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System Logic Description for Pretreatment Facility Cs Nitric Acid Recovery Process (CNP) System

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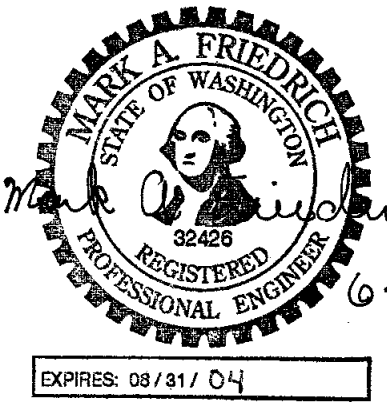

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History Sheet

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Acronyms and Abbreviations

AI	Analog input
CNP	Cesium Nitric Acid Recovery Process System
CXP	Cesium Ion Exchange Process System
HLP	HLW Lag Storage and Feed Blending Process System
IX	Ion exchange
LAH	Level alarm high
LAHH	Level alarm high-high
LI	Level indication
LOL	Lower operating limit
LP	Low pressure
LSH	Level switch high
LSHH	Level switch high-high
LT	Level transmitter
P&ID	Piping and instrumentation diagram
PT	Pretreatment
PWD	Plant Wash & Disposal
UOL	Upper operating limit
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.
batch	The 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	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	Electronic Processors that perform regulatory and logic control functions necessary for plant normal operation.
exception handling	Those functions that deal with plant or process contingencies and other Logic events, which occur outside the normal or desired behavior of batch control.
interlock	This term refers to a mechanism that automatically brings about or prevents the operation of another mechanism.
lower operating limit	A vessel low-level set point used to stop a transfer-out batch operation from the vessel under normal plant operations.
permissive	Interlock which allows a device to change state or 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	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.
upper operating limit	A vessel high-level set point used to stop a transfer-in batch operation to the vessel under normal plant operation.

1 Introduction

This document describes the instrument control logic for tank and ancillary equipment for the Cs Nitric Acid Recovery Process System (CNP) within the pretreatment (PT) facility that are associated with dangerous waste management.

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-CNP-P0001, *P&ID - PTF Cesium Nitric Acid Recovery Process System Eluate Contingency Storage Vessel*

24590-PTF-M6-CNP-P0002, *P&ID - PTF Cesium Nitric Acid Recovery Process System Recovered Nitric Acid Vessel*

24590-PTF-M6-CNP-P0003, *P&ID - PTF Cesium Nitric Acid Recovery Utility Services - PSA Rack*

24590-PTF-M6-CNP-P0004, *P&ID - PTF Cesium Nitric Acid Recovery Utility Services - PSA Rack*

24590-PTF-M6-CNP-P0005, *P&ID - PTF Cesium Nitric Acid Recovery Utility Services - Plant Wash Rack*

24590-PTF-M6-CNP-P0008, *P&ID - PTF Cesium Nitric Acid Recovery Process System, Evaporator Vessel*

24590-PTF-M6-CNP-P0010, *P&ID - PTF Cesium Nitric Acid Recovery Process System Rectifier and Condensers*

3 Description

The following plant items and ancillary equipment are associated with dangerous waste management within the CNP system, which resides in the PT facility.

- Cs Evaporator Eluate Lute Pot (CNP-VSL-00001)
- Eluate Contingency Storage Vessel (CNP-VSL-00003)
- Cs Evaporator Recovered Nitric Acid Vessel (CNP-VSL-00004)
- Cs Evaporator Separator Vessel (CNP-EVAP-00001)
- Cs Evaporator Primary Condenser (CNP-HX-00002)
- Cs Evaporator Inter-Condenser (CNP-HX-00003)
- Cs Evaporator After Condenser (CNP-HX-00004)
- Cs Evaporator Concentrate Reboiler (CNP-HX-00001)
- Cs Evaporator Nitric Acid Rectifier (CNP-DISTC-00001)
- Instrument Bulge (CNP-BULGE-00008)

The Cs Evaporator Inter-Condenser (CNP-HX-00003) and Cs Evaporator After Condenser (CNP-HX-00004) are hydraulically linked with the Cs Evaporator Primary Condenser (CNP-HX-00002) and condensate levels are controlled via the level control in the CXP-HX-00002 condenser boot. The level control for the condenser boot is described in section 3.5 and controls the condensates level in both CNP-HX-00003 and CNP-HX-00004 due to the hydraulic link.

The Cs Evaporator Nitric Acid Rectifier (CNP-DISTC-00001) and the Cs Evaporator Concentrate Reboiler (CNP-HX-00001) do not have level control associated with them. CNP-DISTC-00001 does not contain a normal liquid inventory, recovered 0.5M nitric acid drains directly to the Cs Evaporator Recovered Nitric Acid Vessel (CNP-VSL-00004). CNP-HX-00001 is a reboiler through which the Cs concentrate is circulated on the tube side and low-pressure steam is condensed on the shell side and drained back to the process condensate system.

