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System Logic Description for Pretreatment Facility - Waste Feed Evaporation Process (FEP) System

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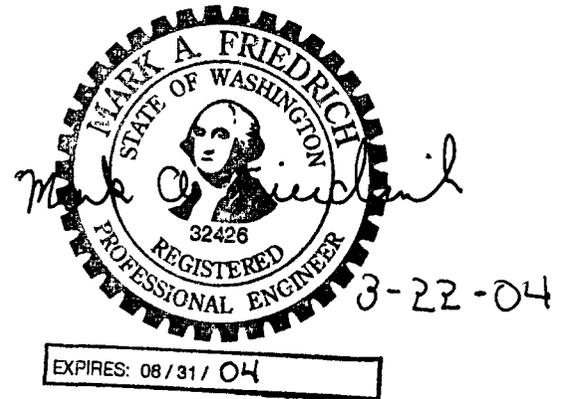
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Acronyms and Abbreviations

AI	analog input
ASD	adjustable speed drive
DOE	US Department of Energy
FEP	waste feed evaporation process
FRP	waste feed receipt process system
HLW	high-level waste
LAH	level alarm high
LAHH	level alarm high-high
LC	level controller
LI	level indication
LOL	lower operating limit
LSH	level switch high
LSHH	level switch high-high
LT	level transmitter
PCS	process control system
PT	pretreatment
PWD	plant wash and disposal
RDP	spent resin collection and dewatering process
RLD	radioactive liquid waste disposal
UFP	ultrafiltration process
UOL	upper operating limit

Glossary

acquire	Acquire is a command under a batch control that reserves a group of equipment for that particular batch control.
actual volume	Actual volume is the amount, in US gallons, of the waste and process fluid in any vessel.
available space	Available space refers to the volume, in US gallons, of waste and process fluid that any vessel can accommodate and still be lower than the upper operating limit (UOL). Available space can be calculated as follows: $Available\ Space = UOL - Actual\ Volume$
available volume	Available volume refers to the volume, in US gallons, of waste and process fluid that any vessel can transfer to another vessel and still be above the lower operating limit (LOL). Available volume can be calculated as follows: $Available\ Volume = Actual\ Volume - LOL$
batch	This refers to material that is being produced or that has been produced by a single execution of a batch process.
batch control	This term refers to control activities and control functions that provide a means to process finite quantities of material over a finite period of time using one or more pieces of equipment and ordered set of processing activities.
exception handling	This term refers to the functions that deal with plant or process contingencies and other events that occur outside the normal or desired behavior of batch control.
permissive	A permissive is an interlock that allows a device to change state or allows a sequence to start. Once a device has changed state or a sequence started, a permissive has no further effect on the device or sequence.
release	Release is a command under a batch control that opens up a group of equipment for any batch control to acquire.
trip	A trip is a conditional interlock that forces a device or a sequence to a defined state. A trip continues to have an effect on the device or sequence until the interlock condition no longer exist.

1 Introduction

This document describes the control logic for dangerous waste regulated systems and components for the waste feed evaporation process (FEP) system within the pretreatment (PT) facility.

2 Applicable Documents

MAF 3-23-04

24590-PTF-3YD-FEP-P0001, *System Description for Waste Feed Evaporation Process (FEP).*
00001

24590-PTF-M6-FEP-P0001, *P&ID - PTF Waste Feed Evaporation Process System Evaporator Feed Vessels FEP-VSL-00017A/B (Q).*

24590-PTF-M6-FEP-P0002, *P&ID - PTF Waste Feed Evaporation Process System Separator FEP-SEP-00001A.*

24590-PTF-M6-FEP-P0003, *P&ID - PTF Waste Feed Evaporation Process System Condensers and Condensate Collection FEP-VSL-00005.*

24590-PTF-M6-FEP-P0004, *P&ID - PTF Waste Feed Evaporation Process System Separator FEP-SEP-00001B.*

24590-PTF-M6-FEP-P0005, *P&ID - PTF Waste Feed Evaporation Process System Condensers.*

