Independent Qualified Registered Professional Engineer
Design Assessment Report
For
Waste Feed Delivery – LAW Feed

IQRPE Design Assessment Report
No. DA-317076-01
Rev. 0

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1.0 INTRODUCTION

Washington Administrative Code (WAC) 173-303-640, *Tank Systems*, provides a set of requirements for owner/operators of dangerous waste tank systems. This Design Assessment Report is prepared for Washington River Protection Solutions, LLC (WRPS) by an Independent Qualified Registered Professional Engineer (IQRPE) to certify that the proposed tank system will have sufficient structural integrity and is acceptable for storing and treating dangerous waste per WAC 173-303-640(3)(a).

The IQRPE maintains “independence” at all times. Comments and suggestions by others are considered by the IQRPE during the preparation of reports and plans. Only the IQRPE can implement changes to the master IQRPE documents.

1.1 PROJECT DESCRIPTION

Background

The Direct Feed Low Activity Waste (DFLAW) Waste Feed Delivery (WFD) Project is executing the design and construction of the necessary upgrades to the Tank Farms to allow the integration and operation of the Tank Side Cesium Removal (TSCR) Demonstration Project for the processing of tank waste. Tank supernatant waste will be pretreated in the TSCR Processing Enclosure, (Project TD101). Feed for the TSCR system is provided from Double-Shell Tank (DST) 241-AP-107 and treated waste will be transferred from TSCR to DST 241-AP-106. Transfer system upgrades will enable transferring treated waste from DST 241-AP-106 to Waste Treatment Plant (WTP) and receiving treated effluent from WTP into DST 241-AP-102.

The WFD – Low Activity Waste (LAW) Feed will support work that will occur on the Hanford Nuclear Reservation the 200 East Area.

IQRPE Scope

Meier Architecture • Engineering (Meier) provided an IQRPE to perform the Design Assessment per WRPSs Statement of Work (SOW) No. 317076, *IQRPE for Waste Feed Delivery – LAW Feed (BMA 64658)*. The scope includes an IQRPE review of the draft and final design media (drawings, specifications, calculations, etc.) needed to support a Resource Conservation and Recovery Act (RCRA) permit modification request.

The IQRPE performed this design assessment to the requirements of WAC 173-303-640 for the applicable WFD – LAW Feed components.
Figure 1: Hanford Map Showing the Location of the AP DST Tank Farm in the 200 East Area
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Figure 15: 241-AP-06A Central Pump Pit Jumper AP06A-WT-J-[L-M-(H)] (H-14-111306, Sheet 1)
Figure 16: 241-AP-06A Central Pump Pit Wall Nozzle Assembly (H-14-111307, Sheet 1)
Figure 17: Tie-in to Waste Transfer Lines 3” SN-637 & 3” SN-700 (ECN-714908)
1.2 DESIGN REVIEW REQUIREMENTS

Many of the WFD – LAW Feed components required for the storage, treatment, and transfer of dangerous or mixed waste are regulated by WAC 173-303-640(3) requirements. WAC codes require an IQRPE’s review of the design of these components prior to installation.

As a basis for the IQRPE certification, a review is performed on a final version of the document design package as prepared and reviewed by WRPS. Documents such as drawings, calculations, Engineering Change Notices (ECNs), Engineering Design Transmittals (EDTs), Technical Evaluations, and specifications included in the design review package that are marked as final, and have signatures of the preparer, checker, and approver, are reviewed by the IQRPE as a completed document. All other documents will be reviewed as preliminary or supportive information.

The IQRPE maintains “independence” at all times. Comments and suggestions by others may be considered by the IQRPE during the preparation of reports and plans, but only the IQRPE can implement changes to the master IQRPE documents.

1.3 DESIGN OVERVIEW FOR WASTE FEED DELIVERY – LAW FEED

This Design Assessment Report is prepared for the Owner by an IQRPE to certify that the proposed tank system will have sufficient structural integrity, and is acceptable for storing and treating dangerous waste per WAC 173-303-640(3)(a).

The WFD – LAW Feed will support the effort to provide a waste feed to the Waste Treatment Plant (WTP) in support of the DFLAW-WFD Upgrades Project.

The components within the scope of this IQRPE Design Assessment for WFD – LAW Feed include only those that will be in direct contact with waste fluids and are situated above the riser level of the DST. These components include:

- **DST 241-AP-102 Equipment:**
  - **Pump Pit 241-AP-02D:**
    - 02D Riser Adapter Assembly
    - Jumper Assembly AP02D-WT-J-[W-U]
  - **Central Pump Pit 241-AP-06A:**
    - 06A Riser Adapter Assembly
    - Feed Pump Assembly WT-P-001 (Serial No. 000-0)
    - Feed Pump Assembly WT-P-002 (Serial No. 000-0)
    - Jumper Assembly AP06A-WT-J-[F-G-P1-P2].
    - Jumper Assembly AP06A-WT-J-[K-(H)]
    - Jumper Assembly AP06A-WT-J-[F-H]
    - Jumper Assembly AP06A-WT-J-[L-M-(H)]
    - Wall Nozzle
- **Tie-in to Waste Transfer Lines 3”SN-637 & 3”SN-700**

The following sections list and briefly describe each of the WFD – LAW Feed equipment components included in this design review.
1.3.1 Waste Feed Delivery – LAW Feed Equipment: Pump Pit 241-AP-02D

1.3.1.1 02D Riser Adapter Assembly


1.3.1.2 Jumper Assembly AP02D-WT-J-[W-U]


1.3.2 Waste Feed Delivery – LAW Feed Equipment: Central Pump Pit 241-AP-06A

1.3.2.1 06A Riser Adapter Assembly


1.3.2.2 Feed Pump Assembly P-001A (Serial No. 000-1A)

Feed Pump Assembly P-001A (Serial No. 000-1A) is a 30 horsepower (H-14-020803) vertical turbine pump with a length of 49-ft. 3-in. (SK-AP-06A-A01, AP Farm Waste Transfer 241-AP-06A Feed Pump Sketch). The discharge of the pump is routed through Nozzle “P1”. The pump is
both situated on, and supported by, the 06A Riser Adapter Assembly (H-14-111308) at the top of 42” Riser-013 in Central Pump Pit 241-AP-06A (H-14-010503; H-14-111311).

