DOCUMENT RELEASE AND CHANGE FORM

Prepared For the U.S. Department of Energy, Assistant Secretary for Environmental Management
By Washington River Protection Solutions, LLC., PO Box 850, Richland, WA 99352
Contractor For U.S. Department of Energy, Office of River Protection, under Contract DE-AC27-08RV14800

Release Stamp

DATE: Mar 23,2021 HANFORD RELEASE

1. **Doc No:** RPP-RPT-63053 **Rev.** 00

2. **Title:**
Engineering Report Supporting Treatment of the WTP DFLAW Waste Stream at the 200 Area Effluent Treatment Facility Richland, WA

3. **Project Number:** ☒N/A

4. **Design Verification Required:** ☐Yes ☒No

5. **USQ Number:** ☒ N/A N/A-9

6. **PrHA Number** **Rev.** ☐ N/A

Clearance Review Restriction Type: public

7. **Approvals**

Title	Name	Signature	Date
Checker	Russell, Rose M	*Russell, Rose M*	03/04/2021
Clearance Review	Ayers, Lynn M	*Ayers, Lynn M*	03/23/2021
Document Control Approval	Scales, Anthony	*Scales, Anthony*	03/23/2021
Environmental Protection	Beam, Tom	*Beam, Tom*	03/04/2021
Originator	Turner, Behr G	*Turner, Behr G*	03/04/2021
Other Approver	Filip, Jeff	*Turner, Behr G for Filip, Jeff per email*	03/04/2021
Responsible Manager	Hendrickson, Doug W	*Hendrickson, Doug W*	03/04/2021
USQ Evaluator	Wheeler, Ronnie	*Wheeler, Ronnie*	03/04/2021

8. **Description of Change and Justification**

This document is a new release.

9. **TBDs or Holds** ☒N/A

10. **Related Structures, Systems, and Components**

a. **Related Building/Facilities** ☐N/A	b. **Related Systems** ☒N/A	c. **Related Equipment ID Nos. (EIN)** ☒N/A
2025E		

11. **Impacted Documents – Engineering** ☒N/A

Document Number	Rev.	Title

12. **Impacted Documents (Outside SPF):**

N/A

13. **Related Documents** ☐N/A

Document Number	Rev.	Title
ECN-715736	00	ETF Existing Process Connections for Steam Stripper
H-2-839048 SH 001	00	ETF STEAM STRIPPER PROCESS FLOW DIAGRAM STEAM STPR HMB TABLE
HNF-3172	10	Liquid Waste Processing Facilities Waste Acceptance Criteria
RPP-CALC-61950	00	Fate and Transport Analyses of Historical and Future Tritium Releases from the State Approved Land Disposal Site, FY 2018
RPP-CALC-64263	00	Steam Stripper Equipment Sizing Calculations
RPP-CALC-64269	00	ETF Steam Stripper Mass and Energy Balance
RPP-ENV-59397	04	Operations and Maintenance Manual/Pollution Prevention Plan/Spill Plan for the 200 Area Effluent Treatment Facility
RPP-ENV-61571	02	Information Supporting the Renewal Application for State Waste Discharge Permit ST0004500
RPP-PLAN-60723	01	Sampling and Analysis Plan for the Effluent Treatment Facility, Liquid Effluent Retention Facility, and Treated Effluent Disposal Facility
RPP-RPT-61766	00	Alternative Evaluation for Acetonitrile Treatment at the Effluent Treatment Facility
RPP-RPT-62621	00	ETF Acetonitrile Steam Stripper Process Description
RPP-RPT-62622	00	ETF Acetonitrile Steam Stripper Process Control Narrative
RPP-RPT-62739	00	Basis of Preliminary Engineering Targets Set for Receipt of WTP EMF Wastewater at LERF/ETF to Support DFLAW Operations

14. **Distribution**

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Miskho, Anthony (Tony)	INFRASTRUCTURE INTEGRATION
Russell, Rose M	ETF ENGINEERING
Turner, Behr G	AIR & WATER PERMITTING

INFORMATION CLEARANCE REVIEW AND RELEASE APPROVAL

Part I: Background Information

Title: Engineering Report Supporting Treatment of Wastewaters at the 200 Area Effluent Treatment Facility Richland, WA

Publish to OSTI? ☐ Yes ☑ No

Information Category:
☐ Abstract ☐ Journal Article ☐ Summary
☐ Internet ☐ Visual Aid ☐ Software
☐ Full Paper ☐ Report ☑ Other Engineer Report for Permitting Action

Trademark/Copyright "Right to Use" Information or Permission Documentation	Yes	NA
	☐	☑

Document Number: RPP-RPT-63053 Revision 00 Date: March 2021

Author: Turner, Behr G

Part II: External/Public Presentation Information

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Sponsoring Organization(s): Washington River Protection Solutions

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Part III: WRPS Document Originator Checklist

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Document Release Criteria in TFC-ENG-DESIGN-C-25 completed? (Attach checklist)	☐	☑	
If product contains pictures, safety review completed?	☐	☑	

Part IV: WRPS Internal Review

Function	*Organization*	*Date*	*Print Name/Signature/Date*
Subject Matter Expert	WRPS	03/19/2021	Turner, Behr G IDMS Data File att.
Responsible Manager	WRPS	03/04/2021	Hendrickson, Doug W IDMS Data File att.
Other:			

Part V: IRM Clearance Services Review

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Additional Comments from Information Clearance Specialist Review?	☐	☒	Information Clearance Specialist Approval APPROVED By Janis Aardal at 8:16 am, Mar 22, 2021 Print Name/Signature/Date

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INFORMATION CLEARANCE REVIEW AND RELEASE APPROVAL

Part VI: Final Review and Approvals

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	Yes	*N/A*		
WRPS External Affairs	☒	☐	IDMS Data File att.	Mc Cune, Hal C
WRPS Office of Chief Counsel	☒	☐	IDMS Data File att.	Roden, Mari L
DOE – ORP Public Affairs/Communications	☒	☐	IDMS Data File att.	Tyree, Geoffrey T
Other: ORP SME	☒	☐	IDMS Data/Email Pg. 3	Evans, Rana L/Valle, Richard J
Other: DOE OCC	☒	☐	IDMS Data File att.	Hellstrom, George W

Comments Required for WRPS-Indicate Purpose of Document:

This Engineering Report presents to the Environmental Protection Agency and the State of Washington Department of Ecology the technical basis, data, and information to support a planned amendment to the approved federal delisting included in 40 CFR 261, Appendix IX, Table 2 and to demonstrate compliance with the requirements of the Washington State Waste Discharge Permit Number ST0004500.

APPROVED
By Janis Aardal at 8:16 am, Mar 22, 2021

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From: Evans, Rana
To: Aardal, Janis D
Cc: Turner, Behr G; Valle, Richard J
Subject: RE: TOC-RORI-21-007 & RPP-RPT-63053
Date: Tuesday, March 09, 2021 5:46:06 PM

As requested

From: Valle, Richard J <richard_j_valle@orp.doe.gov>
Sent: Friday, March 5, 2021 3:52 PM
To: Evans, Rana <rana_evans@orp.doe.gov>
Subject: RE: ETF Engineering Report

Hi Rana,

I read through and did not have any comments.

Thanks,

Richard J. Valle

U.S. Department of Energy
Office of River Protection
Tank Farm Programs Division

Ph: (509) 376-7256
Cell: (509) 316-1373

- <workflow name="**(JDA) RUSH - RPP-RPT-63053 R0_TreatmentWastewatersETF**" id="**298977429**">
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    <comments>**ATTN - Due Mon., Mar. 8, 2021 - NOON Please approve the Rev. 0, Engineering Report Supporting Treatment of Wastewaters at the 200 Area Effluent Treatment Facility Richland, WA, submitted by Behr Turner for public release to DOE for EPA & Ecology on Monday, March 8th. Thank you, Janis Aardal Information Clearance**</comments>
  </task>
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    <comments>**Rana Evans's comments were addressed and an updated document revision was uploaded to the external clearance work flow.**</comments>
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</workflow>

RPP-RPT-63053
Revision 0

Engineering Report Supporting Treatment of the WTP DFLAW Waste Stream at the 200 Area Effluent Treatment Facility Richland, WA

Prepared by

DK Luneke
S Amali
Akana for Washington River Protection Solutions LLC

Date Published
March 2021

Prepared for the U.S. Department of Energy
Office of River Protection

Contract No. DE-AC27-08RV14800

ENGINEERING REPORT SUPPORTING TREATMENT OF THE WTP DFLAW WASTE STREAM AT THE 200 AREA EFFLUENT TREATMENT FACILITY RICHLAND, WA

Akana Project No. 20-015
March 12, 2021

Prepared for:

washington river protection solutions
an amentum-led company

2425 Stevens Center Place
Richland, WA 99352

Prepared by:

AKANA

6400 SE Lake Road, Suite 270

Portland, Oregon 97222

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Executive Summary

This Engineering Report (ER) presents the technical basis, data, and information to support a planned amendment to the approved federal delisting included in Title 40, *Code of Federal Regulations*, Part 261, Appendix IX, Table 2 and to demonstrate compliance with the requirements of Washington State Waste Discharge Permit Number ST0004500. The regulation and permit are applicable to the operations of the 200 Area Effluent Treatment Facility (ETF) located at the Hanford Site in Richland, Washington. The federal delisting allows the removal of listed waste codes from the waste streams treated at the 200 Area ETF prior to discharge as a non-dangerous/non-hazardous waste to the State-Approved Land Disposal Site. The United States Department of Energy, Office of River Protection is responsible for operations of the 200 Area ETF.