24590-WTP-M6-50-P0001, *P&ID Symbols and Legend Sheet 1 of 6.*

24590-WTP-M6-50-P0002, *P&ID Symbols and Legend Sheet 2 of 6.*

24590-WTP-M6-50-P0003, *P&ID Symbols and Legend Sheet 3 of 6.*

24590-WTP-M6-50-P0004, *P&ID Symbols and Legend Sheet 4 of 6.*

24590-WTP-M6-50-P0005, *P&ID Symbols and Legend Sheet 5 of 6.*

24590-WTP-M6-50-P0006, *P&ID Symbols and Legend Sheet 6 of 6.*

3 Description

3.1 System Requirement

The vessels (along with the corresponding valves and instruments) associated with dangerous waste management within the FEP system are the following:

FEP-VSL-00017A/B	waste feed evaporator feed vessels
FEP-SEP-00001A/B	waste feed evaporator separator vessels
FEP-VSL-00005	waste feed evaporator condensate vessel

3.1.1 General Process

The FEP system primarily serves to evaporate recycle streams that would otherwise accumulate in the plant wash and disposal (PWD) and the spent resin collection and dewatering process (RDP) systems. When a waste feed below approximately 5 molar Na concentration is received, it is blended with other recycles and the concentration raised to approximately 5 molar Na.

The primary mode of operation has one waste feed evaporator feed vessel accumulating recycle feed (FEP-VSL-00017A or FEP-VSL-00017B) while the other vessel feeds an evaporator. In addition, either waste feed evaporator feed vessel (FEP-VSL-000017A or FEP-VSL-000017B) can feed both evaporators simultaneously, using both waste feed evaporator feed pumps (FEP-PMP-00007A and FEP-PMP-00007B). It is also possible for each waste feed evaporator feed vessel (FEP-VSL-00017A and FEP-VSL-00017B) to be dedicated to an evaporator train and for the two trains to operate simultaneously.

Concentrated product from the evaporator is usually sent to the ultrafiltration process (UFP) system. It can also be transferred to the waste feed receipt process (FRP) system.

Additional routing also provide for operations that include:

- Adding high-level waste (HLW) feed to the waste feed evaporator feed vessels (FEP-VSL-00017A and FEP-VSL-00017B) for blending solids with evaporator feed
- Reprocessing concentrated product that did not meet the desired concentration

Instrumentation, alarms, control, and interlocks will be provided for all vessels in the FEP system to indicate or prevent the following conditions:

- Vessel contents overflow (level indication and passive overflow routes to the ultimate overflow vessel PWD-VSL-00033)
- Loss of system integrity (sump level indication)
- Inadvertent transfer (permissive signals to transfer)
- True vessel level (density compensated level)

3.1.2 Waste Feed Evaporator Feed Vessels

Waste feed evaporator feed vessels (FEP-VSL-00017A and FEP-VSL-00017B) are identical.

The two waste feed evaporator feed vessels (FEP-VSL-00017A and FEP-VSL-00017B) receive waste feed and recycle feed. Waste feed is transferred from the waste receipt vessels (FRP-VSL-00002A, FRP-VSL-00002B, FRP-VSL-00002C, FRP-VSL-00002D, and HLP-VSL-00022). Recycle feed is routed from the plant wash and disposal vessel (PWD-VSL-00044), the acidic-alkaline effluent vessels (PWD-VSL-00015 and PWD-VSL-00016), resin flush vessels (RDP-VSL-00002A, RDP-VSL-00002B, and RDP-VSL-00002C), and ultrafiltration feed preparation vessels (UFP-VSL-00001A, and UFP-VSL-00001B). Waste feed evaporator feed vessels (FEP-VSL-00017A, and FEP-VSL-00017B) are equipped with remote sampling capability.

The waste feed evaporator feed vessels (FEP-VSL-00017A, and FEP-VSL-00017B) can operate filling and discharging at the same time or by alternating one vessel filling and the other discharging.

For better control of the transfer operation, transfers are limited by the batch control transfer-in or transfer-out operation per vessel. Once the batch control sequence acquires any of these vessels, no other batch control operation can acquire this vessel until it is released from the initial operation. The acquiring and releasing steps ensure that the acquired vessel cannot transfer or receive from multiple destinations at the same time.