1.3.2.3 Feed Pump Assembly P-001B (Serial No. 000-1B)

Feed Pump Assembly P-001B (Serial No. 000-1B) is a 30 horse power (H-14-020803) vertical turbine pump with a length of 49-ft. 3-in. (SK-AP-06A-001). The discharge of the pump is routed through Nozzle “P2”. The pump is both situated on, and supported by, the 06A Riser Adapter Assembly (H-14-111308) at the top of 42” Riser-013 in Central Pump Pit 241-AP-06A (H-14-010503; H-14-111311).

1.3.2.4 Jumper Assembly AP06A-WT-J-[(F)-G-P1-P2]

Jumper Assembly AP06A-WT-J-[(F)-G-P1-P2] (H-14-111303) incorporates Connectors “G”, “P1” and “P2” and Nozzle “F”. Connector “P1” engages with Nozzle “P1” on Feed Pump Assembly P-001A; Connector “P2” engages with Nozzle “P2” on Feed Pump Assembly P-001B. Connector “G” engages with Nozzle “G” on the 241-AP-06A Riser Adapter Assembly (H-14-111308) to route flow to DST 241-AP-106. Nozzle “F” engages with Connector “F” on Jumper Assembly AP06A-WT-J-[F-H] (H-14-111305, AP Farm Waste Transfer 241-AP-06A Jumper AP06A-WT-J-[F-H]). The jumper assembly is equipped with two (2) integral ball valves, V-121 and V-124 (H-14-111303). V-121 is a three-way ball valve used for routing pump flow from either Connector “P1” or “P2” to Nozzle “F”. V-124 is used to route flow from the jumper to Nozzle “G” for flow into DST 241-AP-106 (H-14-020803).

1.3.2.5 Jumper Assembly AP06A-WT-J-[K-(H)]


1.3.2.6 Jumper Assembly AP06A-WT-J-[F-H]


Connector “H” engages with Nozzle “H” on Jumper Assembly AP06A-WT-J-[LM-(H)] (H-14-111306) during commissioning of the WFD – LAW Feed system for recycling flow to DST 241-AP-106 (H-14-020803). When waste flow is to be routed out of Central Pump Pit 241-AP-06A, Connector “H” is subsequently engaged with Nozzle “H” on Jumper Assembly AP06A-WT-J-[K-(H)].
1.3.2.7 Jumper Assembly AP06A -WT-J-[L-M-(H)]

Jumper Assembly AP06A -WT-J-[L-M-(H)] (H-14-111306) contains Nozzle “H”, Nozzle “L” and Connector “M”. The jumper is used during commissioning of the WFD – LAW Feed system for recycling flow to DST 241-AP-106. During the recycling operation, Nozzle “H” is engaged to Connector “H” of Jumper Assembly AP06A-WT-J-[F-H] and Connector “M” is engaged to Nozzle “M” on the 06A Riser Adapter Assembly (H-14-111308). When the WFD – LAW Feed system is ready to be configured for routing waste flow out of Central Pump Pit 241-AP-06A via Wall Nozzle “K” (H-14-111307), Jumper Assembly AP06A-WT-J-[L-M-(H)] is removed and Jumper Assembly AP06A-WT-J-[K-H] (H-14-111304) is installed in its place (ECN-714959, 241-AP-06A Transfer Pump Jumper Tie-In to Line 3”SN-637; H-14-020803).

1.3.2.8 Wall Nozzle

The Wall Nozzle (H-14-111307) is installed in the south wall of Central Pump Pit 241-AP-06A (H-14-010503; H-14-111311). It contains Nozzle “K” which engages with Connector “K” on Jumper Assembly AP06A-WT-J-[K-H] (H-14-111304) and is used to route waste flow into and out of Central Pump Pit 241-AP-06A (H-14-020803, Sheet 15).

1.3.3 Waste Feed Delivery – LAW Feed Equipment: Tie-in to Waste Transfer Lines 3”SN-637 & 3”SN-700

New sections of buried piping will be installed to tie in to existing encapsulated pipe lines 3”SN-637 & 3”SN-700 for WFD to the WTP and return of waste effluent from the WTP to the 241-AP Tank Farm. (ECN-714471, Cut and Cap Lines 3” SN-637 and 3” SN-700 at Locations Identified for W-211 Transfer Line Upgrade; ECN-714910, Connect New Line From Pump Pit 241-AP-06A to 3” SN-637 Piping; RPP-SPEC-62666, Procurement Specification for Fabrication of a Double Containment Piping System for Tank Farm Upgrades/Waste Feed.

The pipe materials for the new piping are specified in RPP-SPEC-62029, Waste Feed Delivery: Tank Farm System Infrastructure Upgrades Specification. The primary pipe is ASTM A312 TP316L and the secondary pipe is ASTM A106 Grade B (RPP-CALC-62528, B31.3 Evaluation of Tie-In Transfer Lines).

1.4 SCOPE OF IQRPE DESIGN ASSESSMENT

This design assessment includes a comprehensive review of the design package per WAC 173-303-640(3).

