



TRANSNET NATIONAL PORTS AUTHORITY



Haw & Inglis Civil Engineering (Pty)



Robinson Dry Dock Dewatering System Upgrade Control Philosophy

P07551-ELE-REP-001

April 2022

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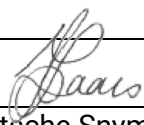
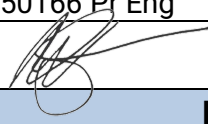
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ROBINSON DRY DOCK UPGRADE

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1 CONTROL NARRATIVE

The process and instrumentation diagrams (P&ID), drawings P07551-E-PI-002 and PI07551-E-PI-003 and the Proposed Control Philosophy Routine Flow charts (Annexure A), should be read in conjunction with this Control Narrative. The list of routines are as follow:

Routine Code	Routine Name
R1	DEWATERING FAST ROUTINE
R2	DEWATERING SLOW ROUTINE
R3	DEWATERING STOP ROUTINE
R4	DRAINAGE PUMP ROUTINE
R5	FILLING PENSTOCK 1 ROUTINE
R6	FILLING PENSTOCK 2 ROUTINE
R7	DRAINAGE PENSTOCK CLOSE ROUTINE
R8	DRAINAGE PENSTOCK OPEN ROUTINE
R9	SEEPAGE PUMP ROUTINE
R10	PUMP HOUSE E-STOP ROUTINE
SR1	DEWATERING PUMP SELECTION SUBROUTINE
SR2	DRAINAGE PUMP SELECTION SUBROUTINE
SR3	PUMP PROTECTION SUBROUTINE

1.1 Dewatering

The dewatering procedure in the dry dock shall be achieved by automatic operation but initiated by the pump operator upon instruction from the Dock Master, refer to flow diagram for routine R1 and R2.

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The drainage penstock is opened automatically to flood the drainage culverts. When the penstock is fully opened and after a short time delay, the duty Dewatering Pump is started. Selection of the duty Dewatering Pump will be automatic based on the pump availability and total running hours, refer to flow diagram for subroutine SR1.

Dewatering of the dry dock is done for two reasons:

- a) When a new ship has entered the dry dock
- b) When preparing the blocks at dock bottom for a new ship's arrival

For (b) above, dewatering can happen at the highest rate. (Routine R1)

For (a) above, the dewatering process shall include limiting the flow rates by means of slowing down the pumps using VFCs by initiating the *"Dewatering Slow"* command (Routine R2), as the water level approaches the blocks. Pumps shall be stopped just before ships settle on the blocks by initiating the *"Dewatering Stop"* command (Routine R3), for divers to inspect the ship's keel. The Dock Master determines when pumps are stopped or started, but all start up and shut down procedures shall be automatically achieved. The Dewatering Pumps shut down when reaching the pre-set low level.

The duty Drainage Pumps (Subroutine SR2) will start up automatically after the duty Dewatering Pump but will continue after the Dewatering Pump has stopped to clear the drainage culverts and drainage suction sump, until the level in the drainage sump reaches the low level setpoint. The Drainage Pump will maintain the drainage suction sump at the pre-set level, refer to flow diagram for routine R4.

The Dock Master will have the further option to control the rate of dewatering by partially opening either or both filling penstock valves to the required opening position, refer to flow diagram for routine R5 and R6. This will achieve slower dewatering rates than what is allowed for by the Dewatering Pump minimum speed under the Dewatering Slow Routine R2.

The dock shall be emptied in about 4 hours, depending on level of the ocean.

The dewatering process shall be controllable from both the SCADA at the Dock Master's office, the control panel inside the pump station, the control panel at the MCC room and the rugged mobile tablets.

For both Dewatering and Drainage Pumps, the actuated delivery valve shall be opened automatically when the pump is started and closed again when the pump is stopped. Duty rotation of the pumps shall be done automatically by the PLC based on run hours (SR1 and SR2).

The drainage penstock is left opened after the dewatering process for ongoing draining of the dry dock. The drainage penstock can be open and closed at will, refer to flow diagrams for routine R7 and R8.

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1.1.1 Emergency stop

Each dewatering pump will have an emergency stop located on the VSD panels. These will activate a pump stop by initiating a ramp down and shut down via the VSD as well as initiate close signal to the affected actuated valve.

Each drainage pump and the seepage pump will have an emergency stop located on the MCC panel. These will initiate a shunt trip of the particular pump circuit breaker, and in the case of the drainage pumps close the particular pump delivery valve.

Three emergency stop buttons will be located in the pump house, all three will have the same function of stopping the complete plant (excluding the seepage system). The dewatering and drainage pumps will be stopped by initiating a hard-wired shunt trip via a safety relay to all four circuit breakers and PLC. All four pump delivery valves will be closed via the PLC. The seepage system will be unaffected by these emergency stops. Refer to routine R10.

1.1.2 Control Modules

Control modules correspond to a specific device in the field. Refer to I/O list (Annexure C) for control modules and tag numbers.

1.1.3 Interlocks

Main Dewatering Pumps P01 and P02:

Type	Interlock	Description	Inhibit
Protection	Motor winding temp. (R, W, B)	Motor winding temperature above cut out value	No
Protection	Motor bearing temp. (DE, NDE)	Motor bearing temperature above cut out value	No
Protection	Motor bearing vibration (DE, NDE)	Motor bearing vibration above cut out level	No
Protection	Water/Oil ingress	Oil or water ingress float switch	No
Protection	Moisture in motor	Moisture sensor/s in motor housing active	No
Protection	Sump water level below start level	Sump level below minimum pump start level	Yes
Protection	Pump delivery pressure sensor	Pressure above max set level	No

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Start/run	Pump house emergency stop	E-stop is active	No
Start/run	Duty/standby pump is running	Prevent both pumps to run at the same time	No

Drainage Pumps P03 and P04:

Type	Interlock	Description	Inhibit
Protection	Motor case temp.	Motor winding temperature above cut out value	No
Protection	Motor bearing temp. (DE, NDE)	Motor bearing temperature above cut out value	No
Protection	Pump bearing temp (DE)	Pump bearing temperature above cut out value	No
Protection	Motor bearing vibration (DE, NDE)	Motor bearing vibration above cut out level	No
Protection	Pump bearing vibration (DE)	Pump bearing vibration above cut out level	No
Protection	Water/Oil ingress	Oil or water ingress float switch	No
Protection	Sump water level below start level	Sump level below minimum pump start level	Yes
Protection	Pump delivery pressure sensor	Pressure above max set level	No
Start/run	Pump house emergency stop	E-stop is active	No

1.2 Flooding

The filling of the dock can happen for two reasons, namely:

- When the dock needs to be filled to bring a vessel in
- When the dock needs to be filled after a vessel has been repaired.