When the correct vessels have been acquired, the transfer-in sequence is initiated. Under normal operating conditions, the transfer-in sequence will be completed when either of the following occurs:

- The required batch volume has been transferred and post-transfer flushing is complete.
- The receipt vessel reaches its upper operating limit (UOL).

When the vessels are released, the process control system (PCS) can then initiate a transfer-out sequence. Under normal operating conditions the transfer-out sequence can be stopped if any of the following occurs:

- When the level in a waste feed evaporator feed vessel (FEP-VSL-00017A, FEP-VSL-00017B) reaches its lower operating limit (LOL).
- A specified volume is transferred.
- The destination vessel reaches its UOL.

For batch volume transfers, the Operator, based on PCS information, confirms that the available space in the destination vessel and the available volume in the sending vessel are consistent with the target batch volume specified by the operator. That means that during the batch transfer the destination UOL and sending LOL are not exceeded.

The transferring process to the waste feed evaporator feed vessel (FEP-VSL-00017A, FEP-VSL-00017B) stops if the “HIGH-HIGH” level in the ultimate overflow vessel (PWD-VSL-00033) alarm is activated. This PCS action stops the discharging pump on all other systems and closes the inlet valves on the waste feed evaporator feed vessel (FEP-VSL-00017A, FEP-VSL-00017B). This interruption occurs regardless of the current status of the transferring operation. During the entire transfer-in or transfer-out sequence, the PCS monitors the sump alarms within the PT facility and notifies the operator if an alarm condition occurs. The operator can then manually stop the transfer or allow the batch control to switch to an exception handling logic.

Each step in the batch operation will be performed automatically with built-in operator prompts as dictated by the pre-transfer, during-transfer, and post-transfer operator-PCS interface and controls listed below.

Action	The Goal of the Action
<ul style="list-style-type: none"> • Select receiving vessel (FEP-VSL-00017A or FEP-VSL-00017B). 	This will allow proper valve alignment thereby preventing misrouting of feed within PT facility.
<ul style="list-style-type: none"> • Specify the feed volume from each of the source vessels to the selected feed evaporator vessel, based on the available volume, including flush volume. 	This will control vessel filling level, vessel filling sequence, and prevent overflow.
<ul style="list-style-type: none"> • Operator enables permissive to start transfer. 	This will authorize initiation of the transfer operation.
<ul style="list-style-type: none"> • Confirm start (by flow totalizer) of transfer. 	This ensures that the valves are aligned properly.
<ul style="list-style-type: none"> • Confirm receipt of feed from level in the 	This ensures a controlled operation.

Action	The Goal of the Action
<ul style="list-style-type: none"> vessel and flow totalizer instrumentation. • Secure valving. 	<p>This will ensure that the valves are in the proper position after the transfer.</p>

The following are interlocks between the FEP system and other systems that are working all the time. These signals tie into the interlock logic performed within each of the control systems. These trips disable the transfer permissive.

Interlock Signal	Usage
<ul style="list-style-type: none"> • “HIGH-HIGH” level in ultimate overflow vessel (PWD-VSL-00033). 	<p>This signal will be used as a trip in other systems to stop the transfer, preventing an overflow of the ultimate overflow vessel (PWD-VSL-00033).</p>
<ul style="list-style-type: none"> • “HIGH” level in any receiving vessel. 	<p>This will prevent an overflow condition within FEP.</p>
<ul style="list-style-type: none"> • Valves are not properly aligned in FEP for transfer from other system within PT facility. 	<p>This signal will be used to avoid deadheading of the transfer pump and will prevent a misroute.</p>
<ul style="list-style-type: none"> • Control valves or associated instrumentation are not functional. 	<p>This will ensure that the transfer can be monitored and controlled.</p>
<ul style="list-style-type: none"> • Operator disables transfer. 	<p>This signal will be used as a trip to stop the transfer pump.</p>

Figure 1 shows the interlocks and alarms for the level instruments associated with the waste feed evaporator feed vessels (FRP-VSL-00017A and FEP-VSL-00017B).

