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System Logic Description for Pretreatment Vessel Vent Process and Exhaust Systems

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History Sheet

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Acronyms and Abbreviations

CLR	Cooler
DOE	US Department of Energy
HEME	High Efficiency Mist Eleminator
HLW	High Level Waste
LAH	Level Alarm High
LAHH	Level Alarm High-High
LAL	Level Alarm Low
LALL	Level Alarm Low-Low
LI	Level Indication
LOL	lower operating limit
LSH	Level Switch High
LSHH	Level Switch High-High
LSL	Level Switch Low
LSLL	Level Switch Low-Low
LT	Level Transmitter
P&ID	Piping and Instrumentation Diagram
PCS	Process Control System
PT	Pretreatment
PVP	Pretreatment Vessel Vent Process System
PVV	Pretreatment Vessel Vent Exhaust system
PWD	Plant Wash and Disposal System
RLD	Radioactive Liquid Disposal System
SCB	Scrubber
TFC	tank farm contractor
UOL	upper operating limit
VOC	Volatile Organic Compound
WTP	River Protection Project - Waste Treatment Plant

Glossary

acquire	Acquire is a command under a batch control that reserves a group of equipment for that particular batch control operation.
actual volume	Actual volume is the amount, in US gallons, of waste or process fluid in any vessel.
available space	Available space refers to the volume, in US gallons, of waste or process fluid that any vessel can accommodate and remain below 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 or process fluid that any vessel can transfer to another vessel and remain 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 an ordered set of processing activities to complete a batch process.
batch process	A batch process leads to the production of a finite quantity of material by subjecting quantities of input material to an ordered set of processing activities over a finite period of time using one or more pieces of equipment.
control system	This term refers to electronic processors that perform regulatory and logic control functions necessary for normal operation of the plant.
exception handling	This term refers to those functions that deal with plant or process contingencies and other events that occur outside the normal or desired behavior of batch control.
intermediate products	These are treated high-level waste (HLW) products that are staged and blended in the pretreatment (PT) facility prior to immobilization in the HLW vitrification facility. These products include treated solids slurry, strontium and transuranic elements (Sr/TRU) precipitate slurry and cesium concentrate.
LOL	Lower operating limit- a vessel low level set point used to stop a transfer-out batch operation from that vessel under normal plant operations.
permissive	A permissive is an interlock that allows a device to change state or a sequence to start. Once a device has changed state or a sequence has 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.
requested volume	The requested volume is the volume, in US gallons, of waste or process fluid that can be delivered to the destination vessel and the total volume will remain below the vessel's upper operating level.

Sr/TRU precipitate	For envelope C feed, the strontium and transuranic elements are precipitated out of solution and separated from the supernate along with any entrained solids to produce the slurry.
trip	A trip is an interlock that does not allow a device to change state or a sequence to start. Once a device has changed state or a sequence has started, a trip continues to have an effect on the device or sequence.
UOL	Upper operating limit – A vessel high level setpoint used to stop a transfer-in batch operation to that vessel under normal plant operation.

1 Introduction

This document describes the control logic associated with vessel instrumentation and other ancillary equipment within the Pretreatment Vessel Vent Process (PVP) and the Pretreatment Vessel Vent Exhaust (PVV) Systems that function to prevent inadvertent overflows within these systems through the control system.

2 Applicable Documents

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.*

24590-PTF-M6-PVP-P0017, *P&ID-PTF Pretreatment Vessel Vent Process System Caustic Scrubber to HEMEs (Q)*

24590-PTF-M6-PVP-P0018, *P&ID-PTF Pretreatment Vessel Vent Process System (PVP) HEMEs to VOC Oxidation Unit (Q).*

24590-PTF-3YD-PVP-00001, *System Description for Pretreatment Vessel Vent Process System, PVP*

3 Description

The following plant items and associated ancillary equipment are associated with dangerous waste management within the PVP and the PVV systems as a part of the PT facility.