1.4.1 Portions of the Waste Feed Delivery – LAW Feed Included in Scope for IQRPE Certification

Documents included in this design review for the WFD – LAW Feed include:

- Calculations,
- Procurement Specifications,
- Technical Specifications,
- Design and Fabrication Drawings,
• ECNs,
• DCNs,
• Piping and Instrumentation Drawings (P&IDs)

A list of documents reviewed by the IQRPE as part of this Design Assessment Report is included in Section 4.0.

1.4.2 Portions of the Waste Feed Delivery – LAW Feed Not Included in Scope for IQRPE Certification

Components that are not within the scope of this IQRPE Design Assessment for WFD – LAW Feed include those that will not be in direct contact with waste fluids or are situated below 42” Riser-013 in Central Pump Pit 241-AP-06A and reside inside of DST 241-AP-106. These components include:

• Feed Pump Assemblies P-001A and P-001B (SK-AP-06A-001) for all pump components situated below the 06A Riser Adapter Assembly (H-14-111308).

2.0 ASSESSMENT SUMMARY

As described in Section 2.2, systems within the IQRPE scope of this assessment (Section 1.4.1) are adequately designed to prevent failure caused by corrosion or by structural loads imposed by the system’s intended service. These conditions are described in more detail below. The system design complies with the applicable requirements of WAC 173-303-640(3). Design documents that were reviewed as part of this assessment are referenced in Section 4.0.

2.1 CODES, STANDARDS, AND REGULATIONS

The codes, standards, and regulations specifically used during the preparation of this certification are referenced, as necessary, throughout this report. A complete list of applicable references is contained in Section 4.0.

2.2 BASIS OF DESIGN

The primary features of the WFD – LAW Feed components are presented in Table 1.

Table 1: Waste Feed Delivery – LAW Feed Component Features

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>02D Riser Adapter Assembly</td>
<td>• Situated at top of 12” Riser-015 in Pump Pit 241-AP-02D</td>
</tr>
<tr>
<td></td>
<td>• Contains Nozzles “W” and “Y”</td>
</tr>
<tr>
<td></td>
<td>• Nozzle “W” engages with Connector “W” on Jumper Assembly AP02D-WT-J-[W-U]</td>
</tr>
<tr>
<td></td>
<td>• Nozzle Y fitted with 3” horizontal isolation blank</td>
</tr>
<tr>
<td></td>
<td>• Used for routing waste flow to DST 241-AP-102</td>
</tr>
<tr>
<td></td>
<td>• 1” thick carbon steel base plate</td>
</tr>
<tr>
<td>Equipment</td>
<td>Features</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Jumper Assembly AP02D-WT-J-[W-U]              | • Contains Connectors “U” and “W”  
• Connector “W” engages with Nozzle “W” on 02D Riser Adapter Assembly  
• Connector “U” engages with existing Nozzle “U” in Pump Pit 241-AP-02D wall  
• Used for routing waste flow to DST 241-AP-102 |
| 06A Riser Adapter Assembly                    | • Situated at top of 42” Riser-013 in Central Pump Pit 241-AP-06A  
• Contains Nozzles, “G” and “M”  
• Positions and supports Feed Pump Assemblies P-001A & P-001B  
• 1 1/8” thick carbon steel base plate assembly |
| Feed Pump Assemblies P-001A & P-001B           | • Situated on top of, and supported by, 06A Riser Adapter Assembly  
• 30 horse power motor.  
• 49-ft. 3-in. overall length below base plate  
• Dead head does not exceed 150 psig  
• Designed for flow rate of 60-88 gpm |
| Jumper Assembly AP06A-WT-J-[F]-G-P1-P2         | • Contains Connectors “G”, “P1” and “P2” and Nozzle “F”  
• Connectors “P1” and “P2” engage with discharge of Feed Pump Assemblies P-001A & P-001B, respectively  
• Incorporates two integral ball valves, V-121 and V-124 |
| Jumper Assembly AP06A-WT-J-[K-(H)]             | • Contains Connector “K” and Nozzle “H”  
• Used to route waste flow out of Central Pump Pit 241-AP-06A via Nozzle “K” on the wall nozzle assembly |
| Jumper Assembly AP06A-WT-J-[F-H]               | • Contains Connector “F” and Connector “H”  
• Connector “H” engaged with Nozzle “H” on Jumper Assembly AP06A-WT-J-[K-(H)] to route waste flow out of Central Pump Pit 241-AP-06A |
| Jumper Assembly AP06A-WT-J-[L-M-(H)]           | • Contains Nozzle “H”, Nozzle “L” and Connector “M”  
• Used during commissioning of the WFD – LAW Feed system for recycling flow to DST 241-AP-106 |
| Wall Nozzle                                    | • Contains Nozzle “K”  
• Installed in the south wall of Central Pump Pit 241-AP-06A  
• Engages with Connector “K” on Jumper Assembly AP06A-WT-J-[K-(H)]  
• Used to route waste flow into and out of Central Pump Pit 241-AP-06A |
| Tie-in to Waste Transfer Lines 3”SN-637 & 3”SN-700 | • 3” primary pipe made of ASTM A312 TP316L  
• 6” secondary pipe made of ASTM A106 Grade B |
2.2.1 Structural Design Standards

WAC 173-303-640, Tank Systems, requires that an IQRPE certify that the proposed tank system will have sufficient structural integrity and is acceptable for storing and treating dangerous waste. This assessment must show, in accordance with WAC 173-303-640(3)(a), Design and Installation of New Tank Systems or Components, that the foundation, structural support, seams, connections, and pressure controls are adequately designed and that the tank system has sufficient structural strength, compatibility with the waste to be stored and treated, and corrosion protection to ensure that it will not collapse, rupture, or fail.