3.1.3 Waste Feed Evaporator Condensate Vessel

The waste feed evaporator condensate vessel (FEP-VSL-00005) collects condensate from the condensers (primary condenser, inter-condenser, and after-condenser). During normal operation, the clean condensate is directed to the process condensate vessels (RLD-VSL-00006A and RLD-VSL-00006B). At the same time some portion of the condensate outlet is recycled to the separator vessel (FEP-SEP-00001A or FEP-SEP-00001B) for spraying the demister pads.

Condensate discharges are batched out by upper and lower liquid level setpoints.

Figure 2 shows the interlocks and alarms for level instruments associated with the waste feed evaporator condensate vessel (FRP-VSL-00005).

3.1.4 Waste Feed Evaporator Separator Vessels

Waste feed evaporator separator vessels (FEP-SEP-00001A and FEP-SEP-00001B) are identical. Each of the waste feed evaporator separator vessel (FEP-SEP-00001A or FEP-SEP-00001B) can receive waste from either waste feed evaporator feed vessels (FEP-VSL-00017A or FEP-VSL-00017B). Transfer to any separator vessel is a continuous process.

Waste transfer to the separator vessel occurs via one of the waste feed evaporator feed pump (FEP-PMP-00007A or FEP-PMP-00007B). Selection of the transfer pump to be used for transferring is done by the operator before starting the evaporation process in the system.

The transferring process is based on the level control in the waste feed evaporator separator vessel. During the normal transfer process, the speed of the transfer pump depends on the level in the vessel: the higher the level is in the vessel, the slower the transfer pump is running and vice versa. In addition, the transfer stops if the “HIGH-HIGH” level into vessel is activated. This PCS action stops the transfer pump and closes the feed inlet valves.

Each step in the continuous transfer process is performed automatically with built-in operator prompts as dictated by the pre-transfer and during-transfer operator-PCS interface and controls listed below.

