**Department of Energy**
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

13-ESQ-0075

OCT 4 2013

Ms. S. L. Dahl-Crumpler
Nuclear Waste Program
State of Washington
Department of Ecology
3100 Port of Benton Boulevard
Richland, Washington 99354

Dear Ms. Dahl-Crumpler:

CLASS 1 MODIFICATIONS TO THE HANFORD FACILITY RESOURCE CONSERVATION AND RECOVERY ACT PERMIT (PERMIT), QUARTER ENDING SEPTEMBER 30, 2013

In accordance with Permit Condition I.C.3, enclosed for your notification are the Class 1 modifications for the quarter ending September 30, 2013.

These modifications update information in the List of Attachments, Part II, and Part III of Permit Revision 8C. The Part III modifications pertain to the Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility, the 242-A Evaporator, and the Waste Treatment and Immobilization Plant. The Class 1 modifications are being made to ensure that activities are conducted in compliance with the Permit. A record of the enclosed documentation is maintained in the Hanford Facility Operating Record.

If you have any questions, please contact me, or your staff may contact Ray J. Corey, Assistant Manager for Safety and Environment, on (509) 376-0108.

Sincerely,

Matt McCormick
Manager

ESQ:ACM

Enclosure

cc w/encl: See page 2

cc w/encl:
P. G. Harrington, ORP (CD ROM)
Administrative Record, TSD: H-0-1, H-0-8, T-3-4, H6-08 (CD ROM)
Ecology NWP Library (Hardcopy)
Environmental Portal, LMSI, A3-95 (CD ROM)
HF Operating Record (J. K. Perry, MSA, H7-28) (CD ROM)

cc w/o encl:
F. W. Bond, Ecology
D. M. Busche, BNI
A. S. Carlson, Ecology
B. L. Curn, URS
L. L. Fritz, MSA
J. A. Hedges, Ecology
A. L. Hummer, WRPS
D. L. McDonald, Ecology
A. G. Miskho, WRPS
A. L. Prignano, Ecology
J. R. Seaver, CHPRC

ENCLOSURE

**CLASS 1 MODIFICATIONS FOR QUARTER ENDING September 30, 2013**
**Ms. S. L. Dahl-Crumpler, Ecology**

Consisting of 468 pages,
including this cover page

# Hanford Facility RCRA Permit Modification Notification Forms

## Permit Revision 8C

## Part II, General Facility Conditions

### Index

Page 2 of 3 List of Attachments

Page 3 of 3 Section II.P.2

Reviewed by RL Program Office:

Date

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **Permit Revision 8C** | **Part II General Facility Conditions** |

Description of Modification:

List of Attachments

The following listed documents are attached in their entirety.....

| | |
|---|---|
| Attachment 1 | Hanford Federal Facility Agreement and Consent Order, (as amended) http://www.hanford.gov/tpa/coverpg.htm |
| Attachment 2 | Hanford Facility Legal Description, from Class [1]1 modification, dated January 7, 1999 |
| Attachment 3 | Security, dated September 30, 2010 |
| Attachment 4 | *Hanford Emergency Management Plan*, DOE/RL-94-02 ~~Revision 2~~Revision 5, as amended and approved modifications |
| Attachment 5 | Hanford Facility Personnel Training Program, dated September 30, 2010 |
| Attachment 6 | Reports and Records, dated September 30, 2010 |
| Attachment 7 | Policy on Remediation of Existing Wells and Acceptance Criteria for RCRA and CERCLA, June 1990 |
| Attachment 8 | Hanford Well Maintenance and Inspection Plan, BHI-01265, Revision 0, May 1999 |
| Attachment 9 | Permit Applicability Matrix, dated September 30, 2010 |
| Attachment 10 | Purgewater Management Plan, July 1990 |

| WAC 173-303-830 Modification Class [1 2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1

Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. This change corrects an outdated revision number. There are no actual text changes to the document (DOE/RL-94-02). The subject document (DOE/RL-94-02) was revised from rev. 4 to Rev. 5 on 12/20/12. Pursuant to RCRA permit conditions II.A.1 and I.C.3, portions of DOE/RL-94-02, Rev. 5 were incorporated into the RCRA permit through the Class 1 permit modification for the quarter ending 12/31/12 (DOE to Ecology letter 13-EMD-0018, dated 1/10/13 and Ecology to DOE letter, 13-NWP-018, dated 2/26/13)

Modification Approved: ☑ Yes ☐ No (state reason for denial)

Reason for denial:

Reviewed by Ecology:

S. L. Dahl-Crumpler — Date: 9/24/13

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **Permit Revision 8C** | **Part II General Facility Conditions** |

Description of Modification:
Section II.P.2:

II.P.2 Transportation of dangerous wastes along roadways, if such routes are not closed to general public access at the time of transport, can be manifested pursuant to an alternate tracking system as allowed by WAC 173-303-180~~(6)~~(5). The alternate tracking system can be a paper system or an electronic system. The roadways addressed by this condition are a public or private right-of-way within or along the border of contiguous property where the movement is under control of the USDOE. The alternate tracking system will consist of documentation between the offering Hanford Facility location and the receiving Hanford Facility location containing the following information:

| WAC 173-303-830 Modification Class [1 2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1

Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. This change corrects an outdated regulatory citation reference. The citation change is needed to maintain consistency with the June 2009 WAC 173-303 rule change (Publication Number 09-04-018, comment number 11, and WSR 09-14-105/Order 07-12).

Modification Approved: ☑ Yes ☐ No (state reason for denial)

Reason for denial:

Reviewed by Ecology:

S. L. Dahl-Crumpler — Date: 9/24/13

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

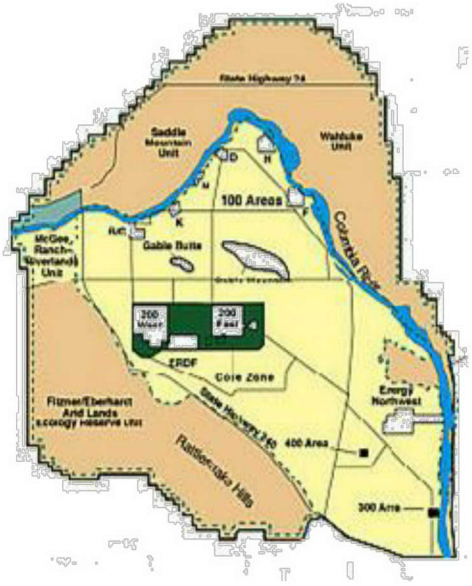
## Remove and Replace the Following Sections:

Remove Permit Revision 8C, dated September 30, 2010, and replace with Permit Revision 8C dated September 30, 2013.

# Hanford Facility
# Resource Conservation and Recovery Act Permit, Dangerous Waste Portion

## Revision 8C

**For the Treatment, Storage, and Disposal of Dangerous Waste**




**Washington State Department of Ecology**
**Nuclear Waste Program**

**September 2010**

For additional copies of this permit contact:

Washington State Department of Ecology
3100 Port of Benton Boulevard
Richland, Washington 99354-1670
509-372-7950

*The Department of Ecology is an equal-opportunity agency and does not discriminate on the basis of race, creed, color disability, age, religion, national origin, sex, marital status, disabled-veteran status, Vietnam-era veteran status or sexual orientation.*

*For more information or if you have special accommodation needs, please contact the Nuclear Waste Program at (509) 372-7950.*

*Department of Ecology Headquarters telecommunications device for the deaf (TDD) number is: (360) 407-6006*

# DANGEROUS WASTE PORTION OF THE RESOURCE CONSERVATION AND RECOVERY ACT PERMIT FOR THE TREATMENT, STORAGE, AND DISPOSAL OF DANGEROUS WASTE

Washington State Department of Ecology
Nuclear Waste Program
3100 Port of Benton Boulevard
Richland, Washington 99354
Telephone: 509-372-7950

Issued in accordance with the applicable provisions of the Hazardous Waste Management Act, Chapter 70.105 Revised Code of Washington (RCW), and the regulations promulgated there under in Chapter 173-303 Washington Administrative Code (WAC).

---

## ISSUED TO:

United States Department of Energy
Richland Operations Office
(Owner/Operator)
P.O. Box 550, MSIN A7-50
Richland, Washington 99352
Telephone: (509) 376-7395

United States Department of Energy
Office of River Protection
(Owner/Operator)
P.O. Box 450, MSIN H6-60
Richland, Washington 99352
Telephone: (509) 372-3062

Mission Support Alliance
2490 Garlick, MSIN H1-30
Richland, Washington 99354
Telephone: (509) 376-1310

Bechtel National, Inc.
(Co-Operator)
2435 Stevens Center Place MSIN H4-02
Richland, Washington 99354
Telephone: (509) 371-2335

Washington Closure Hanford, LLC
(Co-operator)
2620 Fermi Avenue, MSIN H4-24
Richland, Washington 99354
Telephone: (509) 372-9951

Washington River Protection Solutions, LLC
(Co-operator)
P.O. Box 1500, MSIN H6-63
Richland, Washington 99352
Telephone: (509) 372-9138

Pacific Northwest National Laboratory
(Co-operator)
P.O. Box 999, MSIN K1-46
Richland, Washington 99352
Telephone: (509) 375-5911

CH2MHILL Plateau Remediation Company
(Co-operator)
P.O. Box 1600, MSIN H7-30
Richland, Washington 99352
Telephone: (509) 376-0556

This Permit as modified on October 22, 2007, will remain in effect until reissuance of the September 27, 2004 Permit, unless revoked and reissued under WAC 173-303-830(3), terminated under WAC 173-303-830(5), or continued in accordance with WAC 173-303-806(7).

ISSUED BY:
**WASHINGTON STATE DEPARTMENT OF ECOLOGY**

_____ Date: 10/17/07

Jane A. Hedges, Program Manager
Nuclear Waste Program, Department of Ecology

# TABLE OF CONTENTS

LIST OF ATTACHMENTS ..... 4
INTRODUCTION ..... 5
UNIT STATUS TABLE ..... 8
DEFINITIONS ..... 10
ACRONYMS ..... 13
PART I STANDARD CONDITIONS ..... 15
I.A EFFECT OF PERMIT ..... 15
I.B PERSONAL AND PROPERTY RIGHTS ..... 16
I.C PERMIT ACTIONS ..... 16
I.D SEVERABILITY ..... 16
I.E DUTIES AND REQUIREMENTS ..... 17
I.F SIGNATORY REQUIREMENT ..... 22
I.G CONFIDENTIAL INFORMATION ..... 22
I.H DOCUMENTS TO BE MAINTAINED AT FACILITY SITE ..... 22
PART II GENERAL FACILITY CONDITIONS ..... 23
II.A FACILITY CONTINGENCY PLAN ..... 23
II.B PREPAREDNESS AND PREVENTION ..... 23
II.C PERSONNEL TRAINING ..... 24
II.D WASTE ANALYSIS ..... 24
II.E QUALITY ASSURANCE/QUALITY CONTROL ..... 25
II.F GROUND WATER AND VADOSE ZONE MONITORING ..... 26
II.G SITING CRITERIA ..... 26
II.H RECORDKEEPING AND REPORTING ..... 27
II.I FACILITY OPERATING RECORD ..... 27
II.J FACILITY CLOSURE ..... 28
II.K SOIL/GROUND WATER CLOSURE PERFORMANCE STANDARDS ..... 29
II.L DESIGN AND OPERATION OF THE FACILITY ..... 30
II.M SECURITY ..... 31
II.N RECEIPT OF DANGEROUS WASTES GENERATED OFF-SITE ..... 31
II.O GENERAL INSPECTION REQUIREMENTS ..... 32
II.P MANIFEST SYSTEM ..... 32
II.Q ON-SITE TRANSPORTATION ..... 33
II.R EQUIVALENT MATERIALS ..... 33
II.S LAND DISPOSAL RESTRICTIONS (LDR) ..... 34
II.T ACCESS AND INFORMATION ..... 34
II.U MAPPING OF UNDERGROUND PIPING ..... 34
II.V MARKING OF UNDERGROUND PIPING ..... 34
II.W OTHER PERMITS AND/OR APPROVALS ..... 35
II.X SCHEDULE EXTENSIONS ..... 35
II.Y CORRECTIVE ACTION ..... 35
II.Z WASTE MINIMIZATION ..... 40
II.AA AIR EMISSION STANDARDS FOR PROCESS VENTS ..... 40
II.BB AIR EMISSION STANDARDS FOR EQUIPMENT LEAKS ..... 40
II.CC AIR EMISSION STANDARDS FOR TANKS, SURFACE IMPOUNDMENTS, AND CONTAINERS ..... 40
PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS ..... 41

PART IV UNIT SPECIFIC CONDITIONS FOR CORRECTIVE ACTION ..... 41
PART V UNIT-SPECIFIC CONDITIONS FOR UNITS UNDERGOING CLOSURE..... 41
PART VI UNIT-SPECIFIC CONDITIONS FOR UNITS IN POST-CLOSURE ..... 41
UNITS RETIRED FROM THE PERMIT ..... 41

## List of Attachments

The following listed documents are attached in their entirety. However, only those portions of the attachments specified in Parts I through VI are enforceable conditions of this Permit and subject to the permit modification requirements of Permit Condition I.C.3. Changes to portions of the attachments, which are not subject to the permit modification process, will be addressed in accordance with Permit Conditions I.E.8, I.E.11, I.E.13, I.E.15, through I.E.20, and I.E.22. Ecology has, as deemed necessary, modified specific language in these attachments. These modifications are described in the conditions (Parts I through VI), and thereby supersede the language of the attachment.

| | |
|---|---|
| Attachment 1 | Hanford Federal Facility Agreement and Consent Order, (as amended) http://www.hanford.gov/tpa/coverpg.htm |
| Attachment 2 | Hanford Facility Legal Description, from Class [1]1 modification, dated January 7, 1999 |
| Attachment 3 | Security, dated September 30, 2010 |
| Attachment 4 | *Hanford Emergency Management Plan*, DOE/RL-94-02 Revision 5, as amended and approved modifications |
| Attachment 5 | Hanford Facility Personnel Training Program, dated September 30, 2010 |
| Attachment 6 | Reports and Records, dated September 30, 2010 |
| Attachment 7 | Policy on Remediation of Existing Wells and Acceptance Criteria for RCRA and CERCLA, June 1990 |
| Attachment 8 | Hanford Well Maintenance and Inspection Plan, BHI-01265, Revision 0, May 1999 |
| Attachment 9 | Permit Applicability Matrix, dated September 30, 2010 |
| Attachment 10 | Purgewater Management Plan, July 1990 |

## Introduction

Where information regarding treatment, management, and disposal of the radioactive source, byproduct material, special nuclear material (as defined by the Atomic Energy Act of 1954, as amended) and/or the radionuclide component of mixed waste has been incorporated into this permit, it is not incorporated for the purpose of regulating the radiation hazards of such components under the authority of this permit or Chapter 70.105 RCW.

Pursuant to Chapter 70.105 RCW, the Hazardous Waste Management Act (HWMA) of 1976, as amended, Chapter 70.105D RCW, the Model Toxics Control Act (MTCA), and regulations promulgated there under by the Washington State Department of Ecology (hereafter called Ecology), codified in Chapter 173-303 Washington Administrative Code (WAC), Dangerous Waste Regulations, a Dangerous Waste Permit is issued to the United States Department of Energy (USDOE) - Richland Operations Office (RL) and Office of River Protection (ORP) [owner/operator], and its contractors [co-operators], Bechtel National, Incorporated (BNI), CH2MHILL Plateau Remediation Company (CHPRC), Mission Support Alliance, LLC (MSA)], Pacific Northwest National Laboratory (PNNL), Washington Closure Hanford, LLC (WCH), and Washington River Protection Solutions, LLC (WRPS) and hereafter called the Permittees, for the treatment, storage, and disposal of dangerous waste at the Hanford Facility.

This Dangerous Waste Permit, issued in conjunction with the United States Environmental Protection Agency's (hereafter called EPA) Hazardous and Solid Waste Amendments Portion of the Resource Conservation and Recovery Act (RCRA) Permit for the Treatment, Storage, and Disposal (TSD) of Hazardous Waste (HSWA Permit), constitutes the RCRA Permit for the Hanford Facility. Use of the term "Permit" within the Dangerous Waste Permit will refer to the Dangerous Waste Permit, while use of the term "Permit" within the HSWA Permit, will refer to the HSWA Permit. Use of the same term in both the Dangerous Waste Permit and the HSWA Permit, will have the standard meaning associated with the activities addressed by the permit in which the term is used. Such meanings will prevail, except where specifically stated otherwise.

The Permittees will comply with all terms and conditions set forth in this Permit and those portions of the Attachments that have been specifically incorporated into this Permit. When the Permit and the Attachments (except Permit Attachment 1) conflict, the wording of the Permit will prevail. The Permit is intended to be consistent with the terms and conditions of the Hanford Federal Facility Agreement and Consent Order (HFFACO, Permit Attachment 1). The Permittees will also comply with all applicable state regulations, including Chapter 173-303 WAC.

Applicable state regulations are those which are in effect on the date of issuance, or as specified in subsequent modifications of this Permit. In addition, applicable state regulations include any self-implementing statutory provisions and related regulations which, according to the requirements of the HWMA, as amended, or other law(s), are automatically applicable to the Permittees' dangerous waste management activities, notwithstanding the conditions of this Permit.

This Permit is based upon the Administrative Record, as required by WAC 173-303-840. The Permittees' failure in the application, or during the Permit issuance process, to fully disclose all relevant facts, or the Permittees' misrepresentation of any relevant facts at any time, will be grounds for the termination or modification of this Permit and/or initiation of an enforcement action, including criminal proceedings. The Permittees will inform Ecology of any deviation from the Permit conditions, or changes in the information on which the application is based, which would affect either the Permittees' ability to comply, or actual compliance with the applicable regulations or the Permit conditions, or which alters any condition of this Permit in any way.

Ecology will enforce all conditions of this Permit for which the State of Washington is authorized, or which are "state-only" provisions (i.e., conditions broader in scope or more stringent than the federal RCRA program). Any challenges of any Permit condition may be appealed in accordance with WAC 173-303-845. In the event that any Permit condition is challenged by any Permittee under WAC 173-303-845, Ecology may stay any such Permit condition as it pertains to all Permittees, in accordance with the same terms of any stay it grants to the challenging Permittee. If such a stay is granted, it will constitute a "stay by the issuing agency" within the meaning of RCW 43.21B.320(1).

This Permit has been developed to allow a step-wise permitting process of the Hanford Facility to ensure the proper implementation of the HFFACO. In order to accomplish this, this Permit consists of six (6) parts.

**Part I, Standard Conditions**, contains conditions which are similar to those appearing in all dangerous waste permits.

**Part II, General Facility Conditions**, combines typical dangerous waste permit conditions with those conditions intended to address issues specific to the Hanford Facility. Where appropriate, the general facility conditions apply to all final status dangerous waste management activities at the Facility. Where appropriate, the general facility conditions also address dangerous waste management activities which may not be directly associated with distinct TSD units, or which may be associated with many TSD units (i.e., spill reporting, training, contingency planning, etc.). Part II also includes conditions that address corrective action at solid waste management units and areas of concern.

**Part III, Unit-Specific Conditions for Operating Units**, contains those Permit requirements that apply to each individual TSD unit operating under final status. Conditions for each TSD unit are found in a chapter dedicated to that TSD unit. These unit-specific chapters contain references to Standard Conditions (Part I) and General Conditions (Part II), as well as additional requirements which are intended to ensure that each TSD unit is operated in an efficient and environmentally protective manner. Additional requirements may also be added when an operating unit ceases operations and undergoes closure.

**Part IV, Unit-Specific Conditions for Corrective Action**, contains those permit requirements which apply to specific RPP units that are undergoing corrective action under the HFFACO. RPP units may include solid waste management units and other areas of concern (i.e., releases that are not at solid waste management units and do not constitute a solid waste management unit) that are undergoing corrective action. For The Comprehensive Environmental Response, Conservation, and Liability Act (CERCLA) and RCRA past practice (RPP) units identified in the HFFACO, the corrective action conditions are structured around continued coordination with, and reliance on, the investigation and cleanup requirements established under the HFFACO. For TSD units identified in the HFFACO, the corrective action conditions contemplate use of closure and post-closure processes to satisfy corrective action.

**Part V, Unit-Specific Conditions for Units Undergoing Closure**, contains those requirements which apply to those specific TSD units, included in this part, that are undergoing closure. In accordance with Section 5.3 of the Action Plan of the HFFACO, all TSD units that undergo closure, irrespective of permit status, will be closed pursuant to the authorized State Dangerous Waste Program in accordance with WAC 173-303-610. Requirements for each TSD unit undergoing closure are found in a chapter dedicated to that TSD unit. These unit-specific chapters contain references to Standard Conditions (Part I) and General Conditions (Part II), as well as additional requirements which are intended to ensure that each TSD unit is closed in an efficient and environmentally protective manner.

**Part VI, Unit-Specific Conditions for Units in Post-Closure,** contains those requirements which apply to those specific units in this part that have completed modified or landfill closure requirements, and now only need to meet Post-Closure Standards. As set forth in Section 5.3 of the Action Plan of the HFFACO, certain TSD units will be permitted for post-closure care pursuant to the authorized State Dangerous Waste Program (173-303 WAC) and the Hazardous and Solid Waste Amendments. Requirements for each unit undergoing post-closure care are found in a chapter, within this part, dedicated to that unit. These unit specific chapters may contain references to Standard Conditions (Part I) and General Conditions (Part II), as well as the unit specific conditions, all of which are intended to ensure the unit is managed in an efficient, environmentally protective manner.