Mechanical calculations performed for the WFD-LAW Feed piping systems are prepared in accordance with piping code requirements in ASME B31.3, Process Piping (RPP-CALC-62528, B31.3 Evaluation of Tie-In Transfer Lines). Calculations include the following areas as applicable:

- Pipe wall thickness calculations for pressure.
- Stress calculations for sustained loads due to pressure, dead load, and other sources.
- Stress calculations for displacement due to thermal loads.
- Stress calculations for occasional loads such as pressure, weight, and earthquake loads.

WAC 173-303, Dangerous Waste Regulations, defines backfill requirements to provide structural support to prevent excessive settlement and corrosion. The corrosion assessment is addressed in Section 2.2.2 of this report.

The following activities were conducted in the review of design standards for the WFD – LAW Feed:

- Structural design standards, codes, and criteria were reviewed to ensure clear and specific references.
- Structural calculations were reviewed.

Where possible, the IQRPE has reviewed the design package to ensure that the following activities have been incorporated into the technical specifications:

- Structural calculations are provided for the WFD – LAW Feed components.
- Calculations of thickness account for the assumed corrosion/erosion rate.
- Seismic considerations appropriate for the risk zone are included in the structural calculations.
- Foundations are deep enough in the ground to eliminate frost heave per the requirements of WAC 173-303-640(3)(a)(v)(C). New equipment is either attached to existing tank structures or designed to accommodate frost heave.
- Adequate freeze protection is provided.

The information below highlights the IQRPE structural design standard review for the relevant WFD – LAW Feed components and also identifies any specific exceptions to this IQRPE certification as they relate to the structural review.

The loadings imposed on the domes of DST 241-AP-102 and 241-AP-106 from the equipment associated with the WFD – LAW Feed were evaluated to assure they were within acceptable values (RPP-CALC-62820, WFD Associated Dome Load Evaluation).

Both pump pits are equipped with instrumentation that enables them to be monitored for freezing temperatures (H-14-109814, Tank Farm Internal Pit Temperature Monitors). The components
installed in Pump Pit 241-AP-02D and Central Pump Pit 241-AP-06A are protected from freezing temperatures by both the heaters installed in the cover blocks to the pits (H-2-76462, *Structural Pump Pit 241-AP-02D Plans*; H-2-90447, Sheet 9, *Structural Central Pump Pits Plan, Sect & Details*; H-14-020803; H-14-110254, *In Pit Heating Heater Top Level Assembly*) and the configuration of the pits themselves. The pit walls are entirely surrounded with earth and the pit bottom is situated approximately 10 feet below grade (ECN-714763, 241-AP-02D Pit Equipment Installation; ECN-714793, Pump Pit 241-AP-06A Equipment Installation). The frost heaving of foundations and back fill requirements to provide structural support to prevent excessive settlement will not be an issue due to the configurations of the existing pump pits.

The design of the coverblock for Central Pump Pit 241-AP-06A (H-14-111310, *AP Farm Waste Transfer 241-AP-06A Coverblock Assembly*) was evaluated for its adequacy in resisting the loads, including seismic loading, and was found to be acceptable as designed (RPP-CALC-62944, AP-06A Cover Block Analysis).

The south wall of Central Pump Pit 241-AP-06A was required to be core drilled for the installation of the wall nozzle assembly (H-14-111309, *AP Farm Waste Transfer 241-AP-06A Penetration Location Plan*; H-14-111307, *AP Farm Waste Transfer 241-AP-06A Wall Nozzle Assembly*). The structure of the pump pit wall was evaluated to confirm that the loss of reinforcement from the core drilling would not compromise the load and acceptance criteria for the pump pit (RPP-CALC-62608, *Structural Analysis of the Pump Pit 241-AP-06A Wall for the Effect of the Core Drilled Penetrations*; RPP-CALC-62729, *Design of the Penetration in Pump Pit 241-AP-06A*).

The work scope associated with the WFD – LAW Feed Project will install various piping components, including jumpers, in both Pump Pit 241-AP-02D and Central Pump Pit 241-AP-06A. These components include riser adapters, jumpers, pump discharge connectors, and a new pit wall nozzle.

All steel piping components are welded and inspected per ASME B31.3 for the category of normal fluid service. All structural carbon and stainless steel component are welded in accordance with AWS D1.1, *Structural Welding Code - Steel* or AWS D1.6, *Structural Welding Code - Stainless Steel*, as applicable, for statically loaded criteria (H-14-111303; H-14-111304; H-14-111305; H-14-111306); H-14-111307; H-14-111308).

As part of the scope of evaluation related to ASME B31.3, the jumpers in both Pump Pit 241-AP-02D and Central Pump Pit 241-AP-06A were analyzed for loadings related to seismic stresses; thermal contraction; and the effects of support anchor and terminal movement. The calculations determined that the design of the jumpers is adequate for the dead loads, operational loads, seismic loads and other loads and were found to meet ASME B31.3 and NDC-2 requirement including the seismic requirements of ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures* (RPP-CALC-62678, 241-AP-02D Jumper ASME B31.3 Analysis; RPP-CALC-62680, 241-AP-106 Jumper ASME B31.3 Analysis).