3.1 CNP-VSL-00001

The Cs Evaporator Eluate Lute Pot (CNP-VSL-00001) in conjunction with the Cs Evaporator Breakpot (CNP-BRKPT-00002) and ancillary equipment provides a path for fluids into the Cs Evaporator Separator Vessel (CNP-EVAP-00001) and maintains a vacuum seal for the Cs Evaporator Separator Vessel. CNP-VSL-00001 transfers the following feeds to the Cs Evaporator Separator Vessel:

- 5M to 8M nitric acid used to charge the Cs Evaporator Separator Vessel
- Process condensate
- Cs eluate
- Recycled concentrate if required.

The Cs Evaporator Eluate Lute Pot operates as a fully flooded vessel and is connected to both the Cs Evaporator Breakpot and Cs Evaporator Separator Vessel; both located a barometric head above the Cs Evaporator Eluate Lute Pot. The barometric head (33.9 ft of water) provides a vacuum seal between the Cs Evaporator Separator Vessel and the Cs Evaporator Breakpot, which operate at approximately 1.45 psia and 14.5 psia respectively. Since the Cs Evaporator Eluate Lute Pot is a fully flooded vessel, the reference leg of the level instrument is located in CNP-BRKPT-00002 while the density and level legs are located in CNP-VSL-00001. This allows the height of liquid in the piping between CNP-BRKPT-00002 and CNP-VSL-00001 to be monitored and protect against overflow of CNP-BRKPT-00002

For greater waste management reliability, batch controlled transfers to the Cs Evaporator Eluate Lute Pot are limited by the control system to one transfer in or out at a time by the batch control mechanism of acquiring and releasing and basic interlocks.

The Cs Evaporator Eluate Lute Pot will be acquired to make a transfer when the Cs Evaporator Separator Vessel (CNP-EVAP-00001) requires a transfer of nitric acid or process condensate; the CXP system transfers eluate to the Cs Evaporator Separator Vessel; or the Eluate Contingency Storage Vessel transfers eluate or Cs Concentrate to the Cs Evaporator Separator Vessel. Once the sequence is initiated, the control system will verify that instruments, utilities, and equipment associated with the transfer are within operational parameters. If any of the monitored parameters are not within the specified limits during the transfer, the control system will switch to exception handling logic. The transfer is stopped by the control system when any of the following are true for a respective transfer:

- Level in the Cs Evaporator Separator Vessel (CNP-EVAP-00001) reaches its operating set point, for transfers of nitric acid or process condensate to Cs Evaporator Separator Vessel
- Level of the Eluate Contingency Storage Vessel reaches its lower operating limit (LOL), when transferring eluate from the Eluate Contingency Storage Vessel (CNP-VSL-0003).

- CXP system has sent its target volume of eluate to the CNP system.

Once one of the above conditions is met the Cs Evaporator Eluate Lute Pot is released.

If the level is not within the normal operating range, interlocks along with alarms help prevent an overflow condition. At the high alarm set point, an alarm is generated. At the high-high alarm set point, an alarm is generated and all dedicated controlled feeds are isolated. Isolation occurs by a combination of either stopping the motive force, closing valves, or a combination of these actions. Figure 1, shows the typical interlocks and alarms for the level instruments associated with the Cs Evaporator Eluate Lute Pot.

3.2 CNP-VSL-00003

The Eluate Contingency Storage Vessel (CNP-VSL-00003) receives transfers of eluate from the CXP system, transfers of Cs Concentrate from the Cs Evaporator Separator Vessel (CNP-EVAP-00001), and transfer of off-specification recovered eluant from the Cs Evaporator Recovered Nitric Acid Vessel (CNP-VSL-00004). The vessel transfers Cs Concentrate to the HLP system (HLP-VSL-00027B or HLP-VSL-00028) and transfers Cs Concentrate or Cs Eluate to the Cs Evaporator Separator Vessel (CNP-EVAP-00001).

The Eluate Contingency Storage Vessel will receive transfers of Cs Concentrate from the Cs evaporator if the HLP system is unavailable to receive a batch of Cs concentrate at the end of an evaporation cycle. The Eluate Contingency Storage Vessel will also receive batch transfers of eluate during emergency elution and if the Cs evaporator is unavailable to receive eluate from the Cs ion exchange columns. The Eluate Contingency Storage Vessel is acquired by the source vessel and receives each transfer as a batch. Once the transfer sequence is initiated, the control system will verify that instruments, utilities, and equipment associated with the transfer are within operational parameters. If any of the monitored parameters are not within the specified limits during the transfer, the control system will switch to exception handling logic. The transfer is stopped by the control system when any of the following are true for a respective transfer:

- Level in the eluate contingency storage vessel reaches its UOL.
- Target volume of eluate has been transferred from the CXP system to complete elution of an IX column.
- Temperature in Cs Concentrate Breakpot (CNP-BRKPT-00001) reaches its set point and stops the ejector transfer from the Cs Evaporator Separator Vessel to the eluate contingency storage vessel.