1 ## Unit Status Table

| PERMIT REVISION | REVISION DATE | UNITS INCORPORATED |
|---|---|---|
| Permit Revision 0 | 8/29/94 | 616 NDWSF, 305-B Storage Facility, 183-H SEB, 300 ASE, 2727-S, NRDWSF |
| Permit Revision 1 | 4/28/95 | Simulated High-Level Waste Slurry, 218-E-9 Borrow Pit Demo Site, 200 W Area Ash Pit Demo Site, 2101-M Pond, 216-B-3 Expansion Ponds |
| Permit Revision 2 | 8/29/95 | Hanford Patrol Academy Demolition Site, 105-DR Large Sodium Fire Facility, 304 Concretion Facility |
| Permit Revision 3 | 11/25/96 | PUREX Storage Tunnels, 4843 Alkali Metal Storage Facility, 3718-F Alkali Metal Treatment & Storage Facility, 303-K Storage Facility, 300 APT |
| Permit Revision 4 | 1/28/98 | LERF & 200 Area ETF, 242-A Evaporator, 325 HWTUs |
| Permit Revision 5 | 5/18/99 | 100 D Ponds, 1301-N & 1325-Liquid Waste Disposal Facility, 1324-N Surface Impoundment, 1324-NA Percolation Pond |
| Permit Revision 6 | 3/28/00 | Permit Condition II.Y, Corrective Action |
| Permit Revision 7 | 2/27/01 | Waste Treatment & Immobilization Plant, 300 Area WATS |
| Permit Revision 8 | 9/23/04 | No new units, modification updates |
| Permit Revision 8A | 3/6/06 | Integrated Disposal Facility |
| Permit Revision 8B | 1/2007 | 331-C Storage Unit, PFP Treatment Unit, 241-Z Treatment & Storage Tanks, 303-M Oxide Facility |
| Permit Revision 8C | 8/2007 | 400 Area Waste Management Unit, 224-T TRUSAF |

2

| UNIT | Permit Revision | | Comments/History |
|---|---|---|---|
| | Incorporated | Retired | |
| **PART III, OPERATING UNITS** | | | |
| 616 Non-Radioactive Dangerous Waste Storage Facility | Rev. 6 | Rev. 7 | Closed, 9/5/01 |
| 242-A Evaporator | Rev. 4 | | |
| 305-B Storage Facility | Rev. 0 | | Closed, 7/2/07 |
| 325 Hazardous Waste Treatment Units | Rev. 4 | | RLWT procedural closure, 9/04 |
| LERF & 200 Area ETF | Rev. 4 | | |
| PUREX Storage Tunnels | Rev. 3 | | |
| Waste Treatment and Immobilization Plant | Rev. 7 | | Permitted unit under construction |
| Integrated Disposal Facility | Rev. 8A | | |
| 331-C Storage Unit | Rev. 8B | | |
| 400 Area Waste Management Unit | Rev. 8C | | |
| **PART IV, CORRECTIVE ACTION** | | | |
| 100-NR-1 Operable Unit | Rev. 6 | | |
| 100-NR-2 Operable Unit | Rev. 6 | Rev. 8C | Retired, 9/30/09 |
| **PART V, UNDERGOING CLOSURE UNITS** | | | |
| 100-D Ponds | Rev. 5 | Rev. 6 | Closed, 8/9/99 |
| 105 DR Large Sodium Fire Facility | Rev. 2 | Rev. 6 | Closed, 7/1/04 |
| 1301-N Liquid Waste Disposal Facility | Rev. 5 | | |
| 1324-N Surface Impoundment | Rev. 5 | | |
| 1324-NA Percolation Pond | Rev. 5 | | |
| 1325-N Liquid Waste Disposal Facility | Rev. 5 | | |
| 200 West Area Ash Pit Demo Site | Rev. 1 | Rev. 6 | Closed, 11/28/95 |
| 2101-M Pond | Rev. 1 | Rev. 6 | Closed, 11/28/95 |
| 216-B-3 Expansion Ponds | Rev. 1 | Rev. 6 | Closed, 7/31/95 |
| 218-E-8 Borrow Demolition Site | Rev. 1 | Rev. 6 | Closed, 11/28/95 |
| 2727-S Storage Facility | Rev. 0 | Rev. 6 | Closed, 7/31/95 |
| 300 Area Solvent Evaporator | Rev. 0 | Rev. 6 | Closed, 7/31/95 |
| 300 Area Waste Acid Treatment System | Rev. 6 | Rev. 8B | Closed, 1/21/05 |
| 303-K Storage Facility | Rev. 4 | Rev. 6 | Closed, 7/22/02 |
| 304 Concretion Facility | Rev. 2 | Rev. 6 | Closed, 1/21/96 |
| 311 Tanks (includes 300 Area WATS) | Rev. 6 | Rev. 7 | Closed, 5/20/02 |
| 3718-F Alkali Metal Treatment /Storage | Rev. 3 | Rev. 6 | Closed, 8/4/98 |
| 4843 Alkali Metal Storage Facility | Rev. 3 | Rev. 6 | Closed, 4/14/97 |
| Hanford Patrol Academy Demo Site | Rev. 2 | Rev. 6 | Closed, 11/28/95 |
| Simulated High Level Waste Slurry | Rev. 1 | Rev. 6 | Closed, 9/6/95 |

| UNIT | Permit Revision | | Comments/History |
|---|---|---|---|
| | Incorporated | Retired | |
| PFP Treatment Unit (HA-20MB) | Rev. 8B | Rev. 8B | Closed 2/8/05 |
| 241-Z Treatment and Storage Tanks | Rev. 8B | Rev. 8B | Closed 2/22/07 |
| 303-M Oxide Facility | Rev. 8B | Rev. 8B | Closed 6/15/06 |
| 224-T Transuranic Waste Storage and Assay Facility | Rev. 8C | Rev. 8C | Closed 11/12/08 |
| **PART VI, POSTCLOSURE UNITS** | | | |
| 183-H Solar Evaporation Basin | Rev 4 | | |
| 300 Area Process Trenches | Rev 3 | | |
| **PROCEDURALLY CLOSED** | | | |
| 216-U-12 Crib | N/A | N/A | Closed 7/19/07 |
| 221-T Test Facility | N/A | N/A | Closed 2/22/99 |
| 2727-WA SRE Sodium Storage Bldg | N/A | N/A | Closed 2/22/99 |
| 324 Pilot Plant | N/A | N/A | Closed 6/9/97 |
| 332 Storage Facility | N/A | N/A | Closed 4/21/97 |
| 437 Maintenance and Storage Facility | N/A | N/A | Closed 9/11/03 |
| Biological Treatment Test Facilities | N/A | N/A | Closed12/10/96 |
| Physical/Chemical Treatment Test Facilities | N/A | N/A | Closed 5/13/96 |
| Sodium Storage/Sodium Reaction | N/A | N/A | Closed 9/17/03 |
| Thermal Treatment Test Facilities | N/A | N/A | Closed 5/13/96 |
| **TO BE INCORPORATED** | | | |
| 1706-KE Waste Treatment System | | | |
| 207-A South Retention Basin | | | |
| 216-A-10 Crib | | | |
| 216-A-29 Ditch | | | |
| 216-A-36B Crib | | | |
| 216-A-37-1 Crib | | | |
| 216-B-3 Main Pond | | | |
| 216-B-63 Trench | | | |
| 216-S-10 Pond & Ditch | | | |
| 222-S Dangerous & Mixed Waste TSD Unit | | | |
| 241-CX Tank System | | | |
| 600 Area Purgewater Storage and Treatment Facility | | | |
| Central Waste Complex | | | |
| Contact Handled Transuranic Mixed Waste Packaging and Interim Storage Facility | | | |
| DST System/204-AR Waste Unloading Station | | | |
| Grout Treatment Facility | | | |
| Hexone Storage & Treatment Facility | | | |
| IHLW Interim Storage/Canister Storage Building | | | |
| Low-Level Burial Grounds | | | |
| Nonradioactive Dangerous Waste Landfill | | | |
| Single-Shell Tank System | | | |
| T Plant Complex | | | |
| Waste Encapsulation and Storage Facility | | | |
| Waste Receiving and Processing Facility | | | |
| **TRANSITION UNDER HFFACO ACTION PLAN, SECTION 8 (Will not be incorporated into Permit)** | | | |
| B Plant Complex | | | |
| PUREX Plant | | | |

## Definitions

Except with respect to those terms specifically defined below, all definitions contained in the HFFACO, May 1989, as amended, and in WAC 173-303-040 and other portions of Chapter 173-303 WAC are hereby incorporated, in their entirety, by reference into this Permit. For terms defined in both Chapter 173-303 WAC and the HFFACO, the definitions contained in Chapter 173-303 WAC will control within this Permit. Nonetheless, this Permit is intended to be consistent with the HFFACO.

Where terms are not defined in the regulations, the Permit, or the HFFACO, a standard dictionary reference, or the generally accepted scientific or industrial meaning of the terms will define the meaning associated with such terms.

As used in this Permit, words in the masculine gender also include the feminine and neuter genders, words in the singular include the plural, and words in the plural include the singular.

The following definitions apply throughout this Permit:

The term "**Area of Concern**" means any area of the Facility where a release of dangerous waste or dangerous constituents has occurred, is occurring, is suspected to have occurred, or threatens to occur.

The term "**Contractor(s)**" means, unless specifically identified otherwise in this Permit, or Attachments, Bechtel National, Inc. (BNI), CH2M HILL Plateau Remediation Company, Inc. (CHPRC), Mission Support Alliance, LLC (MSA), Pacific Northwest National Laboratory (PNNL), Washington Closure Hanford, LLC (WCH), and Washington River Protection Solutions, LLC (WRPS).

The term "**Critical Systems**" as applied to determining whether a Permit modification is required, means those specific portions of a TSD unit's structure, or equipment, whose failure could lead to the release of dangerous waste into the environment, and/or systems which include processes which treat, transfer, store, or dispose of regulated wastes. A list identifying the critical systems of a specific TSD unit may be developed and included in Part III, V, and/or VI of this Permit. In developing a critical system list, or in the absence of a critical system list, WAC 173-303-830 Modifications will be considered.

The term "**Dangerous Constituent**" means any constituent identified in WAC 173-303-9905 or 40 CFR Part 264 Appendix IX, any constituent which caused a waste to be listed or designated as dangerous under Chapter 173-303 WAC, and any constituents within the meaning of hazardous substance at RCW 70.105D.020(7).

The term "**Dangerous Waste**" means those solid wastes designated under Chapter 173-303 WAC as dangerous or extremely hazardous waste. As used in the Permit, the phrase "dangerous waste" will refer to the full universe of wastes regulated by Chapter 70.105 RCW and Chapter 173-303 WAC (including dangerous waste, hazardous waste, extremely hazardous waste, mixed waste, and acutely hazardous waste).

The term "**Days**" means calendar days, unless specifically identified otherwise. Any submittal, notification, or recordkeeping requirement that would be due, under the Conditions of this Permit, on a Saturday, Sunday, or federal, or state holiday, will be due on the following business day, unless specifically stated otherwise in the Permit.

The term "**Director**" means the Director of the Washington State Department of Ecology, or a designated representative. The Program Manager of the Nuclear Waste Program (with the address as specified on page one [1] of this Permit) is a duly authorized and designated representative of the Director for purposes of this Permit.

The term "**Ecology**" means the Washington State Department of Ecology (with the address as specified on page one [1] of this Permit).

The term "**Facility**" means all contiguous land, structures, other appurtenances, and improvements on the land used for recycling, reusing, reclaiming, transferring, storing, treating, or disposing of dangerous waste. The legal and physical description of the Facility is set forth in Permit Attachment 2.

The term "**Facility**" for the purposes of corrective action under Permit Condition II.Y, means all contiguous property under the control of the Permittees and all property within the meaning of "facility" at RCW 70.105D.020(3) as set forth in Permit Attachment 2.

The term "**HFFACO**" means the Hanford Federal Facility Agreement and Consent Order, as amended (Commonly referred to as Tri-Party Agreement [TPA]).

The term "**Permittees**" means the United States Department of Energy (owner/operator), Bechtel National, Inc. (Co-operator), CH2M HILL Plateau Remediation Company (Co-operator), Mission Support Alliance, LLC (MSA), Pacific Northwest National Laboratory (Co-operator), Washington Closure Hanford, LLC (Co-operator), Washington River Protection Solutions, LLC.

The term "**Permittees**" for purposes of corrective action under Permit Condition II.Y means only the United States Department of Energy (owner/operator).

The term "**Raw Data**" means the initial value of analog or digital instrument output, and/or manually recorded values obtained from measurement tools or personal observation. These values are converted into reportable data (e.g., concentration, percent moisture) via automated procedures and/or manual calculations.

The term "**RCRA Permit**" means the Dangerous Waste Portion of the RCRA Permit for the Treatment, Storage, and Disposal of Dangerous Waste (Dangerous Waste Permit) issued by the Washington State Department of Ecology, pursuant to Chapter 70.105 RCW and Chapter 173-303 WAC, coupled with the HSWA Portion of the RCRA Permit for the Treatment, Storage, and Disposal of Hazardous Waste (HSWA Permit) issued by EPA, Region 10, pursuant to 42 U.S.C. 6901 et seq. and 40 CFR Parts 124 and 270.

The term "**Reasonable Times**" means normal business hours; hours during which production, treatment, storage, construction, disposal, or discharge occurs, or times when Ecology suspects a violation requiring immediate inspection.

The term "**Release**" means any intentional or unintentional spilling, leaking, pouring, emitting, emptying, discharging, injecting, pumping, escaping, leaching, dumping, or disposing of dangerous constituents into the environment and includes the abandonment or discarding of barrels, containers, and other receptacles containing dangerous waste or dangerous constituents, and includes any releases within the meaning of release at RCW 70.105D.020(20).

The term "**Significant Discrepancy**" in regard to a manifest or shipping paper, means a discrepancy between the quantity or type of dangerous waste designated on the manifest, or shipping paper, and the quantity or type of dangerous waste a TSD unit actually receives. A significant discrepancy in quantity is a variation greater than ten (10) percent in weight for bulk quantities (e.g., tanker trucks, railroad tank cars, etc.), or any variation in piece count for nonbulk quantities (i.e., any missing container or package would be a significant discrepancy). A significant discrepancy in type is an obvious physical or chemical difference which can be discovered by inspection or waste analysis (e.g., waste solvent substituted for waste acid).

The term "**Solid Waste Management Unit (SWMU)**" means any discernible location at the Facility where solid wastes have been placed at any time, irrespective of whether the location was intended for the management of solid or dangerous waste, and includes any area at the Facility at which solid wastes have been routinely and systematically released (for example through spills), and includes dangerous waste treatment, storage, and disposal units.

The term "**Unit**" **or** "**TSD unit**", as used in Parts I through VI of this Permit, means the contiguous area of land on or in which dangerous waste is placed, or the largest area in which there is a significant likelihood of mixing dangerous waste constituents in the same area. A TSD unit, for purposes of this Permit, is a subgroup of the Facility which has been identified in a Hanford Facility Dangerous Waste Part A Form.

## Acronyms

| | |
|---|---|
| ALARA | As Low As Reasonably Achievable |
| AMSF | Alkali Metal Storage Facility |
| APDS | Ash Pit Demolition Site |
| APP | Used to Denote Appendix Page Numbers |
| APT | Area Process Trenches |
| ARAR | Applicable, Relevant, and Appropriate Requirements |
| BNI | Bechtel National, Inc |
| BPDS | Borrow Pit Demolition Site |
| CD/RR | Chemical Disposal/Recycle Request |
| CERCLA | Comprehensive Environmental Response Compensation and Liability Act of 1980 (as Amended by the Superfund Reauthorization Act of 1986) |
| CFR | Code of Federal Regulations |
| CHPRC | CH2M HILL Plateau Remediation Company |
| CIP | Construction Inspection Plan |
| CLARC | Cleanup Levels and Risk Calculations |
| CLP | Contract Laboratory Program |
| COC | Chemical Contaminants of Concern |
| CPP | CERCLA Past Practice |
| USDOE-RL | U.S. Department of Energy, Richland Operations Office |
| USDOE-ORP | U.S. Department of Energy, Office of River Protection |
| DQO | Data Quality Objective |
| DSC | Differential Scanning Colorimetry |
| EC | Emergency Coordinator |
| Ecology | Washington State Department of Ecology |
| EPA | U.S. Environmental Protection Agency |
| ERA | Expedited Response Action |
| ETF | 200 Area Effluent Treatment Facility |
| HFFACO | Hanford Federal Facility Agreement and Consent Order |
| GW | Ground Water |
| HPADS | Hanford Patrol Academy Demolition Site |
| HSWA | Hazardous and Solid Waste Amendments of 1984 |
| HWMA | Hazardous Waste Management Act |
| ID | Identification |
| IRM | Interim Remedial Measure |
| LDR | Land Disposal Restrictions |
| LERF | Liquid Effluent Retention Facility |
| LSFF | 105-DR Large Sodium Fire Facility |
| MSA | Mission Support Alliance, LLC |
| MTCA | Model Toxics Control Act |

| | |
|---|---|
| OSWER | Office of Solid Waste and Emergency Response |
| PNNL | Pacific Northwest National Laboratory |
| QA | Quality Assurance |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| RCRA | Resource Conservation and Recovery Act of 1976 |
| RCW | Revised Code of Washington |
| ROD | Record of Decision |
| RPD | Relative Percent Difference |
| RPP | RCRA Past Practice |
| SAP | Sampling and Analysis Plan |
| SARA | Superfund Amendments and Reauthorization Act of 1986 |
| SCD | Security Control Devices |
| SHLWS | Simulated High Level Waste Slurry |
| SOP | Standard Operating Procedure |
| SWMU | Solid Waste Management Unit |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TSD | Treatment, Storage, and/or Disposal |
| USDOE | United States Department of Energy |
| U.S.C. | United States Code |
| WAC | Washington Administrative Code |
| WAP | Waste Analysis Plan |
| WCH | Washington Closure Hanford, LLC |
| WRPS | Washington River Protection Solutions, LLC |
| WTP | Waste Treatment and Immobilization Plant |
| 183-H | 183-H Solar Evaporation Basins |
| 242-A | 242-A Evaporator |
| 300 APT | 300 Area Process Trenches |
| 300 ASE | 300 Area Solar Evaporator |
| 303-K | 303-K Storage Facility |
| 305-B | 305-B Storage Facility |
| 325 HWTUs | 325 Hazardous Waste Treatment Units |
| 616-NRDWSF | 616 Nonradioactive Dangerous Waste Storage Facility |

# PART I STANDARD CONDITIONS

## I.A EFFECT OF PERMIT

The Permittees are authorized to treat, store, and dispose of dangerous waste in accordance with the Conditions of this Permit and in accordance with the applicable provisions of Chapter 173-303 WAC (including provisions of the Chapter as they have been applied in the HFFACO). Any treatment, storage, or disposal of dangerous waste by the Permittees at the Facility that is not authorized by this Permit, or by WAC 173-303-400 (including provisions of this regulation as they have been applied in the HFFACO), for those TSD units not subject to this Permit, and for which a Permit is required by Chapter 173-303 WAC, is prohibited.

TSD units operating or closing under interim status will maintain interim status until that TSD unit is incorporated into Part III, V, and/or VI of this Permit, or until interim status is terminated under WAC 173-303-805(8). Interim status units will be incorporated into this Permit through the Permit modification process.

The Conditions of this Permit will be applied to the Facility as defined by the Permit Applicability Matrix (Permit Attachment 9).

I.A.1 USDOE is responsible for activities which include, but are not limited to, the overall management and operation of the Facility.

BNI is identified as a Permittee for activities subject to the Conditions of this Permit where its agents, employees, or subcontractors have operational and/or management responsibilities and control.

CHPRC is identified as a Permittee for activities subject to the Conditions of this Permit where its agents, employees, or subcontractors have operational and/or management responsibilities and control.

MSA is identified as a Permittee for activities subject to the Conditions of this Permit where its agents, employees, or subcontractors have operational and/or management responsibilities and control.

PNNL is identified as a Permittee for activities subject to the Conditions of this Permit where its agents, employees, or subcontractors have operational and/or management responsibilities and control.

WCH is identified as a Permittee for activities subject to the Conditions of this Permit where its agents, employees, or subcontractors have operational and/or management responsibilities and control.

WRPS is identified as a Permittee for activities subject to the Conditions of this Permit where its agents, employees, or subcontractors have operational and/or management responsibilities and control.

I.A.2 Coordination with the HFFACO

Each TSD unit will have an application for a final status Permit or closure/post-closure plan submitted to Ecology in accordance with the schedules identified in the HFFACO Milestone M-20-00 or in accordance with WAC 173-303-830. After completion of the Permit application or closure/post-closure plan review, a final Permit decision will be made pursuant to WAC 173-303-840. Specific Conditions for each TSD unit will be incorporated into this Permit in accordance with the Class 3 Permit modification procedure identified in Permit Condition I.C.3.

## I.B PERSONAL AND PROPERTY RIGHTS

This Permit does not convey property rights of any sort, or any exclusive privilege; nor does it authorize any injury to persons or property, or any invasion of other private rights, or any violation of federal, state, or local laws or regulations.

## I.C PERMIT ACTIONS

I.C.1 Modification, Revocation, Reissuance, or Termination

This Permit may be modified, revoked and reissued, or terminated by Ecology for cause per WAC 173-303-810(7) as specified in WAC 173-303-830(3), (4), and (5).

I.C.2 Filing of a Request

The filing of a request for a Permit modification, or revocation and reissuance, or termination, or a notification of planned changes, or anticipated noncompliance on the part of the Permittees, will not stay any Permit condition [WAC 173-303-810(7)]except as provided in WAC 173-303-810(2) under an emergency permit.

I.C.3 Modifications

I.C.3.a Except as provided otherwise by specific language in this Permit, the Permit modification procedures of WAC 173-303-830(2), (3), and (4) will apply to modifications or changes in design or operation of the Facility, or any modification or change in dangerous waste management practices covered by this Permit.

I.C.3.b As an exception, the Permittees will provide notifications to Ecology required by WAC 173-303-830(4)(a)(i)(A) on a quarterly basis. Each quarterly notification will be submitted within ten (10) days of the end of the quarter, and provide the required information for all such modification s put into effect during that reporting period.

I.C.3.c Quarterly reporting periods will be based upon the state Fiscal Year. For notifications required by the Permittees to persons on the facility mailing list described in WAC 173-303-830(4)(a)(i)(B), -830(4)(b)(ii), -830(4)(c)(ii), and -830(4)(e)(ii)(C), use of appropriate HFFACO Community Relations Plan publications and/or list servers for public involvement satisfy the notification requirements.

## I.D SEVERABILITY

I.D.1 Effect of Invalidation

The provisions of this Permit are severable, and if any provision of this Permit, or the application of any provision of this Permit to any circumstance is contested and/or held invalid, the application of such provision to other circumstances and the remainder of this Permit will not be affected thereby. Invalidation of any state statutory or regulatory provision which forms the basis for any Condition of this Permit does not affect the validity of any other state statutory or regulatory basis for said Condition.

I.D.2 Final Resolution

In the event that a Condition of this Permit is stayed for any reason, the Permittees will continue to comply with the related applicable and relevant interim status standards in WAC 173-303-400 until final resolution of the stayed Condition, unless Ecology determines compliance with the related applicable and relevant interim status standards would be technologically incompatible with compliance with other Conditions of this Permit, which have not been stayed, or unless the HFFACO authorizes an alternative action, in which case the Permittees will comply with the HFFACO.

## I.E DUTIES AND REQUIREMENTS

### I.E.1 Duty to Comply

The Permittees will comply with all Conditions of this Permit, except to the extent and for the duration such noncompliance is authorized by an emergency Permit issued under WAC 173-303-804. Any Permit noncompliance other than noncompliance authorized by an emergency Permit constitutes a violation of Chapter 70.105 RCW, as amended, and is grounds for enforcement action, Permit termination, modification or revocation and reissuance of the Permit, and/or denial of a Permit renewal application.

### I.E.2 Compliance Not Constituting Defense

Compliance with the terms of this Permit does not constitute a defense to any order issued or any action brought under Section 3007, 3008, 3013, or 7003 of RCRA (42 U.S.C. Sections 6927, 6928, 6934, and 6973), Section 104, 106(a) or 107 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) [42 U.S.C. Sections 9604, 9606(a), and 9607], as amended by the Superfund Amendments and Reauthorization Act of 1986 (42 U.S.C. 9601 et seq.), or any other federal, state, or local law governing protection of public health, or the environment; provided, however, that compliance with this Permit during its term constitutes compliance at those areas subject to this Permit for the purpose of enforcement with WAC 173-303-140, WAC 173-303-180, WAC 173-303-280 through -395, WAC 173-303-600 through -680, WAC 173-303-810, and WAC 173-303-830, except for Permit modification s and those requirements not included in the Permit that become effective by statute, or that are promulgated under 40 CFR Part 268 restricting the placement of dangerous waste in or on the land.

### I.E.3 Duty to Reapply

If the Permittees wish to continue an activity regulated by this Permit after the expiration date of this Permit, the Permittees must apply for, and obtain a new Permit, in accordance with WAC 173-303-806(6).