The 200 Area ETF is an operating facility with a flexible process treating multiple waste streams from a variety of Hanford Site operations. A new waste stream from the Waste Treatment and Immobilization Plant, which is currently under construction to immobilize and treat the Hanford Site tank farm mixed wastes as part of the Direct Feed Low Activity Waste program, is planned for treatment at the 200 Area ETF.

The Waste Treatment and Immobilization Plant Direct Feed Low Activity Waste program waste stream is projected to contain a range of organic and inorganic constituents within the 200 Area ETF treatability envelope except for the organic compound acetonitrile. Acetonitrile is projected to be present in Waste Treatment and Immobilization Plant waste stream at concentrations up to 59.9 milligrams per liter (mg/L) which exceeds the approved acetonitrile treatability envelope of 23.1 mg/L. Acetonitrile is projected to be formed as a product of incomplete combustion within the Waste Treatment and Immobilization Plant and not present in the waste feed from the tank farms. The Waste Treatment and Immobilization Plant waste stream containing acetonitrile will be primarily generated from the submerged bed scrubber and wet electrostatic precipitator components.

The ER presents summary descriptions of supplemental organic treatment (i.e., a steam stripping treatment unit) as an additional key unit operation in the 200 Area ETF main treatment train (or primary treatment train as the terms are used interchangeably in operational and regulatory documents) to treat elevated acetonitrile concentrations to below the delisting discharge level of 1.2 mg/L. This ER includes descriptions of the processes by which the 200 Area ETF accepts wastewaters for treatment and its strategy to modify and adjust its treatment processes as necessary to accommodate the wastewaters for effective treatment. Additionally, the ER presents monitoring and verification steps for discharge to the State-Approved Land Disposal Site.

The ER relies on data and information available in a range of technical and regulatory documents to develop its descriptions, evaluations, and findings. The ER content and conclusions are based on the 100% design documents issued and certified by independent licensed engineers. It is developed in general accordance with the requirements of *Washington Administrative Code* 173-240-130.

1.0 INTRODUCTION

This Engineering Report (ER) contains the technical basis, data, and information to support a planned delisting modification and a potential waste discharge permit modification by the U.S. Department of Energy (DOE), to the U.S. Environmental Protection Agency, Region 10 (EPA) and the Washington State Department of Ecology (Ecology). The Office of River Protection operates the Liquid Effluent Retention Facility (LERF) and 200 Area Effluent Treatment Facility (ETF). The 200 Area ETF is an operating facility associated with the approved delisting included in Title 40, *Code of Federal Regulations*, Part 261 (40 CFR 261), Appendix IX, Table 2[1] and State Waste Discharge Permit Number ST0004500 (ST4500)[2]. The approved delisting allows the removal of listed waste codes from waste streams prior to discharge as a non-dangerous/non-hazardous waste. The ST4500 authorizes discharge of the ETF-treated effluent to the State-Approved Land Disposal Site (SALDS). Figure 1 shows the Hanford Site area map and key facilities[3].

The delisting modification is necessitated by the planned receipt of a new waste stream from the Hanford Site Waste Treatment and Immobilization Plant (WTP) Direct Feed Low Activity Waste (DFLAW) program for treatment in the 200 Area ETF. The 200 Area ETF must be ready to receive the WTP DFLAW waste stream to support hot commissioning of the WTP DFLAW facility.

1.1 BACKGROUND

The LERF and 200 Area ETF, and SALDS are associated to varying extents with the receipt, storage, treatment, and disposal of radiological and/or dangerous/hazardous, and non-dangerous/non-hazardous liquid wastewaters from Hanford Site cleanup activities. Figure 2 shows the LERF and 200 Area ETF flow diagram[4].

The LERF is currently a series of three lined and covered surface impoundments (or basins), as shown in Figure 3 with a fourth basin under design and planned for construction in the previously excavated area. The LERF provides storage capacity for waste streams prior to treatment in the 200 Area ETF. Waste streams to be treated at the 200 Area ETF are typically piped from the LERF, although waste can be added directly into the 200 Area ETF treatment system via tanker trucks or containers. The ETF-treated effluent is temporarily stored in three verification tanks for

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[1] Title 40, *Code of Federal Regulations*, Part 261, "Identification and Listing of Hazardous Waste" (40 CFR Part 261) Appendix IX, "Wastes Excluded Under §§ 260.20 and 260.22," Table 2, "Wastes Excluded from Specific Sources"
[2] ST0004500, *State Waste Discharge Permit Number ST0004500*
[3] RPP-ENV-61571, *Information Supporting the Renewal Application for State Waste Discharge Permit ST0004500*
[4] WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste, Liquid Effluent Retention Facility & 200 Area Effluent Treatment Facility Operating Unit Group 3 (OUG-3)*

sampling prior to discharge to the SALDS in compliance with the requirements of the approved delisting and ST4500.

Upon completion of confirmation sampling, the ETF-treated effluent is pumped from the verification tanks to the SALDS via an approximately 6-mile-long transfer pipeline (Figure 1). The SALDS is a rectangular infiltration gallery, approximately 116 feet by 200 feet, located just north of the 200 West Area. The SALDS allows for direct subsurface ground disposal of the ETF-treated effluent and non-contact wastewater[5].

The operations of the LERF and 200 Area ETF are conducted in accordance with the requirements of the Hanford Facility Dangerous Waste Permit[6] which regulates management of dangerous wastes. In addition, the LERF and 200 Area ETF have received a Risk-Based Disposal Approval from EPA[7] to manage polychlorinated biphenyls under the Toxic Substances Control Act. Other requirements that are beyond the scope of this ER must also be met by the LERF and 200 Area ETF such as those associated with health/safety and the Toxic Substances Control Act.

The Hanford Site waste streams treated at the 200 Area ETF originate from multiple sources[8]. These primarily include waste streams from the 242-A Evaporator and from the mixed waste burial trenches. The waste streams include a range of inorganic and organic constituents and radionuclides. The 200 Area ETF treats the waste stream to achieve concentrations that eliminate the hazardous/dangerous characteristics and to meet the required delisting levels. The current wastes excluded can be found in the waste description within the approved delisting[9]. Ecology has approved the delisting under their authority in *Washington Administrative Code* (WAC) 173-303-072[10]. The ST4500 authorizes discharge of the ETF-treated effluent and non-contact wastewaters to the SALDS in accordance with WAC 173-216[11].

Before a waste stream can be approved for receipt at the LERF/ETF, the waste stream must be evaluated to determine if it is within the 200 Area ETF operational envelope. The operational envelope is based on the treatment capability, storage and processing capacity, and compatibility with materials of construction.

The new WTP DFLAW waste stream will contain a range of organic and inorganic constituents forecast to be within the 200 Area ETF treatability envelope concentrations except for the organic compound acetonitrile. Acetonitrile is expected to be present in the WTP DFLAW waste stream in concentrations that exceed its current treatability envelope limit of 23.1 milligrams per

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[5] RPP-ENV-59397, *Operations and Maintenance Manual/Pollution Prevention Plan/Spill Plan for the 200 Area Effluent Treatment Facility*, or RPP-ENV 59397
[6] WA7890008967
[7] External letter, "Approval of the Toxic Substances Control Act (TSCA) Risk-Based Disposal Approval (RBDA) Application for Management of Polychlorinated Biphenyl (PCB) Remediation Waste at the 200 Area Liquid Waste Processing Facilities" (Iani 2004)
[8] DOE/RL-98-62, *200 Area Effluent Treatment Facility Delisting Modification*
[9] 40 CFR 261
[10] *Washington Administrative Code* (WAC) 173-303, "Dangerous Waste Regulations"
[11] WAC 173-216, "State Waste Discharge Permit Program"

liter (mg/L)[12] with an upper bounding acetonitrile concentration of 59.9 mg/L. It is understood that the acetonitrile concentrations may be variable, so an upper bounding acetonitrile concentration of 59.9 mg/L was established. The sizing and capacity calculations for the supplemental organic treatment (i.e., steam stripping treatment unit) used an upper input acetonitrile concentration of 60 mg/L[13].