For (a), it is important to not flood the dock too fast or blocks at the dock bottom could be washed away. For (b), the flooding needs to slow down when the vessels just start floating to allow for internal leak inspections inside the ship.

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The flooding procedure in the dry dock shall be achieved by automatic operation but initiated by the Dock Master, the two filling penstock valves will be independently controlled, refer to flow diagram for routine R5 and R6.

Opening of the two penstock valves shall be controlled by the Dock Master in pre-set steps to enable slow flow into the dry dock initially, but the rate of opening the penstock shall increase once the blocks are submerged and/or the ships floating. The filling rate shall therefore be determined by the Dock Master.

1.2.1 Control Modules

Control modules correspond to a specific device in the field. Refer to I/O list (Annexure C) for control modules and tag numbers.

1.2.2 Interlocks

Penstock Valves VF-01, VF02, VS-01:

No interlocks.

1.3 Seepage

The Seepage Pump shall start automatically on high level inside the pump stations seepage sump and stop automatically on low level, refer to flow diagram for routine R9.

A higher level shall raise an alarm.

1.3.1 Control Modules

Control modules correspond to a specific device in the field. Refer to I/O list (Annexure C) for control modules and tag numbers.

1.3.2 Interlocks

Seepage Pump P05:

Type	Interlock	Description	Inhibit
Protection	Thermal switch	Cut out switch on overheat	No
Protection	Moisture sensor	Cut out on moisture in motor	No
Protection	Seepage Sump water level below start level	Sump level below minimum pump start level	Yes
Protection	Pump delivery pressure sensor	Pressure above max set level	No



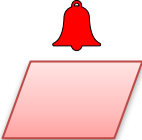
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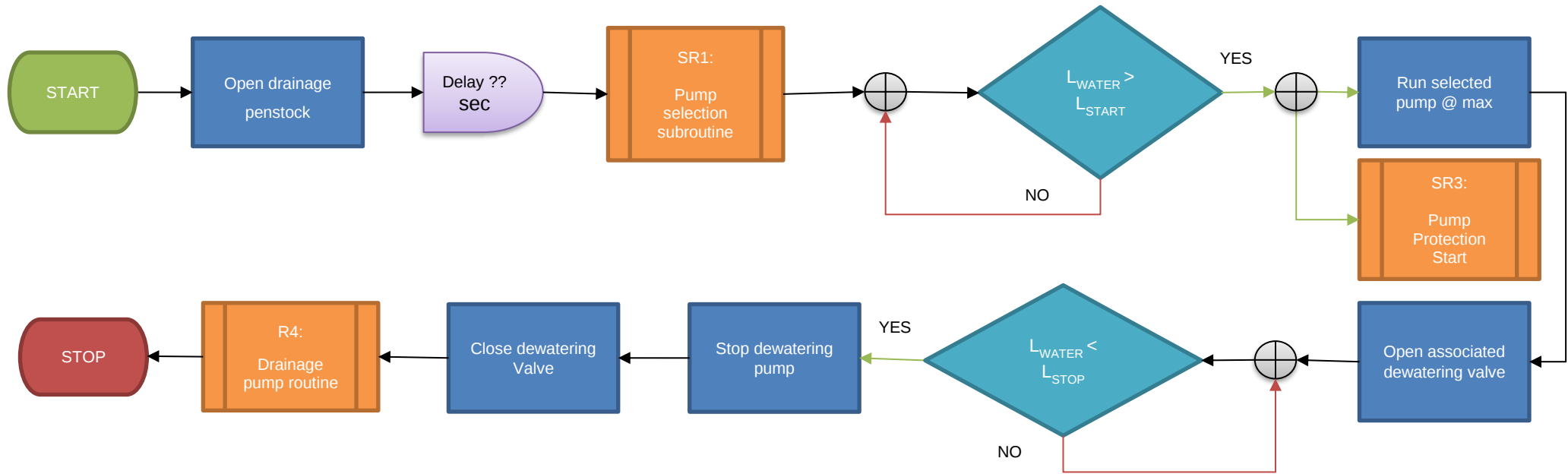
**Robinson Dry Dock Dewatering System Upgrade
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ANNEXURE A: FLOW CHARTS