### I.E.4 Permit Expiration and Continuation

This Permit, and all Conditions herein, will remain in effect beyond the Permit's expiration date until the effective date of the new Permit, if the Permittees have submitted a timely, complete application for renewal per WAC 173-303-806 and, through no fault of the Permittees, Ecology has not made a final Permit determination as set forth in WAC 173-303-840.

### I.E.5 Need to Halt or Reduce Activity Not a Defense

It will not be a defense in the case of an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the Conditions of this Permit.

### I.E.6 Duty to Mitigate

In the event of noncompliance with the Permit, the Permittees will take all reasonable steps to minimize releases to the environment, and will carry out such measures as are reasonable to minimize or correct adverse impacts on human health and the environment.

I.E.7 Proper Operation and Maintenance

The Permittees will at all times properly operate and maintain all facilities and systems of treatment and control, which are installed or used by the Permittees, to achieve compliance with the Conditions of this Permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance/quality control procedures. This provision requires the operation of backup or auxiliary facilities, or similar systems only when necessary to achieve compliance with the Conditions of the Permit.

I.E.8 Duty to Provide Information

The Permittees will furnish to Ecology, within a reasonable time, any relevant information which Ecology may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Permit, or to determine compliance with this Permit. The Permittees will also furnish to Ecology, upon request, copies of records required to be kept by this Permit.

I.E.9 Inspection and Entry

The Permittees will allow Ecology, or authorized representatives, upon the presentation of Ecology credentials, to:

I.E.9.a During operating hours, and at all other reasonable times, enter and inspect the Facility or any unit or area within the Facility, where regulated activities are located or conducted, or where records must be kept under the Conditions of this Permit;

I.E.9.b Have access to, and copy, at reasonable times, any records that must be kept under the Conditions of this Permit;

I.E.9.c Inspect at reasonable times any portion of the Facility, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Permit; and,

I.E.9.d Sample or monitor, at reasonable times, for the purposes of assuring Permit compliance, or as otherwise authorized by state law, as amended, for substances or parameters at any location.

I.E.10 Monitoring and Records

I.E.10.a Samples and measurements taken by the Permittees for the purpose of monitoring required by this Permit will be representative of the monitored activity. Sampling methods will be in accordance with WAC 173-303-110 or 40 CFR 261, unless otherwise specified in this Permit, or agreed to in writing by Ecology. Analytical methods will be as specified in the most recently published test procedure of the documents cited in WAC 173-303-110(3)(a) through (h), unless otherwise specified in this Permit, or agreed to in writing by Ecology.

I.E.10.b The Permittees will retain at the TSD unit(s), or other locations approved by Ecology, as specified in Parts III, V, and/or VI of this Permit, records of monitoring information required for compliance with this Permit, including calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of reports and records required by this Permit, and records of data used to complete the application for this Permit for a period of at least ten (10) years from the date of the sample, measurement, report, or application, unless otherwise required for certain information by other Conditions of this Permit. This information may be retained on electronic media.

I.E.10.c The Permittees will retain at the Facility, or other approved location, records of all monitoring and maintenance records, copies of all reports and records required by this Permit, and records of all data used to complete the application for this Permit, which are not associated with a particular TSD unit, for a period of at least ten (10) years from the date of certification of completion of post-closure care, or corrective action for the Facility, whichever is later. This information may be retained on electronic media.

I.E.10.d The record retention period may be extended by request of Ecology at any time by notification, in writing, to the Permittees, and is automatically extended during the course of any unresolved enforcement action regarding this Facility to ten (10) years beyond the conclusion of the enforcement action.

I.E.10.e Records of monitoring information shall include:

I.E.10.e.i The date, exact place and time of sampling or measurements;

I.E.10.e.ii The individual who performed the sampling or measurements and their affiliation;

I.E.10.e.iii The dates the analyses were performed;

I.E.10.e.iv The individual(s) who performed the analyses and their affiliation;

I.E.10.e.v The analytical techniques or methods used; and,

I.E.10.e.vi The results of such analyses

I.E.11 Reporting Planned Changes

The Permittees will give notice to Ecology, as soon as possible, of any planned physical alterations, or additions to the Facility subject to this Permit. Such notice does not authorize any noncompliance with, or modification of, this Permit.

I.E.12 Certification of Construction or Modification

I.E.12.a The Permittees may not commence treatment, storage, or disposal of dangerous wastes in a new or modified portion of TSD units subject to this Permit until:

I.E.12.b The Permittees have submitted to Ecology, by certified mail, overnight express mail, or hand delivery, a letter signed by the Permittees, and a registered professional engineer, stating that the TSD unit has been constructed or modified in compliance with the Conditions of this Permit; and,

I.E.12.c Ecology has inspected the modified or newly constructed TSD unit, and finds that it is in compliance with the Conditions of this Permit; or

I.E.12.d Within fifteen (15) days of the date of receipt of the Permittees' letter, the Permittees have not received notice from Ecology of its intent to inspect, prior inspection is waived, and the Permittees may commence treatment, storage, and disposal of dangerous waste.

I.E.13 Anticipated Noncompliance

The Permittees will give at least thirty (30) days advance notice to Ecology of any planned changes in the Facility subject to this Permit, or planned activity which might result in noncompliance with Permit requirements.

If thirty (30) days advance notice is not possible, then the Permittees will give notice immediately after the Permittees become aware of the anticipated noncompliance. Such notice does not authorize any noncompliance with, or modification of, this Permit.

I.E.14 Transfer of Permits

I.E.14.a This Permit may be transferred to a new owner/operator only if it is modified, or revoked and reissued, pursuant to WAC 173-303-830(3)(b). Unit-specific portion may be transferred to a new Co-operator as a Class [1]1 modification with prior approval of the Department's director.

I.E.14.b Before transferring ownership or operation of the Facility during its operating life, the owner/operator will notify the new owner/operator in writing, of the requirements of WAC 173-303-290(2), -600 and -806, and this Permit.

I.E.15 Immediate Reporting

I.E.15.a The Permittees will verbally report to Ecology any release of dangerous waste or hazardous substances, or any noncompliance with the Permit which may endanger human health or the environment. Any such information will be reported immediately after the Permittees become aware of the circumstances.

I.E.15.b The immediate verbal report will contain all the information needed to determine the nature and extent of any threat to human health and the environment, including the following:

I.E.15.b.i Name, address, and telephone number of the Permittee responsible for the release or noncompliant activity;

I.E.15.b.ii Name, location, and telephone number of the unit at which the release occurred;

I.E.15.b.iii Date, time, and type of incident;

I.E.15.b.iv Name and quantity of material(s) involved;

I.E.15.b.v The extent of injuries, if any;

I.E.15.b.vi An assessment of actual or potential hazard to the environment and human health, where this is applicable;

I.E.15.b.vii Estimated quantity of released material that resulted from the incident; and,

I.E.15.b.viii Actions which have been undertaken to mitigate the occurrence.

I.E.15.c The Permittees will report, in accordance with Permit Conditions I.E.15.a and I.E.15.b, any information concerning the release, or unpermitted discharge, of any dangerous waste or hazardous substances that may cause an endangerment to drinking water supplies, or ground or surface waters, or of a release, or discharge of dangerous waste, or hazardous substances, or of a fire or explosion at the Facility, which may threaten human health or the environment. The description of the occurrence and its cause will include all information necessary to fully evaluate the situation and to develop an appropriate course of action.

I.E.15.d For any release or noncompliance not required to be reported to Ecology immediately, a brief account must be entered within two (2) working days, into the TSD Operating Record, for a TSD unit, or into the Facility Operating Record, inspection log, or separate spill log, for non-TSD units. This account must include: the time and date of the release, the location and cause of the release, the type and quantity of material released, and a brief description of any response actions taken or planned.

I.E.15.e All releases, regardless of location of release, or quantity of release, will be controlled and mitigated, if necessary, as required by WAC 173-303-145(3).

I.E.16 Written Reporting

Within fifteen (15) days after the time the Permittees become aware of the circumstances of any noncompliance with this Permit, which may endanger human health or the environment, the Permittees will provide to Ecology a written report. The written report will contain a description of the noncompliance and its cause (including the information provided in the verbal notification); the period of noncompliance including exact dates and times; the anticipated time noncompliance is expected to continue, if the noncompliance has not been corrected; corrective measures being undertaken to mitigate the situation, and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

I.E.17 Manifest Discrepancy Report

I.E.17.a For dangerous waste received from outside the Facility, whenever a significant discrepancy in a manifest is discovered, the Permittees will attempt to reconcile the discrepancy. If not reconciled within fifteen (15) days of discovery, the Permittees will submit a letter report in accordance with WAC 173-303-370(4), including a copy of the applicable manifest or shipping paper, to Ecology.

I.E.17.b For dangerous waste which is being transported within the Facility (i.e., shipment of on-site generated dangerous waste), whenever a significant discrepancy in the shipping papers (see Permit Condition II.Q.1) is discovered, the Permittees will attempt to reconcile the discrepancy. If not reconciled within fifteen (15) days of discovery, the Permittees will note the discrepancy in the receiving unit's Operating Record.

I.E.18 Unmanifested Waste Report

The Permittees will follow the provisions of WAC 173-303-370 for the receipt of any dangerous waste shipment from off-site. The Permittees will also submit a report in accordance with WAC 173-303-390(1) to Ecology within fifteen (15) days of receipt of any unmanifested dangerous waste shipment received from off-site sources.

I.E.19 Other Noncompliance

The Permittees will report to Ecology all instances of noncompliance, not otherwise required to be reported elsewhere in this Permit, at the time the Annual Dangerous Waste Report is submitted.

I.E.20 Other Information

Whenever the Permittees become aware that they have failed to submit any relevant facts in a Permit application, closure plan, or post-closure plan, or submitted incorrect information in a Permit application, closure plan, or post-closure plan, or in any report to Ecology, the Permittees will promptly submit such facts or corrected information.

I.E.21 Reports, Notifications, and Submissions

All written reports, notifications or other submissions, which are required by this Permit to be sent, or given to the Director or Ecology, should be sent certified mail, overnight express mail, or hand delivered, to the current address and telephone number shown below. This address and telephone number may be subject to change.

Washington State Department of Ecology
Nuclear Waste Program
3100 Port of Benton Blvd
Richland, Washington 99354
Telephone: (509) 372-7950

Telephonic and oral reports/notifications also need to be provided to Ecology's Richland Office.

Ecology will give the Permittees written notice of a change in address or telephone number. It is the responsibility of the Permittees to ensure any required reports, notifications, or other submissions are transmitted to the addressee listed in this Condition. However, the Permittees will not be responsible for ensuring verbal and written correspondence reaches a new address or telephone number until after their receipt of Ecology's written notification.

I.E.22 Annual Report

The Permittees will comply with the annual reporting requirements of WAC 173-303-390(2)(a) through (e), and (g).

## I.F SIGNATORY REQUIREMENT

All applications, reports, or information submitted to Ecology, which require certification, will be signed and certified in accordance with WAC 173-303-810(12) and (13). All other reports required by this Permit and other information requested by Ecology will be signed in accordance with WAC 173-303-810(12).

## I.G CONFIDENTIAL INFORMATION

The Permittees may declare as confidential any information required to be submitted by this Permit, at the time of submission, in accordance with WAC 173-303-810(15).

## I.H DOCUMENTS TO BE MAINTAINED AT FACILITY SITE

The Permittees will maintain at the Facility, or some other location approved by Ecology, the following documents and amendments, revisions, and modifications to these documents: (1) This Permit and all Attachments; and (2) The Hanford Facility Operating Record.

All dangerous waste Part B permit applications, post closure permit applications, and closure plan applications are maintained in the Administrative Record located at 2440 Stevens, Room 1101, Richland, WA.

Other approved locations: (1) 700 Area, (2) Locations within the City of Richland under control of one or more of the Permittees, (3) Administrative Record locations within the Stevens Center complex, (4) Consolidated Information Center at Washington State University, Tri-Cities. (5) Archived records at the National Archives and Records Administration (NARA), Pacific Alaska Region, 6125 Sand Point Way NE, Seattle, Washington, 98115-7999.

These documents will be maintained for ten (10) years after post-closure care or corrective action for the Facility, whichever is later, has been completed and certified as complete.

# PART II GENERAL FACILITY CONDITIONS

## II.A FACILITY CONTINGENCY PLAN

II.A.1 The Permittees will immediately carry out applicable provisions of the *Hanford Emergency Management Plan* as provided in Permit Attachment 4, pursuant to WAC 173-303-360(2), whenever there is an incident meeting the criteria of Permit Attachment 4, Section 4.2. Enforceable portions of Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02) are identified in Permit Attachment 4, Appendix A.

II.A.2 The Permittees will comply with the requirements of WAC 173-303-350(4), as provided in the *Hanford Emergency Management Plan* (Permit Attachment 4). The *Hanford Emergency Management Plan* provides reference to the need for unit-specific contingency documentation. Unit-specific contingency documentation for Part III TSD units is included in Part III of this Permit. Unit-specific contingency documentation for Part V and VI TSD units required by this Permit condition is maintained in the Hanford Facility Operating Record, Unit-Specific files.

II.A.3 The *Permittees* will review and amend, if necessary, the applicable portions of the *Hanford Emergency Management Plan*, as provided in Permit Attachment 4, pursuant to WAC 173-303-350(5), and in accordance with the provisions of WAC 173-303-830(4). The Permittees will be able to demonstrate how Amendments to the applicable portions are controlled. The plan will be amended within a period of time agreed upon by Ecology.

II.A.4 The Permittees will comply with the requirements of WAC 173-303-350(3) and –360(1) concerning the emergency coordinator, except the names and home telephone numbers will be on file with the single point-of-contact, phone number (509) 373-3800 or 375-2400 (for PNNL units) as described in the *Hanford Emergency Management Plan*.

## II.B PREPAREDNESS AND PREVENTION

II.B.1 The Permittees will equip the Facility with the equipment specified in WAC 173-303-340(1) as specified in the *Hanford Emergency Management Plan* (Permit Attachment 4). Unit-specific preparedness and prevention provisions are included in Parts III, V, and/or VI of this Permit.

II.B.2 The Permittees will test and maintain the equipment specified in Permit Condition II.B.1 as necessary to assure proper operation in the event of emergency.

II.B.3 The Permittees will maintain access to communications or alarms pursuant to WAC 173-303-340(2), as provided in the *Hanford Emergency Management Plan* (Permit Attachment 4) and unit-specific contingency plans.

II.B.4 The Permittees will comply with WAC 173-303-340(4) and WAC 173-303-355(1) pertaining to arrangements with local authorities.

II.B.5 Based on the arrangements with local authorities required by WAC 173-303-340(4) documented in Permit Attachment 4, Table 3-1, the Permittees will maintain the Memorandums of Understanding to comply with WAC 173-303-350(4)(b). The Hanford Facility Memorandums of Understanding with local authorities provides emergency planning and coordination equivalent to submittal of the contingency plan to local authorities

## II.C PERSONNEL TRAINING

II.C.1 The Permittees will conduct personnel training as required by WAC 173-303-330. The Permittees will maintain documents in accordance with WAC 173-303-330(2) and (3). Training records may be maintained in the Hanford Facility Operating Record, or on electronic data storage.

II.C.2 All Hanford Facility personnel will receive general Facility training within six (6) months of hire. This training will provide personnel with orientation of dangerous waste management activities being conducted at the Hanford Facility. This training will include:

II.C.2.a Description of emergency signals and appropriate personnel response;

II.C.2.b Identification of contacts for information regarding dangerous waste management activities;

II.C.2.c Introduction to waste minimization concepts;

II.C.2.d Identification of contact(s) for emergencies involving dangerous waste; and

II.C.2.e Familiarization with the applicable portions of the *Hanford Emergency Management Plan*.

II.C.3 Description of training plans for personnel assigned to TSD units subject to this Permit are delineated in the unit-specific Chapters in Parts III, V, and/or VI of this Permit.

II.C.4 The Permittees will provide the necessary training to non-Facility personnel (i.e., visitors, sub-contractors), as appropriate, for the locations of such personnel, and the activities that will be undertaken. At a minimum, this training will describe dangerous waste management hazards at the Facility.

## II.D WASTE ANALYSIS

II.D.1 All waste analyses required by this Permit will be conducted in accordance with a written waste analysis plan (WAP), or sampling and analysis plan (SAP). Operating TSD units will have a WAP, which will be approved through incorporation of the TSD unit into Part III of this Permit. Closing TSD units, and units in post-closure, should have a SAP and, if necessary, a WAP, which will be approved through incorporation of the TSD unit into Part V and/or VI of this Permit.

II.D.2 Until a WAP is implemented in accordance with Permit Condition II.D.1., any unit(s) identified in Parts III, V, and/or VI of this Permit, without a unit-specific WAP approved by Ecology, will not treat, store, or dispose of dangerous waste, unless specified otherwise by Ecology in writing.

II.D.3 Each TSD unit WAP will include:

II.D.3.a The parameters for which each dangerous waste will be analyzed, and the rationale for selecting these parameters; (i.e., how analysis for these parameters will provide sufficient information on the waste properties to comply with WAC 173-303-300(1), (2), (3), and (4);

II.D.3.b The methods of obtaining or testing for these parameters;

II.D.3.c The methods for obtaining representative samples of wastes for analysis (representative sampling methods are discussed in WAC 173-303-110(2);

II.D.3.d The frequency with which analysis of a waste will be reviewed, or repeated, to ensure that the analysis is accurate and current;

II.D.3.e The waste analyses which generators have agreed to supply;

II.D.3.f Where applicable, the methods for meeting the additional waste analysis requirements for specific waste management methods, as specified in WAC 173-303-140(4)(b), 173-303-395(1), 173-303-630 through 173-303-670, and 40 CFR 264.1034, 264.1063, 284(a), and 268.7, for final status facilities;

II.D.3.f.i For off-site facilities, the procedures for confirming that each dangerous waste received matches the identity of the waste specified on the accompanying manifest, or shipping paper. This includes at least:

II.D.3.f.i.a The procedure for identifying each waste movement at the Facility; and,

II.D.3.f.i.b The method for obtaining a representative sample of the waste to be identified, if the identification method includes sampling.

II.D.3.f.ii For surface impoundments exempted from Land Disposal Restrictions (LDR) under 40 CFR 268.4(a), incorporated by reference in WAC 173-303-140(2), the procedures and schedules for:

II.D.3.f.iii The sampling of impoundment contents;

II.D.3.f.iv The analysis of test data; and

II.D.3.f.v The annual removal of residues that are not delisted under 40 CFR 260.22, or which exhibit a characteristic of hazardous waste and either;

II.D.3.f.v.a Do not meet applicable treatment standards of 40 CFR Part 268, Subpart D; or

II.D.3.f.v.b Where no treatment standards have been established:

II.D.3.f.v.b.1 Such residues are prohibited from land disposal under 40 CFR 268.32, or RCRA Section 3004(d); or

II.D.3.f.v.b.2 Such residues are prohibited from land disposal under 40 CFR 268.33(f); and

II.D.4 Should waste analysis be required by this Permit at a location on the Facility, other than at a TSD unit, a SAP will be maintained by the Permittees, and made available upon request from Ecology. Any SAP required by this Permit, not associated with a particular TSD unit, will include the elements of Permit Conditions II.D.3.a.

## II.E QUALITY ASSURANCE/QUALITY CONTROL

II.E.1 All WAPs and SAPs required by this Permit will include a quality assurance/quality control (QA/QC) plan, or equivalent, to document all monitoring procedures to ensure that all information, data, and resulting decisions are technically sound, statistically valid, and properly documented in accordance with HFFACO Action Plan §6.5, Quality Assurance, and reported/made available in accordance with HFFACO Action Plan §9.6, Data Access and Delivery Requirements.

II.E.2 The level of QA/QC for the collection, preservation, transportation, and analysis of each sample required for implementation of this Permit may be based upon an Ecology-approved DQO for the sample. These DQOs will be approved by Ecology in writing or through incorporation of unit plans and Permits into Parts III, V, and/or VI of this Permit.

## II.F GROUND WATER AND VADOSE ZONE MONITORING

The Permittees will comply with the ground water monitoring requirements of WAC 173-303-645. This Condition will apply only to those wells the Permittees use for the ground water monitoring programs applicable to the TSD units incorporated into Parts III, V, and/or VI of this Permit. Where releases from TSD units subject to this Permit have been documented or confirmed by investigation, or where vadose zone monitoring is proposed for integration with ground water monitoring, the Permittees will evaluate the applicability of vadose zone monitoring. The Permittees will consult with Ecology regarding the implementation of these requirements. If agreed to by Ecology, integration of ground water and vadose zone monitoring, for reasons other than this Permit, may be accommodated by this Permit. Results from other investigation activities will be used whenever possible to supplement and/or replace sampling required by this Permit.

II.F.1 Purgewater Management

Purgewater will be handled in accordance with the requirements set forth in Permit Attachment 10, *Purgewater Management Plan*.

II.F.2 Well Remediation and Abandonment

II.F.2.a The Permittees will inspect the integrity of active resource protection wells as defined by WAC 173-160-030, subject to this Permit, at least once every five (5) years. These inspections will be recorded in the Operating Record. The Permittees will prepare and maintain a plan and schedule by January 26, 1995, specifying the schedule and technical standards for this program. The Permittees will provide a copy of this plan upon the request of Ecology.

II.F.2.b The Permittees will evaluate resource protection wells subject to this Permit according to Sections 4.0 and 5.0 of the *Hanford Well Maintenance Inspection Plan* (Permit Attachment 8) and the *Policy on Remediation of Existing Wells and Acceptance Criteria for RCRA and CERCLA*, June 1990 (Permit Attachment 7), to determine if a well has a potential use as a qualified well. The Permittees will abandon or remediate unusable wells according to the requirements of Chapter 18.104 RCW, Chapter 173-160 WAC, and Chapter 173-162 WAC to ensure that the integrity of wells subject to this Permit is maintained. The time for this remediation will be specified in Parts III, V, and/or VI of this Permit.

II.F.2.c Ecology will receive notice in writing at least seventy-two (72) hours before the Permittees remediate (excluding maintenance activities), or abandon any well subject to this Permit.

II.F.2.d For wells subject to this Permit, the Permittees will achieve full compliance with Chapter 173-160 WAC and Chapter 18.104 RCW consistent with a rolling five (5) year schedule agreed to by Ecology and the Permittees. This process will be completed by the year 2012.

II.F.3 Well Construction

All wells constructed pursuant to this Permit will be constructed in compliance with Chapter 173-160 WAC.

## II.G SITING CRITERIA

The Permittees will comply with the applicable notice of intent and siting criteria of WAC 173-303-281 and WAC 173-303-282, respectively.

## II.H RECORDKEEPING AND REPORTING

The provisions of WAC 173-303-620 are not applicable to the Hanford Facility because the USDOE is both owner and operator of the Hanford Facility. WAC 173-303-620(1)(c).

## II.I FACILITY OPERATING RECORD

II.I.1 The Permittees will maintain a written Facility Operating Record until ten (10) years after post-closure, or corrective action is complete and certified for the Facility, whichever is later. Except as specifically provided otherwise in this Permit, the Permittees will also record all information referenced in this Permit in the Facility Operating Record within seven (7) working days after the information becomes available. A TSD unit-specific Operating Record will be maintained for each TSD unit at a location identified in Parts III, V, and VI of this Permit. This information may be maintained on electronic media. Each TSD unit-specific Operating Record will be included by reference in the Facility Operating Record. Information required in each TSD unit-specific Operating Record is identified on a unit-by-unit basis in Part III, V, or VI of this Permit. The Facility Operating Record will include, but not be limited to, the following information.