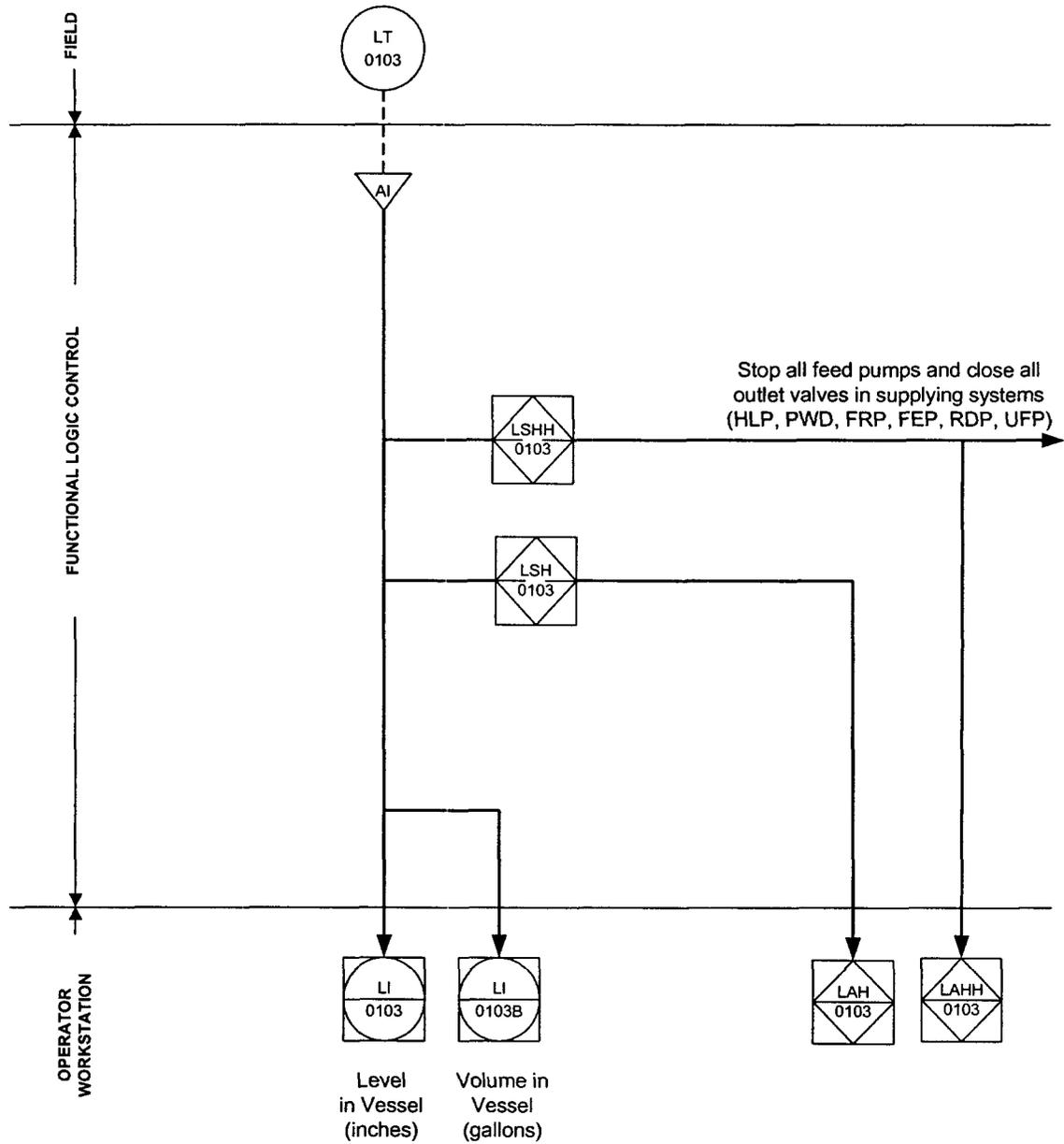
Action	The Goal of the Action
<ul style="list-style-type: none"> • Select waste feed evaporator separator vessel (FEP-SEP-00001A or FEP-SEP-00001B) to proceed with evaporation process 	This will allow proper valve alignment thereby preventing misrouting of feed within PT facility.
<ul style="list-style-type: none"> • Select waste feed evaporator feed pump (FEP-PMP-00007A or FEP-PMP-00007B) to supply selected separator vessel 	This will allow proper valve alignment thereby preventing misrouting of feed within PT facility.
<ul style="list-style-type: none"> • Operator enables permissive to start transfer/evaporation 	This will authorized initiation of the transfer process
<ul style="list-style-type: none"> • Confirm receipt of feed from level in the vessel 	This ensures a controlled operation.
<ul style="list-style-type: none"> • Secure valving. 	This will ensure that the valves are in the proper position after the transfer.

The following are interlocks within the FEP system that are working all the time. These trips disable the transfer permissive and therefore stop the evaporation process.

Interlock Signal	Usage
<ul style="list-style-type: none"> • “HIGH-HIGH” level in waste feed evaporator separator vessel (FEP-VSL-00001A or FEP-SEP-00001B). 	This signal will be used as a trip to stop the transfer (stop transfer pump and close transfer valves), preventing overfilling of the waste feed evaporator separator vessel (FEP-VSL-00001A or FEP-SEP-00001B)
<ul style="list-style-type: none"> • Valves are not properly aligned in FEP for transfer from selected transfer pump to the selected waste feed evaporator separator vessel 	This signal will be used to avoid deadheading of the transfer pump and will prevent a misroute.
<ul style="list-style-type: none"> • Control valves or associated instrumentation is not functional. 	This will ensure that the transfer can be monitored and controlled.
<ul style="list-style-type: none"> • Operator disables transfer (evaporation process) 	This signal will be used as a trip to stop the transfer pump and change operating mode

Figure 3 shows the interlocks and alarms for the level instruments associated with the waste feed evaporator separator vessels (FRP-VSL-00001A and FEP-VSL-00001B).

Figure 1 FEP-LI-0103 for Waste Feed Evaporator Feed Vessel (FEP-VSL-00017A)



Note: Waste Feed Evaporator Feed Vessels FEP-VSL-00017A and FEP-VSL-00017B have identical logic.