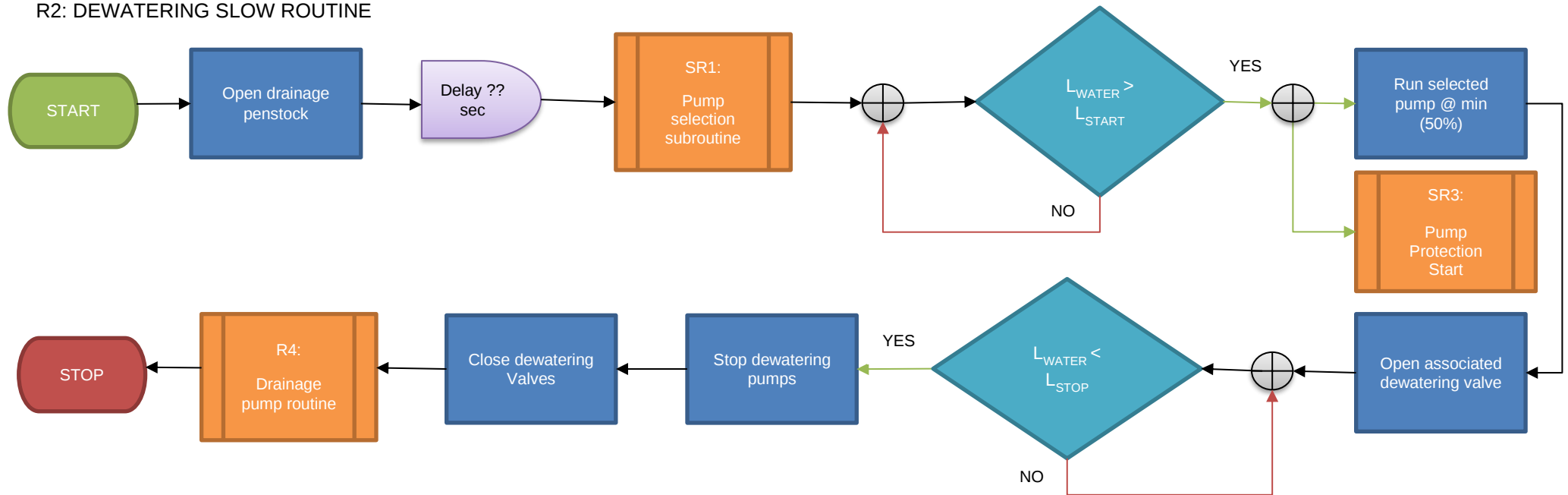
Legend

Icon	Description
	Start or Stop Process
	Process
	Predefined Process
	Decision
	Or
	Warning Message
	Data
	Delay
	Normal Sequence
	Decision: Yes
	Decision: No