II.I.1.a A description of the system(s) currently utilized to identify and map solid waste management units and their locations. The description of the system(s) is required to include an identification of on-site access to the system's data, and an on-site contact name and telephone number. In addition to, or as part of, this system(s), the Permittees will also maintain a list identifying active ninety (90)-day waste storage areas, and dangerous waste satellite accumulation areas and their locations. The list will identify the location, the predominant waste types managed at the area, and a date identifying when the list was compiled. Maps will be provided by the Permittees upon request by Ecology;

II.I.1.b Records and results of waste analyses required by WAC 173-303-300;

II.I.1.c An identification of the system(s) currently utilized to generate Occurrence Reports. The identification of the system(s) is required to include a description, an identification of an on-site location of hard-copy Occurrence Reports, an identification of on-site access to the system's data, and an on-site contact name and telephone number;

II.I.1.d Copies of all unmanifested waste reports;

II.I.1.e The *Hanford Emergency Management Plan*, as well as summary reports, and details of all incidents that require implementing the contingency plan, as specified in WAC 173-303-360(2)(k);

II.I.1.f An identification of the system(s) currently utilized and being developed to record personnel training records and to develop training plans. The identification of the system(s) is required to include a description, an identification of on-site access to the system's data, and an on-site contact name and telephone number;

II.I.1.g Preparedness and prevention arrangements made pursuant to WAC 173-303-340(4) and documentation of refusal by state or local authorities that have declined to enter into agreements in accordance with WAC 173-303-340(5);

II.I.1.h Reserved Condition;

II.I.1.i Reserved Condition;

II.I.1.j Documentation (e.g., waste profile sheets) of all dangerous waste transported to or from any TSD unit subject to this Permit. This documentation will be maintained in the receiving unit's Operating Record from the time the waste is received;

II.I.1.k An identification of the system(s) currently utilized to cross-reference waste locations to specific manifest document numbers. The identification of the system(s) is required to include a thorough description, an identification of an on-site location of a hard-copy data report, an identification of on-site access to the system's data, and an on-site contact name and telephone number;

II.I.1.l Reserved Condition;

II.I.1.m Annual Reports required by this Permit;

II.I.1.n An identification of all systems currently utilized to record monitoring information, including all calibration and maintenance records, and all original strip chart recordings for continuous monitoring instrumentation. The identification of systems will include a description of the systems. The descriptions will include a confirmation that the criteria of Permit Condition I.E.10 is provided by the utilization of the system. The identification of the systems will also include an identification of on-site access to the system's data, an on-site contact name and telephone number;

II.I.1.o Reserved Condition;

II.I.1.p Summaries of all records of ground water corrective action required by WAC 173-303-645;

II.I.1.q An identification of the system(s) currently being utilized and being developed to evaluate compliance with the Conditions of this Permit and with Chapter 173-303 WAC. The identification of the system(s) will include a description of the system(s), an identification of on-site access to the system's data, and an on-site contact name and telephone number. The description of the system(s) will also include a definition of which portion(s) of the system(s) is accessible to Ecology;

II.I.1.r All deed notifications required by this Permit (to be included by reference);

II.I.1.s All inspection reports required by this Permit; and

II.I.1.t All other reports as required by this Permit, including design change documentation and nonconformance documentation.

## II.J FACILITY CLOSURE

II.J.1 Final closure of the Hanford Facility will be achieved when closure activities for all TSD units have been completed, as specified in Parts III, IV, V, or VI of this Permit. Completion of these activities will be documented using either certifications of closure, in accordance with WAC 173-303-610(6), or certifications of completion of post-closure care, in accordance with WAC 173-303-610(11).

II.J.2 The Permittees will close all TSD units as specified in Parts III, V, and/or VI of this Permit.

II.J.3 The Permittees will submit a written notification of, or request for, a Permit modification in accordance with the provisions of WAC 173-303-610(3)(b), whenever there is a change in operating plans, facility design, or the approved closure plan. The written notification or request must include a copy of the amended closure plan for review, or approval, by Ecology.

II.J.4 The Permittees will close the Facility in a manner that:

II.J.4.a Minimizes the need for further maintenance;

II.J.4.b Controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of dangerous waste, dangerous constituents, leachate, contaminated run-off, or dangerous waste decomposition products, to the ground, surface water, ground water, or the atmosphere; and

II.J.4.c Returns the land to the appearance and use of surrounding land areas to the degree possible, given the nature of the previous dangerous waste activity.

II.J.4.d Meets the requirements of WAC 173-303-610(2)(b).

## II.K SOIL/GROUND WATER CLOSURE PERFORMANCE STANDARDS

II.K.1 For purposes of Permit Condition II.K, the term "clean closure" shall mean the status of a TSD unit at the Facility which has been closed to the cleanup levels prescribed by WAC 173-303-610(2)(b), provided certification of such closure has been accepted by Ecology.

II.K.2 The Permittees may close a TSD unit to background levels as defined in Ecology approved Hanford Site Background Documents, if background concentrations exceed the levels prescribed by Permit Condition II.K.1. Closure to these levels, provided the Permittees comply with all other closure requirements for a TSD unit as identified in Parts III, V, and/or VI of this Permit, shall be deemed as "clean closure".

II.K.3 Except for those TSD units identified in Permit Conditions II.K.1, II.K.2, or II.K.4, the Permittees may close a TSD unit to a cleanup level specified under Method C of Chapter 173-340 WAC. Closure of a TSD unit to these levels, provided the Permittees comply with all other closure requirements for the TSD unit as specified in Parts III, V, and/or VI of the Permit, and provided the Permittees comply with Permit Conditions II.K.3.a through II.K.3.c, shall be deemed as a "modified closure".

II.K.3.a For "modified closures", the Permittees shall provide institutional controls in accordance with WAC 173-340-440 which restricts access to the TSD unit for a minimum of five (5) years following completion of closure. The specific details and duration of institutional controls shall be specified in Parts III, V, and/or VI of this Permit for a particular TSD unit.

II.K.3.b For "modified closures", the Permittees shall provide periodic assessments of the TSD unit to determine the effectiveness of the closure. The specific details of the periodic assessments shall be specified in Parts III, V, and/or VI of this Permit. The periodic assessments shall include, as a minimum, a compliance monitoring plan in accordance with WAC 173-340-410 that will address the assessment requirements on a unit-by-unit basis. At least one (1) assessment activity shall take place after a period of five (5) years from the completion of closure, which will demonstrate whether the soils and ground water have been maintained at or below the allowed concentrations as specified in Parts III, V, or VI of this Permit. Should the required assessment activities identify contamination above the allowable limits as specified in Parts III, V, and/or VI, the TSD unit must be further remediated, or the requirements of II.K.4 must be followed. Should the required assessment activities demonstrate that contamination has diminished, or remained the same, the Permittees may request that Ecology reduce, or eliminate the assessment activities and/or institutional controls.

II.K.3.c For "modified closures", the Permittees shall specify the particular activities required by this Condition in a Post-Closure Permit application.

II.K.4 Any TSD unit for which Permit Conditions II.K.1, II.K.2, or II.K.3, are not chosen as the closure option, closing the TSD unit as a landfill may be selected. Closure and post-closure of the TSD unit as a landfill, must follow the procedures and requirements specified in WAC 173-303-610.

II.K.5 The cleanup option selected shall be specified in Parts III, V, and/or VI of this Permit, and shall be chosen with consideration of the potential future site use for that TSD unit/area. Definitions contained within Chapter 173-340 WAC shall apply to Permit Condition II.K. Where definitions are not otherwise provided by this Permit, the HFFACO, or Chapter 173-303 WAC.

II.K.6 Deviations from a TSD unit closure plan required by unforeseen circumstances encountered during closure activities, which do not impact the overall closure strategy, but provide equivalent results, shall be documented in the TSD unit-specific Operating Record and made available to Ecology upon request, or during the course of an inspection.

II.K.7 Where agreed to by Ecology, integration of other statutorily or regulatory mandated cleanups may be accommodated by this Permit. Results from other cleanup investigation activities shall be used whenever possible to supplement and/or replace TSD unit closure investigation activities. All, or appropriate parts of, multipurpose cleanup and closure documents can be incorporated into this Permit through the Permit modification process. Cleanup and closures conducted under any statutory authority, with oversight by either Ecology or the EPA, which meet the equivalent of the technical requirements of Permit Conditions II.K.1 through II.K.4, may be considered as satisfying the requirements of this Permit.

## II.L DESIGN AND OPERATION OF THE FACILITY

II.L.1 Proper Design and Construction

The Permittees will design, construct, maintain, and operate the Facility to minimize the possibility of a fire, explosion, or any unplanned sudden or non-sudden release of hazardous substances to air, soil, ground water, or surface water, which could threaten human health, or the environment.

II.L.2 Design Changes, Nonconformance, and As-Built Drawings

II.L.2.a After completing the Permit modification process in Permit Condition I.C.3, the Permittees will conduct all construction subject to this Permit in accordance with the approved designs, plans and specifications that are required by this Permit, unless authorized otherwise in Permit Conditions II.L.2.b or II.L.2.c. For purposes of Permit Conditions II.L.2.b and II.L.2.c, an Ecology construction inspector, or TSD unit manager, are designated representatives of Ecology.

II.L.2.b During construction of a project subject to this Permit, changes to the approved designs, plans and specifications will be formally documented. All design change documentation will be maintained in the TSD unit-specific Operating Record and will be made available to Ecology upon request or during the course of an inspection. The Permittees will provide copies of design change documentation affecting any critical system to Ecology within five (5) working days of initiating the design change documentation. Identification of critical systems will be included by the Permittees in each TSD unit-specific dangerous waste Permit application, closure plan or Permit modification, as appropriate. Ecology will review a design change documentation modifying a critical system, and inform the Permittees in writing within two (2) working days, whether the proposed design change documentation, when issued, will require a Class 1, 2, or 3

Permit modification. If after two (2) working days Ecology has not responded, it will be deemed as acceptance of the design change documentation by Ecology.

II.L.2.c During construction of a project subject to this Permit, any work completed which does not meet or exceed the standards of the approved design, plans and specifications will be formally documented with nonconformance documentation. All nonconformance documentation will be maintained in the TSD unit-specific Operating Record and will be made available to Ecology upon request, or during the course of an inspection. The Permittees will provide copies of nonconformance documentation affecting any critical system to Ecology within five (5) working days after identification of the nonconformance. Ecology will review nonconformance documentation affecting a critical system and inform the Permittees in writing, within two (2) working days, whether a Permit modification is required for any nonconformance, and whether prior approval is required from Ecology before work proceeds, which affects the nonconforming item. If Ecology does not respond within two (2) working days, it will be deemed as acceptance and no Permit modification will be required.

II.L.2.d Upon completion of a construction project subject to this Permit, the Permittees will produce as-built drawings of the project which incorporate the design and construction modifications resulting from all project design change documentation and nonconformance documentation, as well as modifications made pursuant to WAC 173-303-830. The Permittees will place the drawings into the Operating Record within twelve (12) months of completing construction, or within an alternate period of time specified in a unit-specific Permit Condition in Part III or V of this Permit.

II.L.2.e Facility Compliance

The Permittees in receiving, storing, transferring, handling, treating, processing, and disposing of dangerous waste, will design, operate, and/or maintain the Facility in compliance with all applicable federal, state, and local laws and regulations.

## II.M SECURITY

The Permittees will comply with the security provisions of WAC 173-303-310. The Permittees may comply with the requirements of WAC 173-303-310(2) on a unit-by-unit basis.

## II.N RECEIPT OF DANGEROUS WASTES GENERATED OFF-SITE

II.N.1 Receipt of Off-Site Waste

The Permittees will comply with Permit Conditions II.N.2 and II.N.3 for any dangerous wastes which are received from sources outside the United States, or from off-site generators.

II.N.2 Waste from Sources Outside the United States

The Permittees will meet the requirements of WAC 173-303-290(1) for waste received from outside the United States.

II.N.3 Notice to Generator

For waste received from off-site sources (except where the owner/operator is also the generator), the Permittees will inform the generator in writing that they have the appropriate Permits for, and will accept, the waste the generator is shipping, as required by WAC 173-303-290(3). The Permittees will keep a copy of this written notice as part of the TSD unit-specific Operating Record.

## II.O GENERAL INSPECTION REQUIREMENTS

II.O.1 The Permittees will inspect the Facility to prevent malfunctions and deterioration, operator errors, and discharges, which may cause or lead to the release of dangerous waste constituents to the environment, or threaten human health. Inspections must be conducted in accordance with the provisions of WAC 173-303-320(2). In addition to the TSD unit inspections specified in Parts III, V, and/or VI, the following inspections will also be conducted:

II.O.1.a The 100, 200 East, 200 West, 300, and 400 areas will be inspected annually.

II.O.1.b The Permittees will inspect the banks of the Columbia River, contained within the Facility boundary, once a year. The inspection will be performed from the river, by boat, and the inspectors will follow the criteria in Permit Condition II.O.1.c.

II.O.1.c The Permittees will visually inspect the areas identified in Permit Conditions II.O.1.a and II.O.1.b for malfunctions, deterioration, operator errors, and discharges which may cause or lead to the release of dangerous waste constituents to the environment, or that threaten human health. Specific items to be noted are as follows:

II.O.1.c.i Remains of waste containers, labels, or other waste management equipment;

II.O.1.c.ii Solid waste disposal sites not previously identified for remedial action;

II.O.1.c.iii Uncontrolled waste containers (e.g., orphan drums);

II.O.1.c.iv Temporary or permanent activities that could generate an uncontrolled waste form; and

II.O.1.c.v Unpermitted waste discharges.

II.O.1.d The Permittees will notify Ecology at least seven (7) days prior to conducting these inspections in order to allow representatives of Ecology to be present during the inspections.

II.O.2 If the inspection by the Permittees, conducted pursuant to Permit Condition II.O.1, reveals any problems, the Permittees will take remedial action on a schedule agreed to by Ecology.

II.O.3 The inspection of high radiation areas will be addressed on a case-by-case basis in either Part III of this Permit, or prior to the inspections required in Permit Condition II.O.1.

## II.P MANIFEST SYSTEM

II.P.1 The Permittees will comply with the manifest requirements of WAC 173-303-370 for waste received from off-site and WAC 173-303-180 for waste shipped off-site.

II.P.2 Transportation of dangerous wastes along roadways, if such routes are not closed to general public access at the time of transport, can be manifested pursuant to an alternate tracking system as allowed by WAC 173-303-180(5). The alternate tracking system can be a paper system or an electronic system. The roadways addressed by this condition are a public or private right-of-way within or along the border of contiguous property where the movement is under control of the USDOE. The alternate tracking system will consist of documentation between the offering Hanford Facility location and the receiving Hanford Facility location containing the following information:

II.P.2.a Hanford Facility offeror name, location, and telephone number;

II.P.2.b Hanford Facility receiver name, location, and telephone number;

II.P.2.c Description of waste;

II.P.2.d Number and type of containers;

II.P.2.e Total quantity of waste;

II.P.2.f Unit volume/weight;

II.P.2.g Dangerous waste number(s) or U.S. Department of Transportation hazard class; and

II.P.2.h Special handling instructions including emergency contacts.

II.P.3 The Hanford Facility offeror and receiver will resolve any discrepancies of information found related to Permit Conditions II.P.2.a through II.P.2.h.

II.P.4 If the discrepancies cannot be resolved at the Hanford Facility receiving location, a new Hanford Facility receiver location will be agreed upon, or the dangerous waste will be returned to the offeror location. The documentation accompanying the movement of dangerous waste will be updated to reflect the new receiving location.

## II.Q ON-SITE TRANSPORTATION

II.Q.1 Documentation must accompany any on-site dangerous waste which is transported to or from any TSD unit subject to this Permit, through or within the 600 Area, unless the roadway is closed to general public access at the time of shipment. Waste transported by rail or by pipeline is exempt from this Condition. This documentation will include the following information, unless other unit-specified provisions are designated in Part III or V of this Permit:

II.Q.1.a Generator's name, location, and telephone number;

II.Q.1.b Receiving TSD unit's name, location, and telephone number;

II.Q.1.c Description of waste;

II.Q.1.d Number and type of containers;

II.Q.1.e Total quantity of waste;

II.Q.1.f Unit volume/weight;

II.Q.1.g Dangerous waste number(s); and

II.Q.1.h Any special handling instructions.

II.Q.2 All non-containerized solid, dangerous waste transported to or from TSD units, subject to this Permit, will be covered to minimize the potential for material to escape during transport.

## II.R EQUIVALENT MATERIALS

II.R.1 The Permittees may substitute an equivalent or superior product for any equipment or materials specified in this Permit. Use of equivalent or superior products will not be considered a modification of this Permit. A substitution will not be considered equivalent unless it is at least as effective as the original equipment or materials in protecting human health and the environment.

II.R.2 The Permittees will place in the Operating Record (within seven [7] days after the change is put into effect) the substitution documentation, accompanied by a narrative explanation, and the date the substitution became effective. Ecology may judge the soundness of the substitution.

II.R.3 If Ecology determines that a substitution was not equivalent to the original, it will notify the Permittees that the Permittees' claim of equivalency has been denied, of the reasons for the denial, and that the original material or equipment must be used. If the product substitution is denied, the Permittees will comply with the original approved product specification, or find an acceptable substitution.

## II.S LAND DISPOSAL RESTRICTIONS (LDR)

Unless specifically identified otherwise in the HFFACO, the Permittees will comply with all LDR requirements as set forth in WAC 173-303-140.

## II.T ACCESS AND INFORMATION

To the extent that work required by this Permit must be done on property not owned or controlled by the Permittees, the Permittees must utilize their best efforts to obtain access and information at these locations.

## II.U MAPPING OF UNDERGROUND PIPING

II.U.1 Reserved.

II.U.2 Reserved.

II.U.3 The Permittees will maintain piping maps for existing, newly identified, and/or new dangerous waste underground pipelines (including active, inactive, and abandoned pipelines, which contain or contained dangerous waste subject to the provisions of Chapter 173-303 WAC) at the Hanford Facility. The maps will identify the origin, destination, direction of flow, size, depth and type (i.e., reinforced concrete, stainless steel, cast iron, etc.), of each pipe, and the location of their diversion boxes, valve pits, seal pots, catch tanks, receiver tanks, and pumps, and utilize Washington State Plane Coordinates, NAD 83(91), meters. If the type of pipe material is not documented on existing drawings, the most probable material type will be provided. The maps will also identify whether the pipe is active, inactive, or abandoned. The age of all pipes requiring identification pursuant to this Condition will be documented in an Attachment to the submittal. If the age cannot be documented, an estimate of the age of the pipe will be provided based upon best engineering judgment. These maps need not include the pipes within a fenced tank farm or within a building/structure. These maps will be compiled using documented QA/QC control methods and procedures outlined in DOE/RL-96-50, *Hanford Facility RCRA Permit Mapping and Marking of Dangerous Waste Underground Pipelines Report*, September 1996. These maps and any Attachments will be maintained in the Facility Operating Record and be updated annually as required by Permit Condition II.U.4.

II.U.4 Permittees will maintain current all maps required by Permit Condition II.U.3. These maps will be updated to incorporate new or revised information available by March 30th of each year. By September 30th of each year, the Permittees will submit to Ecology a list of maps that have been updated. The updated maps (including any Attachments) and the annual list submitted to Ecology will be maintained in the Facility Operating Record.

## II.V MARKING OF UNDERGROUND PIPING

The Permittees will maintain marking of underground pipelines located outside the 200 East, 200 West, 300, 400, 100N, and 100K Areas. These pipelines will be marked at the point they pass beneath an area fence, at their origin and destination, at any point they cross an improved road, and every 100 meters along the pipeline corridor where practicable. The markers will be labeled with a sign that reads "Buried Dangerous Waste Pipe" and will be visible from a distance of fifteen (15) meters.

## II.W OTHER PERMITS AND/OR APPROVALS

II.W.1 The Permittees will be responsible for obtaining all other applicable federal, state, and local permits authorizing the development and operation of the Facility. To the extent that work required by this Permit must be done under a permit and/or approval pursuant to other regulatory authority, the Permittees will use their best efforts to obtain such permits.

II.W.2 All other permits related to dangerous waste management activities are severable and enforceable through the permitting authority under which they are issued.

II.W.3 All air emissions from units subject to this Permit will comply with all applicable state and federal regulations pertaining to air emission controls, including but not limited to, Chapter 173-400 WAC, General Regulations for Air Pollution Sources; Chapter 173-460 WAC, Controls for New Sources of Toxic Air Pollutants; and Chapter 173-480 WAC, Ambient Air Quality Standards and Emission Limits for Radionuclides.

## II.X SCHEDULE EXTENSIONS

II.X.1 The Permittees will notify Ecology in writing, as soon as possible, of any deviations or expected deviations, from the schedules of this Permit. The Permittees will include with the notification all information supporting their claim that they have used best efforts to meet the required schedules. If Ecology determines that the Permittees have made best efforts to meet the schedules of this Permit, Ecology will notify the Permittees in writing by certified mail, that the Permittees have been granted an extension. Such an extension will not require a Permit modification under Permit Condition I.C.3. Should Ecology determine that the Permittees have not made best efforts to meet the schedules of this Permit, Ecology may take such action as deemed necessary.

Copies of all correspondence regarding schedule extensions will be kept in the Operating Record.

II.X.2 Any schedule extension granted through the approved change control process identified in the HFFACO will be incorporated into this Permit. Such a revision will not require a Permit modification under Permit Condition I.C.3.

## II.Y CORRECTIVE ACTION

In accordance with WAC 173-303-646 and WAC 173-303-815(2)(b)(ii), the Permittee must conduct corrective action, as necessary to protect human health and the environment, for releases of dangerous waste and dangerous constituents from solid waste management units and areas of concern at the facility, including releases that have migrated beyond the facility boundary. The Permittee may be required to implement measures within the facility to address releases, which have migrated beyond the facility's boundary. As specified in Permit Conditions II.Y.1.g, II.Y.2.a.iii, and II.Y.2.a.ii, the Permittee's right to challenge Ecology's authority to impose corrective action with respect to radionuclides, CERCLA Past Practice (CPP) Units (as identified under Permit Condition II.Y.2.a.) and selected solid waste management units not covered by the HFFACO at property currently subleased to US Ecology, Inc. (as identified under Permit Condition II.Y.3.a.i), is reserved until such time as Ecology chooses to impose corrective action in accordance with the Permit modification procedures of WAC 173-303-830.

II.Y.1 Compliance with Chapter 173-340 WAC

In accordance with WAC 173-303-646, the Permittee must conduct corrective action "as necessary to protect human health and the environment". To ensure that corrective action will be conducted as necessary to protect human health and the environment, except as provided in Permit Condition II.Y.2, the Permittee must conduct corrective action in a manner that complies with the following provisions of Chapter 173-340 WAC:

II.Y.1.a As necessary to select a cleanup action in accordance with WAC 173-340-360 and WAC 173-340-350 State Remedial Investigation and Feasibility Study;

II.Y.1.b WAC 173-340-360 Selection of Cleanup Actions;

II.Y.1.c WAC 173-340-400 Cleanup Actions;

II.Y.1.d WAC 173-340-410 Compliance Monitoring Requirements;

II.Y.1.e WAC 173-340-420 Periodic Site Reviews;

II.Y.1.f WAC 173-340-440 Institutional Controls; and

II.Y.1.g WAC 173-340-700 through -760 Cleanup Standards, except that to the extent that Ecology seeks to impose corrective action with respect to radionuclides regulated under the provisions of the Atomic Energy Act, as amended, 42 U.S.C. § 2011 et.seq. (AEA), the Permittee may challenge Ecology's authority to impose such corrective action through a timely appeal of the permit modification issued by Ecology without argument from Ecology that such right has been waived by a failure to fully litigate that issue through an appeal taken within thirty (30) days of the issuance of this permit, and without argument from the Permittee that such requirement fails to satisfy a cause for Permit modification under WAC 173-303-830(3)(a).