If the level is not within the normal operating range, interlocks along with alarms help prevent an overflow condition. At the high alarm set point, an alarm is generated. At the high-high alarm set point, an alarm is generated and all dedicated controlled feeds are isolated. Isolation occurs by a combination of either stopping the motive force, closing valves, or a combination of these actions. Figure 2 shows the interlocks and alarms for the level instrument associated with the Eluate Contingency Storage Vessel (CNP-VSL-00003).

3.3 CNP-VSL-00004

The Cs Evaporator Recovered Nitric Acid Vessel (CNP-VSL-00004) stores recovered eluant for the elution of the CXP IX columns (CXP-IXC-00001/2/3/4). Eluant is fed from the Cs Evaporator Recovered Nitric Acid Vessel to the IX columns as required by the CXP system. The eluate from the columns is returned to the CNP system and concentrated in the evaporator, and 0.5M acid is recovered to be reused as eluant and sent to CNP-VSL-00004. Since the evaporator system recovers eluant at the same time and rate as recovered eluant is sent to the CXP system, the volume in CNP-VSL-00004 fluctuates during operations near its upper operating level. CNP-VSL-00004 receives 2M nitric acid and process condensate transfers to adjust the concentration of the recovered eluant in CNP-VSL-00004 or to make fresh batches of 0.5M nitric acid as required.

When the CXP system requires eluant for elution, CNP-VSL-00004 sends eluant to the CXP system. The eluate is sent back to the CNP system and the eluant recovered is stored in CNP-VSL-00004. This sequence runs until the elution of the IX column is complete, when the transfer of eluant to the CXP system is stopped, the Cs evaporator recovered nitric acid vessel continues to receive recovered eluant from the evaporator until the post elution rinse is complete, bringing the level in CNP-VSL-0004 back to its starting set point. Basic control functions control the level during this sequence, as no operating set points are associated with CNP-VSL-00004, all set points are based on transfer volumes to and from the CXP system.

The contents in the Cs Evaporator Recovered Nitric Acid Vessel (CNP-VSL-00004) are sampled periodically to monitor concentrations of certain ions in solutions. If the results of the sample require adjustments to the concentration of the recovered eluant or a new batch of eluant, 2M nitric acid and process condensate can be added. The operator will determine the volumes required and run the addition sequences. Once the sequence is initiated, the control system will verify that instruments, utilities, and equipment associated with the transfer are within operational parameters. If any of the monitored parameters are not within the specified limits during the transfer, the control system will switch to exception handling logic. The transfer is stopped by the control system when any of the following are true for a respective transfer:

- The level in the Cs evaporator recovered nitric acid vessel (CNP-VSL-00004) reaches its UOL.
- The target volume of 2M nitric acid or process condensate has been transferred to Cs evaporator recovered nitric acid vessel

If the level is no longer within the normal operating range due to an abnormality, interlocks along with alarms help prevent an overflow condition. At the high alarm set point, an alarm is generated. At the high-high alarm set point, an alarm is generated and all dedicated controlled feeds are isolated. Isolation occurs by a combination of either stopping the motive force, closing valves, or a combination of these actions. Figure 3 shows the interlocks and alarms for the level instrument associated with the Cs evaporator recovered nitric acid vessel (CNP-VSL-00004).

3.4 CNP-EVAP-00001

Under normal operations the Cs Evaporator Separator Vessel (CNP-EVAP-00001) receives transfers of eluate from the CXP system, concentrates the eluate, and recovers eluant for reuse in elution of the column. Once the concentrate reaches the endpoint concentration (approximately 2.6M $NaNO_3$) the evaporator is shut down and emptied to the HLP system (HLP-VSL-00027B or HLP-VSL-00028) or to CNP-VSL-00003.

The Cs evaporator separator vessel is initially charged with 5 to 8 molar nitric acid (received from CNP-VSL-00001). The operator initiates a fill sequence that adds acid to CNP-EVAP-00001 until the level set point is reached and the sequence is complete. The transfer is stopped by the control system when the Cs Evaporator Separator Vessel level set point is reached.

