 Flushing

Instance	YC-K3112_HRC1		
Class	DiscreteCS		
Inputs	Parameter	Source	Type
	RunFbkDly	TBDC	Const
	Flt	HA-K3108.AlmErr OR LAH-K3102.AlmErr	Link
	RdyIn	XC-K3105.Rdy AND NOT XC-K3106.CmdOpn	Link
	Run	XC-K3105.CmdOpn AND NOT YC-K3120.Running AND NOT XC-K3106.CmdOpn	Link
	Intlk	HA-K3108.Alm OR LAH-K3102.Alm OR PAL-K3103.Alm	Link
	PathNotRunRdyIn	XC-K1121.ConfOpn AND XC-K1221.ConfCls	Link
	RunAuto		Link
Alarms	Priority as per class		

3.4.2.2 Ballast Addition to HRC 2 Flushing

Similar to HRC1

3.5 HRC Train Reset

Each HRC Train will have a Train Reset PB in the HMI to reset all train Alarms. This is in addition to the Area K Reset PB which resets all the alarms in the area.