II.Y.2 Acceptance of Work under Other Authorities or Programs and Integration with the HFFACO.

Corrective action is necessary to protect human health and the environment for all units identified in Appendix B and Appendix C of the HFFACO. Notwithstanding Permit Condition II.Y.1, work under other cleanup authorities or programs, including work under the HFFACO, may be used to satisfy corrective action requirements, provided it protects human health and the environment.

II.Y.2.a For units identified in Appendix C of the HFFACO, as amended, as CERCLA Past Practice (CPP) Units, Ecology accepts work under the HFFACO, as amended, and under the CERCLA program, as satisfying corrective action requirements to the extent provided for in, and subject to the reservations and requirements of, Permit Conditions II.Y.2.a.i through II.Y.2.a.iv.

II.Y.2.a.i For any unit identified in Appendix C of the HFFACO as a CPP unit, the Permittee must comply with the requirements and schedules related to investigation and cleanup of the CPP unit(s) developed and approved under the HFFACO, as amended. The requirements and schedules related to investigation and cleanup of CPP units currently in place under the HFFACO, as amended, and in the future developed and approved under the FFAOC, as amended, are incorporated into this Permit by this reference and apply under this Permit as if they were fully set forth herein. If the Permittee is not in compliance with requirements of the HFFACO, as amended, that relate to investigation or cleanup of CPP unit(s), Ecology may take action to independently enforce the requirements as corrective action requirements under this Permit.

II.Y.2.a.ii For any unit identified in Appendix C of the HFFACO as a CPP unit, in the case of an interim ROD, a final decision about satisfaction of corrective action requirements will be made in the context of issuance of a final ROD.

II.Y.2.a.iii If EPA and Ecology, after exhausting the dispute resolution process under Section XXVI of the HFFACO, cannot agree on requirements related to investigation or cleanup of CPP unit(s), Ecology will notify the Permittee, in writing, of the disagreement and impose, in accordance with the Permit Modification Procedures of WAC 173-303-830, a requirement for the Permittee to conduct corrective action for the subject units(s) in accordance with Permit Condition II.Y.1. The Permittee may challenge Ecology's authority to impose such corrective action requirements through a timely appeal of such permit modification, without argument from Ecology that the Permittee's right to raise such challenge has been waived by a failure to fully litigate that issue through an appeal taken within thirty (30) days of the issuance of this permit, and without argument from the Permittee that such requirement fails to satisfy a cause for Permit modification under WAC 173-303-830(3)(a). Within sixty (60) days of receipt of the above permit modification, or within some other reasonable period of time agreed to by Ecology and the Permittee, the Permittee must submit for Ecology review and approval, a plan to conduct corrective action in accordance with Permit Condition II.Y.1 for the subject unit(s). The Permittee's plan may include a request that Ecology evaluate work under another authority or program. Approved corrective action plans under this Condition will be incorporated into this Permit in accordance with the Permit Modification Procedures of WAC 173-303-830.

II.Y.2.a.iv The Permittee must maintain information on corrective action for CPP units covered by the HFFACO in accordance with the HFFACO Action Plan §9.0 and §10.0. In addition, the Permittee must maintain all reports and other information developed in whole, or in part, to implement the requirements of Permit Condition II.Y.2.a, including reports of investigations and all raw data, in the Facility Operating Record in accordance with Permit Condition II.I. Information that is maintained in the Hanford Site Administrative Record may be incorporated by reference into the Facility Operating Record.

II.Y.2.b For units identified in Appendix C of the HFFACO, as amended, as RPP units, Ecology accepts work under the HFFACO, as amended, as satisfying corrective action requirements to the extent provided for, and subject to the reservations and requirements of, Permit Conditions II.Y.2.b.i through II.Y.2.b.iv.

II.Y.2.b.i For any unit identified in Appendix C of the HFFACO, as amended, as RPP unit, until a Permit modification is complete under Permit Condition II.Y.2.b.iii., the Permittee must comply with the requirements and schedules related to investigation and cleanup of RPP units developed and approved under the HFFACO, as amended. The requirements and schedules related to investigation and cleanup of RPP units currently in place under the HFFACO, as amended, and in the future developed and approved under the HFFACO, as amended, are incorporated into this Permit by this reference and apply under this Permit as if they were fully set forth herein. Until a permit modification is complete under Permit Condition II.Y.2.b.iii, if the Permittee is not in compliance with requirements and schedules related to investigation and cleanup of RPP units developed and approved under the HFFACO, as amended, Ecology may take action to independently enforce the requirements as corrective action requirements under this Permit.

II.Y.2.b.ii When the Permittee submits a corrective measures study for an individual RPP unit or a group of RPP units, the Permittee must, at the same time, recommend a remedy for the unit(s). The remedy recommendation must contain all the elements of a draft cleanup action plan under WAC 173-340-360(10).

II.Y.2.b.iii After considering the Permittees' corrective measures study and remedy recommendation, Ecology will make a tentative remedy selection decision and publish the decision for public review and comment. Public review and comment may be accomplished by publishing the tentative decision as a draft Permit under WAC 173-303-840(10), or by a method that provides an equivalent opportunity for public review and participation. Following public review and comment, Ecology will make a final remedy selection decision. Final remedy decisions will be incorporated into the Permit using the Permit Modification Procedures of WAC 173-303-830.

II.Y.2.b.iv The Permittee must maintain information on corrective action for RPP units covered by the HFFACO, as amended, in accordance with HFFACO Action Plan §9.0 and §10.0. In addition, the Permittee must maintain all reports and other information developed in whole, or in part, to implement the requirements of Permit Condition II.Y.2.b, including reports of investigations and all raw data, in the Facility Operating Record in accordance with Permit Condition II.I. Information that is maintained in the Hanford Site Administrative Record may be incorporated into the Facility Operating Record by reference.

II.Y.2.c For each TSD unit or group of units, when the Permittee submits a certification of closure or a certification of completion of post-closure care, or at an earlier time agreed to by Ecology and the Permittee, the Permittee must, at the same time, either:

II.Y.2.c.i Document that the activities completed under closure and/or post-closure satisfy the requirements for corrective action; or

II.Y.2.c.ii If the activities completed under closure and/or post-closure care do not satisfy corrective action requirements, identify the remaining corrective action requirements and the schedule under which they will be satisfied, if remaining corrective action requirements will be satisfied by work developed and carried out under the HFFACO provisions for RPP units or CPP units, a reference to the appropriate RPP or CPP process and schedule will suffice.

II.Y.2.c.iii Ecology will make final decisions as to whether the work completed under closure and/or post-closure care satisfies corrective action, specify any unit-specific corrective action requirements, and incorporate the decision into this Permit in accordance with the Permit Modification Procedures of WAC 173-303-830.

II.Y.2.d Notwithstanding any other condition in this Permit, Ecology may directly exercise any administrative or judicial remedy under the following circumstances:

II.Y.2.d.i Any discharge or release of dangerous waste, or dangerous constituents, which are not addressed by the HFFACO, as amended;

II.Y.2.d.ii Discovery of new information regarding dangerous constituents or dangerous waste management, including but not limited to, information about releases of dangerous waste or dangerous constituents which are not addressed under the HFFACO, as amended; or

II.Y.2.d.iii A determination that action beyond the terms of the HFFACO, as amended, is necessary to abate an imminent and substantial endangerment to the public health, or welfare, or to the environment.

II.Y.3 Releases of Dangerous Waste or Dangerous Constituents Not Covered By the HFFACO

II.Y.3.a US Ecology

II.Y.3.a.i The following solid waste management units are not covered by the HFFACO:

II.Y.3.a.i.a US Ecology, Inc., SWMU 1: Chemical Trench;

II.Y.3.a.i.b US Ecology, Inc., SWMU 2-13: Low-level radioactive waste trenches 1 through 11A; and

II.Y.3.a.i.c US Ecology, Inc., SWMU 17: Underground resin tank.

II.Y.3.a.ii Selected solid waste management units identified in Permit Condition II.Y.3.a.i are currently being investigated by US Ecology in accordance with the Comprehensive Investigation US Ecology – Hanford Operations Workplan. Following completion of this investigation and any closure required of such solid waste management unit under the authority of the Washington State Department of Health, or within one (1) year of the effective date of this Permit Condition, whichever is earlier, Ecology will make a tentative decision as to whether additional investigation or cleanup is necessary to protect human health or the environment for the solid waste management units identified in Permit Condition II.Y.3.a.i, and publish that decision as a draft permit in accordance with WAC 173-303-840(10). Following the associated public comment period, and consideration of any public comments received during the public comment period, Ecology will publish as final permit conditions under WAC 173-303-840(8) either:

II.Y.3.a.ii.a A decision that corrective action is not necessary to protect human health or the environment;

II.Y.3.a.ii.b An extension to the schedule established under Permit Condition II.l.Y.3.a.ii; or

II.Y.3.a.ii.c A decision that corrective action in accordance with Permit Condition II.Y.1 is necessary to protect human health or the environment.

II.Y.3.a.iii If Ecology decides under Permit Condition II.Y.3.a.ii that corrective action is necessary to protect human health or the environment, the Permittee may challenge Ecology's authority to impose such corrective action requirements through a timely appeal of such permit modification, without argument from Ecology that the right to raise such challenge has been waived by a failure to fully litigate that issue through an appeal taken within thirty (30) days of the issuance of this permit, and with argument from the Permittee that such requirement fails to satisfy a cause for permit modification under WAC 173-303-830(3)(a). Within one hundred and eighty (180) days of receipt of the above Permit modification, the Permittee must submit, for Ecology review and approval, a plan to conduct corrective action in accordance with Permit Condition II.Y.1. Approved corrective action plans under this condition will be incorporated into this Permit in accordance with the Permit Modification Procedures of WAC 173-303-830.

II.Y.3.b Newly Identified Solid Waste Management Units and Newly Identified Releases of Dangerous Waste or Dangerous Constituents.

The Permittee must notify Ecology of all newly-identified solid waste management units and all newly-identified areas of concern at the Facility. For purposes of this condition, a 'newly-identified' solid waste management unit or a 'newly-identified' area of concern is a unit or area not identified in the HFFACO, as amended, on the effective date of this condition and not identified by Permit Condition II.Y.3.a. Notification to Ecology must be in writing and must include, for each newly-identified unit or area, the information required by WAC 173-303-806(4)(a)(xxiii) and WAC 173-303-806(4)(a)(xxiv). Notification to Ecology must occur at least once every calendar year, in January, and must include all units and areas newly identified since the last notification, except that if a newly identified unit or area may present an imminent and substantial endangerment to human health or the environment, notification must occur within five (5) days of identification of the unit or area. If information required by WAC 173-303-806(4)(a)(xxiii) or WAC 173-303-806(4)(a)(xxiv) is already included in

the Waste Information Data System, it may be incorporated by reference into the required notification.

## II.Z WASTE MINIMIZATION

In accordance with WAC 173-303-380(1)(q), and Section 3005(h) of RCRA, 42 U.S.C. 6925(h), the Permittee must place a certification in the Hanford Facility Operating Record, Unit-Specific Files on an annual basis that:

II.Z.1.a A program is in place to reduce the volume and toxicity of hazardous waste generated to the degree determined by the Permittee to be economically practicable; and,

II.Z.1.b The proposed method of treatment, storage or disposal is that practicable method currently available to the Permittee, which minimizes the present and future threat to human health and the environment.

II.Z.2 The Permittee will maintain each such certification of waste minimization in the operating record as required by Permit Condition II.I.1.

## II.AA AIR EMISSION STANDARDS FOR PROCESS VENTS

The Permittees will comply with applicable requirements of WAC 173-303-690 for process vents associated with Part III units performing specific separations processes unless exempted by WAC 173-303-690(1)(d). Threshold limits applied to process vents potentially requiring emission controls subject to WAC 173-303-690 are evaluated based on the summation of applicable emission sources for the entire Hanford Facility. When the summed emissions fall below threshold limits in 40 CFR 264.1032(a)(1), no emission control devices are required. If threshold limits in 40 CFR 264.1032(a)(1) are predicted to be exceeded, the Permittees will notify Ecology to determine the appropriate course of action. Unit-specific information is contained in Part III of the Permit for applicable units.

## II.BB AIR EMISSION STANDARDS FOR EQUIPMENT LEAKS

The Permittees will comply with applicable requirements of WAC 173-303-691 for certain equipment leaks associated with Part III units unless exempted by WAC 173-303-691(1)(e) or (f). Air emission standards apply to equipment that contacts or contains hazardous wastes with organic concentrations of at least 10 percent by weight. Unit-specific information is contained in Part III of the Permit for applicable units.

## II.CC AIR EMISSION STANDARDS FOR TANKS, SURFACE IMPOUNDMENTS, AND CONTAINERS

The Permittees shall comply with applicable requirements of WAC 173-303-692 for containers, tanks, and surface impoundment areas associated with Part III units unless exempted by WAC 173-303-692(1)(b). Unit-specific information is contained in Part III of the Permit for applicable units.

## PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

Operating Unit 2, PUREX Storage Tunnels
Operating Unit 3, Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility
Operating Unit 4, 242-A Evaporator
Operating Unit 5, 325 Hazardous Waste Treatment Units
Operating Unit 10, Waste Treatment and Immobilization Plant
Operating Unit 11, Integrated Disposal Facility
Operating Unit 15, 331-C Storage Unit
Operating Unit 16, 400 Area Waste Management Unit

## PART IV UNIT SPECIFIC CONDITIONS FOR CORRECTIVE ACTION

Corrective Action Unit 1, 100-NR-1

## PART V UNIT-SPECIFIC CONDITIONS FOR UNITS UNDERGOING CLOSURE

Closure Unit 1, 1325-N Liquid Waste Disposal Facility
Closure Unit 2, 1301-N Liquid Waste Disposal Facility
Closure Unit 3, 1324-N Surface Impoundment and 1324-NA Percolation Pond

## PART VI UNIT-SPECIFIC CONDITIONS FOR UNITS IN POST-CLOSURE

Post Closure Unit 1, 300 Area Process Trenches
Post Closure Unit 2, 183-H Solar Evaporation Basins

## UNITS RETIRED FROM THE PERMIT

100 D Ponds (Closed 8/9/99)
105-DR Large Sodium Fire Facility (Closed 7/1/04)
100-NR-2 Operable Unit (9/30/09)
200 West Area Ash Pit Demolition Site (Closed 11/28/95)
2101-M Pond (Closed 11/28/95)
216-B-3 Expansion Ponds (Closed 7/31/95)
218-E-8 Borrow Pit Demolition Site (Closed 11/28/95)
224-T Transuranic Waste Storage and Assay Facility (Closed 11/12/08)
241-Z Treatment and Storage Tanks (Closed 2/22/07)
2727-S Nonradioactive Dangerous Waste Storage Facility (Closed 7/31/95)
300 Area Solvent Evaporator (Closed 7/31/95)
300 Area Waste Acid Treatment System (Closed 10/30/2005)
303-K Storage Facility (Closed 7/22/02)
303-M Oxide Facility (Closed 6/15/06)
304 Concretion Facility (Closed 1/21/96)
305-B Storage Facility (Closed 7/2/07)
3718-F Alkali Metal Treatment and Storage Facility Closure Plan (Closed 8/4/98)
4843 Alkali Metal Storage Facility Closure Plan (Closed 4/14/97)
Hanford Patrol Academy Demolition Site (Closed 11/28/95)
Plutonium Finishing Plant Treatment Unit (Closed 2/8/05)
Simulated High Level Waste Slurry Treatment and Storage Unit (Closed 10/23/95)

This page intentionally left blank.

# Hanford Facility RCRA Permit Modification Notification Forms

## Part III, Operating Unit 3

## Liquid Effluent Retention Facility & 200 Area Effluent Treatment Facility

### Index


Page 2 of 4 Hanford Facility RCRA Permit III.3 Conditions

Page 3 of 4 Addendum C, Section C.4.3.1.2

Page 4 of 4 Addendum I


Submitted by Co-Operator: 9/9/13
Date

Reviewed by RL Program Office: 9.5.13
Date

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **Liquid Effluent Retention Facility & 200 Area Effluent Treatment Facility** | **Part III, Operating Unit 3** |

Description of Modification:
Hanford Facility RCRA Permit III.3:

**PART III, OPERATING UNIT GROUP 3 PERMIT CONDITIONS**

**Liquid Effluent Retention Facility & 200 Area Effluent Treatment Facility**

### Unit Description:

The Liquid Effluent Retention Facility (LERF) and 200 Area Effluent Treatment Facility(200 Area ETF) consists of an aqueous waste treatment system that provides treatment, storage integral to the treatment process, and storage of secondary wastes from the treatment process for a variety of aqueous mixed waste. The 200 Area ETF is located in the 200 East Area. Aqueous wastes managed by the 200 Area ETF include process condensate from the LERF and 200 Area ETF and other aqueous waste generated from onsite remediation and waste management activities.

The LERF consists of three lined surface impoundments, or basins. Aqueous waste from LERF is pumped to the 200 Area ETF for treatment in a series of process units, or systems, that remove or destroy essentially all of the dangerous waste constituents. The treated effluent is discharged to a State-Approved Land Disposal Site (SALDS) north of the 200 West Area, under the authority of a Washington State Waste Discharge Permit (Ecology 2000) and 200 Area ETF Delisting (40 CFR 261, Appendix IX, Table 2). Construction of the LERF began in 1990. Waste management operations began at LERF in April 1994. Construction of the 200 Area ETF began in 1992. Waste management operations began at 200 Area ETF in November of 1995.

This Chapter provides unit-specific Permit conditions applicable to the dangerous waste management units for LERF and 200 Area ETF.

### List of Addenda Specific to Operating Unit Group 3

| | |
|---|---|
| Addendum A | Part A Form, dated June 20, 2013 |
| Addendum B | Waste Analysis Plan, dated March 31, 2013 |
| Addendum C | Process Information, dated September 30, 2013~~June 20, 2013~~ |
| Chapter 5.0 | Groundwater Monitoring (PNNL-11620 & WHC-SD-EN-AP-024), dated June 30, 2008 |
| Addendum E | Security Requirements, dated, June 30, 2011 |
| Addendum F | Preparedness and Prevention, dated June 20, 2013 |
| Addendum G | Personnel Training, dated June 30, 2012 |
| Addendum H | Closure Plan, dated June 30, 2011 |
| Addendum I | Inspection Requirements, dated September 30, 2013~~June 30, 2011~~ |
| Addendum J | Contingency Plan, dated March 31, 2012 |

| WAC 173-303-830 Modification Class [1 2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1
Enter wording of WAC 173-303-830, Appendix I Modification citation:
Administrative and informational changes.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:
[signature] for 9/3/13
S. L. Dahl-Crumpler Date

[1] Class 1 modifications requiring prior Agency approval.
[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **Liquid Effluent Retention Facility & 200 Area Effluent Treatment Facility** | **Part III, Operating Unit 3** |

Description of Modification:
Addendum C, Section C.4.3.1.2:

**C.4.3.1.2 Specific Containment Systems**
The following discussion presents a description of the individual containment systems associated with specific tank systems.

**Load-In Tank Secondary Containment.** The load-in tanks 59A-TK-109 and -117 are mounted on a 46-centimeter-thick reinforced concrete slab (Drawing H-2-817970). Secondary containment is provided by a pit with 30.5-centimeter-thick walls and a floor constructed of reinforced concrete. The load-in tank pit is sloped to drain solution to a sump. The depth of the pit varies with the slope of the floor, with an average thickness of about 1.1 meters. The volume of the secondary containment is about 73,000 liters, which is capable of containing the volume of at least one load-in tank (i.e., 34,200 liters). Leaks are detected by a leak detector that alarms locally, in the 200 Area ETF control room, and by visual inspection of the secondary containment.

Adjacent to the pit is a 25.4-centimeter-thick reinforced concrete pad that serves as secondary containment for the load-in tanker trucks, containers, transfer pumps, and filter system that serve as the first tanker truck unloading bay. The pad is inside the metal Load-in building and is 15.2 centimeters below grade with north and south walls gently sloped to allow truck access. The pad has a 3-inch drain pipe to route waste solution to the adjacent load-in tank pit. The pad does not have protective coating because it would experience excessive wear from the vehicle traffic.

Load-in tank 59A-TK-1 is located on a 25.4-centimeter-thick reinforced concrete slab (Drawing H-2-817970) inside the metal Load-in building. The tank has a flat bottom which sits on a concrete slab in the secondary containment. Secondary containment for the tank, filter system, and truck unloading piping is provided by an epoxy coated catch basin with a capacity of about 3,400 liters. The catch basin is sloped to route solution from the catch basin through a 15.2-centimeter-wide by 14.3-centimeter-deep trench to the adjacent truck unloading pad. This pad drains to the Load-in tank pit discussed above. The volume of the combined secondary containment of these two systems is greater than 76,400 liters, which is capable of holding the volume of tank 59A-TK-1 (i.e., 26,000 liters).

| WAC 173-303-830 Modification Class [1,2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.2
Enter wording of WAC 173-303-830, Appendix I Modification citation:
Correction of typographical errors.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:
C. P. Wheeler for S. L. Dahl-Crumpler 9/3/13 Date

[1] Class 1 modifications requiring prior Agency approval.
[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **Liquid Effluent Retention Facility & 200 Area Effluent Treatment Facility** | **Part III, Operating Unit 3** |

Description of Modification:
Addendum I:

**DATE IN HEADER NEEDS TO BE CHANGED ON ALL PAGES OF ADDENDUM I FROM JUNE 30, 2010 TO SEPTEMBER 30, 2013. ALSO, THE MODIFICATION CATEGORY WILL BE CHANGED FROM CLASS 1[1] TO CLASS 1**

Class 1 ~~1[1]~~ Modification
September 30, 2013~~June 30, 2010~~

WA7890008967, Part III, Operating Unit 3
LERF & 200 Area ETF

**Addendum I** **Inspection Requirements**


I. INSPECTION REQUIREMENTS ..... I.1
I.1 INSPECTION PLAN ..... I.1
I.1.1 General Inspection Requirements ..... I.1
I.1.2 Specific Process Inspection Requirements ..... I.2
I.1.3 Inspection Log ..... I.4
I.1.4 Storage of Ignitable or Reactive Wastes ..... I.4


**Tables**


Table I.1. Visual Inspection Schedule for the LERF and 200 Area ETF ..... I.5
Table I.2. Inspection Plan for Instrumentation Monitoring ..... I.7


| WAC 173-303-830 Modification Class [1 2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.2

Enter wording of WAC 173-303-830, Appendix I Modification citation: Correction of typographical errors. This change (to Addendum I) is limited to revising the date at the top of each page. No other changes are being made to Addendum I. This change addresses an inconsistency between the LERF/ETF Conditions file and the LERF/ETF Inspection Plan (Addendum I). The discrepancy arose in association with the Class 1 permit modifications for the quarter ending June 30, 2011 [DOE-to-Ecology Letter (11-EMD-0086, dated 7/8/2011) and Ecology-to-DOE Letter (11-NWP-074, dated 7/19/2011)], whereby the LERF/ETF Conditions file was appropriately revised to reflect the June 30, 2011 modification date. However, due to an oversight, the date on the LERF/ETF Inspection Plan was not updated. Also, because the permit modification being addressed herein (i.e., for the quarter ending 9/30/13) is categorized as a Class 1 Modification rather than a Class [1]1 Modification, the inspection plan page heading will be re-marked accordingly.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:

S. L. Dahl-Crumpler 9/3/13
Date

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Remove and Replace the Following Sections:

Remove Part III Permit Conditions, dated June 30, 2013, and replace with Permit Conditions, dated September 30, 2013.