Once the Cs evaporator system is running and available for evaporation, eluate is transferred from the CXP system or CNP-VSL-00003 to the Cs Evaporator Separator Vessel (CNP-EVAP-00001). The eluate is transferred to the Cs evaporator separator vessel at a rate of 6 to 10 gpm. Level control modulates the LP steam valve to evaporate the eluate at the same rate that it enters CNP-EVAP-00001 controlling the level in the separator to its set point. The transfer is stopped by the control system when any of the following are true:

- Level in the eluate contingency storage vessel reaches its LOL (for transfers from CNP-VSL-00003).
- Target volume of eluate has been transferred from the CXP system to complete elution and post elution rinse of an IX column.

When the evaporator is not receiving eluate feed it will be refluxed. If the level in the Cs evaporator separator vessel drops, the operator may initiate a sequence to add process condensate to CNP-EVAP-00001 to return the level to its set point. Once the sequence is initiated, the control system will verify that instruments, utilities, and equipment associated with the transfer are within operational parameters. If any of the monitored parameters are not within the specified limits during the transfer, the control system will switch to exception handling logic. The transfer is stopped by the control system when the Cs Evaporator separator vessel level set point is reached.

The Cs Evaporator Separator Vessel may also receive a charge of Cs concentrate from the Eluate Contingency Storage Vessel if it is required to be recycled or further concentrated. A steam ejector transfers the batch to the Cs evaporator separator vessel. The transfer is stopped by the control system when one of the following is true:

- Level in the Cs evaporator separator vessel reaches its UOL.
- Temperature in Cs Evaporator Breakpot (CNP-BRKPT-00002) reaches its set point and stops the ejector transfer from the eluate contingency storage vessel to the Cs Evaporator Separator Vessel (CNP-EVAP-00001).

If the level is not within the normal operating range, interlocks along with alarms help prevent an overflow condition. At the high alarm set point, an alarm is generated. At the high-high alarm set point, an alarm is generated and all dedicated controlled feeds are isolated. Isolation occurs by a combination of either stopping the motive force, closing valves, or a combination of these actions. Figure 4 shows the interlocks and alarms for the level instrument associated with the Cs evaporator separator vessel (CNP-EVAP-00001).

3.5 CNP-HX-00002

The Cs Evaporator Primary Condenser (CNP-HX-00002) receives overhead vapors from the Cs Evaporator Rectifier (CNP-DISTC-00001) and condenses the vapor and returns most of the condensate to the Cs Evaporator Rectifier as reflux while discharging excess condensate to the PWD system. An inventory of condensate is maintained in the condenser boot and the reflux rate is controlled via a flow control valve on the discharge of the condensate pump that returns reflux to the rectifier. The liquid level is maintained by modulating a valve that purges excess condensate to the PWD system.

If the level is not within the normal operating range, interlocks along with alarms help prevent an overflow condition. At the high alarm set point, an alarm is generated. At the high-high alarm set point, an alarm is generated and all dedicated controlled feeds are isolated. Isolation occurs by a combination of either stopping the motive force, closing valves, or a combination of these actions. Figure 5 shows the interlocks and alarms for the level instrument associated with the Cs evaporator primary condenser (CNP-HX-00002).

3.6 CXP-BULGE-00008

The Instrument Bulge contains valves to direct recovered eluant from the Cs Evaporator Nitric Acid Rectifier to CNP-VSL-00004 or to the Cs Evaporator Separator Vessel. The bulge provides secondary containment and shielding to protect the worker. The Cs IX Process Bulge is instrumented with a level switch to alarm an operator that a leak in the bulge has occurred. Any spilled fluids are drained to the C5 drain collection header. Figure 6 shows the alarm for the level instrument associated with the Instrument Bulge (CNP-BULGE-00008).

Figure 1. Level Measurement for Cs Evaporator Eluate Lute Pot (CNP-VSL-00001)

