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System Logic Description for Analytical Laboratory - Radioactive Liquid Waste Disposal (RLD) System

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System Logic Description for Analytical Laboratory -
Radioactive Liquid Waste (RLD) System

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History Sheet

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Contents

| | |
|--|----------|
| Notice | iii |
| History Sheet | iv |
| Acronyms..... | vi |
| Glossary | vii |
| 1 Introduction | 1 |
| 2 Applicable Documents | 1 |
| 3 Description | 2 |
| 3.1 Hotcell Drain Collection Vessel..... | 2 |
| 3.2 Radiological Laboratory Area Sink Drain Collection Vessel..... | 3 |
| 3.3 Cell and Equipment Sumps..... | 4 |
| 3.4 Leak Detection Boxes..... | 5 |

Tables

| | |
|---|---|
| Table 1 Associated Instruments for LAB Radioactive Liquid Waste Disposal System | 6 |
|---|---|

Figures

| | |
|---|----|
| Figure 1 Typical Drain Collection Vessel Level Detection..... | 8 |
| Figure 2 Typical Sump Level Detection..... | 9 |
| Figure 3 Typical Leak Detection Box Level Detection | 10 |

Acronyms

| | |
|------|---|
| AEA | Atomic Energy Act |
| DOE | US Department of Energy |
| DWP | Dangerous Waste Permit |
| LAB | analytical laboratory |
| LAH | level alarm high |
| LAHH | level alarm high high |
| LAL | level alarm low |
| LI | level indicator |
| LSH | level switch high |
| LT | level transmitter |
| P&ID | pipng and instrumentation diagram |
| RLD | radioactive liquid waste disposal |
| WTP | Hanford Tank Waste Treatment and Immobilization Plant |

Glossary

| | |
|------------------------------|---|
| acquire | Acquire is a command under batch control that reserves a group of equipment for a particular batch control operation. |
| batch | Batch is the material that is being produced or that has been produced by a single execution of a batch process. |
| batch control | Batch control 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 is a process that leads to the production of finite quantities of material by subjecting quantities of input materials to an ordered set of processing activities over a finite period of time using one or more pieces of equipment. |
| control system | Refers to electronic processors that perform regulatory and logical control functions necessary for normal plant operation |
| exception handling | Exception handling 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. |
| level alarm high (LAH) | A vessel high-level setpoint used to stop a transfer-in batch operation to a vessel under normal plant operation. |
| level alarm high high (LAHH) | Refers to a notification in the control system that is activated when the applicable variable reaches a point that is significantly higher than that expected during normal operation |
| level alarm low (LAL) | A vessel low-level set point used to stop a transfer-out batch operation from a vessel under normal plant operations. |
| release | Release is a command under batch control that opens up a group of equipment for any batch control to acquire. |

1 Introduction

This document describes the instrument control logic for Dangerous Waste Permit (DWP) tank and ancillary equipment in the radioactive liquid waste disposal (RLD) system within the analytical laboratory (LAB) associated with dangerous waste management.