Component loads originating from hoisting activities were also evaluated. The design of both the 241-AP-02D and 241-AP-06A riser adapter assemblies was evaluated for lifting loads and loads imposed by a seismic event. The adapter designs were found to be adequate in both instances (RPP-CALC-62671, 241-AP-02D Riser Adapter Assembly Structural Analysis; RPP-CALC-62670, 241-AP-06A Riser Adapter Assembly Structural Analysis).
All of the Pump Pit 241-AP-06A jumper assemblies (H-14-111303; H-14-111304; H-14-111305; H-14-111306) were evaluated for adequacy for withstanding the hoisting loads associated with their installation in Pump Pit 241-AP-06A. The evaluation was performed in accordance with RPP-8360, *Lifting Attachment and Lifted Item Evaluation*; ASME B31.3 and the AISC Steel Construction Manual. The structural integrity of the jumpers was found to be acceptable for resisting hoisting imposed loads (RPP-CALC-62681, 241-AP-106 Jumper Hoisting Analysis).

Waste Transfer Lines 3”SN-637 & 3”SN-700 are used for connecting Central Pump Pit 241-AP-06A of DST 241-AP-106 and Pump Pit 241-AP-02D of DST 241-AP-102, respectively, to their appropriate interface connection points at the WTP. The lines are supported at numerous points along the length of their travel path (H-14-111322, *Piping Waste Feed Line Mod Pipe Support Plan*; H-14-111372, *Piping LAW Interface Piping Pipe Support Plan*; H-14-111373, *Piping Details AP Farm Yard Piping*). The configuration of the below-grade piping supports for the LAW Facility feed piping was structurally evaluated and found adequate for the various dead, live, and seismic loadings that may be expected to be experienced (RPP-CALC-62660, *LAW Feed Buried Structural Supports*).

The design details associated with the tie-in of the new line segments to the existing waste transfer lines were evaluated for structural concerns related to their adequacy relative to deadweight, seismic, and other design loads as specified in ASME B31.3. The evaluation determined that the design of the installation meets ASME B31.3 and Natural Phenomena Hazard (NPH) Design Category (NDC)-2 requirements including ASCE 7 seismic loading (RPP-CALC-62528, *B31.3 Evaluation of Tie-In Transfer Lines*).

The waste present in the waste transfer lines is protected from freezing by both the earthen covering over the lines and also by line configurations that enable their liquid waste content to self-drain. Transfer piping 3”SN-637 between Central Pump Pit 241-AP-06A to the interface connection at the WTP has a high point that enables the shorter portion of the piping run to drain into Central Pump Pit 241-AP-06A and the long portion of the run to drain to the WTP. Transfer piping 3”SN-700 between Pump Pit 241-AP-02D to the interface connection at the WTP has a continuous downward slope from the pump pit to the interface point enabling the piping run to drain to the WTP (H-14-111375, *Piping AP Farm Waste Feed Hydraulic Diagram*; H-14-111321, *LAW Feed Upgrades Civil Plan and Profile*; H-14-111371, *LAW Interface Piping Civil Plan and Profile*).

The IQRPE concludes that the appropriate structural considerations for the WFD – LAW Feed have been made.

### 2.2.1.1 Structural Design Exceptions

Based on the above review, there are no IQRPE certification exceptions to the structural design of the components used for the WFD – LAW Feed.

The IQRPE concurs that this structural design meets the requirements of WAC 173-303-640(3).

### 2.2.2 Waste Compatibility

Regulations located in WAC 173-303-640(3)(a) require tank systems be compatible with the wastes transported or otherwise handled. The compatibility of the WFD – LAW Feed components with waste stream products was evaluated.
RPP-RPT-61441, *Waste Feed Delivery Tank Farm Upgrades Design Non-Metallic Material Evaluation*, evaluated the non-metallic materials of the WFD – LAW Feed that would be in contact with the waste stream. The evaluation of the non-metallic materials took into consideration their resistance to both radiation and chemicals as well as constraints imposed by the range of operating temperatures and the intended applications.

Materials in contact with the waste stream includes both metallic and nonmetallic materials. The nonmetallic materials include EPDM (Ethylene Propylene Diene Monomer); EPR (Ethylene Propylene Rubber); ETEF (Ethylene-Tetrafluoroethylene)(Tefzel); Neoprene (Polychloroprene); PTFE (Polytetrafluoroethylene (Teflon)); PVDF (Polyvinylidene Fluoride or Polyvinylidene Difluoride, Kynar).

Both the carbon and stainless steel metallic materials used for the WFD – LAW Feed components were determined to be suitable for their intended applications.

### 2.2.3 Anticipated Chemistry and Controls

Information on the composition of the liquid waste originating from the DST can be found in RPP-SPEC-61910, *Specification for the Tank-Side Cesium Removal Demonstration Project (Project TD101)*.

All materials in contact with tank waste are austenitic stainless steel, polytetrafluoroethylene (PTFE), or ethylene propylene (EPM or EPDM). The primary piping material in contact with the liquid waste stream is made of stainless steel. Each of these materials has a long history of successful use with Hanford nuclear waste. Tank waste conditions that contribute to corrosion are strictly monitored and controlled for compliance with waste specifications.

Per RPP-CALC-62678, 241-AP-02D Jumper ASME B31.3 Analysis, and RPP-CALC-62680, 241-AP-106 Jumper ASME B31.3 Analysis, the corrosion-erosion allowance for both carbon steel and austenitic stainless steel piping is 0.2 mils per year for the 25 year design life of all metallic process piping (RPP-SPEC-62029, *Waste Feed Delivery: Tank Farm System Infrastructure Upgrades Specification*). When the 0.2 mils per year value is taken over the 25 year design life it yields a total value of 0.005 in.

The WFD – LAW Feed components installed in Pump Pit 241-AP-02D and Central Pump Pit 241-AP-06A are in a covered concrete structure. The enclosures serve to limit any corrosion on the exterior of the components from weather elements. In addition, the waste composition that will be pumped through piping components is strictly controlled and will not contribute to a corrosion rate greater than the design corrosion rate of 0.2 mils per year.