This ER includes a summary description of a proposed steam stripping treatment unit, as an additional key unit operation in the 200 Area ETF main treatment train when treating the WTP DFLAW waste stream. This unit will treat the acetonitrile concentrations projected in the new WTP DFLAW waste stream to below the delisting discharge limit of 1.2 mg/L[14] for discharge to the SALDS.

1.2 OBJECTIVES

The 200 Area ETF treatability envelope needs to be increased to accept and treat the WTP DFLAW waste stream. Treatment of the WTP DFLAW waste stream will require a steam stripping treatment unit at the 200 Area ETF to meet the acetonitrile delisting level. This ER provides technical data and information needed to justify modifications to the approved delisting and provides supplemental information for the ST4500 renewal. Specifically, the objectives of this ER are as follows.

1. Support approval of the WTP DFLAW delisting modification through an amendment of the approved delisting in 40 CFR 261, Appendix IX, Table 2 to add steam stripping as a new key unit operation in the 200 Area ETF main treatment train in Condition 1(d) to meet the 1.2 mg/L acetonitrile delisting level in Condition 5.

2. Modify the 200 Area ETF influent treatability envelope specified in Table C-2 of the November 29, 2001, delisting petition[15] to reflect changes in treatment technology or operating practices as required by the Rule Condition 1(b) to increase the treatability envelope of acetonitrile from 23.1 mg/L to 59.9 mg/L.

3. Demonstrate that the planned changes will meet the ST4500 requirements.

The ER is structured using WAC 173-240-130[16] as a guideline because the approved delisting does not specify a format for an engineering report.

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[12] DOE/RL-98-62
[13] RPP-CALC-64269, *ETF Steam Stripper Mass and Energy Balance*, or RPP-CALC-64269
[14] 40 CFR 261
[15] DOE/RL-98-62
[16] WAC 173-240, “Submission of Plans and Reports for Construction of Wastewater Facilities”

1.3 REGULATORY REQUIREMENTS

A brief summary of the past regulatory processes culminating in the issuance of the approved delisting and ST4500 is provided below.

1.3.1 Approved Delisting Process

There have been two approved federal delisting decisions, the initial delisting and the modified delisting. The initial delisting for the 200 Area ETF was published in the Federal Register on June 13, 1995,[17] and Ecology provided their approval via a separate letter[18]. The DOE recognized the initial delisting was inadequate for the scope of Hanford Site cleanup and began a process to modify the delisting in 1998. The modified delisting accomplished the following three changes:

1. Increased the annual output volume of the 200 Area ETF to 210 million liters per year, which resulted in a reduction of the dilution attenuation factor from 10 to 6 for calculating delisting levels
2. Added "U" and "P" listed waste codes as eligible for delisting
3. Expanded constituents under listed waste code F039 (landfill multi-source leachate) derived from those only associated with listed waste codes F001-F005 to the entire list of constituents under F039

The EPA published the modified delisting in the Federal Register on August 3, 2005[19]. Ecology approved the modified delisting on August 8, 2005[20].

The 2005 modified delisting acknowledged the future need to accept and treat the WTP waste stream. The 2005 modified delisting proposed rule[21] stated the following:

> *Beginning in 2007, DOE-RL expects to begin processing liquid effluents (wastewaters) from the Waste Treatment Plant (WTP), which currently is being designed and constructed to treat high-level mixed waste stored in 177 underground storage tanks. At this time, a complete, detailed characterization of WTP liquid effluents is not available. Should this waste stream fit within the conditions of today's proposal, then the WTP effluents could be managed under this delisting action, if finalized. Should WTP effluents require significant reconfiguration of the 200 Area ETF system to be treated successfully*

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[17] 60 FR 31115, "Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Final Exclusion"
[18] External letter, "Effluent Treatment Facility Delisting Petition" Julian (1995)
[19] 70 FR 44496, "Hazardous Waste Management System; Final Exclusion for Identification and Listing Hazardous Waste"
[20] External letter, "Response to Hanford Effluent Treatment Facility Delisting Petition" (Rice and Wilson 2005)
[21] 69 FR 42395, "Hazardous Waste Management System; Proposed Exclusion for Identifying and Listing Hazardous Waste"

> *or be outside the waste volume limitations or treatability envelope, or otherwise fail to meet the requirements of today's proposal, the DOE-RL could not manage either the treated effluent or concentrated wastes resulting from processing of WTP effluents as excluded wastes. In this instance, the DOE-RL would need to seek a further modification of the delisting rulemaking.*
>
> *Given the lack of characterization data for future WTP effluents, EPA specifically is not considering this waste stream in its analysis of the proposed delisting action, other than to acknowledge that the DOE-RL might manage WTP effluents in the 200 Area ETF, provided the applicable delisting criteria and verification sampling requirements are met. EPA anticipates that it might be necessary to further modify the treated effluent delisting rule once WTP effluents are fully characterized.*

Similar to the initial delisting and the modified delisting, after the DOE submits the delisting petition package, Ecology and EPA will determine if any additional information is needed prior to initiating public comment on the proposed action. Once the informational needs are resolved, a public comment period will be initiated. EPA will publish a proposed rule in the Federal Register and Ecology will announce the public comment period on their website. Once comments received from the public are addressed, EPA and Ecology will finalize the WTP DFLAW delisting modification. EPA will publish the final rule in the Federal Register, and Ecology will follow with an approval letter.

1.3.2 Ecology Waste Discharge Permitting Process

Ecology published the ST4500 Fact Sheet on August 25, 2014[22], and issued the permit on December 15, 2015[23]. On December 31, 2019, Ecology extended the terms and conditions of the current ST4500 permit for up to five years or until further notice by Ecology[24].

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[22] Ecology, 2014, *Fact Sheet for State Waste Discharge Permit ST0004500*
[23] ST0004500
[24] External letter, "Resubmittal of the State Waste Discharge Permit ST0004500 Renewal Application for the State-Approved Land Disposal Site" Ecology, 2019 (Howell, 2019)

1.4 CERTIFICATION STATEMENT

We certify that this ER has been completed under our direct oversight and supervision. No original calculations, designs, or evaluations were performed as part of development of the ER.

The intent of this ER is to present solely the available data and information contained in technical and regulatory reports that were prepared by others in a format, clarity, and completeness to support and present technical information required to modify the delisting through an amendment of the approved federal delisting in 40 CFR 261, Appendix IX, Table 2 and document compliance with ST4500 using WAC 173-240-130 as a guideline.

Signature

Said Amali, Ph.D., PE
Project Manager

March 12, 2021
Date

David K. Luneke, PE
Senior Engineer

March 12, 2021
Date

DAVID K. LUNEKE
STATE OF WASHINGTON
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Figure 1. Hanford Site Area Map and Key Facilities