Vessel Vent Caustic Scrubber (PVP-SCB-00002)

Vessel Vent High Efficiency Mist Eliminators (HEMEs) (PVP-HEME-00001A/B/C)

Vessel Vent HEME Drain Collection Vessel (PVP-VSL-00001)

Vessel Vent Volatile Organic Compounds (VOC) Oxidizer Unit (PVP-OXID-00001)

Vessel Vent After Cooler (PVP-CLR-00001)

Vessel Vent Carbon Bed Adsorbers (PVP-ADBR-00001A/B)

Vessel Vent Primary HEPA Filters (PVV-HEPA-00001A/B)

Vessel Vent Secondary HEPA Filters (PVV-HEPA-00002A/B)

Vessel Vent Adsorber Outlet Filter (PVP-MOD-00001)

Vessel Vent Exhaust Fans (PVV-FAN-00001A/B)

3.1 Vessel Vent Caustic Scrubber (PVP-SCB-00002)

During normal operations, the vessel vent caustic scrubber is operated continuously to receive the combined vent off gas stream collected from the process vessels located in the pretreatment facility through the common exhaust header. The primary function of the caustic scrubber is to absorb the Nitrogen Oxides (NO_x) and acid gases and remove large particulates from the feed gases. The vent off gases enters the caustic scrubber and flow upward through a packed bed, which provide contact with alkaline scrubbing liquid flowing downward. The reaction results in a scrubbing liquid solution that is collected in the caustic scrubber (PVP-SCB-00002). While in operation, the scrubber liquid solution is continuously recycled back to the caustic scrubber (PVP-SCB-00002) to provide adequate mixing.

Under normal conditions, the level in the caustic scrubber (PVP-SCB-00002) is continuously monitored and maintained by the control system within the normal operating range by transferring of the scrubber solution upon reaching the upper operating limit.

The control system will verify that instruments, utilities and equipment associated with the transfer are within operational parameters. The transfer is initiated by the control system when the level in the caustic scrubber (PVP-SCB-00002) reaches its upper operating limit (UOL). The transfer is stopped by the control system when any of the following are true: The level in the Caustic scrubber (PVP-SCB-00002) reaches its lower operating limit (LOL), or the level in the receiving vessel PWD-VSL-00044 reaches its upper operating limit (UOL).

The scrubber transfers are also controlled by the batch control mechanism of acquiring and releasing of the plant wash vessel in system PWD. The acquire and release commands ensure that the entities involved in this batch transfer cannot transfer in or out from multiple destinations at the same time. Once the scrubber (PVP-SCB-00002) is ready to transfer, the operator will initiate a transfer-out sequence within the control system. Once initiated, the control system verifies that instruments, utilities, and equipment associated with the transfer are within operational parameters and remain as such throughout the transfer. If any of the monitored parameters are not within the specified limits during the transfer, the control system will switch to exception handling logic. Under normal operating conditions the sequence will end if any of the following becomes true:

- The level in the plant wash vessel (PWD-VSL-00044) reaches its upper operating limit (UOL).
- The specified volume is transferred.
- The level in the scrubber (PVP-SCB-00002) reaches its lower operating limit (LOL).

When the level in the caustic scrubber (PVP-SCB-00002) is no longer within the normal operating range due to abnormality, interlocks along with alarms within the control system help prevent an overflow condition. Figure 1 shows the interlocks and alarms for the level instrument associated with the caustic scrubber (PVP-SCB-00002).

3.2 High Efficiency Mist Eliminators (HEMEs) PVP-HEME-00001A, PVP-HEME-00001B, PVP-HEME-00001C

The combined vessel vent exhaust gas stream will flow from the vessel vent caustic scrubber (PVP-SCB-00002) outlet to the HEMEs for removal of mist. There will be three 50% capacity HEMEs, of which two are in service and one is available as standby. HEMEs are passive devices and can be put in service or isolated from the process by opening or closing the isolation valve provided at the inlet of each HEME.

When a HEME is put in service, a continuous spray of demineralized water is applied at its inlet nozzle to ensure the inlet gas stream is saturated. The drain from the HEMEs flows into the HEME drain collection vessel (PVP-VSL-00001). During normal operation, the level in the HEME is continuously monitored by the control system. If the level reaches a predetermined high set point due to abnormality such as a clog in the drain line, interlocks and alarms within the control system stop the demineralized water supply to the HEME. Alternatively, demineralized water supply can be stopped manually at the discretion of the operator.

Refer to Figure 2, 3 and 4 for level measurement details for the HEMEs.

3.3 HEME Drain Collection Vessel, PVP-VSL-00001

When the HEMEs are operating, the HEME drain collection vessel (PVP-VSL-00001) will continuously receive and store any liquid collected from the HEMEs. It will also receive any liquid collected from any flush solution (primarily process condensate from the radioactive liquid disposal system (RLD)) from the header should the header require flushing. This vessel can also receive process condensate directly from system RLD to ensure a minimum level is maintained. When the level reached a predetermined setpoint, a portion of the solution is transferred to the plant wash vessel (PWD-VSL-00044) in the plant wash and disposal system (PWD). While stored, the liquid solution is continuously recirculated to provide adequate mixing and avoid settling of solids.