2 Applicable Documents

| | |
|---------------------------|--|
| 24590-WTP-M6-50-00001 | <i>P&ID Symbols and Legend Sheet 1 of 8</i> |
| 24590-WTP-M6-50-00002 | <i>P&ID Symbols and Legend Sheet 2 of 8</i> |
| 24590-WTP-M6-50-00003 | <i>P&ID Symbols and Legend Sheet 3 of 8</i> |
| 24590-WTP-M6-50-00004 | <i>P&ID Symbols and Legend Sheet 4 of 8</i> |
| 24590-WTP-M6-50-00005 | <i>P&ID Symbols and Legend Sheet 5 of 8</i> |
| 24590-WTP-M6-50-00006 | <i>P&ID Symbols and Legend Sheet 6 of 8</i> |
| 24590-WTP-M6-50-00007 | <i>P&ID Symbols and Legend Sheet 7 of 8</i> |
| 24590-WTP-M6-50-00008 | <i>P&ID Symbols and Legend Sheet 8 of 8</i> |
| 24590-LAB-M6-RLD-00001001 | <i>P&ID - LAB Radioactive Liquid Waste Disposal System C5 Collection and Transfer RLD-VSL-00165</i> |
| 24590-LAB-M6-RLD-00001002 | <i>P&ID - LAB Radioactive Liquid Waste Disposal System C5 Collection and Transfer RLD-PMP-00183A</i> |
| 24590-LAB-M6-RLD-00001003 | <i>P&ID - LAB Radioactive Liquid Waste Disposal System C5 Collection and Transfer RLD-PMP-00183B</i> |
| 24590-LAB-M6-RLD-00001004 | <i>P&ID - LAB Radioactive Liquid Waste Disposal System C5 Collection and Transfer Valve Pit</i> |
| 24590-LAB-M6-RLD-00002001 | <i>P&ID - LAB Radioactive Liquid Waste Disposal System C3 Collection & Transfer RLD-VSL-00164</i> |
| 24590-LAB-M6-RLD-00002003 | <i>P&ID - LAB Radioactive Liquid Waste Disposal System C3 Collection & Transfer RLD-PMP-00182A/B</i> |
| 24590-LAB-M6-RLD-00006001 | <i>P&ID - LAB Radioactive Liquid Waste Disposal System C3 RAD LAB Collection</i> |
| 24590-LAB-M6-RLD-00006002 | <i>P&ID - LAB Radioactive Liquid Waste Disposal System C3 RAD LAB Collection</i> |
| 24590-LAB-M6-RLD-00006003 | <i>P&ID - LAB Radioactive Liquid Waste Disposal System C3 RAD LAB Collection</i> |

| | |
|---------------------------|--|
| 24590-LAB-M6-RLD-00007001 | <i>P&ID - LAB Radioactive Liquid Waste Disposal System C3 Leak Detection Boxes</i> |
| 24590-LAB-M6-RLD-00007002 | <i>P&ID - LAB Radioactive Liquid Waste Disposal System C3 Collection Drain Header</i> |
| 24590-LAB-M6-RLD-00008001 | <i>P&ID - LAB Radioactive Liquid Waste Disposal System - C5 Leak Detection Boxes</i> |
| 24590-LAB-M6-RLD-00008002 | <i>P&ID - LAB Radioactive Liquid Waste Disposal System C5 Drain Collection Headers</i> |
| 24590-LAB-3YD-RLD-00001 | <i>System Description for the Analytical Laboratory Radioactive Liquid Waste Disposal System (RLD)</i> |

3 Description

The DWP tank and ancillary equipment associated with dangerous waste management within the RLD system are the following:

| | |
|-------------------|--|
| • RLD-VSL-00165 | Hotcell drain collection vessel (C5 vessel) |
| • RLD-VSL-00164 | Lab area sink drain collection vessel (C3 vessel) |
| • RLD-PMP-00183A | Hotcell drain collection vessel pump (C5 vessel) |
| • RLD-PMP-00183B | Hotcell drain collection vessel pump (C5 vessel) |
| • RLD-PMP-00182A | Lab area sink drain collection vessel pump (C3 vessel) |
| • RLD-PMP-00182B | Lab area sink drain collection vessel pump (C3 vessel) |
| • RLD-SUMP-00042 | C5 vessel cell sump |
| • RLD-SUMP-00041 | C3 vessel cell pump |
| • RLD-SUMP-00043A | C5 pump pit sump |
| • RLD-SUMP-00043B | C5 pump pit sump |
| • RLD-SUMP-00044 | C5 piping pit sump |
| • RLD-SUMP-00045 | C3 pump pit sump |
| • RLD-LDB-00002 | Hotcell collection leak detection box |
| • RLD-LDB-00004 | C3 transfer leak detection box |
| • RLD-LDB-00005 | RAD Lab sink collection header leak detection box |
| • RLD-LDB-00006 | PVA drain header leak detection box |
| • RLD-LDB-00007 | C3 maintenance drain header leak detection box |
| • RLD-LDB-00008 | Sample receive/send drain header leak detection box |
| • RLD-LDB-00009 | Glovebox header leak detection box |
| • RLD-LDB-00011 | ASX equipment drain collection header leak detection box |