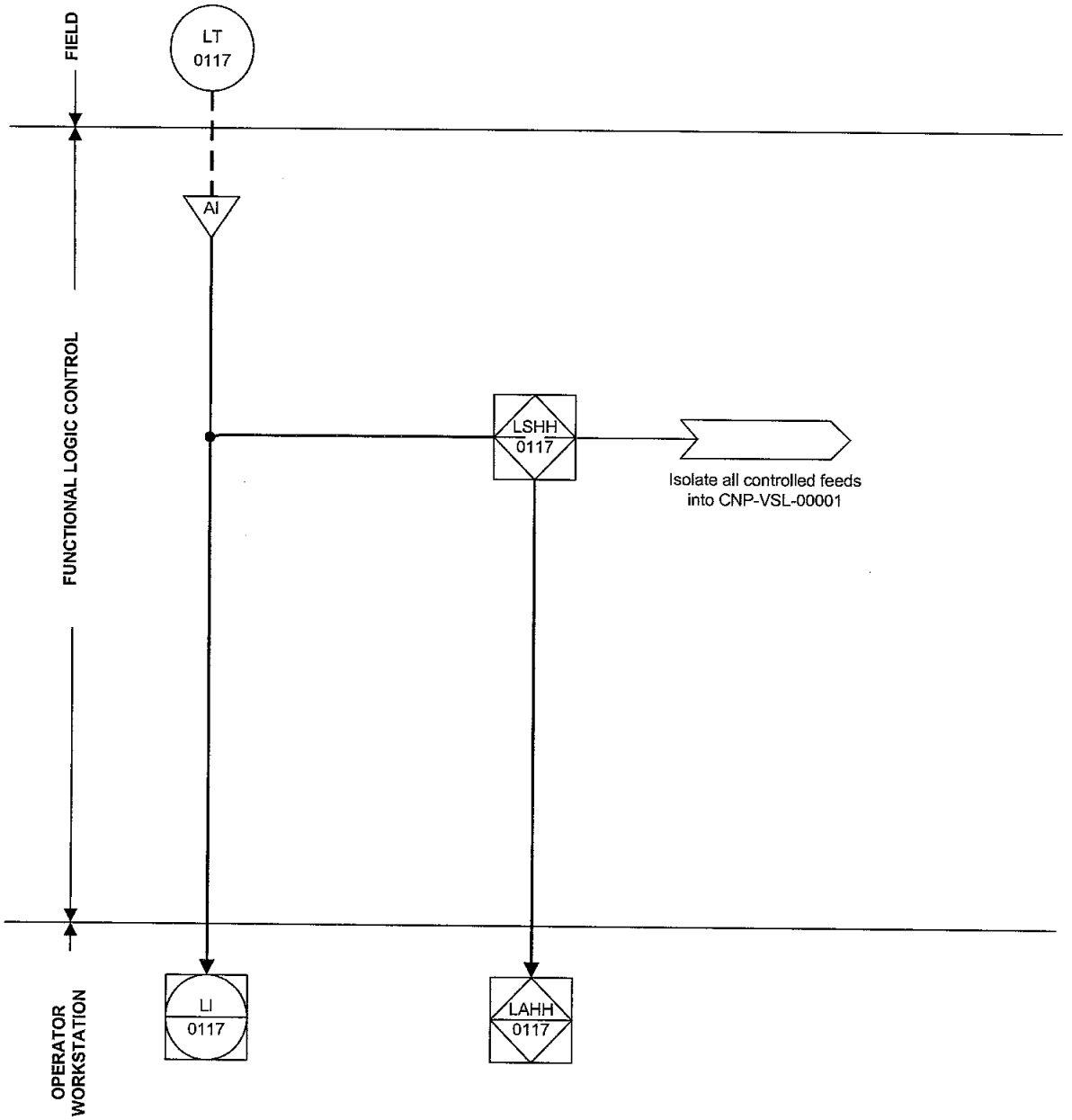


Figure 2. Level Measurement for Eluate Contingency Storage Vessel (CNP-VSL-00003)