Under normal conditions, the level in the HEME drain collection vessel is continuously monitored and maintained by the control system within the normal operating range by transferring excess of the liquid solution to the plant wash vessel (PWD-VSL-00044) in the plant wash and disposal system (PWD).

The HEME drain collection vessel transfers are controlled by the control system and limited by the batch control mechanism of acquiring and releasing of the plant wash vessel in system PWD. The acquire and release commands ensure that the entities involved in this batch transfer cannot transfer in or out from multiple destinations at the same time. Once the HEME drain collection vessel (PVP-VSL-00001) is ready to transfer, the operator will initiate a transfer-out sequence within the control system. Once initiated, the control system verifies that instruments, utilities, and equipment associated with the transfer are within operational parameters and remain as such throughout the transfer. If any of the monitored parameters are not within the specified limits during the transfer, the control system will switch to exception handling logic. Under normal operating conditions the sequence will end if any of the following becomes true:

- The level in the plant wash vessel (PWD-VSL-00044) reaches its upper operating limit (UOL).
- The specified volume is transferred.
- The level in the HEME drain collection vessel (PVP-VSL-00001) reaches its lower operating limit (LOL).

When the level in the HEME drain collection vessel is no longer within the normal operating range due to abnormality, low level interlocks along with alarms within the control system will stop the moving force. Overflow conditions will be prevented administratively by the operator upon receiving a High level alarm.

Refer to Figure 5 for level measurement details for the vessel vent HEME drain collection vessel (PVP-VSL-00001).

3.4 Other Miscellaneous Treatment Units

Pending design evolution of the Pretreatment Vessel Vent Process (PVP) and Pretreatment Vessel Vent Exhaust (PVV) Systems.

Figure 1 Level Measurement for Vessel Vent Scrubber (PVP-SCB-00002)