3.1 Hotcell Drain Collection Vessel

The hotcell drain collection vessel (RLD-VSL-00165) receives effluent from hotcell glovebox drains, hotcell cupsinks, hotcell transfer drawers, the master-slave manipulator decontamination glovebox, hotcell sample drop station, and the hotcell drain collection vessel pump pits and valve pit sumps. Effluents from the lab area sink drain collection vessel (RLD-VSL-00164) and the floor drain collection vessel (RLD-VSL-00163) can also be transferred to the hotcell drain collection vessel

(RLD-VSL-00165). The Floor Drain Collection Vessel (RLD-VSL-00163) collects, contains, and transfers non-contaminated liquid effluent. Although the floor drain collection vessel is identified as part of the RLD system, it is not designed or permitted to manage mixed or dangerous wastes. For waste management reliability, batch controlled transfers into RLD-VSL-00165 are limited by the control system to one transfer in or out at a time by the batch control mechanism of acquiring and releasing. Once acquired, no other batch control operation will be able to coordinate activities with the hotcell drain collection vessel (RLD-VSL-00165) until it is released.

When the vessel is available to receive effluent, the operator will initiate the transfer-in sequence. 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 that will return the equipment associated with the transfer to a safe state. During normal operation, the batch transfer sequence is stopped by the control system when any of the following conditions are met:

- The level in the hotcell drain collection vessel (RLD-VSL-00165) reaches its level alarm high (LAH)
- The level of the sending equipment reaches its level alarm low (LAL).

When the LAH of the hotcell drain collection vessel (RLD-VSL-00165) is reached, the control system will notify an operator through the plant control system interface that the hotcell drain collection vessel (RLD-VSL-00165) is ready to transfer its contents. The operator will then initiate the 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 that will return the equipment associated with the transfer to a safe state. During normal operation, the batch transfer sequence will end when any of the following conditions are met:

- The level in the hotcell drain collection vessel (RLD-VSL-00165) reaches its LAL
- The level of the receiving equipment reaches its LAH (during routine operations, pretreatment plant wash vessel, PWD-VSL-00044 or the pretreatment ultimate overflow vessel, PWD-VSL-00033, which receives transfer line flushes).

When the level is above the normal operating range due to an abnormality, interlocks and alarms within the control system help prevent an overflow condition. Figure 1 shows the interlocks and alarms for the level instrument associated with the hotcell drain collection vessel (RLD-VSL-00165). At the high high-alarm setpoint, an alarm (LAHH) is generated and all dedicated controlled feeds are isolated. Isolation occurs by stopping the motive force, closing valves, or a combination of both.

3.2 Radiological Laboratory Area Sink Drain Collection Vessel

The radiological laboratory (referred to in this document as the lab) area sink drain collection vessel (RLD-VSL-00164) receives effluent from the lab sinks, the lab fume hood sinks, decontamination showers and sinks, autosampling system equipment drains, the receiving and shipping area, process vacuum equipment, other floor drains throughout the LAB, and the C3 pump pit sump (RLD-SUMP-00045). Effluents from the floor drain collection vessel (RLD-VSL-00163) can also be transferred to the lab area sink drain collection vessel (RLD-VSL-00164). For waste management

reliability, batch controlled transfers into RLD-VSL-00164 are limited by the control system to one transfer in or out at a time by the batch control mechanism of acquiring and releasing. Once acquired, no other batch control operation will be able to coordinate activities with the lab area sink drain collection vessel (RLD-VSL-00164) until it is released.