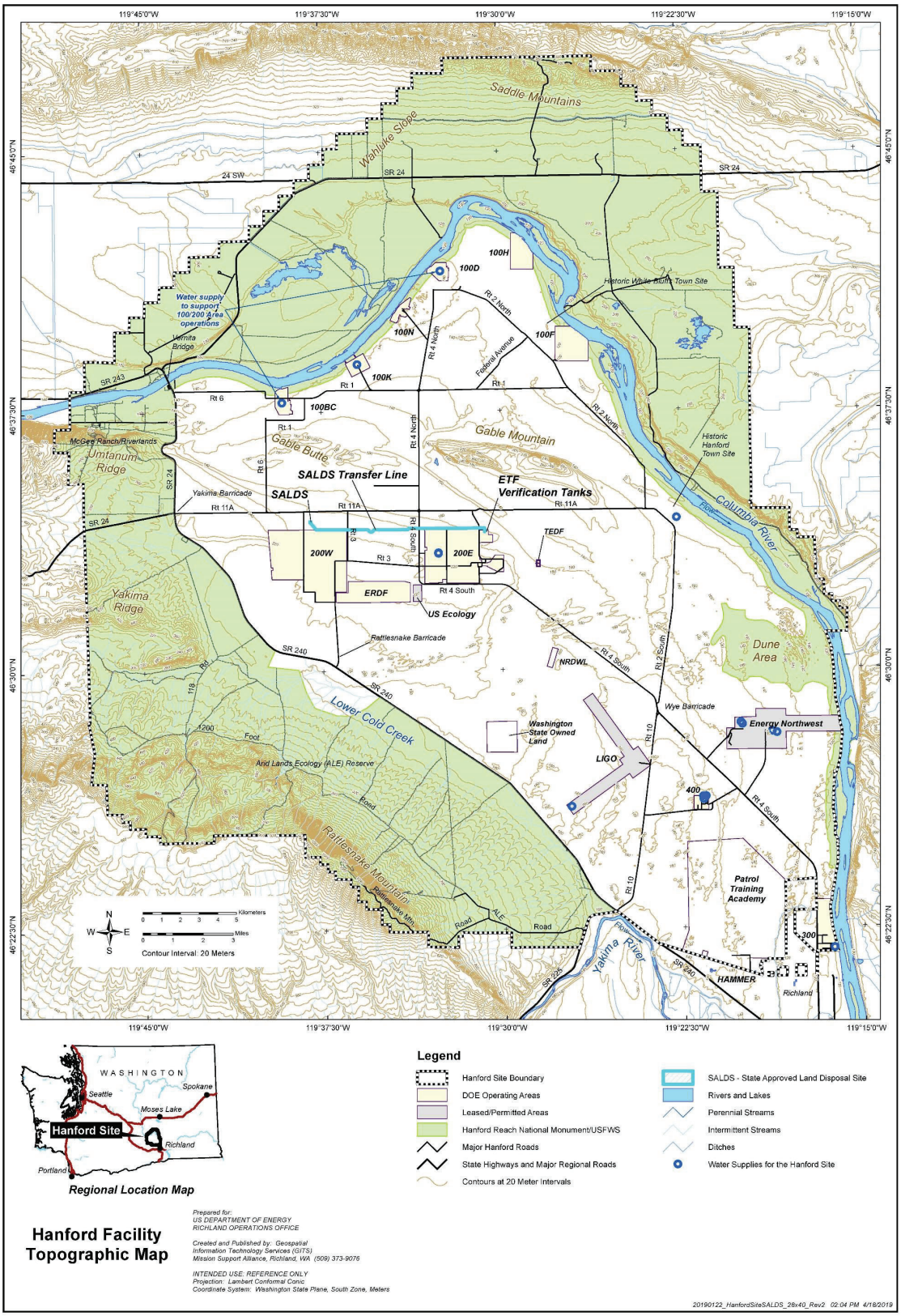

Figure 2. Existing LERF and 200 Area ETF Flow Diagram

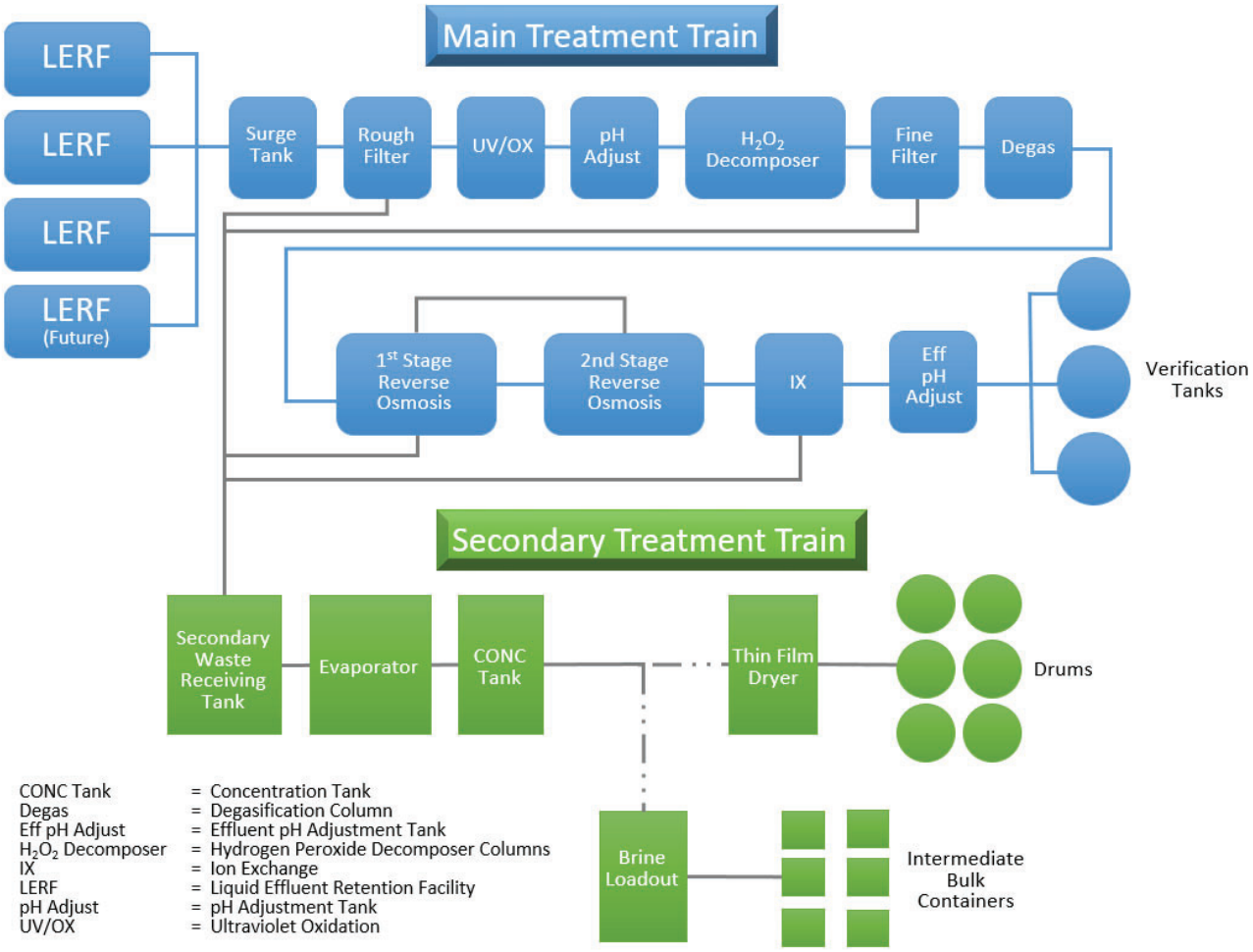

Figure 3. LERF and 200 Area ETF Facilities Location Map

Photo 2/2010

2.0 EXISTING ETF CONDITIONS

Acceptance and treatment of the WTP DFLAW waste stream and discharge of the ETF-treated effluent under the current 200 Area ETF configuration will not allow the 200 Area ETF to meet its obligations under the approved delisting and ST4500. This section presents a description of the current 200 Area ETF operations subject to change upon approval of the WTP DFLAW delisting.

2.1 CURRENT OPERATIONS

The Hanford Site was historically used by the U.S. government to produce nuclear materials. The production of these materials produced waste streams still in storage today requiring treatment and disposal. The present-day mission of the Hanford Site operations has changed from nuclear material production to environmental cleanup.

The 200 Area ETF is an essential facility in the Hanford Site cleanup efforts to manage, treat, and properly dispose of the Hanford Site mixed wastes. The 200 Area ETF commenced operations in 1995. Its location is relatively proximal to the tank farm's mixed waste storage tanks, the WTP, the 242-A Evaporator, and other Hanford Site facilities that generate contaminated wastewater.

2.2 PROVISIONS FOR ANY COMMITTED FUTURE PLANS

The DOE plans to perform the necessary upgrades to the LERF and 200 Area ETF to receive and treat the WPT DFLAW waste stream. The modifications being put into place for the WTP DFLAW startup are planned to last through the DFLAW mission.

The DOE is the operator of the Hanford Site on behalf of the U.S. government and will remain so for the foreseeable future.

2.3 FACILITY AND PROCESS DESCRIPTION

The ETF receives the following wastewaters directly from the LERF basins:

- The 242-A Evaporator process condensate
- Multi-source leachate (primarily precipitation percolating through land-disposed waste) from the 200 West Area Low Level Burial Grounds Trenches 31 and 34 Subtitle C landfills
- Wastewater generated from cleanup/decontamination activities such as from the 100K Basin.

The approved delisting allows the 200 Area ETF to treat a broad range of inorganic and organic constituents and generate a maximum of 210 million liters per year. The 200 Area ETF treatment processes consist of two series of units (referred to as the main treatment train and the secondary treatment train) configured to treat expected contaminants (Figure 2).

The 200 Area ETF main treatment train includes the following steps that successfully treat dangerous/hazardous and radioactive constituents in waste streams[25]:

- Surge tank at the 200 Area ETF inlet to provide flow surge capacity and pH adjustment
- Filtration for removal of suspended solids generated within the treatment process
- Ultraviolet/hydrogen peroxide oxidation (UV/OX) for destruction of organic constituents
- pH adjustment to prepare for downstream treatment processes
- Excess hydrogen peroxide decomposition
- Degasification for removal of carbon dioxide
- Fine filtration
- Reverse osmosis for removal of dissolved solids and radionuclides
- Ion exchange (IX) as a polishing step to remove dissolved solids and radionuclides.