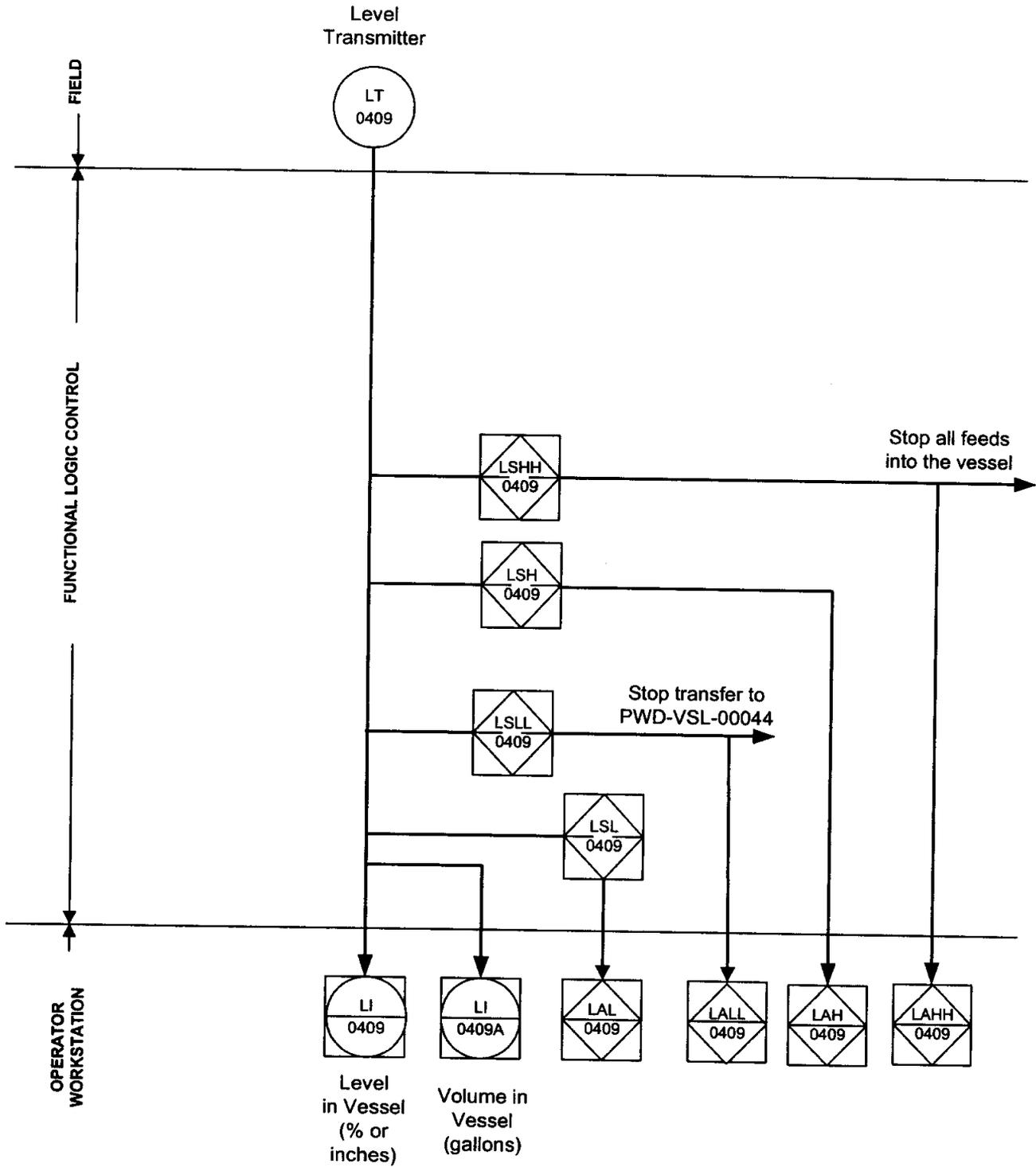


Figure 2 Level Measurement for the Vessel Vent HEME (PVP-HEME-00001A)