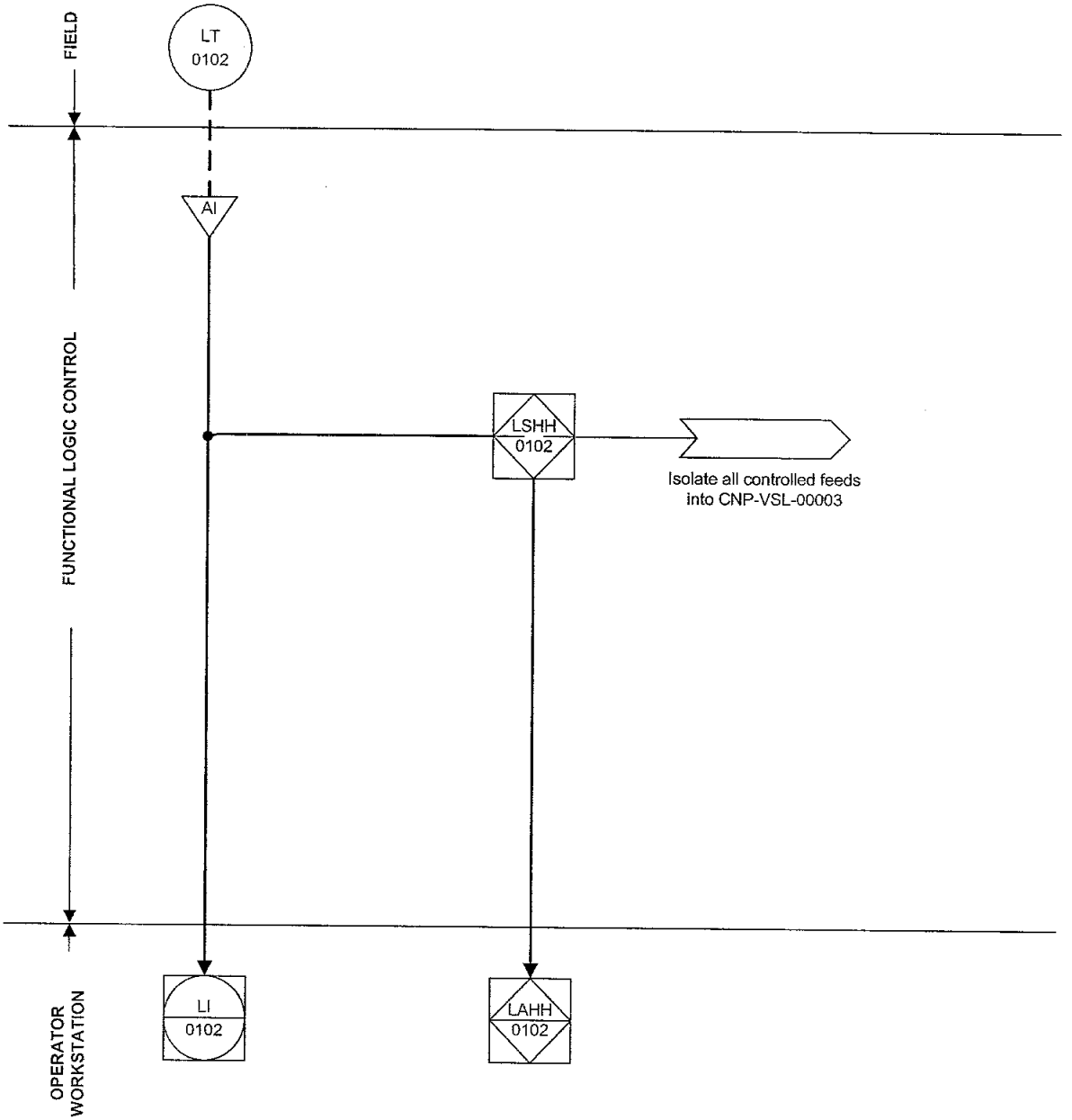


Figure 3. Level Measurement for Cs Evaporator Recovered Nitric Acid Vessel (CNP-VSL-00004)