The 200 Area ETF secondary treatment train typically processes the waste produced from the main treatment train (e.g., concentrate from the reverse osmosis, filter backwash, regeneration waste from the IX system, etc.). The waste is concentrated in an evaporator and the evaporator brine is transferred to the concentrate tanks for disposition and management. Under the current 200 Area ETF configuration, the brine is fed to the thin film dryer where the waste is dried into a powder. The waste powders are placed in approved containers for transfer to storage and/or final disposal in a landfill meeting Resource Conservation and Recovery Act permitted Subtitle C requirements (i.e., the Environmental Restoration Disposal Facility in the 200 West Area of the Hanford Site).

[25] DOE/RL-98-62

2.4 WASTE ACCEPTANCE PROCESS

The LERF and 200 Area ETF accepts dangerous, low-level, and mixed waste streams for treatment[26]. Various requirements limit the waste stream constituents and concentrations that can be accepted for treatment. The combination of the LERF and 200 Area ETF regulatory and operational limits defines the 200 Area ETF waste acceptance criteria.

Before acceptance, personnel from the Hanford Site generating location documents the available knowledge about the influent waste stream on a waste profile sheet using available supporting analytical data and documentation. It is the generator's responsibility to certify the accuracy and validity of the waste profile information that is submitted to the LERF and 200 Area ETF. This includes providing modeling data (if needed) and knowledge (meeting the definition of knowledge in WAC 173-303-040) to address the target list of constituents and parameters defined in the Liquid Waste Processing Facilities Waste Acceptance Criteria[27]. The target list of constituents and parameters was established to verify the treatability of an aqueous waste stream and to develop a waste processing strategy[28]. Sampling of the incoming waste stream is performed to confirm that it will meet the 200 Area ETF waste acceptance criteria as determined by the LERF and 200 Area ETF personnel evaluating the waste profile.

The characterization data for a new waste stream are compared to the waste acceptance criteria by the LERF and 200 Area ETF personnel. The waste stream may be accepted in a particular LERF basin storing other waste streams or transferred directly into the 200 Area ETF. Because most waste streams are blended in one of the LERF basins before conveyance into the 200 Area ETF, any impact to the aggregate basin content is also considered during the waste acceptance process.

2.5 WASTE PROCESSING STRATEGY

The 200 Area ETF is designed with operational flexibility that can be used to modify its operating parameters for the effective treatment of specific waste stream. A waste processing strategy is developed for each waste stream treated at the 200 Area ETF. The waste processing strategy sets the processing operating parameters so the ETF-treated effluent meets discharge criteria.

The waste processing strategy is an approach that identifies adjustments to the 200 Area ETF treatment processes and/or changes to the configuration of the 200 Area ETF treatment units as necessary to treat the waste stream. The waste processing strategy results in a document that is used to guide operations. It further defines specific key unit operation configurations, primary operating parameters, and expected maximum waste stream total dissolved solids and total organic carbon content. The waste processing strategy requires monitoring and recording of the

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[26] HNF-3172, *Liquid Waste Processing Facilities Waste Acceptance Criteria*
[27] HNF-3172
[28] DOE/RL-98-62

ETF-treated effluent conductivity and primary operating parameters as necessary to demonstrate that the 200 Area ETF operations are in accordance with the predicted parameters[29].

2.6 TREATED EFFLUENT VERIFICATION SAMPLING

The ETF-treated effluent is stored in three verification tanks. Before discharge to the SALDS, the ETF-treated effluent stored in the verification tanks is sampled to comply with the ST4500 requirements[30]. Additionally, the first verification tank and every fifteenth verification tank thereafter of each waste processing strategy is sampled to verify delisting compliance. If the ETF-treated effluent does not meet the delisting levels, it is returned to the 200 Area ETF main treatment train or to the LERF. To date, no verification tank has failed to meet the delisting levels. The existing LERF and 200 Area ETF sampling points are shown in Figure 4[31].

The use of the verification tanks alternates between being filled, sampled, and discharged. Once a verification tank is sampled, no effluent is added without resampling. The verification tank is recirculated to fully purge the recirculation lines before collecting the verification samples. The verification tank batches are traced to the sampling results which are confirmed to meet the delisting levels.

2.7 DISCHARGE REQUIREMENTS

The ETF-treated effluent is transferred from the verification tanks via pipeline to the SALDS for subsurface land disposal. The designated exposure pathway for constituents in ETF-treated effluent is the transport to groundwater through the overlying vadose zone soils. The local groundwater is the designated receiving waterbody for the discharge and is encountered at depths of greater than 200 feet below the SALDS. Groundwater characterization, monitoring data, and discussion including seasonal trends in groundwater depth, mounding beneath the SALDS, and effects of mounding on the local groundwater flow system are presented and discussed elsewhere[32]. The additional ETF-treated effluent quantities generated from the treatment of the WTP DFLAW waste stream will remain within the authorized maximum discharge volume of 210 million liters per year[33].

The discharges of the ETF-treated effluent to the SALDS are monitored for the constituents in accordance with the requirements of the federal delisting and ST4500. The ST4500 includes

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[29] TFC-ENG-FACSUP-P-36, “Effluent Treatment Facility Waste Processing Strategy”
[30] HNF-3172
[31] RPP-PLAN-60723, *Sampling and Analysis Plan for the Effluent Treatment Facility, Liquid Effluent Retention Facility, and Treated Effluent Disposal Facility*
[32] RPP-CALC-61950, *Fate and Transport Analyses of Historical and Future Tritium Releases from the State Approved Land Disposal Site, FY 2018*
[33] 40 CFR 261

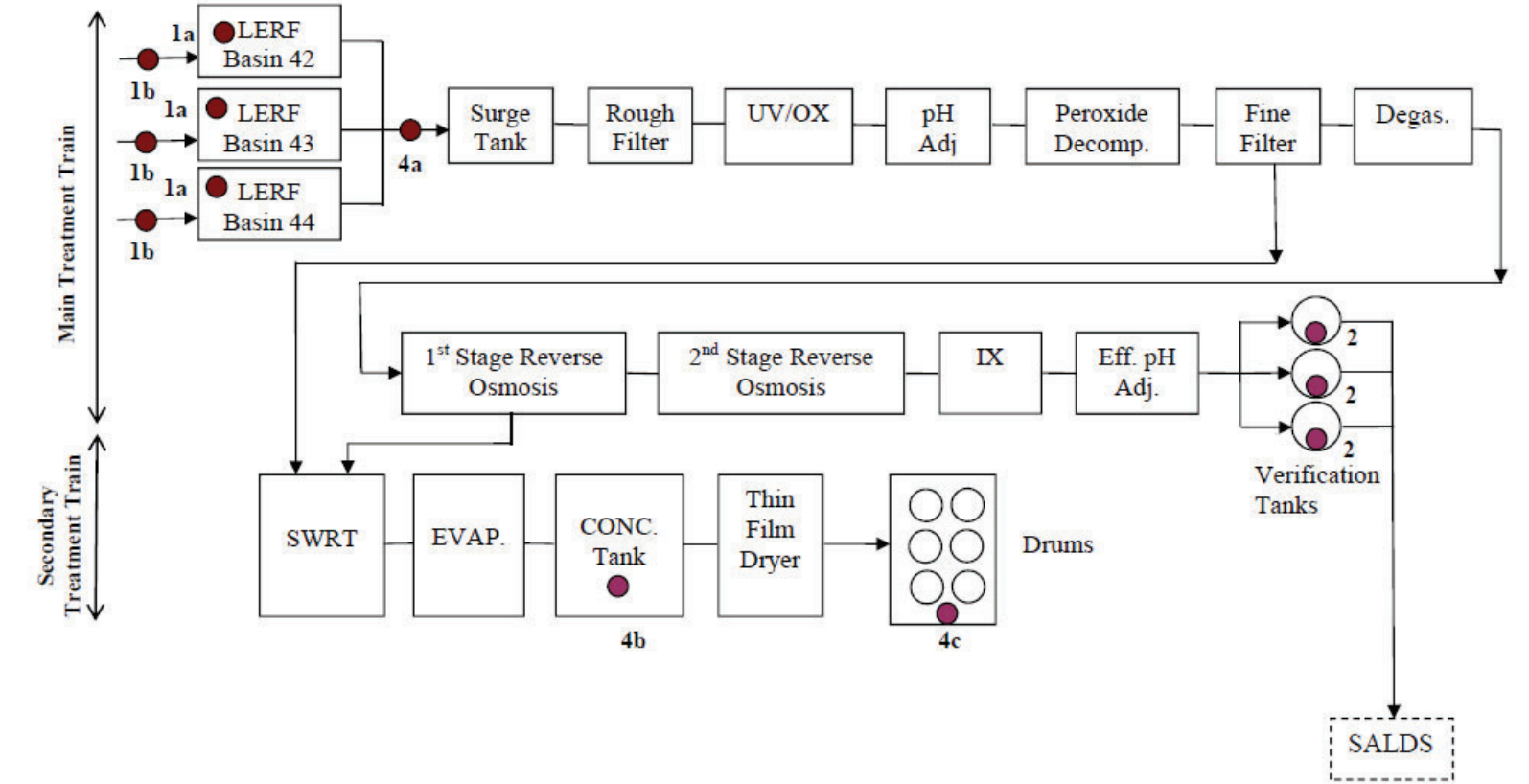
monitoring, recording, and reporting requirements to verify that the 200 Area ETF treatment processes are functioning correctly, that groundwater criteria are not violated, and that discharge limitations are being achieved. The separation points between management of dangerous waste under the Resource Conservation and Recovery Act-based Dangerous Waste Permit[34] and management of the ETF-treated effluent under ST4500 are two isolation valves, 60H-103 and 60H-104, located in the 200 Area ETF on the piping downstream of the transfer pumps[35]. These are the last isolation valves before the piping combines to become the transfer pipeline to the SALDS.