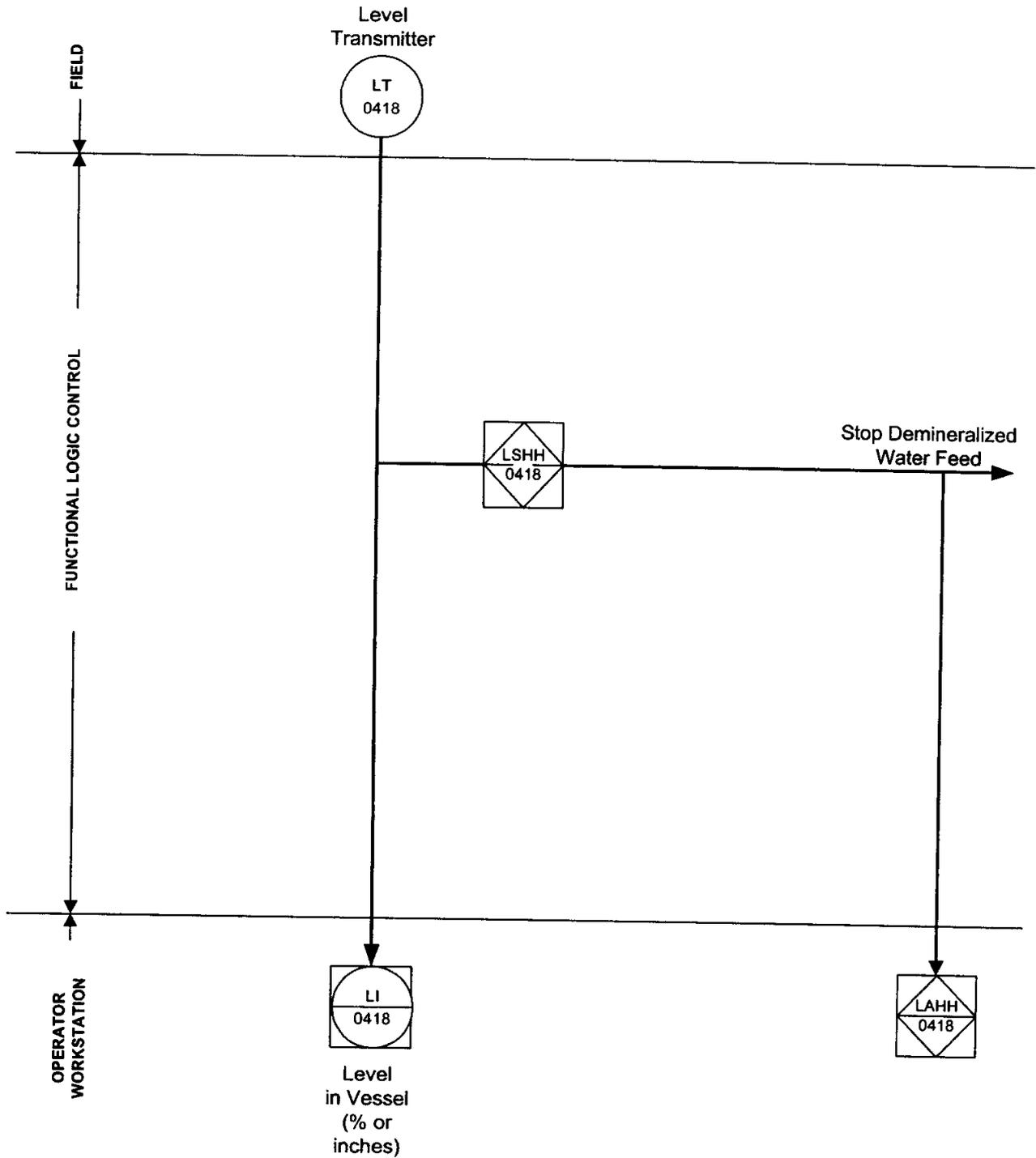


Figure 3 Level Measurement for the Vessel Vent HEME (PVP-HEME-00001B)

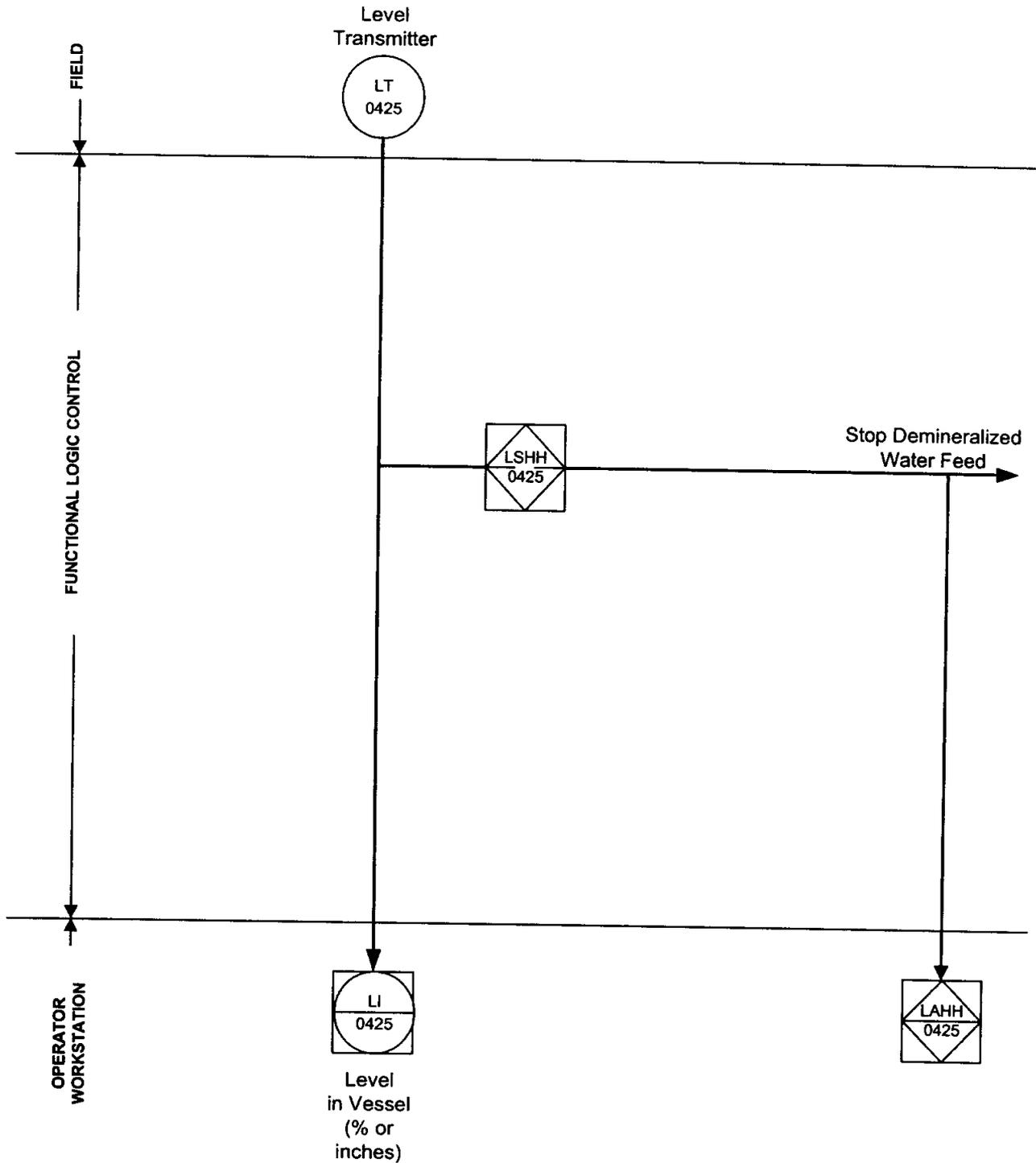


Figure 4 Level Measurement for the Vessel Vent HEME (PVP-HEME-00001C)