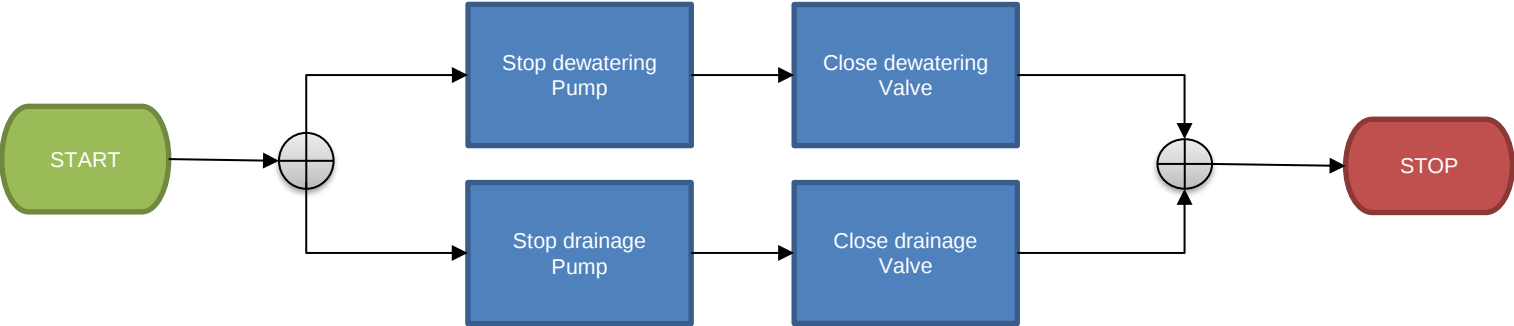
R1: DEWATERING FAST ROUTINE



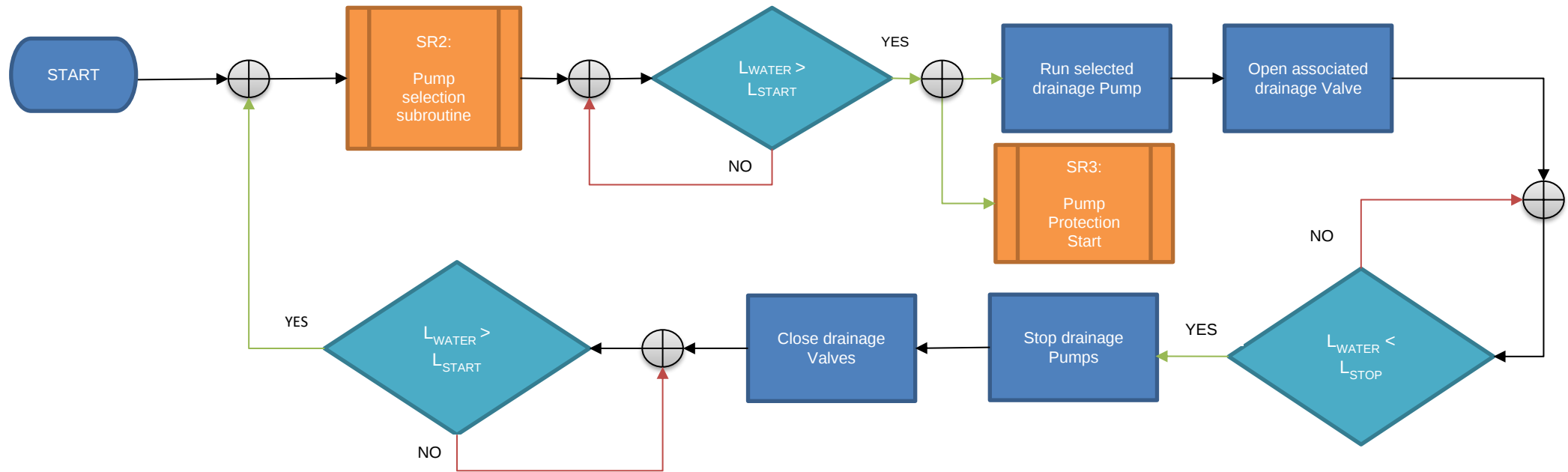
R2: DEWATERING SLOW ROUTINE



R3: DEWATERING STOP ROUTINE

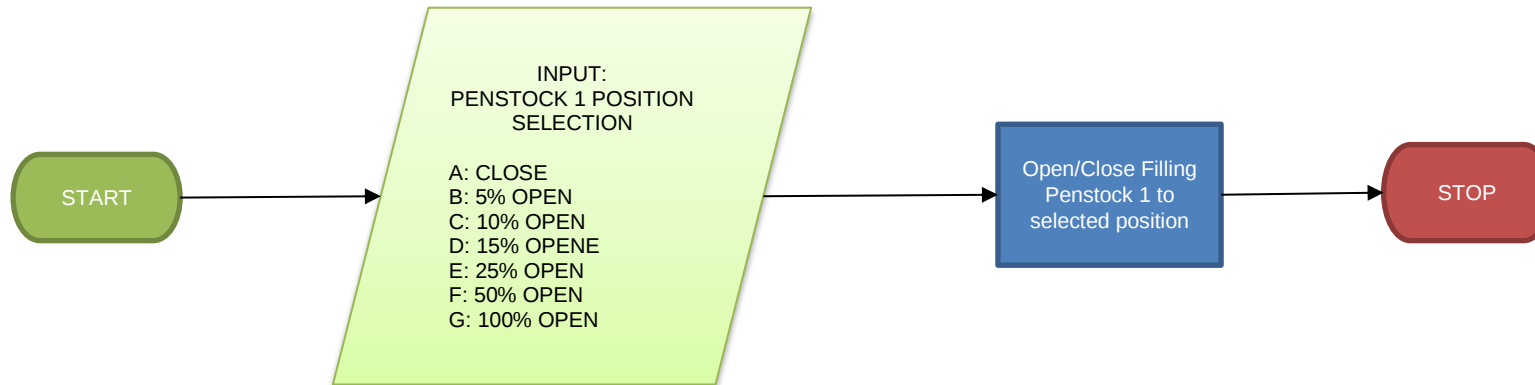


R4: DRAINAGE PUMP ROUTINE