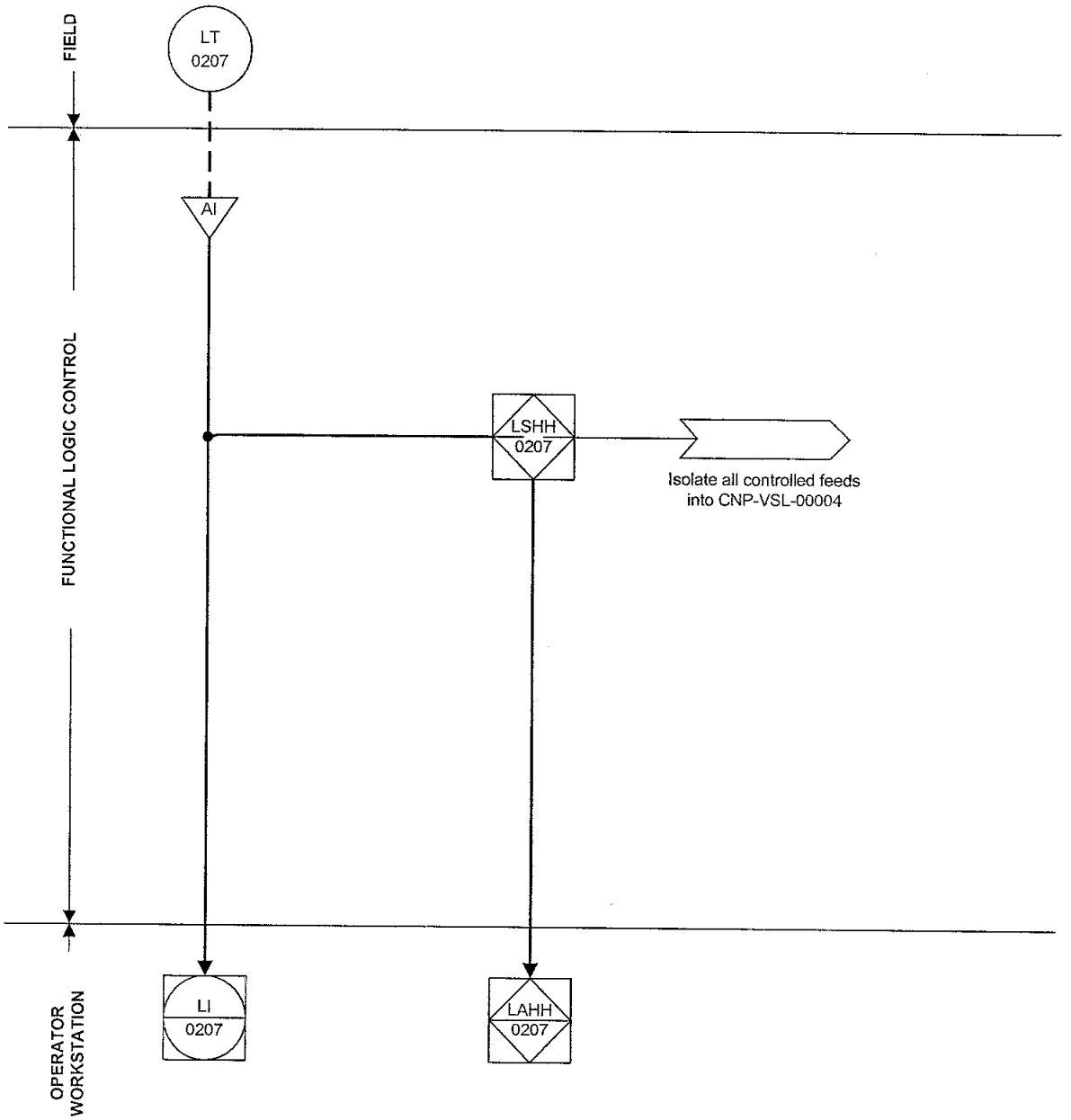
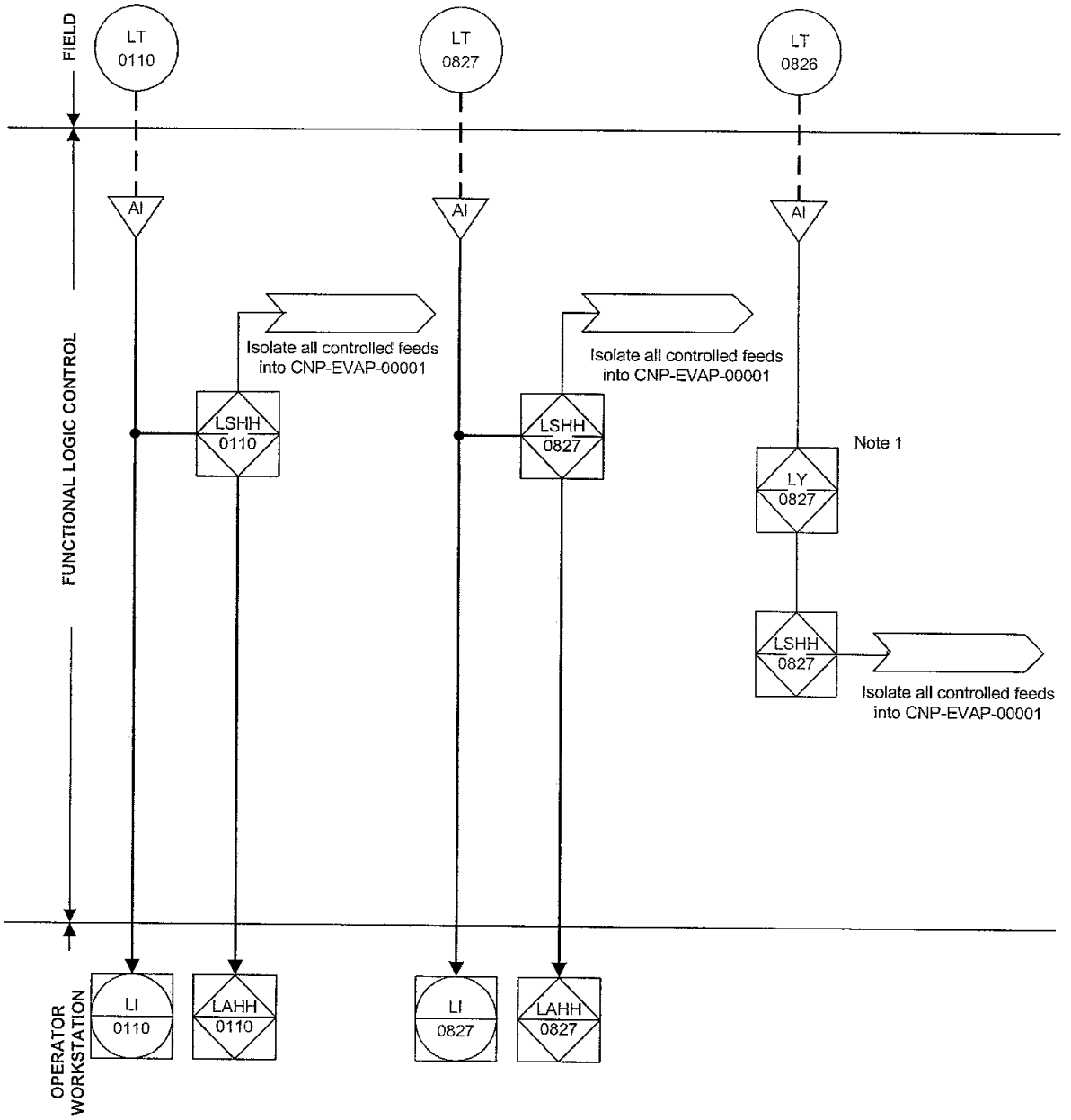


Figure 4. Level Measurement for Cs Evaporator Separator Vessel (CNP-EVAP-00001)



Note:
1. Measures deviation between each leg, once deviation is reached a trip occurs.