The volumes of verification tank discharges are obtained from changes in the verification tank level monitoring instruments. The verification tanks are discharged in batches that take approximately 2.5 days to complete. The discharge start time, stop time, and volumes are recorded on data sheets by operating personnel during the transfers. The data from the data sheets are loaded into a utility calculation software spreadsheet where daily discharge volumes are calculated. The data are provided to Ecology in quarterly discharge monitoring reports.

Groundwater monitoring is performed at two monitoring wells near the SALDS, specifically wells 699-48-77C and 699-48-77D. Groundwater is sampled quarterly at these wells for the parameters included in the ST4500. Well 699-48-77D is no longer sampled as the well recently went dry.

[34] WA7890008967
[35] RPP-ENV-59397

Figure 4. LERF and 200 Area ETF Sampling Points (Shown as ●)



Sample Points:

1a:	LERF and ETF sample
1b:	Basin influent sample
2:	Verification Tank sample (treated effluent sample)
3:	(reserved)
4a:	Influent sample (secondary waste liquid sample)
4b:	Concentrate Tank sample (secondary waste liquid sample)
4c:	Powder sample (secondary waste solid sample)

Conc. Tank	=	Concentrate tank
Decomp.	=	Decomposer
Degas.	=	Degasification column
Eff. pH Adj.	=	Effluent pH adjustment tank
Evap	=	Evaporator

IX	=	Ion exchange
pH Adj	=	pH adjustment tank
SALD	=	State-Approved Land Disposal Site
SWRT	=	Secondary waste receiving tank
UV/OX	=	Ultraviolet oxidation

3.0 PROPOSED NEW TREATMENT FACILITIES AND OPERATIONS

This section includes descriptions of the processes and operations for the 200 Area ETF steam stripping treatment unit which was designed to remove elevated acetonitrile concentrations in the WTP DFLAW waste stream to levels less than the 1.2 mg/L delisting level.

3.1 NEW WASTE STREAM

This section includes information on the new waste stream.

3.1.1 Source

The WTP is currently under construction to immobilize and treat the Hanford Site tank farm mixed waste as part of the DFLAW program. The WTP DFLAW melter is the point in the DFLAW process where acetonitrile is formed as a product of incomplete combustion. Acetonitrile is not a constituent in the waste feed from the tank farms. A waste stream containing acetonitrile will be generated within the WTP treatment and immobilization process primarily from the submerged bed scrubber and the wet electrostatic precipitator melter offgas treatment units. The waste stream is processed through the WTP Effluent Management Facility (EMF) evaporator. The condensate generated during the waste processing at the EMF evaporator is combined with liquid from the caustic scrubber and transferred to the LERF for storage until treatment at the 200 Area ETF[36]. Figure 5 shows the flow diagram of waste stream processing within the WTP through the EMF to the LERF.

3.1.2 Quantity and Quality of Effluent Feed to the LERF/ETF

Since the WTP is still under construction, the quantity of WTP DFLAW waste stream to the LERF, and the specific constituents and their concentrations were estimated from the results of a model run and the predicted feed to WTP from the Hanford Site tank farms. The model is based on an Aspen Process Performance Simulation[37] designed for estimating the WTP emissions supporting the WTP air permits. The projected WTP DFLAW waste stream quantity, constituents, and concentrations for the most recent model run in January 2020 are presented in the certified WTP DFLAW Waste Profile Sheet[38].

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[36] RPP-RPT-61766, *Alternative Evaluation for Acetonitrile Treatment at the Effluent Treatment Facility*
[37] RPP-CALC-64269
[38] RPP-RPT-62739, *Basis of Preliminary Engineering Targets Set for Receipt of WTP EMF Wastewater at LERF/ETF to Support DFLAW Operations*

The model runs predict that up to 20.4 million liters of wastewater per year will be conveyed to the LERF and 200 Area ETF from the WTP EMF in batches via transfer lines. The WTP DFLAW waste stream is projected to contain a range of organic and inorganic constituents. The constituents that are not currently listed in Tables C-1 and C-2 will be added to the tables as part of the administrative updates to Tables C-1 and C-2 and is beyond the scope of this ER. Acetonitrile is the only organic constituent whose predicted concentration (i.e., 32.1 mg/L with an upper bounding concentration of 59.9 mg/L) in the WTP DFLAW waste stream exceeds its treatability envelope concentration (i.e., 23.1 mg/L).

3.2 FACILITY INFORMATION AND TREATMENT PROCESS

This section includes information on the treatment process selection and details.

3.2.1 Treatment Alternatives Evaluated

The acetonitrile concentrations within the WTP DFLAW waste stream are expected to exceed the treatability envelope; therefore, several supplemental treatment methods were considered to treat the WTP DFLAW waste stream to meet the acetonitrile delisting level.

The alternative treatment technologies were evaluated to determine the most effective and efficient supplemental option. The results of the alternatives analysis were presented in a technology selection report[39].

An initial broad list of potential technologies was screened to identify a short-list of the following 10 technologies for further evaluation:

- Air stripping
- Steam stripping
- Biological processing
- UV/OX w/peroxide
- Caustic hydrolysis
- Acid hydrolysis
- Peroxide decomposition

[39] RPP-RPT-61766

- Super critical water oxidation
- Granulated activated carbon
- Liquid CO_2 separation.

The evaluation of assumptions, existing facility capacity, and environmental permitting options were considered as key parts of the design process. The processing methodology selected to isolate and concentrate acetonitrile is steam stripping.

3.2.2 Steam Stripping Treatment Unit Process and Operation

The steam stripping treatment unit details are presented in the project design documentation. A brief summary of the design process is presented in this section. Figure 6 shows the detailed process flow diagram[40].

Treatment of the WTP DFLAW wastes within the 200 Area ETF main treatment train when routed to the steam stripping treatment unit includes the following seven (8) tie-in points[41]:

- Tie-ins #1 and #2: The steam stripper process feed supply and processed fluid return require tie-ins after the effluent pH adjustment tank, but before the verification tanks. The pumps immediately adjacent to the effluent pH adjustment tank, supply the steam stripper.
- Tie-in #3: The steam stripper boiler feed water supply (and condensate fill lines) requires a tie-in to the verification tank return pump and piping to produce steam for the steam stripper functions.
- Tie-in #4: The steam stripper system requires a drain piping line to Sump Tank 2 which is located in the northwest corner of the 200 Area ETF.
- Tie-in #5: The steam stripper process ventilation system requires a tie-in with the current 200 Area ETF vapor-off-gas system.
- Tie-in #6: The effluent pH adjustment tank replacement pumps (feed pumps to steam stripper) require a higher recirculation rate than the current recirculation line design allows and require a recirculation tie-in to the top of the effluent pH adjustment tank.

[40] RPP-RPT-62622, *ETF Acetonitrile Steam Stripper Process Control Narrative*, or RPP-RPT-62622
[41] ECN-715736

- Tie-in # 7 During facility clean out, connections are made so the treated effluent from the end of the main treatment train is recycled to the front of the main treatment train and run all the way through the steam stripping system in a loop.
- Tie-in #8 A tie-in will be created to the acetonitrile distillate storage tank during the design effort.