Dissimilar materials are noted on the dunnage of the jumper assemblies (H-14-111303; H-14-111304; H-14-111305; H-14-111306; H-14-111313). The hollow structural steel is carbon steel, which is welded to austenitic stainless steel channels to support the process piping. Welding austenitic stainless steels to carbon and low alloy steels are established methods in the process and construction industries. Post-weld surface coating will ensure that galvanic corrosion cells cannot be set up across the joint where there is a composition gradient. All exposed carbon steel surfaces will be painted with two coats of Amercoat®1 220, a water-based acrylic enamel or can be powder-coated as an option to painting (H-14-111303; H-14-111304; H-14-111305; H-14-111306; H-14-

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1 Amercoat is a trademark of PPG Industries Ohio, Inc.,
111313). Sacrificial corrosion of the carbon steel components in contact with the jumper assembly is not expected. The stainless steel materials in contact with waste are not at risk of galvanic corrosion.

The IQRPE concludes that appropriate corrosion considerations have been made.

2.2.3.1 Compatibility Exceptions

Based on the above review, there are no IQRPE certification exceptions to the anticipated waste compatibility or corrosion issues with the piping materials used for the WFD – LAW Feed that may come into contact with the liquid waste stream.

2.2.4 Pressure Control System

WAC 173-303-640 requires that an IQRPE certify that the proposed tank system has been designed with appropriate pressure control systems. The piping components of the WFD – LAW Feed were evaluated for pressure control issues.

2.2.4.1 Waste Feed Delivery – LAW Feed Equipment: Pump Pit 241-AP-02D

The pressure retaining components installed in Pump Pit 241-AP-02D include the 02D Riser Adapter Assembly (H-14-111314, AP Farm Waste Transfer 241-AP-02D Riser Adapter Assembly) and Jumper Assembly AP02D-WT-J-[W-U] (H-14-111313). Both of these items contain piping components which are welded and inspected per ASME B31.3, for the category of normal fluid service. Jumper Assembly AP02D-WT-J-[W-U] is fabricated and tested in accordance with RPP-14541, Jumper Fabrication and Testing Specification for Tank Farms. The design pressure for both assemblies is 400 psig and the design temperature is 200 °F. They are required to undergo hydrostatic testing at 600 psig. Both the jumper and the riser adapter underwent a detailed ASME B31.3 analysis (RPP-CALC-62678).

2.2.4.2 Waste Feed Delivery – LAW Feed Equipment: Central Pump Pit 241-AP-06A

The pressure retaining components installed in Central Pump Pit 241-AP-06A include the 06A Riser Adapter Assembly (H-14-111308); Feed Pump Assemblies P-001A & P-001B (SK-AP-06A-001), Jumper Assembly AP06A-WT-J-[F-G-P1-P2] (H-14-111303), Jumper Assembly AP06A-WT-J-[K-H)] (H-14-111304), Jumper Assembly AP06A-WT-J-[F-H] (H-14-111305), Jumper Assembly AP06A -WT-J-[L-M-H)] (H-14-111306), and the Wall Nozzle (H-14-111307).

Feed Pump Assemblies P-001A and P-001B are designed to produce a flow rate of 60-88 gpm while not exceed a dead head pressure that would be capable of producing pressures greater than 150 psig in the WTP piping. A flow control valve is used in conjunction with the pumps to maintain the desired flow rate to the WTP (RPP-CALC-62607, AP-106 to WTP LAW Facility Flow Analysis).

The pressure retaining piping of the 06A Riser Adapter Assembly; the four jumpers; and the Wall Nozzle is required to be fabricated, welded, inspected and tested in accordance with ASME B31.3 for the category of normal fluid service. The design pressure for the piping of the 06A Riser Adapter Assembly and the four jumpers is 400 psig and the design temperature is 200 °F; the
piping is required to undergo hydrostatic pressure testing at 600 psig (H-14-111308; H-14-111303; H-14-111304; H-14-111305; H-14-111306).

The primary pipe of the wall nozzle has a design pressure of 620 psig and design temperature of 200 °F; it is required to undergo a hydrostatic pressure test at 930 psig. The design pressure for the encasement (outer) portion of the wall nozzle assembly is 50 psig and the design temperature is 150 °F; it is required to undergo a hydrostatic leak pressure test at 75 psig. (H-14-111307).

Jumpers AP06A-WT-J-[(F)-G-P1-P2]; AP06A-WT-J-[K-(H)]; AP06A-WT-J-[F-H] and AP06A -WT-J-[L-M-(H)] are fabricated and tested in accordance with RPP-14541. The pressure retaining piping of the four jumpers and the 06A Riser Adapter Assembly underwent an ASME B31.3 evaluation; their designs were determined to have met ASME B31.3 requirements (RPP-CALC-62680).

2.2.4.3 Waste Feed Delivery – LAW Feed Equipment: Tie-in to Waste Transfer Lines 3”SN-637 & 3”SN-700

Both the existing and new buried waste transfer piping underwent an evaluation for differences in the ASME B31.3 code requirements between the 1996 and 2016 editions of the code. The evaluation determined that the 2016 version of the ASME code used more conservative methods of analysis. This in turn meant that results based on the 1996 version of the code did not pose any concern for adversely compromising design responses when compared the criteria in the 2016 code (RPP-CALC-62950, B31.3 Code of Record Gap Analysis).

The design details associated with the tie-in of the new lines to existing Waste Transfer Lines 3”SN-637 & 3”SN-700 were evaluated for their compliance with ASME B31.3 piping code requirements. The evaluation determined that the design of the new waste transfer piping installation meets ASME B31.3 code requirements (RPP-CALC-62528, B31.3 Evaluation of Tie-In Transfer Lines).