When the vessel is available to receive effluent, the operator will initiate the transfer-in sequence. 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 that will return the equipment associated with the transfer to a safe state. During normal operation, the batch transfer sequence is stopped by the control system when any of the following conditions are met:

- The level in the lab area sink drain collection vessel (RLD-VSL-00164) reaches its LAH
- The level of the sending equipment reaches its LAL.

When the LAH of the lab area sink drain collection vessel (RLD-VSL-00164) is reached, the control system will notify an operator through the plant control system interface that the lab area sink drain collection vessel is ready to transfer its contents. The operator will then initiate the 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 that will return the equipment associated with the transfer to a safe state. During normal operation, the batch transfer sequence will end when any of the following conditions are met:

- The level in the lab area sink drain collection vessel (RLD-VSL-00164) reaches its LAL
- The level of the receiving equipment reaches its LAH.

When the level is above the normal operating range due to an 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 lab area sink drain collection vessel (RLD-VSL-00164). At the high high-alarm setpoint, an alarm (LAHH) is generated and all dedicated controlled feeds are isolated. Isolation occurs by stopping the motive force, closing valves, or a combination of both.

3.3 Cell and Equipment Sumps

The LAB has two different types of sumps: pump or piping pit (equipment) and vessel cell sumps. All of the sumps are maintained dry. A general description of radar level detection in sumps can be found in 24590-WTP-PER-J-02-002, *Leak Detection in Secondary Containment Systems*, section 3.2.1.

Upon detection of a high liquid level in a cell sump, the control system alarms at which point the operator must take the necessary action to diagnose the source of the leakage and empty the cell sump. Figure 2 shows the alarms for the level instrument associated with the C5 vessel cell sump (RLD-SUMP-00042), which also serves as a typical method of operation for the C3 vessel cell sump (RLD-SUMP-00041).

The pump or piping pit sumps are self-emptying and automatically drain back to their respective vessel. Upon detection of a high liquid level in a pit sump, the control system alarms at which point the operator

removes the weir from the sump and diagnoses the source of the leakage. Figure 2 shows the alarms for the level instrument associated with one of the C5 pump pit sumps (RLD-SUMP-00043A), which serves as a typical method of operation for all pit sumps in the LAB.

The hotcell drain collection vessel (RLD-VSL-00165) and the lab area sink drain collection vessel (RLD-VSL-00164) have their own set of sumps. The sumps for the hotcell drain collection vessel (RLD-VSL-00165) are the C5 vessel cell sump (RLD-SUMP-00042), the C5 pump pit sumps (RLD-SUMP-00043A and RLD-SUMP-00043B), and the C5 piping pit sump (RLD-SUMP-00044). In the event of a level detection in the C5 vessel cell sump, the operator routes the liquid to the pretreatment plant wash vessel (PWD-VSL-00044). The sumps for the lab area sink drain collection vessel (RLD-VSL-00164) are the C3 vessel cell sump (RLD-SUMP-00041) and the C3 pump pit sump (RLD-SUMP-00045). In the event of a level detection in the C3 vessel cell sump, the operator routes the liquid to the hotcell drain collection vessel (RLD-VSL-00165).

3.4 Leak Detection Boxes

The LAB has leak detection boxes on the headers draining into the hotcell drain collection vessel (RLD-VSL-00165) and the lab area sink drain collection vessel (RLD-VSL-00164). The leak detection boxes are designed to detect a leak in the annular space of the coaxial or double-walled piping. Each box is installed with a drain plug in the closed position to create a detectable level. Upon detection of a level, the control system alarms, at which point the operator lifts the plug to drain the leak detection box. An overflow plug installed in the open position prevents overflow of the leak detection box until it can be drained. The leak detection boxes for the C3 drain collection headers drain to the C3 vessel cell sump (RLD-SUMP-00041). Similarly, the leak detection boxes for the C5 drain collection headers and the C3 transfer line for the lab area sink drain collection vessel (RLD-VSL-00164) drain to the C5 vessel cell sump (RLD-SUMP-00042). Figure 3 shows the alarm for the level instrument associated with one of the C3 transfer leak detection box (RLD-LDB-00004), which serves as a typical method of operation for all leak detection boxes in the LAB.