Figure 5. Level Measurement for Cs Evaporator Primary Condenser (CNP-HX-00002)

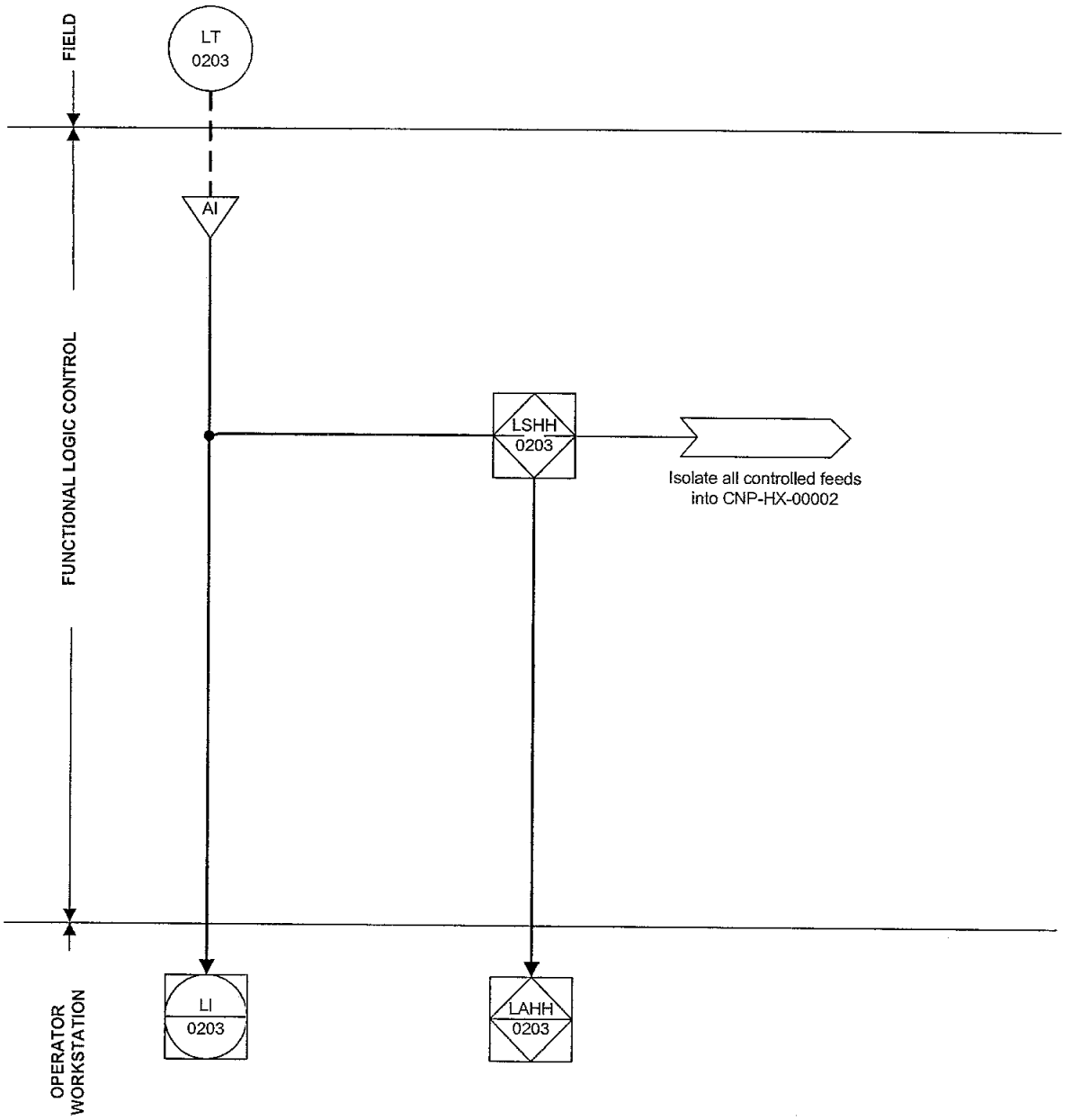


Figure 6. Level Switch for Instrument Bulge (CNP-BULGE-00008)