Remove Addendum C, dated June 20, 2013, and replace with Addendum C, dated September 30, 2013.

Remove Addendum I, dated June 30, 2010, and replace with Addendum I, dated September 30, 2013.

# PART III, OPERATING UNIT GROUP 3 PERMIT CONDITIONS

## Liquid Effluent Retention Facility & 200 Area Effluent Treatment Facility

### Unit Description:

The Liquid Effluent Retention Facility (LERF) and 200 Area Effluent Treatment Facility(200 Area ETF) consists of an aqueous waste treatment system that provides treatment, storage integral to the treatment process, and storage of secondary wastes from the treatment process for a variety of aqueous mixed waste. The 200 Area ETF is located in the 200 East Area. Aqueous wastes managed by the 200 Area ETF include process condensate from the LERF and 200 Area ETF and other aqueous waste generated from onsite remediation and waste management activities.

The LERF consists of three lined surface impoundments, or basins. Aqueous waste from LERF is pumped to the 200 Area ETF for treatment in a series of process units, or systems, that remove or destroy essentially all of the dangerous waste constituents. The treated effluent is discharged to a State-Approved Land Disposal Site (SALDS) north of the 200 West Area, under the authority of a Washington State Waste Discharge Permit (Ecology 2000) and 200 Area ETF Delisting (40 CFR 261, Appendix IX, Table 2). Construction of the LERF began in 1990. Waste management operations began at LERF in April 1994. Construction of the 200 Area ETF began in 1992. Waste management operations began at 200 Area ETF in November of 1995.

This Chapter provides unit-specific Permit conditions applicable to the dangerous waste management units for LERF and 200 Area ETF.

### List of Addenda Specific to Operating Unit Group 3

| | |
|---|---|
| Addendum A | Part A Form, dated June 20, 2013 |
| Addendum B | Waste Analysis Plan, dated March 31, 2013 |
| Addendum C | Process Information, dated September 30, 2103 |
| Chapter 5.0 | Groundwater Monitoring (PNNL-11620 & WHC-SD-EN-AP-024), dated June 30, 2008 |
| Addendum E | Security Requirements, dated, June 30, 2011 |
| Addendum F | Preparedness and Prevention, dated June 20, 2013 |
| Addendum G | Personnel Training, dated June 30, 2012 |
| Addendum H | Closure Plan, dated June 30, 2011 |
| Addendum I | Inspection Requirements, dated September 30, 2013 |
| Addendum J | Contingency Plan, dated March 31, 2012 |

### Definitions

**State and federal delisting actions:** The state delisting action pursuant to WAC 173-303-910(3), August 8, 2005, and the federal delisting action appearing in 40 CFR 261, Appendix IX, Table 2 applicable to the United States, Department of Energy, Richland, Washington.

### Acronyms

LERF and 200 Area ETF 200-Area Liquids Processing Facility

### III.3.A COMPLIANCE WITH UNIT-SPECIFIC PERMIT CONDITIONS

III.3.A.1 The Permittees will comply with all Permit Conditions in this Chapter and its Addendums and Chapters with respect to dangerous waste management and dangerous waste management units in LERF and 200 Area ETF, in addition to requirements in Permit Part I and Part II.

## III.3.B GENERAL WASTE MANAGEMENT

III.3.B.1 The Permittees are authorized to accept dangerous and/or mixed waste for treatment in dangerous waste management units that satisfies the waste acceptance criteria in Permit Addendum B according to the waste acceptance procedures in Permit Addendum B. [WAC 173-303-300]

III.3.B.2 The Permittees are authorized to manage dangerous and/or mixed wastes physically present in the dangerous waste management units in LERF and 200 Area ETF as of the effective date of this Permit according to the requirements of Permit Condition III.15.B.1.

III.3.B.3 The Permittees are authorized to treat and/or store dangerous/mixed waste in the dangerous waste management units in LERF and 200 Area ETF according to the following requirements:

III.3.B.3.a The Permittees are authorized to treat, and store as necessary in support of treatment, dangerous waste in the 200 Area ETF tank systems identified in Permit Addendum C, Section C.2, and Section C.4 according to the Permit Conditions of this Chapter.

III.3.B.3.b The Permittees are authorized to store and treat those dangerous and/or mixed waste identified in Permit Addendum C, Section C.3, in containers according to the requirements of this Chapter. All container management activities pursuant to this Permit Condition will take place within the container storage area or within the 200 Area ETF process area identified in Permit Addendum C, Figure C.3.

III.3.B.3.c Treatment in containers authorized by Permit Condition III.3.B.3.b is limited to decanting of free liquids, and addition of sorbents to free liquids. The Permittees will ensure that sorbents are compatible with wastes and the containers. Sorbents will be compliant with the requirements of WAC 173-303-140(4)(b)(iv), incorporated by reference.

III.3.B.3.d The Permittees are authorized to treat aqueous waste in LERF Basins (Basins 42, 43 and 44) subject to the following requirements:

III.3.B.3.d.1 Following treatment in a LERF basin, aqueous wastes must be treated in 200 Area ETF according to Permit Conditions III.3.B.3.a through c.; [40 CFR 268.4(2)(iii), incorporated by reference by WAC 173-303-140]

III.3.B.3.d.2 The Permittees must ensure that for each basin, either supernatant is removed on a flow-through basis, to meet the requirement of 40 CFR 268.4(a)(2)(ii) incorporated by reference by WAC 173-303-140, or incoming waste is shown to not contain solids by either: (1) sampling results showing the waste does not contain detectable solids, or (2) filtering through a 10 micron filter;[WAC 173-303-815(2)(b)(ii)]

III.3.B.4 The Permittees will maintain the physical structure of the LERF and 200 Area ETF as documented in the applicable sections of Permit Addendum C, Section C.2. [WAC 173-303-630(7), WAC 173-303-640(3), WAC 173-303-640(4)]

III.3.B.5 The Permittees are authorized to use treated effluent for recycle/makeup water purposes at the 200 Area ETF as outlined in Permit Addendum C, Section C.2.5.5, and the letters dated August 19, 2005, EPA Region 10 to Keith A. Klein; and August 8, 2005, Department of Ecology to Keith A. Klein. [WAC 173-303-815 (2)(b)(ii)]

III.3.B.6 The Permittees will maintain and operate systems for the 200 Area ETF documented in Permit Addendum C, Section C.2.5 as necessary for proper operation of the 200 Area ETF, compliance with the conditions of this Permit, and protection of human health and the environment. For purposes of this Permit Condition, the Monitor and Control System documented in Permit Addendum C, Section C.2.5.1, is considered to include all indicators, sensors, transducers, actuators and other control devices connected to but remote from the centralized monitor and control system (MCS) computer.

III.3.B.7 The Permittees must complete the following requirements prior to acceptance for treatment in 200 Area ETF aqueous waste streams with listed waste numbers subject to the requirements of the State and Federal delisting: [WAC 173-303-815(2)(b)(ii)]

III.3.B.7.a The Permittees will prepare a written waste processing strategy according to the requirements of the State and Federal Delisting Actions Conditions (1)(a)(ii) and (1)(b), incorporated by reference, and Permit Addendum B, Section B.2.2.2.

III.3.B.7.b The waste processing strategy required by Permit Condition III.3.B.7.a, must document the proposed processing configuration for the 200 Area ETF, operating conditions for each processing unit, and the expected treated effluent characteristics based on the process model and treatability envelope data required by State and Federal Delisting Conditions (1)(a)(ii) and (1)(b).

III.3.B.7.c The written waste processing strategy required by Permit Condition III.3.B.7.a must demonstrate that the projected treated effluent characteristics satisfy the delisting exclusion limits in State and Federal Delisting Condition (5) of the state and federal delisting actions, and the discharge limits of the State Discharge Permit ST-4500.

III.3.B.7.d The Permittees will place a copy of the written waste processing strategy required by Permit Condition III.3.B.7.a in the Hanford Facility Operating Record, LERF and 200 Area ETF file as part of the documentation of waste streams accepted for management at the 200 Area ETF.

III.3.B.8 Treatment of aqueous waste streams in the 200 Area ETF with listed waste numbers that are subject to the requirements of the state and federal delisting actions must comply with the requirements of State and Federal Delisting Condition (1)(c), incorporated by reference. [WAC 173-303-815 (2)(b)(ii)]

III.3.B.9 The Permittees will manage treated effluent in the final verification tanks according to the requirements of the State and Federal Delisting Conditions (3) and (5), incorporated by reference. [WAC 173-303-815 (2)(b)(ii)]

III.3.B.10 The Permittees will manage treated effluent from the 200 Area ETF according to the requirements of the State Waste Discharge Permit ST 4500 and State and Federal Delisting Condition (7). [WAC 173-303-815(2)(b)(ii)]

III.3.B.11 The Permittees will ensure compliance with treatment standards (40 CFR 268, incorporated by reference by WAC 173-303-140) applicable to treated effluent prior to discharge to the State Authorized Land Disposal Site (SALDS), the delisting criteria at 40 CFR 261, Appendix IX, Table 2, and the corresponding state-approved delisting (dated August 8, 2005, all incorporated by reference). Sampling and analysis necessary for these demonstrations must meet the corresponding requirements in Permit Addendum B. [WAC 173-303-140, WAC 173-303-815 (2)(b)(ii)]

## III.3.C WASTE ANALYSIS

III.3.C.1 The Permittees will comply with requirements in Permit Addendum B for sampling and analysis of all dangerous and/or mixed waste required by conditions in this Chapter. [WAC 173-303-300]

III.3.C.2 The Permittees will have an accurate and complete waste profile as described in Permit Addendum B, Section B.2.1.2, for every waste stream accepted for management in LERF and 200 Area ETF dangerous waste management units. [WAC 173-303-380 (1)(a), (b)]

III.3.C.3 The Permittees will place a copy of each waste profile required by Permit Condition III.15.C.2 in the Hanford Facility Operating Record, LERF and 200 Area ETF file required by Permit Condition II.I.2. [WAC 173-303-380 (1)(a), (b)]

III.3.C.4 The Permittees will make a copy of the waste profile required by Permit Condition III.15.C.2 available upon request. [WAC 173-303-380 (1)(a), (b)]

III.3.C.5 Records and results of waste analysis described in this Permit will be maintained in the Hanford Facility Operating Record, LERF and 200 Area ETF file required by Permit Condition II.I.2. [WAC 173-303-380 (1)(a), (b)]

## III.3.D RECORDKEEPING AND REPORTING

III.3.D.1 The Permittees will place the following into the Hanford Facility Operating Record, LERF and 200 Area ETF file required by Permit Condition II.I.2:

III.3.D.1.a Records required by WAC 173-303-380 (1)(k), and -(o) incorporated by reference.

III.3.D.1.b Records and results of waste analysis, waste determinations (as required by Subpart CC) and trial tests required by WAC 173-303-300, General waste analysis, and by 40 CFR §264.1034,§264.1063, §264.1083, §265.1034, §265.1063, §265.1084, §268.4(a), and §268.7; [WAC 173-303-310(2)]

III.3.D.1.c An inspection log, summarizing inspections conducted pursuant to Permit Condition III.3.H.1; [WAC 173-303-380(1)(e)]

III.3.D.1.d Records required by the State and Federal Delisting Condition (6), incorporated by reference; [WAC 173-303-815 (2)(b)(ii)]

## III.3.E SECURITY

III.3.E.1 The Permittees comply with the Security requirements specific to the LERF and 200 Area ETF in Addendum E and Permit Attachment 3 as required by Permit Condition II.L. [WAC 173-303-310(2)]

## III.3.F PREPAREDNESS AND PREVENTION

III.3.F.1 The Permittees will comply with the Preparedness and Prevention requirements specific to LERF and 200 Area ETF in Addendum F. [WAC 173-303-340]

## III.3.G CONTINGENCY PLAN

III.3.G.1 The Permittees will comply with Addendum J, Contingency Plan, in addition to the requirements of Permit Condition II.A when applicable. [WAC 173-303-350]

## III.3.H INSPECTIONS

III.3.H.1 The Permittees will comply with Addendum I in addition to the requirements of Permit Condition II.X. [ WAC 173-303-320]

## III.3.I TRAINING PLAN

III.3.I.1 The Permittees will include the training requirements described in Addendum G of this Chapter specific to the dangerous waste management units and waste management activities at LERF and 200 Area ETF into the written training plan required by Permit Condition II.C.

## III.3.J GENERAL REQUIREMENTS

III.3.J.1 The Permittees will comply with the requirements of WAC 173-303-395(1), incorporated by reference, for prevention of reaction of ignitable, reactive, or incompatible wastes.

## III.3.K CLOSURE

III.3.K.1 The Permittees will close dangerous waste management units in the LERF and 200 Area ETF in accordance with Addendum H, Closure Plan, and Permit Condition II.J. [WAC 173-303-610(3)(a)]

## III.3.L POST CLOSURE – RESERVED

## III.3.M CRITICAL SYSTEMS – RESERVED

## III.3.N RESERVED

## III.3.O CONTAINERS

III.3.O.1 Container Storage and Treatment Unit Standards

III.3.O.1.a As part of or in addition to the requirements of Permit Condition III.3.B.2, the Permittees will ensure the integrity of container storage secondary containment and the chemically resistant coating described in Addendum C, Section C.3.4.1 as necessary to ensure any spills or releases to secondary containment do not migrate to the underlying concrete or soils.

III.3.O.1.a.1 Include documentation of any damage and subsequent repairs in the Hanford Facility Operating Record, LERF and 200 Area ETF file required by Permit Condition II.I.2.

III.3.O.2 Container Management Standards

III.3.O.2.a The Permittees will maintain and manage wastes in accordance with the requirements of Addendum C, Section 4.3.2, and Section 4.3.2. [WAC 173-303-630(2)]

III.3.O.2.b The Permittees will label containers in accordance with the requirements of Addendum C, Section C.3.2, and Section C.3.3. [WAC 173-303-630(3)]

III.3.O.2.c The Permittees will comply with the requirements for managing wastes in containers in WAC 173-303-630(5), incorporated by reference.

III.3.O.2.d The Permittees will ensure wastes are compatible with containers and with other wastes stored or treated in containers within the 200 Area ETF according to the requirements of Addendum C, Section C.3.4.3. [WAC 173-303-630(4), WAC 173-303-630(9)]

III.3.O.2.e The Permittees may treat wastes in containers via decanting of free liquids and addition of sorbents. The Permittees may not use addition of sorbents for purposes of changing the treatability group of a waste with respect to the land disposal restriction standards of 40 CFR 268, incorporated by reference by WAC 173-303-140.

III.3.O.2.f The Permittees will remove any accumulated liquids from container storage areas in 200 Area ETF according to the requirements of Addendum C, Section C.3.4.2, to ensure containers are not in contact with free liquids and to prevent overflow of the container storage area secondary containment.

III.3.O.2.g The Permittees will comply with the requirements for air emissions from containers in Addendum C, Section C.6.3.2. [WAC 173-303-692]

## III.3.P TANK SYSTEMS

III.3.P.1 Tank System Requirements

III.3.P.1.a The Permittees will develop a schedule for conducting integrity assessments (IA). The schedule will meet the requirements of Addendum C, Section C.4.2, and consideration of the factors in WAC 173-303-640(2)(e) or WAC 173-303-640(3)(b) as applicable:

III.3.P.1.b The Permittees will maintain a copy of the schedule required by Permit Condition III.3.P.1.a, in the Hanford Facility Operating Record, LERF and 200 Area ETF file, and conduct periodic integrity assessments according to the schedule. The Permittees will document results of integrity assessments conducted according to the IA in the Hanford Facility Operating Record, LERF and 200 Area ETF file.

III.3.P.1.c For existing tank systems, if a tank system is found to be leaking, or is unfit for use, the Permittees must follow the requirements of WAC 173-303-640(7), incorporated by reference. [WAC 173-303-640(3)(b)]

III.3.P.2 Tank System Operating Requirements

III.3.P.2.a The Permittees will comply with the requirements of WAC 173-303-640(5)(a), incorporated by reference.

III.3.P.2.b The Permittees will comply with the requirements of Addendum C, Section C.4.5.2. [WAC 173-303-640(5)(b)]

III.3.P.2.c The Permittees will comply with the requirements of Addendum C, Section C.4.6. [WAC 173-303-640(5)(d)]

III.3.P.2.d The Permittees will comply with the requirements of WAC 173-303-640(7), incorporated by reference, in response to spills or leaks from tanks systems at 200 Area ETF. [WAC 173-303-640(5)(c)]

III.3.P.2.e The Permittees will ensure that the Waste Processing Strategy required by Permit Condition III.3.B.7.a, provides for the immediate treatment or blending of waste accepted for management at the 200 Area ETF such that the resulting waste or mixture is no longer reactive or ignitable when further managed in 200 Area ETF tank systems. [WAC 173-303-640(9)]

III.3.P.2.f The Permittees will comply with the requirements of WAC 173-303-640(10), incorporated by reference.

## III.3.Q SURFACE IMPOUNDMENTS

III.3.Q.1 The Permittees will maintain the three LERF basins according to the requirements of WAC 173-303-650 (2)(f), incorporated by reference.

III.3.Q.2 The Permittees will operate the LERF basins according to the requirements of Addendum C, Section C.5.3, and Addendum I, Section I.2.2.3.1 to prevent over-topping. [WAC 173-303-650 (2)(c)]

III.3.Q.3 The Permittees will develop and maintain, and operate the LERF basins to ensure that any flow of waste into the impoundment can be immediately shut off in the event of overtopping or liner failure. [WAC 173-303-650 (2)(d)]

III.3.Q.4 The Permittees will comply with the requirements of WAC 173-303-650 (2)(g), incorporated by reference.

III.3.Q.5 The Permittees will comply with the requirements of WAC 173-303-650 (4)(b), incorporated by reference.

III.3.Q.6 The Permittees will comply with the requirements of WAC 173-303-650 (4)(c), incorporated by reference. The certification required by this Permit Condition must be provided to Ecology no later than seven calendar days after the date of the certification. A copy of the certification will be placed in the Hanford Facility Operating Record, LERF and 200 Area ETF file required by Permit Condition II.I.2. [WAC 173-303-650 (4)(c)]

III.3.Q.7 The Permittees will comply with the requirements of WAC 173-303-650(5)(b), incorporated by reference, in response to events in WAC 173-303-650(5)(a), incorporated by reference.

III.3.Q.8 The Permittees will comply with the requirements of WAC 173-303-650(5)(d) for any LERF basin that has been removed from service in accordance with Permit Condition III.3.Q.7 that the Permittees will restore to service. [WAC 173-303-650(5)(d)]

III.3.Q.9 The Permittees will close any LERF basin removed from service in accordance with the requirements of Permit Condition III.3.Q.7 or a basin that cannot be repaired or that the Permittees will not to return to service. [WAC 173-303-650(5)(e)]

III.3.Q.10 The Permittees will comply with the requirements of Addendum C, Section C.5.10 with respect to management of ignitable or reactive wastes in the LERF basins. [WAC 173-303-650(7)]

III.3.Q.11 The Permittees can place incompatible wastes and materials in the same LERF basin only if in compliance with the requirements of WAC 173-303-395(1)(b), (c). [WAC 173-303-650(8)]

III.3.Q.12 The Permittees will use the action leakage rate in Addendum C, Section C.5.8, for operation of LERF basins, and comply with the requirements of WAC 173-303-650(10)(b). [WAC 173-303-650(10)]

III.3.Q.13 The Permittees will comply with the requirements of WAC 173-303-650(11), incorporated by reference.

III.3.Q.14 The Permittees will comply with the requirements of 40 CFR 264, Subpart CC, incorporated by reference by WAC 173-303-692.

III.3.Q.15 Groundwater Monitoring

III.3.Q.15.a The Permittees will comply with the requirements of Chapter 5.0. [WAC 173-303-645]

This page intentionally left blank.

**Addendum C** **Process Information**

C. PROCESS INFORMATION ..... C.1

C.1 LIQUID EFFLUENT RETENTION FACILITY PROCESS DESCRIPTION ..... C.1

C.2 EFFLUENT TREATMENT FACILITY PROCESS DESCRIPTION ..... C.2
C.2.1 Load-In Station ..... C.2
C.2.2 Effluent Treatment Facility Operating Configuration ..... C.3
C.2.3 Primary Treatment Train ..... C.3
C.2.4 Secondary Treatment Train ..... C.5
C.2.5 Other Effluent Treatment Facility Systems ..... C.7

C.3 CONTAINERS ..... C.9
C.3.1 Description of Containers ..... C.9
C.3.2 Container Management Practices ..... C.10
C.3.3 Container Labeling ..... C.10
C.3.4 Containment Requirements for Managing Containers ..... C.10

C.4 TANK SYSTEMS ..... C.12
C.4.1 Design Requirements ..... C.12
C.4.2 Additional Requirements for New Tanks ..... C.17
C.4.3 Secondary Containment and Release Detection for Tank Systems ..... C.17
C.4.4 Tank Management Practices ..... C.21
C.4.5 Labels or Signs ..... C.24
C.4.6 Air Emissions ..... C.24
C.4.7 Management of Ignitable or Reactive Wastes in Tanks Systems ..... C.24
C.4.8 Management of Incompatible Wastes in Tanks Systems ..... C.24

C.5 SURFACE IMPOUNDMENTS ..... C.24
C.5.1 List of Dangerous Waste ..... C.25
C.5.2 Construction, Operation, and Maintenance of Liner System ..... C.25
C.5.3 Prevention of Overtopping ..... C.32
C.5.4 Structural Integrity of Dikes ..... C.33
C.5.5 Piping Systems ..... C.34
C.5.6 Double Liner and Leak Detection, Collection, and Removal System ..... C.35
C.5.7 Construction Quality Assurance ..... C.36
C.5.8 Proposed Action Leakage Rate and Response Action Plan ..... C.36
C.5.9 Dike Structural Integrity Engineering Certification ..... C.36
C.5.10 Management of Ignitable, Reactive, or Incompatible Wastes ..... C.37

C.6 AIR EMISSIONS CONTROL ..... C.37
C.6.1 Applicability of Subpart AA Standards ..... C.37
C.6.2 Process Vents - Demonstrating Compliance ..... C.37
C.6.3 Applicability of Subpart CC Standards ..... C.38

C.7 ENGINEERING DRAWINGS ..... C.39
C.7.1 Liquid Effluent Retention Facility ..... C.39
C.7.2 200 Area Effluent Treatment Facility ..... C.40

## Figures

Figure C.1. Liquid Effluent Retention Facility Layout ..... C.47
Figure C.2. Plan View of the 200 Area Effluent Treatment Facility ..... C.48
Figure C.3. 200 Area Effluent Treatment Facility Layout ..... C.49
Figure C.4. 200 Area Effluent Treatment Facility ..... C.50
Figure C.5. Example - 200 Area Effluent Treatment Facility Configuration 1 ..... C.51
Figure C.6. Example - 200 Area Effluent Treatment Facility Configuration 2 ..... C.52
Figure C.7. Surge Tank ..... C.53
Figure C.8. Ultraviolet Light/Oxidation Unit ..... C.54
Figure C.9. Reverse Osmosis Unit ..... C.55
Figure C.10. Ion Exchange Unit ..... C.56
Figure C.11. Verification Tanks ..... C.57
Figure C.12. Effluent Treatment Facility Evaporator ..... C.58
Figure C.13. Thin Film Dryer ..... C.59
Figure C.14. Container Handling System ..... C.60
Figure C.15. Effluent Treatment Facility Sump Tanks ..... C.61
Figure C.16. Liner Anchor Wall and Cover Tension System ..... C.62
Figure C.17. Liner System Schematic ..... C.63
Figure C.18. Detail of Leachate Collection Sump ..... C.64

## Tables

Table C.1. Liquid Effluent Retention Facility Containment System ..... C.40
Table C.2. Liquid Effluent Retention Facility Piping and Instrumentation ..... C.40
Table C.3. Effluent Treatment Facility and Load-In Station Secondary Containment Systems ..... C.40
Table C.4. Major Process Units and Tanks at the Effluent Treatment Facility and Load-In Station ..... C.41
Table C.5. 200 Area Effluent Treatment Facility Tank Systems Information ..... C.42
Table C.6. 200 Area Effluent Treatment Facility Additional Tank System Information ..... C.43
Table C.7. Ancillary Equipment and Material Data ..... C.44
Table C.8. Concrete and Masonary Coatings ..... C.45
Table C.9. Geomembrane Material Specifications ..... C.45
Table C.10. Drainage Gravel Specifications ..... C.46

# C. PROCESS INFORMATION

This addendum provides a detailed discussion of the LERF and 200 Area ETF processes and equipment. The LERF and 200 Area ETF comprise an aqueous waste treatment system located in the 200 East Area that provides storage and treatment for a variety of aqueous mixed waste. This aqueous waste includes process condensate from the 242-A Evaporator and other aqueous waste generated from onsite remediation and waste management activities.