Table 1 Associated Instruments for LAB Radioactive Liquid Waste Disposal System

| P&ID | Monitoring/control parameter | Type of instrument/control device | Instrument/control device tag number |
|---------------------------|---------------------------------------|--|---|
| 24590-LAB-M6-RLD-00001001 | Level Measurement for RLD-VSL-00165 | Level Element | LE-6104 |
| | | Level Transmitter | LT-6104 |
| | | Level Indicator | LI-6104 |
| 24590-LAB-M6-RLD-00001001 | Level Measurement for RLD-SUMP-00042 | Level Transmitter | LT-6115 |
| | | Level Indicator | LI-6115 |
| 24590-LAB-M6-RLD-00001002 | Level Measurement for RLD-SUMP-00043A | Level Transmitter | LT-6116 |
| | | Level Indicator | LI-6116 |
| 24590-LAB-M6-RLD-00001003 | Level Measurement for RLD-SUMP-00043B | Level Transmitter | LT-6124 |
| | | Level Indicator | LI-6124 |
| 24590-LAB-M6-RLD-00001004 | Level Measurement for RLD-SUMP-00044 | Level Transmitter | LT-6123 |
| | | Level Indicator | LI-6123 |
| 24590-LAB-M6-RLD-00002001 | Level Measurement for RLD-VSL-00164 | Level Element | LE-6202 |
| | | Level Transmitter | LT-6202 |
| | | Level Indicator | LI-6202 |
| 24590-LAB-M6-RLD-00002001 | Level Measurement for RLD-SUMP-00041 | Level Transmitter | LT-6211 |
| | | Level Indicator | LI-6211 |
| 24590-LAB-M6-RLD-00002003 | Level Measurement for RLD-SUMP-00045 | Level Transmitter | LT-6212 |
| | | Level Indicator | LI-6212 |
| 24590-LAB-M6-RLD-00007001 | Level Measurement for RLD-LDB-00005 | Level High Switch | LSH-6215 |
| | | Level High Alarm | LAH-6215 |
| 24590-LAB-M6-RLD-00007001 | Level Measurement for RLD-LDB-00006 | Level High Switch | LSH-6701 |
| | | Level High Alarm | LAH-6701 |
| 24590-LAB-M6-RLD-00007001 | Level Measurement for RLD-LDB-00007 | Level High Switch | LSH-6702 |
| | | Level High Alarm | LAH-6702 |

24590-LAB-PER-J-03-001, Rev 1
System Logic Description for Analytical Laboratory -
Radioactive Liquid Waste (RLD) System

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|---------------------------|-------------------------------------|-------------------|----------|
| 24590-LAB-M6-RLD-00007001 | Level Measurement for RLD-LDB-00008 | Level High Switch | LSH-6703 |
| | | Level High Alarm | LAH-6703 |
| 24590-LAB-M6-RLD-00007001 | Level Measurement for RLD-LDB-00011 | Level High Switch | LSH-6704 |
| | | Level High Alarm | LAH-6704 |
| 24590-LAB-M6-RLD-00008001 | Level Measurement for RLD-LDB-00002 | Level High Switch | LSH-6120 |
| | | Level High Alarm | LAH-6120 |
| 24590-LAB-M6-RLD-00008001 | Level Measurement for RLD-LDB-00004 | Level High Switch | LSH-6118 |
| | | Level High Alarm | LAH-6118 |
| 24590-LAB-M6-RLD-00008001 | Level Measurement for RLD-LDB-00009 | Level High Switch | LSH-6801 |
| | | Level High Alarm | LAH-6801 |