Figure 2 FEP-LI-0321 for Waste Feed Evaporator Condensate Vessel (FEP-VSL-00005)

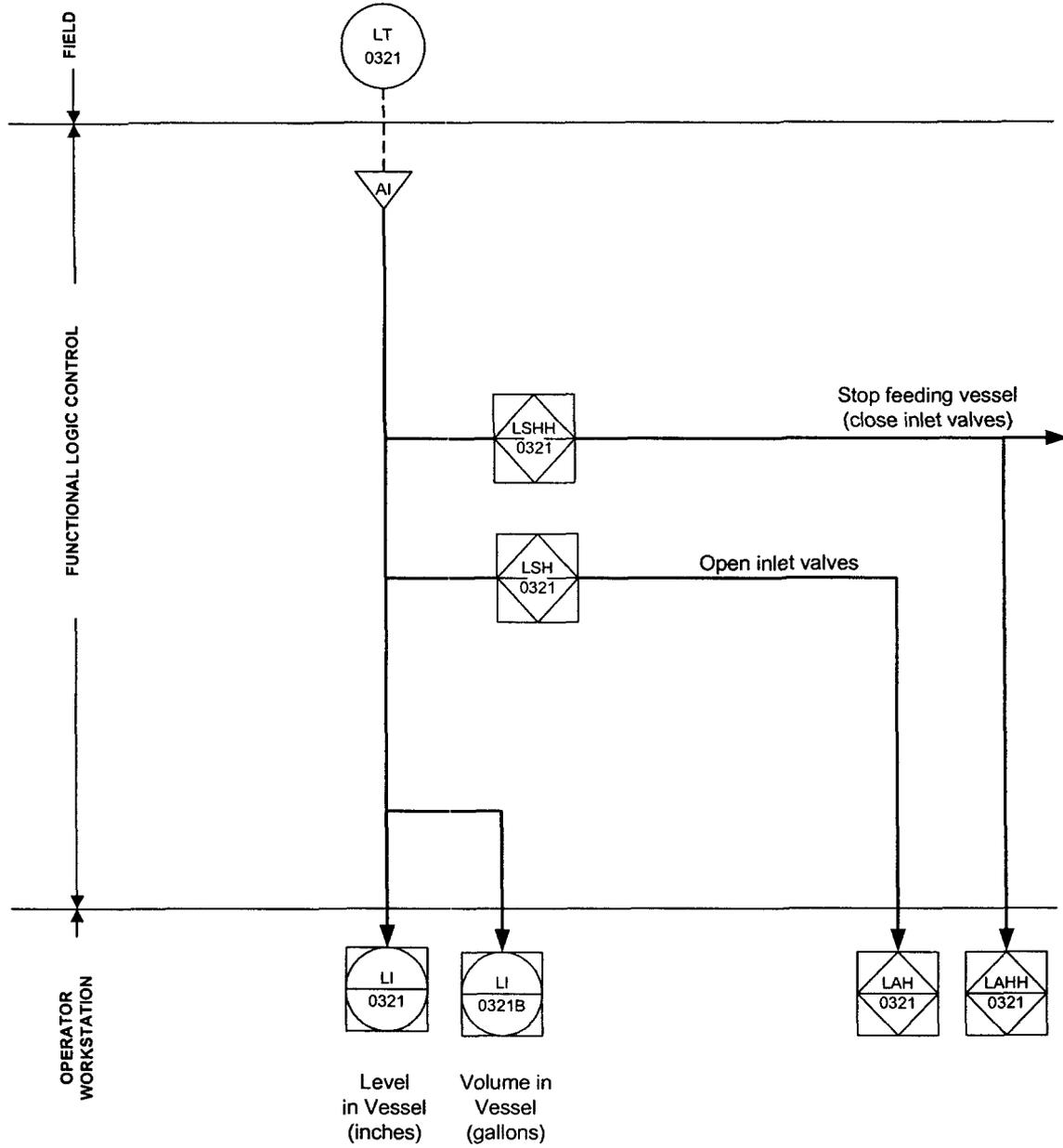
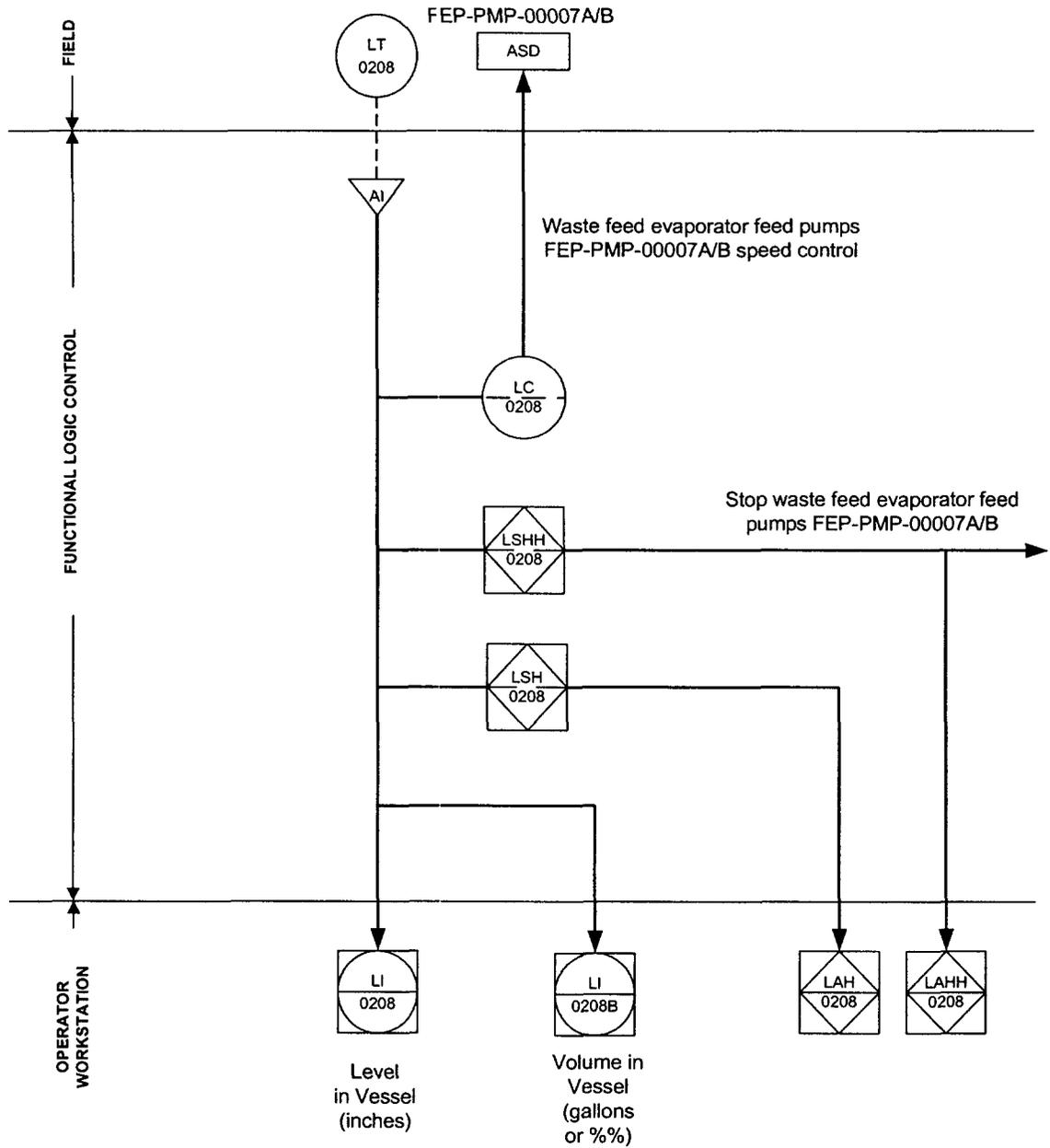


Figure 3 FEP-LI-0208 for Waste Feed Evaporator Separator Vessel (FEP-SEP-00001A)



Note: Waste Feed Evaporator Separator Vessels FEP-SEP-00001A and FEP-SEP-00001B have identical logic.