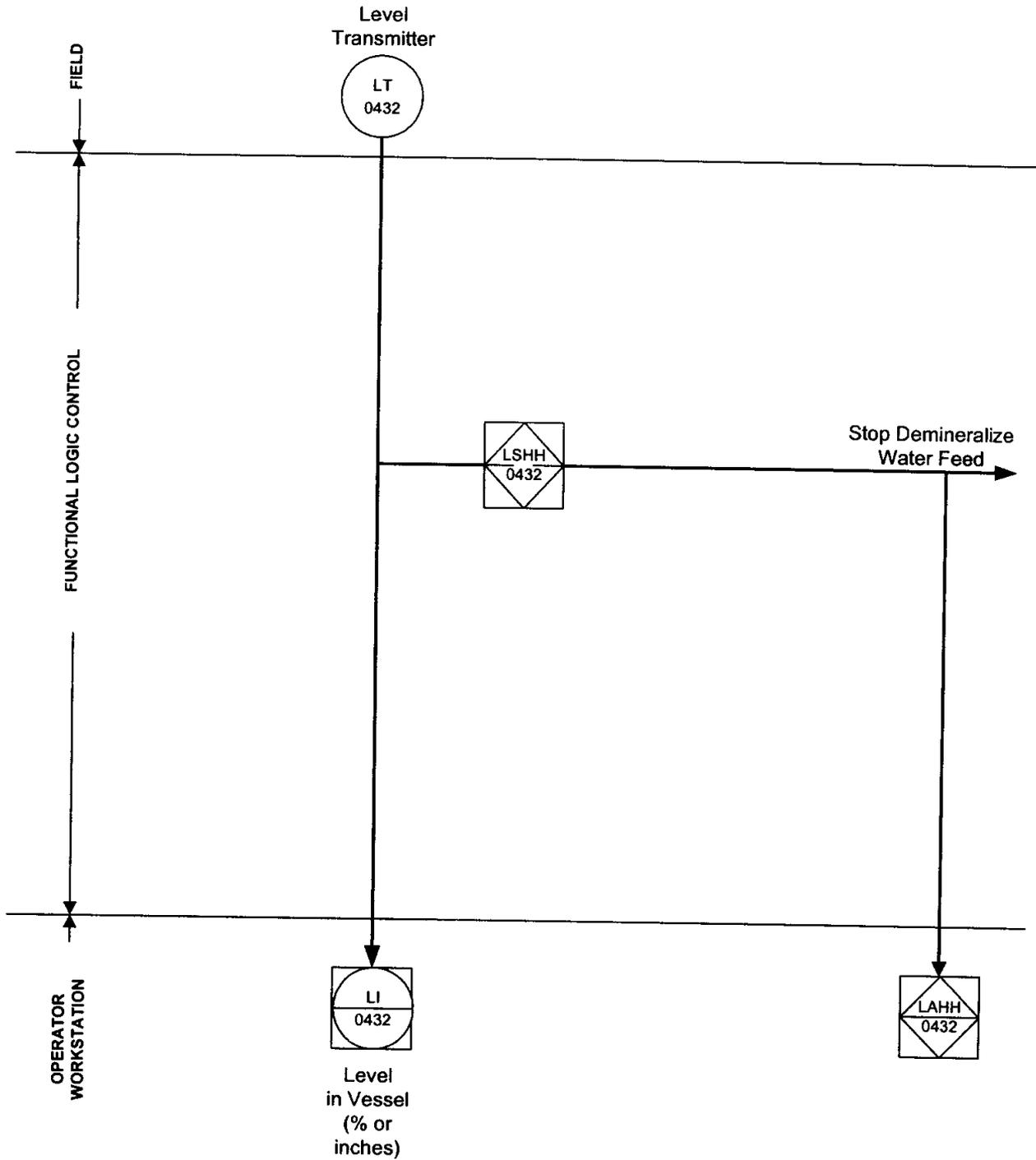


Figure 5 Level Measurement for Vessel Vent HEME Drain Collection Vessel (PVP-VSL-00001)