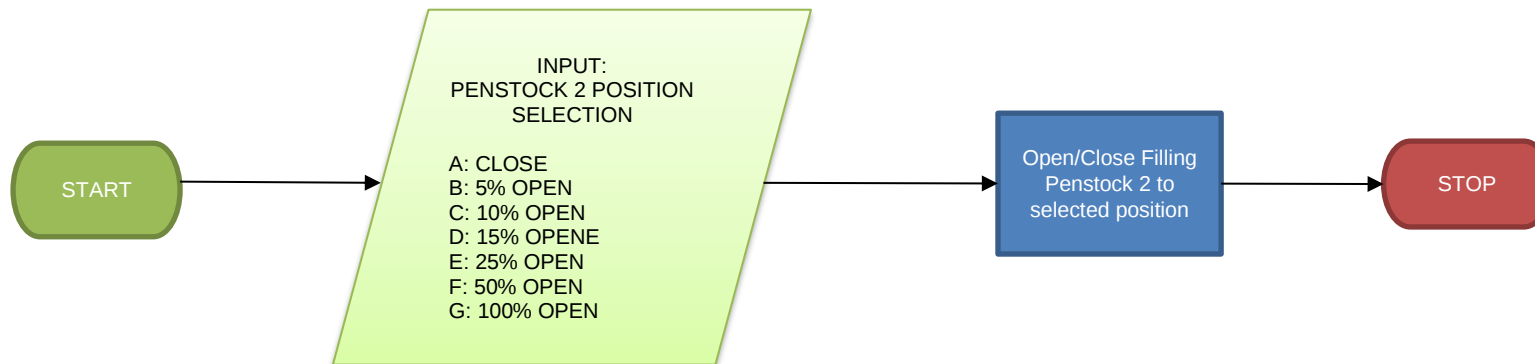


Note 1: This routine is stopped by R3

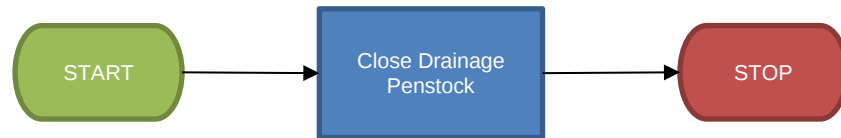
R5: FILLING PENSTOCK 1 ROUTINE



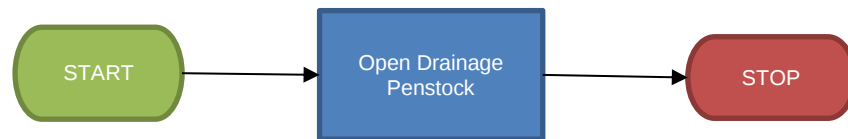
R6: FILLING PENSTOCK 2 ROUTINE