The WFD system piping and components located between the 241-AP Tank Farm and the WTP-LAW facility were evaluated to determine if internal transient pressures and forces due to hydraulic transient loads were within the allowable values of ASME B31.3. The evaluation detailed both engineered and administrative controls that could be employed to eliminate the potential for creating overpressure conditions in the system (RPP-CALC-62531, AP Farm to WTP LAW Facility Hydraulic Transient Analysis).

2.2.4.4 Pressure Control System Exceptions

Based on the above review, there are no IQRPE Certification exceptions to the pressure control system review.

The IQRPE concurs that this design basis meets the requirements of WAC 173-303-640(3).

The IQRPE concludes that the appropriate pressure control considerations for the WFD – LAW Feed have been made.

2.2.5 Secondary Containment System

WAC 173-303-640 requires that an IQRPE certify that the proposed tank system has been designed with an appropriate secondary containment system. Secondary containment for tank systems that
store, accumulate, or treat dangerous waste must be designed and installed to meet the requirements of WAC 173-303-640(4)(b). Secondary containment for the WFC – LAW Feed is accomplished by Pump Pit 241-AP-02D of DST 241-AP-102 and Central Pump Pit 241-AP-06A of DST 241-AP-106. Each of the pump pits is equipped with an integral floor drain to route any leakage from internal components back to the respective DST via the 12” riser (H-14-010803; H-2-90599, *Jumper Arrangement Central Pump Pit 241-AP-01A Thru 08A*).

Two (2) leak detectors are installed for monitoring Central Pump Pit 241-AP-06A: LDE-216A and LDE-216B (H-14-020803, *Waste Transfer System (WT) O&M System P&ID*, Sheet 4). Two (2) other leak detectors are installed for monitoring Pump Pit 241-AP-02D: LDE-205A and LDE-205B (H-14-020803). Leak detector placement is consistent with generally accepted engineering practices to provide timely detection of any leakage from the primary pathway into the secondary containment.

All waste transfer activities outside Pump Pit 241-AP-02D of DST 241-AP-102 and Central Pump Pit 241-AP-06A of DST 241-AP-106 are conducted through both new and waste existing waste transfer lines. These lines include both primary piping and a secondary encasement. Transfer piping 3”SN-637 between Central Pump Pit 241-AP-06A to the interface connection at the WTP has a high point that enables the shorter portion of the piping run to drain into Central Pump Pit 241-AP-06A and the long portion of the run to drain to the WTP. Transfer piping 3”SN-700 between Pump Pit 241-AP-02D to the interface connection at the WTP has a continuous downward slope from the pump pit to the interface point enabling the piping run to drain to the WTP (H-14-111375, *Piping AP Farm Waste Feed Hydraulic Diagram*; H-14-111321, *LAW Feed Upgrades Civil Plan and Profile*; H-14-111371, *LAW Interface Piping Civil Plan and Profile*).

All waste transfers are required to undergo reviews within the scope of waste leak path evaluations. These evaluations are required to be completed prior to the initiation of any waste transfer activities.

Conclusions from the review of the design standards for the WFD – LAW Feed are summarized below:

- The WFD– LAW Feed is designed to prevent any migration of wastes out of the secondary containment system to the soil, groundwater, or surface water at any time during the use of the system.
- The system is constructed of materials that are compatible with the wastes to be placed in the system.
- The system has been specified to have sufficient strength to withstand stresses due to static head during a release, pressure gradients, climatic conditions, and other stresses resulting from daily operations.
- A leak-detection system for liquids has been provided.
- The system is sloped or otherwise designed or operated to drain and remove liquids resulting from leaks, spills, or precipitation.

The IQRPE concludes that the appropriate secondary containment considerations have been made.
2.2.5.1 Secondary Containment System Exceptions
Due to the fact that secondary containment was already incorporated into the WFD – LAW Feed design, there are no exceptions to the IQRPE certification of the secondary containment review assessment.

The IQRPE concurs that this design basis meets the requirements of WAC 173-303-640.

2.2.6 Ancillary Equipment Design
WAC 173-303-640 requires that an IQRPE certify that the proposed tank system has been designed with appropriate ancillary equipment in accordance with the requirements of WAC 173-303-640(3)(f) and (4)(f). WAC 173-303-040 defines “Ancillary Equipment” as any device including, but not limited to, such devices as piping, fittings, flanges, valves, and pumps, that is used to distribute, meter, or control the flow of dangerous waste from its point of generation to a storage or treatment tank(s), between dangerous waste storage and treatment tanks to a point of disposal on-site, or to a point of shipment for disposal off-site. A review of the ancillary equipment design is normally part of the IQRPE review. The scope of this review includes components listed as in-scope in Section 1.3 and as described in the review sections above. Piping, fittings, flanges, valves, and pumps have been evaluated by the IQRPE throughout this report, which includes all ancillary equipment in-scope for this Design Assessment. No other ancillary equipment was identified.

2.2.6.1 Ancillary Equipment Design Exceptions
Based on the above review, there are no IQRPE certification exceptions to the ancillary equipment design review.

The IQRPE concurs that this design basis meets the requirements of WAC 173-303-640(3).

2.2.7 P&ID Review
The P&ID details for WFD – LAW Feed are depicted on. H-14-020803, Waste Transfer System (WT) P&ID.

The IQRPE concludes that the appropriate P&ID review has been made.

2.2.8 Corrosion Assessment
WAC 173-303-640 requires an IQRPE corrosion assessment of the external portion of the primary containment that is in direct contact with soil or water and that the tank be compatible with the waste stored within it.