The LERF consists of three lined surface impoundments, or basins. Aqueous waste from LERF is pumped to the200 Area ETF for treatment in a series of process units, or systems, that remove or destroy essentially all of the dangerous waste constituents. The treated effluent is discharged to a State-Approved Land Disposal Site (SALDS) north of the 200 West Area, under the authority of a Washington State Waste Discharge Permit (Ecology 2000) and the Final Delisting (40 CFR 261, Appendix IX, Table 2).

## C.1 LIQUID EFFLUENT RETENTION FACILITY PROCESS DESCRIPTION

Each of the three LERF basins has an operating capacity of 29.5-million liters. The LERF receives aqueous waste through several inlets including the following:

- A pipeline that connects LERF with the 242-A Evaporator
- A pipeline from the 200 West Area
- A pipeline that connects LERF to the Load-In Station at the 200 Area ETF
- A series of sample ports located at each basin.

Figure C.1 presents a general layout of LERF and associated pipelines. Aqueous waste from LERF is pumped to the 200 Area ETF through one of two double-walled fiberglass transfer pipelines. Effluent from the 200 Area ETF also can be transferred back to the LERF through one of these transfer pipelines. These pipelines are equipped with leak detection located in the annulus between the inner and outer pipes. In the event that these leak detectors are not in service, the pipelines are visually inspected during transfers for leakage by opening the secondary containment drain lines located at the 200 Area ETF end of the transfer pipelines.

Each basin is equipped with six available sample risers constructed of 6-inch perforated pipe. A seventh sample riser in each basin is dedicated to influent aqueous waste receipt piping (except for aqueous waste received from the 242-A Evaporator), and an eighth riser in each basin contains liquid level instrumentation. Each riser extends along the sides of each basin from the top to the bottom of the basin and allows samples to be collected from any depth. Personnel access to these sample ports is from the perimeter area of the basins.

A catch basin is provided at the northwest corner of each LERF basin for aboveground piping and manifolds for transfer pumps. Aqueous waste from the 242-A Evaporator is transferred through piping which ties into piping at the catch basins. Under routine operations, a submersible pump is used to transfer aqueous waste from a LERF basin to the 200 Area ETF for processing or for basin-to-basin transfers. This pump is connected to a fixed manifold on one of four available risers.

Each basin consists of a multilayer liner system supported by a concrete anchor wall around the basin perimeter and a soil-bentonite clay underlayment. The multilayer liner system consists of a primary liner in contact with the aqueous waste, a layer of bentonite carpet, a geonet, a geotextile, a gravel layer, and a secondary liner that rests on the bentonite underlayment. Any aqueous waste leakage through the primary liner flows through the geonet and gravel to a leachate collection system. The leachate flows to a sump at the northwest corner of each basin, where the leachate is pumped up the side slope and back into the basin above the primary liner. Each liner is constructed of high-density polyethylene. A floating cover made of very low-density polyethylene is stretched over each basin above the primary liner. These covers serve to keep unwanted material from entering the basins, and to minimize evaporation of the liquid contents.

## C.2 EFFLUENT TREATMENT FACILITY PROCESS DESCRIPTION

The 200 Area ETF is designed as a flexible treatment system that provides treatment for contaminants anticipated in process condensate and other onsite aqueous waste. The design influent flow rate into the 200 Area ETF is approximately 570 liters per minute, with planned outages for activities such as maintenance on the 200 Area ETF systems. Maintenance outages typically are scheduled between treating a batch of aqueous waste, referred to as treatment campaigns. The effluent flow (or volume) is equivalent to the influent flow (or volume).

The 200 Area ETF generally receives aqueous waste directly from the LERF. However, aqueous waste also can be transferred from tanker trucks at the Load-In Station to the 200 Area ETF and from containers (e.g., carboys, drums) directly to ETF. Aqueous waste is treated and stored in the 200 Area ETF process areas in a series of tank systems, referred to as process units. Within the ETF, waste also is managed in containers through treatment and/or storage. Figure C.2 provides the relative locations of the process and container storage areas within the ETF.

The process units are grouped in either the primary or the secondary treatment train. The primary treatment train provides for the removal or destruction of contaminants. Typically, the secondary treatment train processes the waste by-products from the primary treatment train by reducing the volume of waste. In the secondary treatment train, contaminants are concentrated and dried to a powder. The liquid fraction is routed to the primary treatment train. Figure C.3 provides an overview of the layout of the ETF, 2025E Building). Figure C.4 presents the 200 Area ETF floor plan, the relative locations of the individual process units and associated tanks within the ETF, and the location of the Load-In Station.

The dry powder waste and maintenance and operations waste are containerized and stored or treated in the container storage areas or in collection or treatment areas within the Process Area. Secondary containment is provided for all containers and tank systems (including ancillary equipment) housed within the ETF. The trenches and floor of the 200 Area ETF comprise the secondary containment system. The floor includes approximately a 15.2-centimeter rise (berm) along the containing walls of the process and container storage areas. Any spilled or leaked material from within the process area or container storage area is collected into trenches that feed into either sump tank 1 or sump tank 2. From these sump tanks, the spilled or leaked material (i.e., waste) is fed to either the surge tank and processed in the primary treatment train or the secondary waste receiving tanks and processed in the secondary treatment train. All tank systems outside of the 200 Area ETF are provided with a secondary containment system.

In the following sections, several figures are provided that present general illustrations of the treatment units and the relation to the process.

### C.2.1 Load-In Station

The 200 Area ETF receives aqueous waste from LERF or the Load-In Station. The 200 Area ETF Load-In Station, located due east of the surge tank and outside of the perimeter fence (Figure C.4), was designed and constructed to provide the capability to unload, store, and transfer aqueous waste to the LERF or 200 Area ETF from tanker trucks and other containers (such as drums). The Load-In Station consists of two truck bays equipped with load-in tanks, transfer pumps, filtration system, level instrumentation for tanker trucks, leak detection capabilities for the containment basin and transfer line, and an underground transfer line that connects to lines in the surge tank berm, allowing transfers to either the 200 Area ETF surge tank or LERF. The Load-In Station is covered with a steel building for weather protection. Tanker trucks and other containers are used to unload aqueous waste at the Load-In Station. To perform unloading, the tanker truck is positioned on a truck pad, a 'load-in' transfer line is connected to the truck, and the tanker contents are pumped into one of the Load-In Station tanks, the surge tank, or directly to the LERF. For container unloading, the container is placed on the truck pad and the container contents are pumped into one of the Load-In Station tanks, the surge tank, or directly to the LERF.

During unloading operations, solids may be removed from the waste by pumping the contents of the tanker truck or container through a filtration system. If solids removal is not needed, the filtration system is not used and the solution is transferred directly to the Load-In Station tanks, surge tank, or to LERF.

Any leaks at the Load-In Station drain to the sump. A leak detector in the sump alarms locally and in the 200 Area ETF control room. Alternatively, leaks can be visually detected.

### C.2.2 Effluent Treatment Facility Operating Configuration

Because the operating configuration of the 200 Area ETF can be adjusted or modified, most aqueous waste streams can be effectively treated to below Delisting and Discharge Permit limits. The operating configuration of the 200 Area ETF depends on the unique chemistry of an aqueous waste stream(s). Before an aqueous waste stream is accepted for treatment, the waste is characterized and evaluated. Information from the characterization is used to adjust the treatment process or change the configuration of the 200 Area ETF process units, as necessary, to optimize the treatment process for a particular aqueous waste stream.

Typically, an aqueous waste is processed first in the primary treatment train, where the 200 Area ETF is configured to process an aqueous waste through the UV/OX unit first, followed by the RO unit. However, under an alternate configuration, an aqueous waste could be processed in the RO unit first. For example, high concentrations of nitrates in an aqueous waste might interfere with the performance of the UV/OX. In this case, the 200 Area ETF could be configured to process the waste in the RO unit before the UV/OX unit.

The flexibility of the 200 Area ETF also allows some aqueous waste to be processed in the secondary treatment train first. For example, for small volume aqueous waste with high concentrations of some anions and metals, the approach could be to first process the waste stream in the secondary treatment train. This approach would prevent premature fouling or scaling of the RO unit. The liquid portion (i.e., untreated overheads from the 200 Area ETF evaporator and thin film dryer) would be sent to the primary treatment train.

Figure C.5 and Figure C.6 provide example process flow diagrams for two different operating configurations.

### C.2.3 Primary Treatment Train

The primary treatment train consists of the following processes:

- Influent Receipt/Surge tank - inlet, surge capacity
- Filtration - for suspended solids removal
- UV/OX - organic destruction
- pH adjustment - waste neutralization
- Hydrogen peroxide decomposition - removal of excess hydrogen peroxide
- Degasification - removal of carbon dioxide
- RO - removal of dissolved solids
- IX - removal of dissolved solids
- Verification - holding tanks during verification

**Influent Receipt/Surge Tank.** Depending on the configuration of the ETF, the surge tank is one inlet used to feed an aqueous waste into the 200 Area ETF for treatment. In Configuration 1 (Figure C.5), the surge tank is the first component downstream of the LERF. The surge tank provides a storage/surge volume for chemical pretreatment and controls feed flow rates from the LERF to the 200 Area ETF. However, in Configuration 2 (Figure C.6), aqueous waste from LERF is fed directly into the treatment units. In this configuration, the surge tank receives aqueous waste, which has been processed in the RO units, and provides the feed stream to the remaining downstream process units. In yet another configuration, some small volume aqueous waste could be received into the secondary treatment train first for processing. In this case, the aqueous waste would be received directly into the secondary waste

receiving tanks. Finally, the surge tank also receives waste extracted from various systems within the primary and secondary treatment train while in operation.

The surge tank is located outside the 200 Area ETF on the south side. In the surge tank (Figure C.7), the pH of an aqueous waste is adjusted using the metered addition of sulfuric acid and sodium hydroxide, as necessary, to prepare the waste for treatment in downstream processes. In addition, hydrogen peroxide or biocides could be added to control biological growth in the surge tank. A pump recirculates the contents in the surge tank, mixing the chemical reagents with the waste to a uniform pH.

**Filtration.** Two primary filter systems remove suspended particles in an aqueous waste: a rough filter removes the larger particulates, while a fine filter removes the smaller particulates. The location of these filters depends on the configuration of the primary treatment train. However, the filters normally are located upstream of the RO units.

The solids accumulating on these filter elements are backwashed to the secondary waste receiving tanks with pulses of compressed air and water, forcing water back through the filter. The backwash operation is initiated either automatically by a rise in differential pressure across the filter or manually by an operator. The filters are cleaned chemically when the backwashing process does not facilitate acceptable filter performance.

Auxiliary fine and rough filters (e.g., disposable filters) have been installed to provide additional filtration capabilities. Depending on the configuration of the ETF, the auxiliary filters are operated either in series with the primary filters to provide additional filtration or in parallel, instead of the primary fine and rough filters, to allow cleaning/maintenance of the primary fine and rough filters while the primary treatment train is in operation.

**Ultraviolet Light/Oxidation.** Organic compounds contained in an aqueous waste stream are destroyed in the UV/OX system (Figure C.8). Hydrogen peroxide is mixed with the waste. The UV/OX system uses the photochemical reaction of UV light on hydrogen peroxide to form hydroxyl radicals and other reactive species that oxidize the organic compounds. The final products of the complete reaction are carbon dioxide, water, and inorganic ions.

Organic destruction is accomplished in two UV/OX units operating in parallel. During the UV/OX process, the aqueous waste passes through reaction chambers where hydrogen peroxide is added. While in the UV/OX system, the temperature of an aqueous waste is monitored. Heat exchangers are used to reduce the temperature of the waste should the temperature of the waste approach the upper limits for the UV/OX or RO systems.

**pH Adjustment.** The pH of a waste stream is monitored and controlled at different points throughout the treatment process. Within the primary treatment train, the pH of a waste can be adjusted with sulfuric acid or sodium hydroxide to optimize operation of downstream treatment processes or adjusted before final discharge. For example, the pH of an aqueous waste would be adjusted in the pH adjustment tank after the UV/OX process and before the RO process. In this example, pH is adjusted to cause certain chemical species such as ammonia to form ammonium sulfate, thereby increasing the rejection rate of the RO.

**Hydrogen Peroxide Decomposition.** Typically, hydrogen peroxide added into the UV/OX system is not consumed completely by the system. Because hydrogen peroxide is a strong oxidizer, the residual hydrogen peroxide from the UV/OX system is removed to protect the downstream equipment. The hydrogen peroxide decomposer uses a catalyst to break down the hydrogen peroxide that is not consumed completely in the process of organic destruction. The aqueous waste is sent through a column that breaks down the hydrogen peroxide into water and oxygen. The gas generated by the decomposition of the hydrogen peroxide is vented to the vessel off gas system.

**Degasification.** The degasification column is used to purge dissolved carbon dioxide from the aqueous waste to reduce the carbonate loading to downstream dissolved solids removal processes within the 200 Area ETF primary treatment train. The purged carbon dioxide is vented to the vessel off gas system.

**Reverse Osmosis.** The RO system (Figure C.9) uses pressure to force clean water molecules through semi-permeable membranes while keeping the larger molecule contaminants, such as dissolved solids, and large molecular weight organic materials, in the membrane. The RO process uses a staged configuration to maximize water recovery. The process produces two separate streams, including a clean 'permeate' and a concentrate (or retentate), which are concentrated as much as possible to minimize the amount of secondary waste produced.

The RO process is divided into first and second stages. Aqueous waste is fed to the first RO stage from the RO feed tank. The secondary waste receiving tanks of the secondary treatment train receive the retentate removed from the first RO stage, while the second RO stage receives the permeate (i.e., 'treated' aqueous waste from the first RO stage). In the second RO stage, the retentate is sent to the first stage RO feed tank while the permeate is sent to the IX system or to the surge tank, depending on the configuration of the ETF.

Two support systems facilitate this process. An anti-scale system injects scale inhibitors as needed into the feed waste to prevent scale from forming on the membrane surface. A clean-in-place system using cleaning agents, such as descalants and surfactants, cleans the membrane pores of surface and subsurface deposits that have fouled the membranes.

**Ion Exchange.** Because the RO process removes most of the dissolved solids in an aqueous waste, the IX process (Figure C.10) acts as a polishing unit. The IX system consists of three columns containing beds of cation and/or anion resins. This system is designed to allow for regeneration of resins and maintenance of one column while the other two are in operation. Though the two columns generally are operated in series, the two columns also can be operated in parallel or individually.

Typically, the two columns in operation are arranged in a primary/secondary (lead/lag) configuration, and the third (regenerated) column is maintained in standby. When dissolved solids breakthrough the first IX column and are detected by a conductivity sensor, this column is removed from service for regeneration, and the second column replaces the first column and the third column is placed into service. The column normally is regenerated using sulfuric acid and sodium hydroxide. The resulting regeneration waste is collected in the secondary waste receiving tanks.

Spent resins are transferred into a disposal container should regeneration of the IX resins become inefficient Free water is removed from the container and returned to the surge tank. Dewatered resins are transferred to a final storage/disposal point.

**Verification.** The three verification tanks (Figure C.11) are used to hold the treated effluent while a determination is made that the effluent meets discharge limits. The effluent can be returned to the primary treatment train for additional treatment, or to the LERF, should a treated effluent not meet Discharge Permit or Final Delisting requirements.

The three verification tanks alternate between three operating modes: receiving treated effluent, holding treated effluent during laboratory analysis and verification, or discharging verified effluent. Treated effluent may also be returned to the 200 Area ETF to provide 'clean' service water for operational and maintenance functions, e.g., for boiler water and for backwashing the filters. This recycling keeps the quantity of fresh water used to a minimum.

### C.2.4 Secondary Treatment Train

The secondary treatment system typically receives and processes the following by-products generated from the primary treatment train: concentrate from the first RO stage, filter backwash, regeneration waste from the ion exchange system, and spillage or overflow received into the process sumps. Depending on the operating configuration, however, some aqueous waste could be processed in the secondary treatment train before the primary treatment train (refer to Figure C.5 and Figure C.6 for example operating configurations).

The secondary treatment train provides the following processes:

- Secondary waste receiving - tank receiving and chemical addition
- Evaporation - concentrates secondary waste streams
- Concentrate staging - concentrate receipt, pH adjustment, and chemical addition
- Thin film drying - dewatering of secondary waste streams
- Container handling - packaging of dewatered secondary waste

**Secondary Waste Receiving.** Waste to be processed in the secondary treatment train is received into two secondary waste receiving tanks, where the pH can be adjusted with sulfuric acid or sodium hydroxide for optimum evaporator performance. Chemicals, such as reducing agents, may be added to waste in the secondary waste receiving tanks to reduce the toxicity or mobility of constituents in the powder.

**Evaporation.** The 200 Area ETF evaporator is fed alternately by the two secondary waste receiving tanks. One tank serves as a waste receiver while the other tank is operated as the feed tank. The 200 Area ETF evaporator vessel (also referred to as the vapor body) is the principal component of the evaporation process (Figure C.12).

Feed from the secondary waste receiving tanks is pumped through a heater to the recirculation loop of the 200 Area ETF evaporator. In this loop, concentrated waste is recirculated from the 200 Area ETF evaporator, to a heater, and back into the evaporator where vaporization occurs. As water leaves the evaporator system in the vapor phase, the concentration of the waste in the evaporator increases. When the concentration of the waste reaches the appropriate density, a portion of the concentrate is pumped to one of the concentrate tanks.

The vapor that is released from the 200 Area ETF evaporator is routed to the entrainment separator, where water droplets and/or particulates are separated from the vapor. The 'cleaned' vapor is routed to the vapor compressor and converted to steam. The steam from the vapor compressor is sent to the heater (reboiler) and used to heat the recirculating concentrate in the 200 Area ETF evaporator. From the heater, the steam is condensed and fed to the distillate flash tank, where the saturated condensate received from the heater drops to atmospheric pressure and cools to the normal boiling point through partial flashing (rapid vaporization caused by a pressure reduction). The resulting distillate is routed to the surge tank. The non-condensable vapors, such as air, are vented through a vent gas cooler to the vessel off gas system.

**Concentrate Staging.** The concentrate tanks make up the head end of the thin film drying process. From the 200 Area ETF evaporator, concentrate is pumped into two concentrate tanks, and pH adjusted chemicals, such as reducing agents, may be added to reduce the toxicity or mobility of constituents when converted to powder. Waste is transferred from the concentrate tanks to the thin film dryer for conversion to a powder. The concentrate tanks function alternately between concentrate receiver and feed tank for the thin film dryer. However, one tank may serve as both concentrate receiver and feed tank.

Because low solubility solids (i.e., calcium and magnesium sulfate) tend to settle in the concentrate tanks, these solids must be removed to prevent fouling and to protect the thin film dryer, and to maintain concentrate tank capacity.

**Thin Film Drying.** From the concentrate tanks, feed is pumped to the thin film dryer (Figure C.13) that is heated by steam. As the concentrated waste flows down the length of the dryer, the waste is dried. The dried film, or powder, is scraped off the dryer cylinder by blades attached to a rotating shaft. The powder is funneled through a cone-shaped powder hopper at the bottom of the dryer and into the Container Handling System.

Overhead vapor released by the drying of the concentrate is condensed in the distillate condenser. Excess heat is removed from the distillate by a water-cooled heat exchanger. Part of the distillate is circulated back to the condenser spray nozzles. The remaining distillate is pumped to the surge tank. Any noncondensible vapors and particulates from the spray condenser are exhausted to the vessel off gas system.

**Container Handling.** Before an empty container is moved into the Container Handling System (Figure C.14), the lid is removed and the container is placed on a conveyor. The containers are moved

into the container filling area after passing through an air lock. The empty container is located under the thin film dryer, and raised into position. The container is sealed to the thin film dryer and a rotary valve begins the transfer of powder to the empty container. Air displaced from the container is vented to the distillate condenser attached to the 200 Area ETF evaporator that exhausts to the vessel off gas system.

The container is filled to a predetermined level, then lowered from the thin film dryer and moved along a conveyor. The filled container is manually recapped, and moved along the conveyor to the airlock. At the airlock, the container is moved onto the conveyor by remote control. The airlock is opened, the smear sample (surface wipe) is taken, and the contamination level counted. A 'C' ring is installed to secure the container lid. If the container has contaminated material on the outside, the container is wiped down and retested. Filled containers that pass the smear test are labeled, placed on pallets, and moved by forklift to the filled container storage area. Section C.3 provides a more detailed discussion of container handling.

### C.2.5 Other Effluent Treatment Facility Systems

The 200 Area ETF is provided with support systems that facilitate treatment in the primary and secondary treatment trains and that provide for worker safety and environmental protection. An overview of the following systems is provided:

- Monitor and control system
- Vessel off gas system
- Sump collection system
- Chemical injection feed system
- Verification tank recycle system
- Utilities

#### C.2.5.1 Monitor and Control System

The operation of the 200 Area ETF is monitored and controlled by a centralized computer system (i.e., monitor and control system or MCS). The MCS continuously monitors data from various field indicators, such as pH, flow, tank level, temperature, pressure, conductivity, alarm status, and valve switch positions. Data gathered by the MCS enable operations and engineering personnel to document and adjust the operation of the ETF.