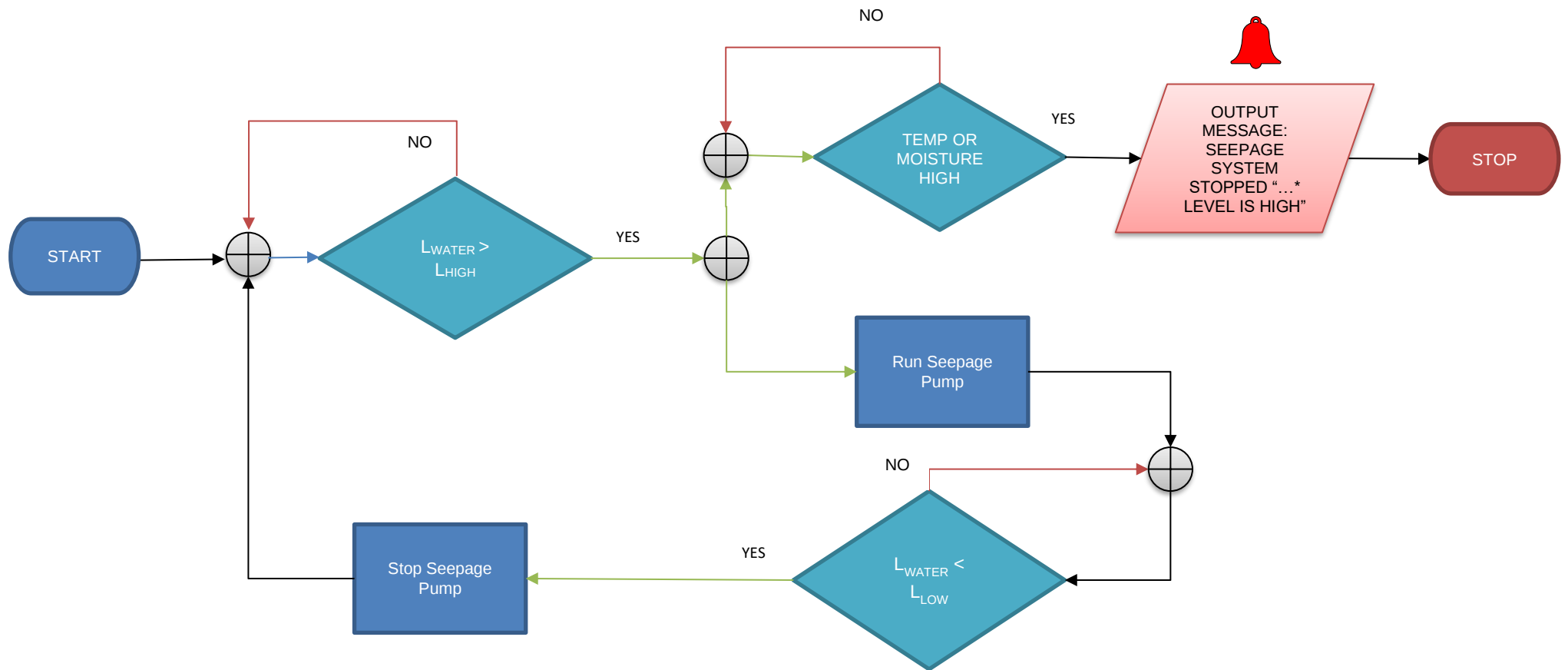
R7: DRAINAGE PENSTOCK CLOSE
ROUTINE



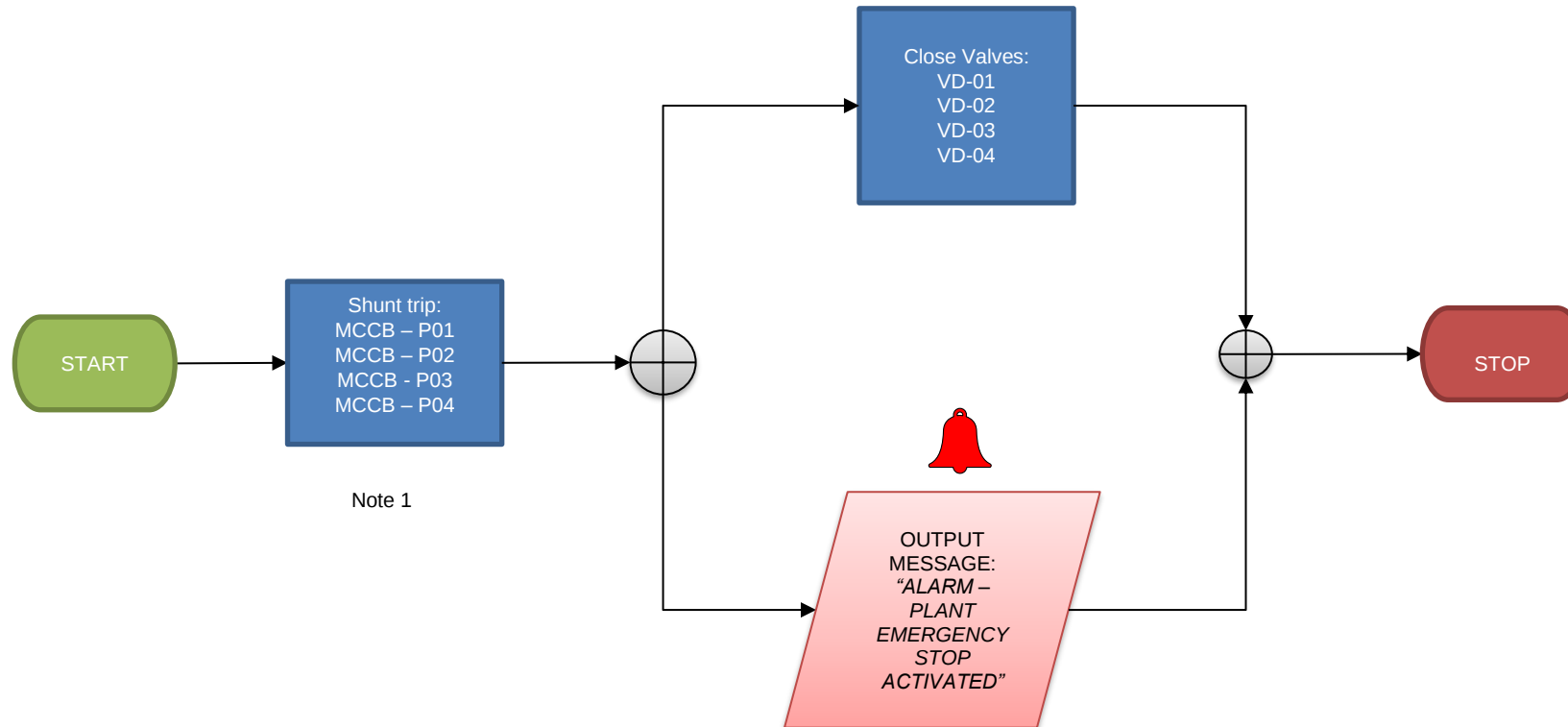
R8: DRAINAGE PENSTOCK OPEN
ROUTINE



R9: SEEPAGE PUMP ROUTINE

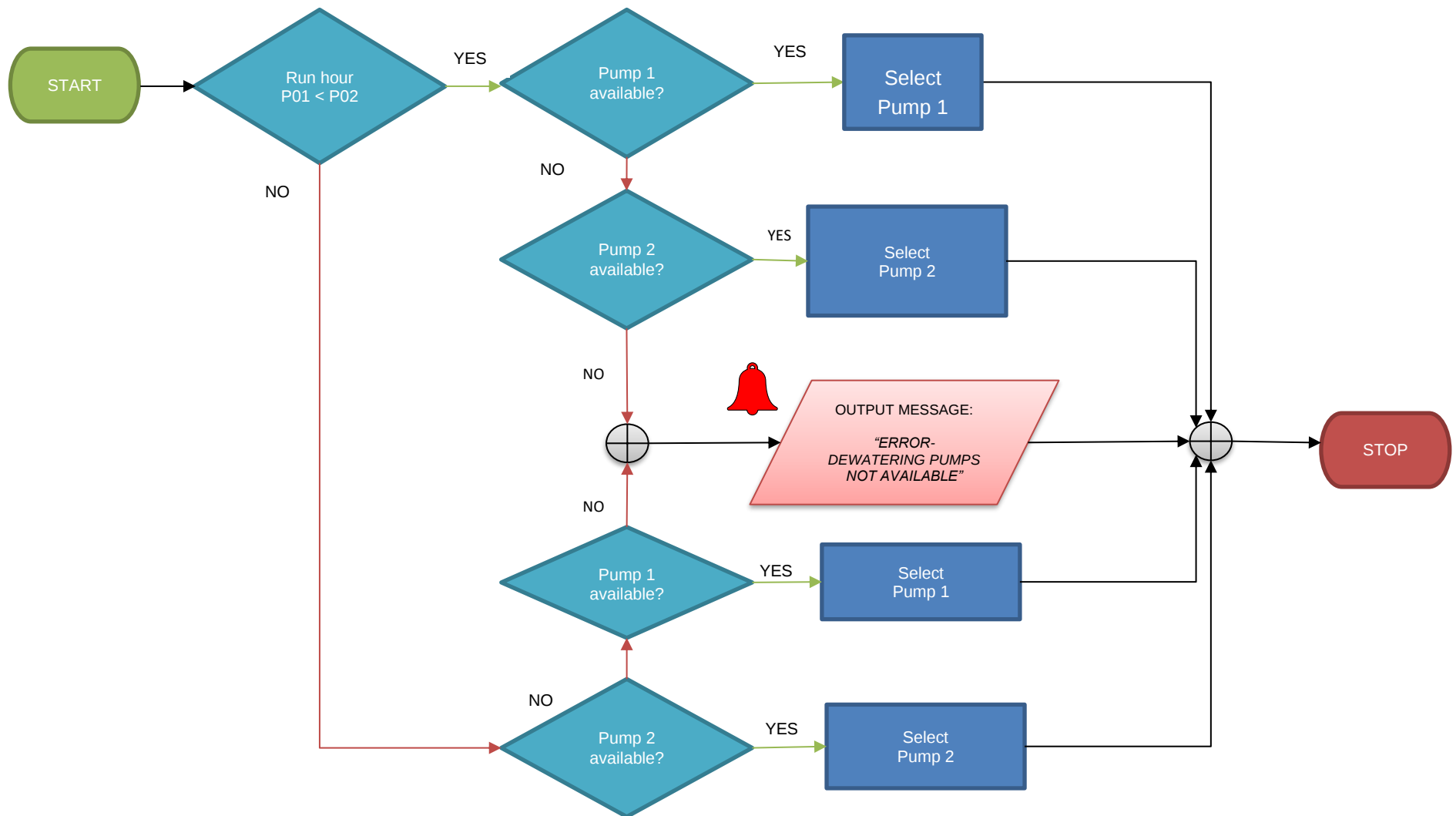