For the waste transfer to WTP, a new Type 316L stainless steel line is being installed between DST AP-106 to a connection to the existing SN-637 line.
2.2.8.1 External Corrosion

According to RPP-RPT-61073, *Cathodic Protection of New SN-637 and SN-700 Lines*, the new line will use the basic layout shown below in Figure 2-1.

![Figure 18: Transfer Line Construction Layout](image)

This design does not require cathodic protection (CP), indeed, application of CP is difficult and may, in most instances be impracticable. Nevertheless, an inert anode will be installed in the pipe trench (RPP-PLAN-62941, *Pre-Construction Cathodic Protection Test Plan for Pipelines to WTP*) and can be activated at a later date if desired.

2.2.8.2 Internal Corrosion

As noted in Paragraph 2.2.2, the polymers planned for use in this project are compatible with the waste. It has been previously shown in Project W-211 documents that the existing stainless steel lines are compatible with the waste. Similarly, the use of Type 316L is as acceptable for the planned use as Type 304L.

The IQRPE concludes that appropriate corrosion considerations have been made for the WFD – LAW Feed.

2.2.8.3 Corrosion Assessment Exceptions

Based on the above requirements, there are no IQRPE certification exceptions to the corrosion assessment review with the materials.

The IQRPE concurs that this design basis meets the requirements of WAC 173-303-640.

2.2.9 Recommended Inspection Schedule

Inspections are not included within the current scope of this Design Assessment report for WFD – LAW Feed.

The IQRPE concurs that this design basis meets the requirements of WAC 173-303-640.
3.0 DESIGN REVIEW ASSESSMENT CERTIFICATIONS

The WFD – LAW Feed design, as previously described, has been reviewed by the IQRPE and was assessed to be in compliance with the applicable sections of WAC 173-303-640. These results are based on a review of the applicable codes, standards, and documents.

The following individuals participated in the preparation of this design assessment.

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The certification below is in accordance with the requirements of WAC 173-303-810(13)(a).

**WAC 173-303-810(13)(a)**

_I certify under penalty of the law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations._

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Report Reviewed by:

Paul M. Giever, PE  
Independent Qualified Registered Professional Engineer

**September 9, 2019**

Date
4.0 REFERENCES


H-14-109814, 2017, Sheet 1, Tank Farm Internal Pit Temperature Monitors, Rev. 9, Washington River Protection Solutions, LLC, Richland, Washington.


H-14-111301, 2019, Sheet 1, AP Farm Waste Transfer Waste Feed Layout General Arrangement, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.


H-14-111303, 2019, Sheet 8, AP Farm Waste Transfer 241-AP-06A Jumper Details, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.


H-14-111308, 2019, Sheet 3, AP Farm Waste Transfer 241-AP-06A Riser Adapter Sections and Details, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

H-14-111308, 2019, Sheets 4-5, AP Farm Waste Transfer 241-AP-06A Riser Adapter Details, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

H-14-111309, 2019, Sheets 1-2, AP Farm Waste Transfer 241-AP-06A Penetration Location Plan, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

H-14-111310, 2019, Sheet 1, AP Farm Waste Transfer 241-AP-06A Coverblock Notes and Parts List, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.


H-14-111310, 2019, Sheet 4, AP Farm Waste Transfer 241-AP-06A Coverblock Sections and Details, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

H-14-111310, 2019, Sheet 5, AP Farm Waste Transfer 241-AP-06A Coverblock Details, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

H-14-111310, 2019, Sheet 6, AP Farm Waste Transfer 241-AP-06A Coverblock Details, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.


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H-14-111311, 2019, Sheet 1, AP Farm Waste Transfer 241-AP-06A Pump Pit Assembly, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.


H-14-111311, 2019, Sheet 3, AP Farm Waste Transfer 241-AP-06A Pump Pit Sections and Details, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

H-14-111311, 2019, Sheet 4, AP Farm Waste Transfer 241-AP-06A Pump Pit Sections and Details, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

H-14-111313, 2019, Sheet 1, AP Farm Waste Transfer 241-AP-02D Jumper AP02D-WT-J-[W-U], Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.


H-14-111314, 2019, Sheet 1, AP Farm Waste Transfer 241-AP-02D Riser Adapter Assembly, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

H-14-111314, 2019, Sheet 2, AP Farm Waste Transfer 241-AP-02D Riser Adapter Sections and Details, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

H-14-111314, 2019, Sheet 3, AP Farm Waste Transfer 241-AP-02D Riser Adapter Sections and Details, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

H-14-111317, 2019, Sheet 1, AP Farm Waste Transfer 241-AP-02D Pump Pit Parts List, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.


H-14-111321, 2019, Sheet 1, LAW Feed Upgrades Civil Plan and Profile, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

H-14-111322, 2019, Sheet 1, Piping Waste Feed Line Mod Pipe Support Key Plan, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.


H-14-111371, 2019, Sheets 1-2, LAW Interface Piping Civil Plan and Profile, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

H-14-111372, 2019, Sheet 1, Piping LAW Interface Piping Pipe Support Key Plan, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.


H-14-111373, 2019, Sheet 1, Piping Details AP Farm Yard Piping, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

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RPP-CALC-62531, 2019, AP Farm to WTP LAW Facility Hydraulic Transient Analysis, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.


RPP-CALC-62608, 2019, Structural Analysis of the Pump Pit 241-AP-06A Wall for the Effect of the Core Drilled Penetrations, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-CALC-62660, 2019, LAW Feed Buried Structural Supports, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-CALC-62670, 2019, 241-AP-06A Riser Adapter Assembly Structural Analysis, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.