The effluent feed to the steam stripping treatment unit is pumped from the effluent pH adjustment tank to the steam stripper column. Saturated steam at approximately 360°F is fed to the bottom of the column. The saturated steam preferentially removes acetonitrile from the feed effluent and transports it up through the column. The stripped effluent containing acetonitrile at less than the 1.2 mg/L delisting level requirement flows to the bottom of the column and is pumped to the verification tanks. The overheads go to a condenser and the distillate is collected. To further reduce the distillate volume, it is fed to a concentrator stripper unit and the overheads are condensed and collected. The distillate from the concentrator stripper unit will be transferred to a storage tank for subsequent treatment and disposal in accordance with WAC 173-303 requirements. The 200 Area ETF process includes recycling of the concentrator column bottoms to the steam stripper column feed stream.

ETF-treated effluent from the verification tanks is used as make-up water to the boiler system and for contact cooling in the distillate storage tank. The ETF-treated effluent is also used as makeup, purge, and flush water throughout the 200 Area ETF. The non-contact cooling water from a closed-loop chilled water system is disposed of during periodic maintenance cycles to purge the system. Handling and disposal of purge and flush waters are performed in accordance with the routine system operations within the 200 Area ETF and subject to existing permits.

Vents from vessels containing acetonitrile are connected to the existing process vent collection and treatment system. The compounds of interest in the vent streams, such as low levels of volatile organic compounds and possibly radionuclides, are filtered from the vent streams.

The steam stripper system and concentrator system are to be installed inside the ETF Building 2025E, whereas the steam stripper system column and the concentrator column are to be installed outside and adjacent to ETF Building 2025E[42].

3.2.3 Provisions for Bypass

The 200 Area ETF treatment process is flexible in treating waste streams of varying quantity and quality. It should be noted that this “flexibility” is not real time but is an operational capability defined in the waste processing strategy for each waste stream. Several flow bypass scenarios can be implemented within the 200 Area ETF main treatment train as determined by the waste processing strategy. The waste processing strategy determines which treatment units are used to

[42] RPP-RPT-62622

treat the waste stream. The steam stripping treatment unit will be bypassed if its use is not required to treat the waste stream. In the unlikely event that sampling and monitoring data show that discharge requirements are not met, the ETF-treated effluents in the verification tanks can be routed back to the front end of the 200 Area ETF main treatment train for additional treatment or to the LERF.

3.3 WASTE DELISTING ACTION BASIS

The Federal Register proposed rule associated with the approved delisting[43] acknowledged the future acceptance of the WTP waste stream at the LERF and treatment at the 200 Area ETF. The WTP DLFAW waste stream is projected to contain acetonitrile at concentrations up to 59.9 mg/L. The steam stripping treatment unit combined with the existing ETF process is designed to treat the acetonitrile within the WTP DFLAW waste stream so the ETF-treated effluent meets the 1.2 mg/L delisting level. After EPA and Ecology approval is obtained for the delisting modification, the updated treatability envelope will be incorporated into the LERF and 200 Area ETF waste acceptance process described in Section 3.1.3.

The steam stripping treatment unit operates on the principle that acetonitrile has greater volatility than water, using Henry's Law principles. A formal literature review[44] concluded that the Henry's Law constant for acetonitrile covers the entire concentration range expected in the WTP DFLAW waste stream.

The process of steam stripping to remove acetonitrile was simulated with the multi-component mass and energy balance Chemstations ChemCad process simulation software[45]. The simulator model takes input, such as feed rate and acetonitrile composition of the inlet steam, and calculates the heating, cooling, vapor liquid equilibrium, and condensing of the various unit operations. The model was used to calculate the output of the various steam stripping treatment unit operations and keep the mass and enthalpy in balance at each process step. The model has rigorous techniques to calculate the activity coefficients at each unit operation and, in the case of the Simultaneous Correction Distillation System, within each stage of the unit operation. Sizing and process calculations for the steam stripping treatment unit system components were carried out separately[46].

Specifically, there are two types of inputs to the simulator—the streams and the unit operations. There are three streams that are feed or input streams in this model:

1. Stream 100 (organic-laden water feed design rate, temperature, and composition)

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[43] 69 FR 42395
[44] RPP-RPT-62621, *ETF Acetonitrile Steam Stripper Process Description*
[45] RPP-CALC-64269
[46] RPP-CALC-64263, *ETF Steam Stripper Equipment Sizing Calculations*

2. Stream 102 (Stripper column assumed steam pressure and rate)
3. Stream 103 (Concentrator column assumed steam pressure and rate).

The unit operations have the following design parameters:

1. Pump 521: Outlet Pressure
2. Heat Exchangers 511, 512, 513: Outlet Temperature
3. Heat Exchanger 514: Minimum Delta Temperature
4. SCDS 501 & 502: Number of Stages and Column Pressure Drop.

These design parameters are inputs that define a design envelope for the equipment. These limits define "reasonable" equipment. Figure 7 shows the steam stripping treatment unit diagram as modeled with the streams and unit operations identified[47].

The sizing and design of the steam stripping treatment unit assumed a worst-case scenario in which the acetonitrile is not treated in the 200 Area ETF main treatment train UV/OX unit; therefore, the baseline design capability of the steam stripping treatment unit is to treat influent containing acetonitrile at 60 mg/L to below the delisting level of 1.2 mg/L[48].

The simulator model was able to demonstrate that an influent acetonitrile concentration of 59.9 mg/L in the feed stream (stream 100) could be reduced, in one pass through the stripping column, to a value of 1.11 mg/L (stream 203) which is below the delisting level of 1.2 mg/L. Acetonitrile was primarily concentrated in the distillate high-concentration stream (stream 205) at a concentration of 1,721 mg/L.[49]

Other operational parameters were varied to minimize the volume of the distillate stream produced from the stripping column. This was accomplished in the model by using a "feed-back controller" to change one of the input streams, in this case the stripper steam flow rate, until the desired concentration of acetonitrile in the stripper bottom stream is achieved. Once this value is determined, this controller is turned off and the simulation is checked for convergence. Typically, the tolerance is set higher during the iteration to determine the steam flow rate and then set to a more restrictive level for subsequent calculations with the steam flow rate set at a constant level. The simulator mode was set to the possibility of two liquid phases. Henry's Law constants were activated for each of the organics in the model. The ideal heat capacity was set to the Design Institute for Physical Property Data Model.

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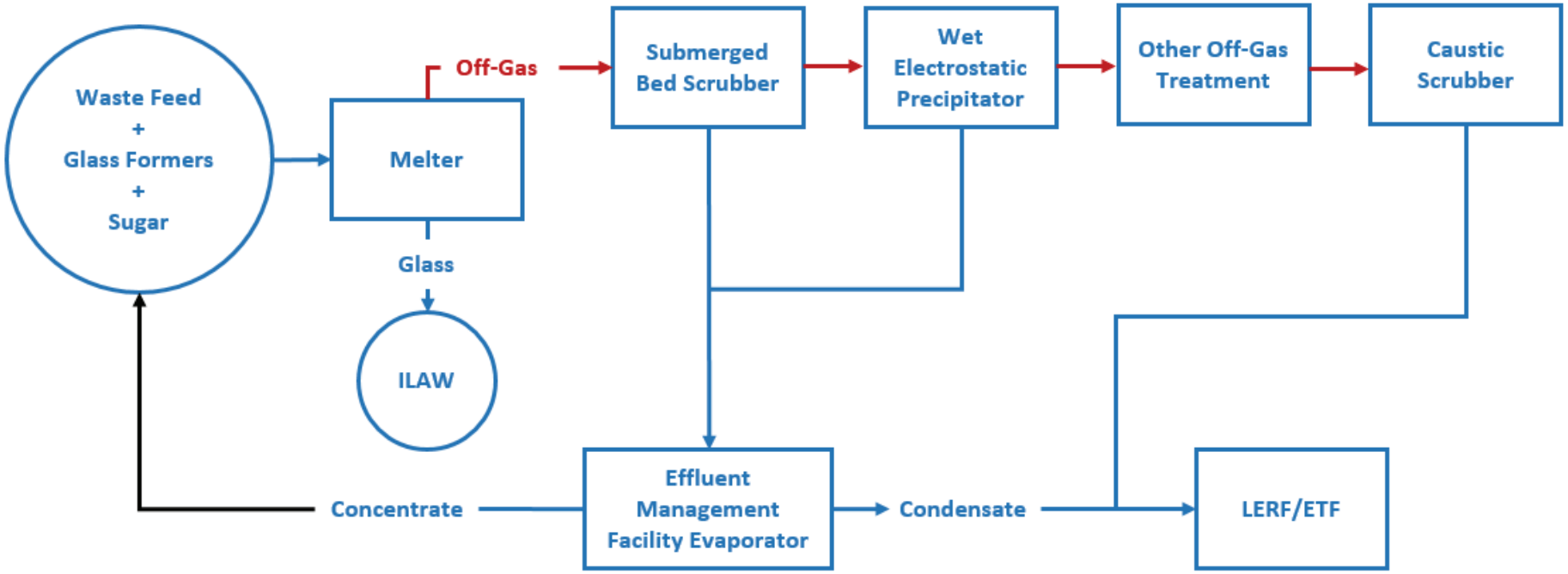
[47] H-2-839048 SH 001, "ETF Steam Stripper Process Flow Diagram Steam STPR HMB Table, February 2021"
[48] RPP-CALC-64269
[49] H-2-839048 SH 001

3.4 TREATED EFFLUENT DISCHARGE REQUIREMENTS

The data and design reports demonstrate that the steam stripping treatment unit was designed and sized to treat acetonitrile within the WTP DFLAW waste stream to meet the delisting level of 1.2 mg/L. The ETF-treated effluent from the steam stripping treatment unit that is routed to the verification tanks is expected to meet the delisting level of 1.2 mg/L.