Figure 1 Typical Drain Collection Vessel Level Detection

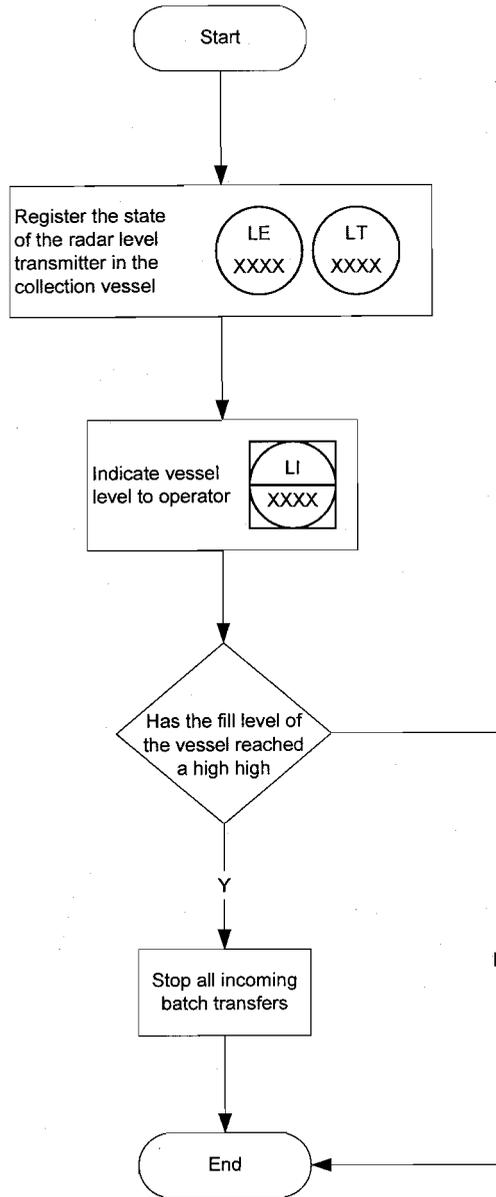


Figure 2 Typical Sump Level Detection

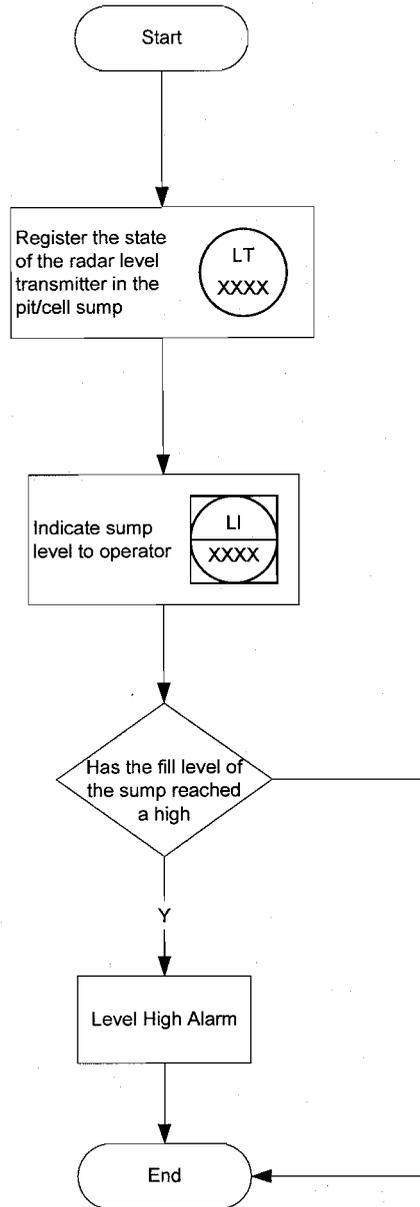


Figure 3 Typical Leak Detection Box Level Detection