R10: PUMP HOUSE E-STOP ROUTINE

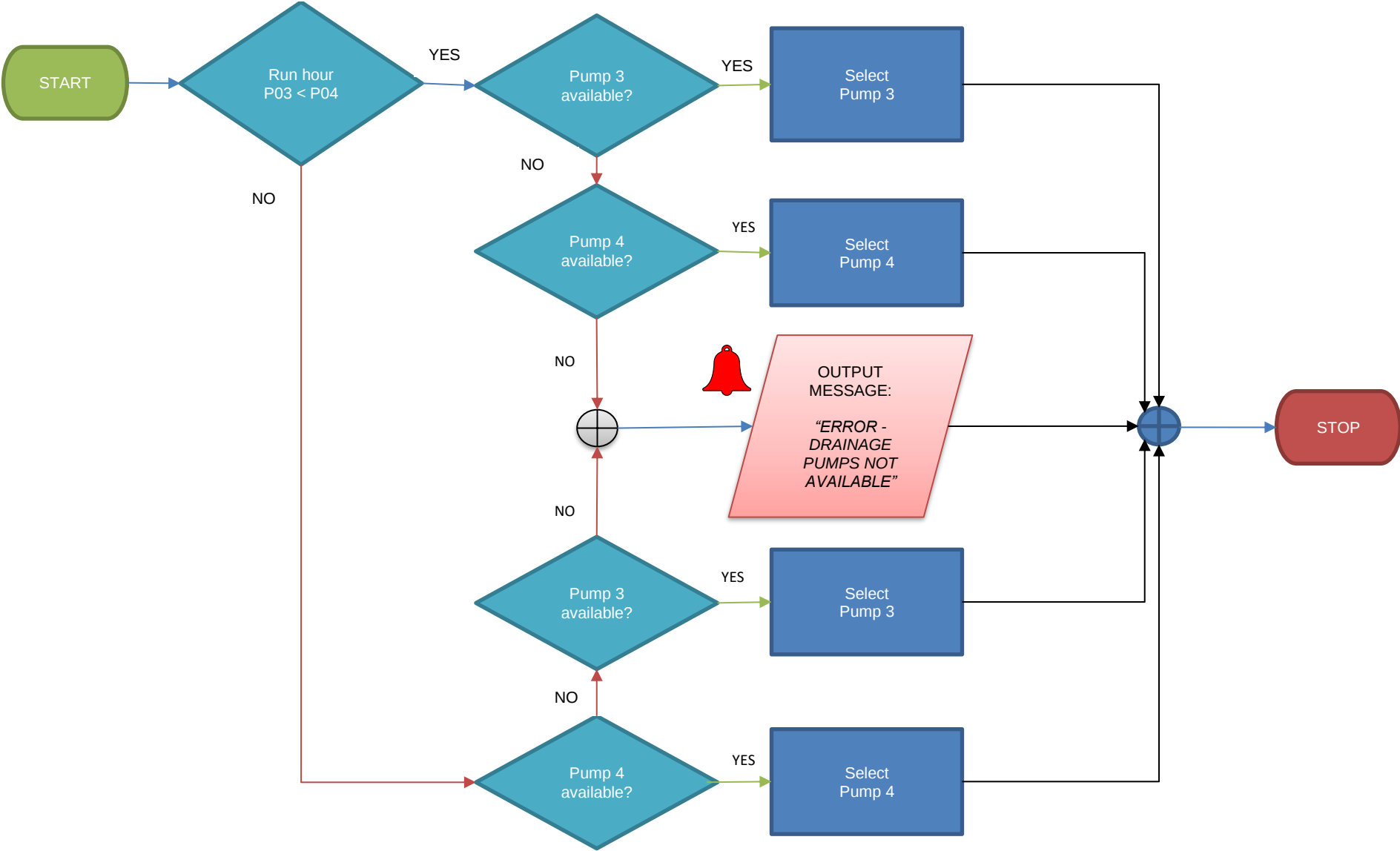


Note 1: Seepage system unaffected by e-stop activation

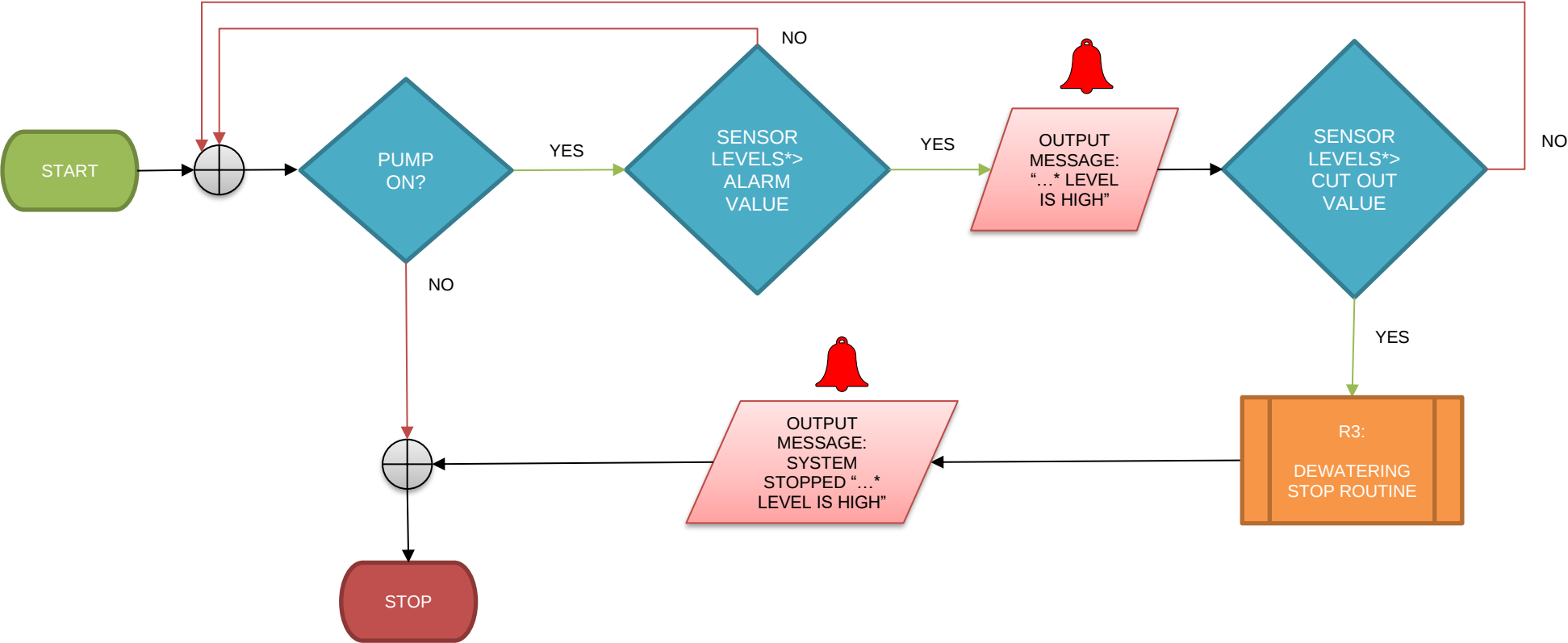
SR1: DEWATERING PUMP SELECTION SUBROUTINE