Figure 5. Flow Diagram of Effluent within WTP through the EMF to the LERF and 200 Area ETF



ILAW = Immobilized Low-Activity Waste

Figure 6. Steam Stripping Treatment Unit Process Flow Diagram

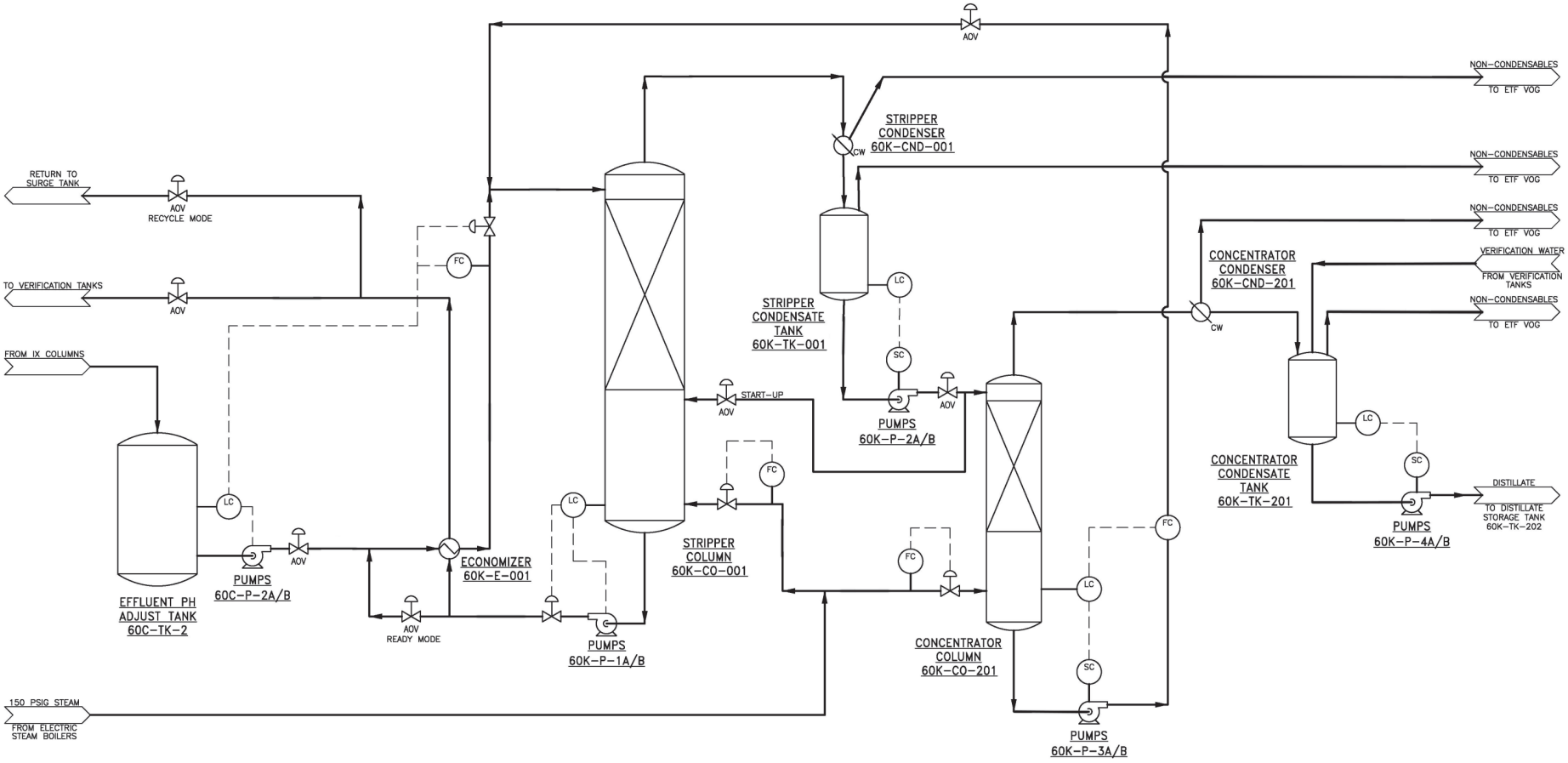


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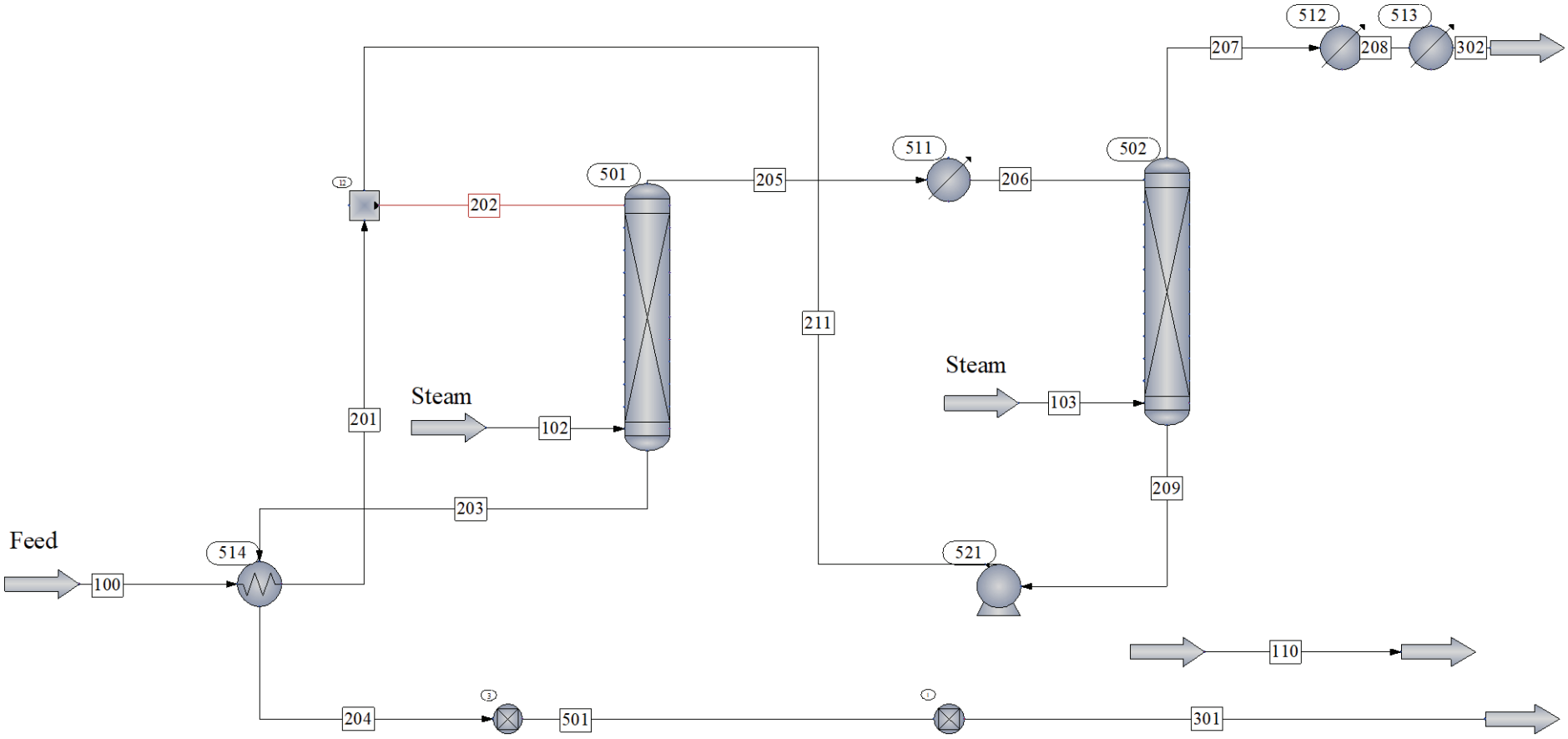
Figure 7. The Modeled Steam Stripping Treatment Unit with Streams and Unit Operations Identified



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