SR2: DRAINAGE PUMP SELECTION SUBROUTINE



SR3: PUMP PROTECTION SUBROUTINE



ANNEXURE B: CONTROL PARAMETERS

Tag No	Description	Set Point/s	Alarm Value	Cut Out Value
CTRR-PH-LIT-01	Dewatering Suction Chamber Level Transmitter	Low level stop -8.00m	N/A	N/A
CTRR-PH-LSH-03	Dewatering Suction Chamber Level Switch High	-8.10m	N/A	N/A
CTRR-PH-LSH-06	Seepage Sump Level Switch High	-3.30m	N/A	N/A
CTRR-PH-LSHH-02	Dewatering Suction Chamber Level Switch High High	-8.00m	N/A	N/A
CTRR-PH-LSHH-07	Seepage Sump Level Switch High High	-3.20m	N/A	N/A
CTRR-PH-LSL-04	Dewatering Suction Chamber Level Switch Low	-9.20m	N/A	N/A
CTRR-PH-LSL-05	Seepage Sump Level Switch Low	-3.8m	N/A	N/A
CTRR-PH-PIT-05	Pump 1 Delivery Pressure Transmitter	N/A	kPA	kPA
CTRR-PH-PIT-06	Pump 2 Delivery Pressure Transmitter	N/A	kPA	kPA
CTRR-PH-PIT-03	Pump 3 Delivery Pressure Transmitter	N/A	kPA	kPA
CTRR-PH-PIT-04	Pump 4 Delivery Pressure Transmitter	N/A	kPA	kPA
CTRR-PH-PIT-07	Pump 5 Delivery Pressure Transmitter	N/A	kPA	kPA
CTRR-PH-TE-01	Pump 1 Motor Bearing DE Temperature Element	N/A	°C	°C
CTRR-PH-TE-02	Pump 1 Motor Bearing NDE Temperature Element	N/A	°C	°C
CTRR-PH-TE-03	Pump 1 Motor Red Winding Temperature Element	N/A	°C	°C
CTRR-PH-TE-04	Pump 1 Motor White Winding Temperature Element	N/A	°C	°C
CTRR-PH-TE-05	Pump 1 Motor Blue Winding Temperature Element	N/A	°C	°C
CTRR-PH-TE-06	Pump 2 Motor Bearing DE Temperature Element	N/A	°C	°C
CTRR-PH-TE-07	Pump 2 Motor Bearing NDE Temperature Element	N/A	°C	°C
CTRR-PH-TE-08	Pump 2 Motor Red Winding Temperature Element	N/A	°C	°C
CTRR-PH-TE-09	Pump 2 Motor White Winding Temperature Element	N/A	°C	°C
CTRR-PH-TE-10	Pump 2 Motor Blue Winding Temperature Element	N/A	°C	°C
CTRR-PH-TE-11	Pump 3 Motor Case temperature Element	N/A	°C	°C
CTRR-PH-TE-12	Pump 3 Motor Bearing DE Temperature Element	N/A	°C	°C
CTRR-PH-TE-13	Pump 3 Motor Bearing NDE Temperature Element	N/A	°C	°C
CTRR-PH-TE-14	Pump 3 Pump Thrust Bearing DE Temperature Element	N/A	°C	°C
CTRR-PH-TE-15	Pump 4 Motor Case temperature Element	N/A	°C	°C
CTRR-PH-TE-16	Pump 4 Motor Bearing DE Temperature Element	N/A	°C	°C
CTRR-PH-TE-17	Pump 4 Motor Bearing NDE Temperature Element	N/A	°C	°C
CTRR-PH-TE-18	Pump 4 Pump Bearing DE Temperature Element	N/A	°C	°C
CTRR-PH-VE-01	Pump 1 Motor Bearing NDE Vibration Element	N/A	mm/sec.	mm/sec
CTRR-PH-VE-02	Pump 1 Motor Bearing DE Vibration Element	N/A	mm/sec.	mm/sec
CTRR-PH-VE-03	Pump 2 Motor Bearing NDE Vibration Element	N/A	mm/sec.	mm/sec
CTRR-PH-VE-04	Pump 2 Motor Bearing DE Vibration Element	N/A	mm/sec.	mm/sec
CTRR-PH-VE-05	Pump 3 Motor Bearing NDE Vibration Element	N/A	mm/sec.	mm/sec
CTRR-PH-VE-06	Pump 3 Motor Bearing DE Vibration Element	N/A	mm/sec.	mm/sec
CTRR-PH-VE-07	Pump 3 Pump Bearing DE Vibration Element	N/A	mm/sec.	mm/sec
CTRR-PH-VE-08	Pump 4 Motor Bearing NDE Vibration Element	N/A	mm/sec.	mm/sec
CTRR-PH-VE-09	Pump 4 Motor Bearing DE Vibration Element	N/A	mm/sec.	mm/sec
CTRR-PH-VE-10	Pump 4 Pump Bearing DE Vibration Element	N/A	mm/sec.	mm/sec
CTRR-PH-VT-01	Pump 1 & 2 Vibration Analyser & Transmitter	N/A	N/A	N/A
CTRR-PH-VT-02	Pump 3 & 4 Vibration Analyser & Transmitter	N/A	N/A	N/A
CTRR-PH-TS-01	Seepage Pump 5 Thermal Switch	N/A DI	N/A DI	N/A DI
CTRR-PH-AES-01	Pump 1 Water in Oil Sensor / float switch	N/A DI	N/A DI	N/A DI
CTRR-PH-AES-02	Pump 1 Moisture Sensor	N/A DI	N/A DI	N/A DI
CTRR-PH-AES-03	Pump 2 Water in Oil Sensor / float switch	N/A DI	N/A DI	N/A DI

CTRR-PH-AES-04	Pump 2 Moisture Sensor	N/A DI	N/A DI	N/A DI
CTRR-PH-AES-05	Seepage Pump 5 Moisture Sensor	N/A DI	N/A DI	N/A DI
CTRR-PH-ES-01	Pump House E/Stop 1 - Pump House	N/A DI	N/A DI	N/A DI
CTRR-PH-ES-02	Pump House E/Stop 2 - Pump House	N/A DI	N/A DI	N/A DI
CTRR-PH-ES-03	Pump House E/Stop 3 - RIO Room	N/A DI	N/A DI	N/A DI

ANNEXURE C: I/O LIST