#### C.2.5.2 Vessel Off gas System

Ventilation for various tanks and vessels is provided through the vessel off gas system. The system includes a moisture separator, duct heater, pre-filter, high-efficiency particulate air filters, carbon absorber (when required to reduce organic emissions), exhaust fans, and ductwork. Gasses ventilated from the tanks and vessels enter the exhaust system through the connected ductwork. The vessel off gas system draws vapors and gasses off the following tanks and treatment systems:

- Surge tank
- Vent gas cooler (off the ETF evaporator/distillate flash tank)
- pH adjustment tank
- Concentrate tanks
- Degasification system
- First and second RO stages
- Dry powder hopper
- Effluent pH adjustment tank
- Drum capping station
- Secondary waste receiving tanks
- Distillate condenser (off the thin film dryer)
- Sump tanks 1 and 2

The vessel off gas system maintains a negative pressure with respect to the atmosphere, which produces a slight vacuum within tanks, vessels, and ancillary equipment for the containment of gas vapor. This system also provides for the collection, monitoring, and treatment of confined airborne in-vessel

contaminants to preclude over-pressurization. The high-efficiency particulate air filters remove particulates and condensate from the air stream before these are discharged to the heating, ventilation, and air conditioning system.

#### C.2.5.3 Sump Collection System

Sump tanks 1 and 2 compose the sump collection system that provides containment of waste streams and liquid overflow associated with the 200 Area ETF processes. The process area floor is sloped to two separate trenches that each drain to a sump tank located under the floor of the 200 Area ETF (Figure C.15). One trench runs the length of the primary treatment train and drains to Sump Tank 2, located underneath the verification tank pump floor. The second trench collects spillage primarily from the secondary treatment train and flows to Sump Tank 1, located near the 200 Area ETF evaporator. Sump tanks 1 and 2 are located below floor level (Figure C.15). An eductor in these tanks prevents sludge from accumulating.

#### C.2.5.4 Chemical Injection Feed System

At several points within the primary and secondary treatment trains, sulfuric acid and sodium hydroxide (or dilute solutions of these reagents) are metered into specific process units to adjust the pH. For example, a dilute solution of 4 percent sulfuric acid and 4 percent sodium hydroxide could be added to the secondary waste receiving tanks to optimize the evaporation process.

#### C.2.5.5 Verification Tank Recycle System

To reduce the amount of water added to the process, verification tank water (i.e., verified effluent) is recycled throughout the 200 Area ETF process. Tanks and ancillary equipment that use verification tank water include:

- 4 percent $H_2SO4$ solution tank and ancillary equipment
- 4 percent NaOH solution tank and ancillary equipment
- Clean-in-place tank and ancillary equipment
- IX columns (during resin regeneration)
- 200 Area ETF evaporator boiler and ancillary equipment
- Thin film dryer boiler and ancillary equipment
- Seal water system.In addition, verification tank water is used extensively during maintenance activities. For example, it may be used to flush piping systems or to confirm the integrity of piping, a process tank or tank truck.

#### C.2.5.6 Utilities

The 200 Area ETF maintains the following utility supply systems required for the operation of the ETF:

- Cooling water system - removes heat from process water via heat exchangers and a cooling tower
- Compressed air system - provides air to process equipment and instrumentation
- Seal water system - provides cool, clean, pressurized water to process equipment for pump seal cooling and pump seal lubrication, and provides protection against failure and fluid leakage
- Demineralized water system - removes solids from raw water system to produce high quality, low ion-content, water for steam boilers, and for the hydrogen peroxide feed system.
- Heating, ventilation, and air conditioning system - provides continuous heating, cooling, and air humidity control throughout the ETF.

The following utilities support 200 Area ETF activities:

- Electrical power
- Sanitary water
- Communication systems
- Raw water

## C.3 CONTAINERS

This section provides specific information on container storage and treatment operations at the 200 Area ETF, including descriptions of containers, labeling, and secondary containment structures.

A list of dangerous and/or mixed waste managed in containers at the 200 Area ETF is presented in Addendum A. The types of dangerous and/or mixed waste managed in containers in the 200 Area ETF could include:

- Secondary waste powder generated from the treatment process
- Aqueous waste received from other Hanford site sources awaiting treatment
- Miscellaneous waste generated by operations and maintenance activities.

The secondary treatment train processes the waste by-products from the primary treatment train, which are concentrated and dried into a powder. Containers are filled with dry powder waste from the thin film dryer via a remotely controlled system. Containers of aqueous waste received from other Hanford site sources are stored at 200 Area ETF until their contents can be transferred to the process for treatment. The waste is usually transferred to the secondary waste receiving or concentration tanks. Miscellaneous waste generated from maintenance and operations activities are stored at the ETF. The waste could include process waste, such as used filter elements; spent RO membranes; damaged equipment, and decontamination and maintenance waste, such as contaminated rags, gloves, and other personal protective equipment. Containers of miscellaneous waste which have free liquids generally are packaged with absorbents.

Several container collection areas could be located within the 200 Area ETF process and container handling areas. These collection areas are used only to accumulate waste in containers. Once a container is filled, the container is transferred to a container storage area (Figure C.3 and Figure C.4), to another TSD unit, or to a less-than-90-day storage pad. Containers stored in the additional storage area (Figure C.4) are elevated or otherwise protected from contact with accumulated liquids. The container storage area within 200 Area ETF is a 22.9 x 8.5-meter room located adjacent to the 200 Area ETF process areas. The containers within the container storage area are clearly labeled, and access to these containers is limited by barriers and by administrative controls. The 200 Area ETF floor provides secondary containment, and the 200 Area ETF roof and walls protects all containers from exposure to the elements.

Waste also could be placed in containers for treatment as indicated in Addendum A. For example, sludge that accumulates in the bottoms of the process tanks is removed periodically and placed into containers. In this example, the waste is solidified by decanting the supernate from the container and the remainder of the waste is allowed to evaporate, or absorbents are added, as necessary, to address remaining liquids. Following treatment, this waste either is stored at the 200 Area ETF or transferred to another TSD unit.

### C.3.1 Description of Containers

The containers used to collect and store dry powder waste are 208-liter steel containers. Most of the aqueous waste received at 200 Area ETF, and maintenance and operation waste generated, are stored in 208-liter steel or plastic containers; however, in a few cases, the size of the container could vary to accommodate the size of a particular waste. For example, some process waste, such as spent filters, might not fit into a 208-liter container. In the case of spent resin from the IX columns, the resin is dewatered, and could be packaged in a special disposal container. In these few cases, specially sized containers could be required. In all cases, however, only approved containers are used and are compatible with the associated waste. Typically, 208-liter containers are used for treatment.

Current operating practices indicate the use of new 208-liter containers that have either a polyethylene liner or a protective coating. Any reused or reconditioned container is inspected for container integrity before use. Overpack containers are available for use with damaged containers. Overpack containers typically are unlined steel or polyethylene.

Per Addendum A, a maximum of 147,630 liters of dangerous and/or mixed waste could be stored in containers in the 200 Area ETF.

### C.3.2 Container Management Practices

Before use, each container is checked for signs of damage such as dents, distortion, corrosion, or scratched coating. For dry powder loading, empty containers on pallets are raised by a forklift and manually placed on the conveyor that transports the containers to the automatic filling station in the container handling room (Figure C.14). The container lids are removed and replaced manually following the filling sequence. After filling, containers exit the container handling room via the filled drum conveyor. Locking rings are installed, the container label is affixed, and the container is moved by dolly or forklift to the container storage area.

Before receipt at 200 Area ETF, each container from other Hanford site sources is inspected for leaks, signs of damage, and a loose lid. The identification number on each container is checked to ensure the proper container is received. The containers are typically placed on pallets and moved by dolly or forklift to the container storage area. These containers are later moved to the process area and the contents transferred to the process for treatment.

Containers used for storing maintenance and operations secondary waste are labeled before being placed in the container storage area or in a collection area. Lids are secured on these containers when not being filled. When the containers in a collection area are full, the containers are transferred by dolly or forklift to the container storage area or to an appropriate TSD unit. Containers used for treating waste also are labeled. The lids on these containers are removed as required to allow for treatment. During treatment, access to these containers is controlled through physical barriers and/or administrative controls.

The filled containers in the container storage area are inventoried, checked for proper labeling, and placed on pallets or in a separate containment device as necessary. Each pallet is moved by forklift. Within the container storage area, palletized containers are stacked no more than three pallets high and in rows no more than two containers wide. Unobstructed aisles with a minimum of 76-centimeter aisle space separate rows.

### C.3.3 Container Labeling

Labels are affixed on containers used to store dry powder when the containers leave the container handling room. Labels are affixed on other waste containers before use. Every container is labeled with the date that the container was filled. Appropriate major risk labels, such as "corrosive", "toxic", or "F-listed", also are added. Each container also has a label with an identification number for tracking purposes.

### C.3.4 Containment Requirements for Managing Containers

Secondary containment is provided in the container management areas within the ETF. The secondary containment provided for tank systems also serves the container management areas. This section describes the design and operation of the secondary containment structure for these areas.

#### C.3.4.1 Secondary Containment System Design

For the container management areas, the reinforced concrete floor and a 15.2-centimeter rise (berm) along the walls of the container storage area of the 200 Area ETF provides secondary containment. The engineering assessment required for tanks (Mausshardt 1995) also describes the design and construction of the secondary containment provided for the 200 Area ETF container management areas. All systems were designed to national codes and standards (e.g., American Society for Testing Materials, American Concrete Institute standards).

The floor is composed of cast-in-place, pre-formed concrete slabs, and has a minimum thickness of 15.2 centimeters. All slab joints and floor and wall joints have water stops installed at the mid-depth of the slab. In addition, filler was applied to each joint. The floor and berms are coated with a chemically resistant; high-solids epoxy coating system consisting of primer and top coating. This coating material is

compatible with the waste managed in containers and is an integral part of the secondary containment system for containers.

The floor is sloped to drain any solution in the container storage area to floor drains along the west wall. Each floor drain consists of a grating over a 20.3-centimeter diameter drain port connected to a 4-inch polyvinyl chloride transfer pipe. The pipe passes under this wall and connects to a trench running along the east wall of the adjacent process area. This trench drains solution to sump tank 1.

The container storage area is separated from the process area by a common wall and a door for access to the two areas (Figure C.3). These two areas also share a common floor and trenches that, with the 15.2-centimeter rise of the containing walls, form the secondary containment system for the process area and the container storage area.

#### C.3.4.2 Structural Integrity of Base

Engineering calculations were performed showing the floor of the container storage area is capable of supporting the weight of containers. These calculations were reviewed and certified by a professional engineer (Mausshardt 1995). The concrete was inspected for damage during construction. Cracks were identified and repaired to the satisfaction of the professional engineer. Documentation of these certifications is included in the engineering assessment (Mausshardt 1995).

#### C.3.4.3 Containment System Capacity

The container storage area is primarily used to store dry powder, aqueous waste awaiting treatment, and maintenance and operation waste. Where appropriate, absorbents are added to fix any trace liquids present. Large volumes of liquid are not stored in the container storage area. However, liquids might be present in those containers that are in the treatment process. The maximum volume of waste that can be stored in containers in the container storage area is 147,630 liters.

Because they are interconnected by floor drains, both the process area and the container storage area are considered in the containment system capacity. The volume available for secondary containment in the process area is approximately 68,000 liters, as discussed in the engineering assessment (Mausshardt 1995). Using the dimensions of the container storage area (23.6 by 8.5 by 0.2 meters), and assuming that 50 percent of the floor area is occupied by containers, the volume of the container storage area is 15,300 liters. The Truck Bay loading areas (see Figure C.4) also provides 10,500 liters of containment as it is connected to the other two areas. The combined volume of the Truck Bay loading areas and process area, and container handling area available for secondary containment, is 93,800 liters. This volume is greater than 10 percent of the maximum total volume of containers allowed for storage in the ETF, as discussed previously.

#### C.3.4.4 Control of Run-on

The container management areas are located within the ETF, which serves to prevent run-on of precipitation.

#### C.3.4.5 Removal of Liquids from Containment Systems

The container storage area is equipped with drains that route solution to a trench in the process area, which drains to sump tank 1. The sump tanks are equipped with alarms that notify operating personnel that a leak is occurring. The sump tanks also are equipped with pumps to transfer waste to the surge tank or the secondary treatment train.

#### C.3.4.6 Prevention of Ignitable, Reactive, and Incompatible Wastes in Containers

Individual waste types (i.e., ignitable, corrosive, and reactive) are stored in separate containers. A waste that could be incompatible with other wastes is separated and protected from the incompatible waste. Incompatible wastes are evaluated using the methodology documented in 40 CFR 264, Appendix V. For example, acidic and caustic wastes are stored in separate containers. Free liquids are absorbed in miscellaneous waste containers that hold incompatible waste. Additionally, ETF-specific packaging

requirements for these types of waste provide extra containment with each individual container. For example, each item of acidic waste is individually bagged and sealed within a lined container.

## C.4 TANK SYSTEMS

This section provides specific information on tank systems and process units. This section also includes a discussion on the types of waste to be managed in the tanks, tank design information, integrity assessments, and additional information on the 200 Area ETF tanks that treat and store dangerous and/or mixed waste. The 200 Area ETF dangerous waste tanks are identified in Section 4C.4.1.1, and the relative locations of the tanks and process units in the 200 Area ETF are presented in Figure C.3.

### C.4.1 Design Requirements

The following sections provide an overview of the design specifications for the tanks within the ETF. A separate discussion on the design of the process units also is provided. In accordance with the new tank system requirements of WAC 173-303-640(3), the following tank components and specifications were assessed:

- Dimensions, capacities, wall thicknesses, and pipe connections
- Materials of construction and linings and compatibility of materials with the waste being processed
- Materials of construction of foundations and structural supports
- Review of design codes and standards used in construction
- Review of structural design calculations, including seismic design basis
- Waste characteristics and the effects of waste on corrosion

This assessment was documented in the *Final RCRA Information Needs Report* (Mausshardt 1995; the engineering assessment performed for the 200 Area ETF tank systems by an independent professional engineer. A similar assessment of design requirements was performed for Load-in tanks 59A-TK-109 and -117 and is documented in *200 Area Effluent BAT/AKART Implementation, ETF Truck Load-in Facility, Project W-291H Integrity Assessment Report* (KEH 1994). An assessment was also performed when Load-in tank 59A-TK-1 was placed into service for receipt of dangerous and mixed wastes. The assessment is documented in *200 Area ETF Purgewater Unloading Facility Tank System Integrity Assessment* (HNF 2009a).

The specifications for the preparation, design, and construction of the tank systems at the 200 Area ETF are documented in the *Design Construction Specification, Project C-018H, 242-A Evaporator/PUREX Plant Process Condensate Treatment Facility* (WHC 1992a). The preparation, design, and construction of Load-in tanks 59A-TK-109 and -117 are provided in the construction specifications in *Project W-291, 200 Area Effluent BAT/AKART Implementation ETF Truck Load-in Facility* (KEH 1994). The preparation, design and construction of Load-in 59A-TK-1 are documented in *Purgewater Unloading Facility Project Documentation* (HNF 2009b).

Most of the tanks in the 200 Area ETF are constructed of stainless steel. According to the design of the ETF, it was determined stainless steel would provide adequate corrosion protection for these tanks. Exceptions include Load-in tank 59A-TK-1, which is constructed of fiberglass-reinforced plastic and the verification tanks, which are constructed of carbon steel with an epoxy coating.The 200 Area ETF evaporator/vapor body (and the internal surfaces of the thin film dryer) is constructed of a corrosion resistant alloy, known as alloy 625, to address the specific corrosion concerns in the secondary treatment train. Finally, the hydrogen peroxide decomposer vessels are constructed of carbon steel and coated with a vinyl ester lining.

The shell thicknesses of the tanks identified in Table C.5 represent a nominal thickness of a new tank when placed into operation. The tank capacities identified in this table represent the maximum volumes. Nominal tank volumes discussed below represent the maximum volume in a tank unit during normal operations.

### C.4.1.1 Codes and Standards for Tank System Construction

Specific standards for the manufacture of tanks and process systems installed in the 200 Area ETF are briefly discussed in the following sections. In addition to these codes and industrial standards, a seismic analysis for each tank and process system is required [WAC 173-303-806(4)(a)(xi)]. The seismic analysis was performed in accordance with UCRL-15910 *Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards*, Section 4 (UCRL 1987). The results of the seismic analyses are summarized in the engineering assessment of the 200 Area ETF tank systems (Mausshardt 1995).

**Storage and Treatment Tanks.** The following tanks store and/or treat dangerous waste at the ETF.

| Tank name | Tank number |
|---|---|
| Surge tank | 2025E-60A-TK-1 |
| pH adjustment tank | 2025E-60C-TK-1 |
| Effluent pH adjustment tank | 2025E-60C-TK-2 |
| First RO feed tank | 2025E-60F-TK-1 |
| Second RO feed tank | 2025E-60F-TK-2 |
| Verification tanks (three) | 2025E-60H-TK-1A/1B/1C |
| Secondary waste receiving tanks (two) | 2025E-60I-TK-1A/1B |
| Evaporator (vapor body) | 2025E-601-EV-1 |
| Concentrate tanks (two) | 2025E-60J-TK-1A/1B |
| Sump tanks (two) | 2025E-20B-TK-1/2 |
| Distillate flash tank | 2025E-60I-TK-2 |
| Load-in tanks | 2025ED-59A-TK-1/109/117 |

The relative location of these tanks is presented in Figure C.3. These tanks are maintained at or near atmospheric pressure. The codes and standards applicable to the design, construction, and testing of the above tanks and ancillary piping systems are as follows:

ASME - B31.3 Chemical Plant and Petroleum Refinery Piping (ASME 1990)

ASME Sect. VIII, Division I Pressure Vessels (ASME 1992a)

AWS - D1.1 Structural Welding Code - Steel (AWS 1992)

ANSI - B16.5 Pipe Flanges and Flanged Fittings (ANSI 1992)

ASME Sect. IX Welding and Brazing Qualifications (ASME 1992b)

API 620 Design and Construction of Large Welded Low Pressure Storage Tanks (API 1990)

AWWA - D100 Welded Steel Tanks for Water Storage (AWWA 1989)

AWWA - D103 Factory-Coated Bolted Steel Tanks for Water Storage (AWWA 1987)

AWWA - D120 Thermosetting Fiberglass-Reinforced Plastic Tanks (AWWA 1984)

ASTM-D3299 Filament Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion Resistant Tanks.

The application of these standards to the construction of 200 Area ETF tanks and independent verification of completed systems ensured that the tank and tank supports had sufficient structural strength and that seams and connections were adequate to ensure tank integrity. In addition, each tank met strict quality assurance requirements. Each tank constructed offsite was tested for integrity and leak tightness before shipment to the Hanford Facility. Following installation, the systems were inspected for damage to ensure against leakage and to verify proper operation. If a tank was damaged during shipment or installation, leak tightness testing was repeated onsite.

### C.4.1.2 Design Information for Tanks Located Outside of Effluent Treatment Facility

The load-in tanks, surge tank, and verification tanks are located outside the ETF. These tanks are located within concrete structures that provide secondary containment.

**Load-In Tanks and Ancillary Equipment.** The load-in tanks 59A-TK-109 and -117are heated and constructed of stainless steel, and have a nominal capacity of 31,000 liters. Load-in tank 59A-TK-1 is heated and constructed of fiberglass reinforced plastic and has a nominal capacity of 24,500 liters. Load-in tanks 59A-TK-109 and -117 are located outside of the metal building while Load-in tank 59A-TK-1 is located inside the building. Ancillary equipment includes transfer pumps, filtration systems, a double encased, fiberglass transfer pipeline, level instruments for tanker trucks, and leak detection equipment. From the Load-In Station, aqueous waste can be routed to the surge tank or to the LERF through a double-encased line. The load-in tanks, sump, pumps, and truck pad are all provided with secondary containment.

**Surge Tank and Ancillary Equipment.** The surge tank is constructed of stainless steel and has a nominal capacity of 421,000 liters. Ancillary equipment to the surge tank includes two underground double encased (i.e., pipe-within-a-pipe) transfer lines connecting to LERF and three pumps for transferring aqueous waste to the primary treatment train. The surge tank is located at the south end of the ETF. The surge tank is insulated and the contents heated to prevent freezing. Eductors in the tank provide mixing.

**Verification Tanks and Ancillary Equipment.** The verification tanks are located north of the ETF. The verification tanks have a nominal capacity of 2,760,000 liters each. For support, the tanks have a center post with a webbing of beams that extend from the center post to the sides of the tank. The roof is constructed of epoxy covered carbon steel that is attached to the cross beams of the webbing. The tank floor also is constructed of epoxy covered carbon steel and is sloped. Eductors are installed in each tank to provide mixing.

Ancillary equipment includes a return pump that provides circulation of treated effluent through the eductors. The return pump also recycles effluent back to the 200 Area ETF for retreatment and can provide service water for 200 Area ETF functions. Two transfer pumps are used to discharge treated effluent to SALDS or back to the LERF.

### C.4.1.3 Design Information for Tanks Located Inside the Effluent Treatment Facility Building

Most of the 200 Area ETF tanks and ancillary equipment that store or treat dangerous and/or mixed waste are located within the ETF. The structure serves as secondary containment for the tank systems.

**pH Adjustment Tank and Ancillary Equipment.** The pH adjustment tank has a nominal capacity of 16,000 liters. Ancillary equipment for this tank includes overflow lines to a sump tank and pumps to transfer waste to other units in the main treatment train.

**Effluent pH Adjustment Tank and Ancillary Equipment.** The effluent pH adjustment tank has a nominal capacity of 13,700 liters. Ancillary equipment includes overflow lines to a sump tank and pumps to transfer waste to the verification tanks.

**First and Second Reverse Osmosis Feed Tanks and Ancillary Equipment.** The first RO feed tank is a vertical, stainless steel tank with a round bottom and has a nominal capacity of 19,700 liters. Conversely, the second RO feed tank is a rectangular vessel with the bottom of the tank sloping sharply to a single outlet in the bottom center. The second RO feed tank has a nominal capacity of 7,800 liters. Each RO tank has a pump to transfer waste to the RO arrays. Overflow lines are routed to a sump tank.

**Secondary Waste Receiving Tanks and Ancillary Equipment.** Two nominal 69,000-liter secondary waste receiving tanks collect waste from the units in the main treatment train, such as concentrate solution (retentate) from the RO units and regeneration solution from the IX columns. These are vertical,

cylindrical tanks with a semi-elliptical bottom and a flat top. Ancillary equipment includes overflow lines to a sump tank and pumps to transfer aqueous waste to the 200 Area ETF evaporator.

**Effluent Treatment Facility Evaporator and Ancillary Equipment.** The 200 Area ETF evaporator, the principal component of the evaporation process, is a cylindrical pressure vessel with a conical bottom. Aqueous waste is fed into the lower portion of the vessel. The top of the vessel is domed and the vapor outlet is configured to prevent carryover of liquid during the foaming or bumping (violent boiling) at the liquid surface. The 200 Area ETF evaporator has a nominal operating capacity of approximately 18,500 liters.

The 200 Area ETF evaporator includes the following ancillary equipment:

- Preheater
- Recirculation pump
- Waste heater with steam level control tank
- Concentrate transfer pump
- Entrainment separator
- Vapor compressor with silencers
- Silencer drain pump.

**Distillate Flash Tank and Ancillary Equipment**. The distillate flash tank is a horizontal tank that has a nominal operating capacity of 780 liters. Ancillary equipment includes a pump to transfer the distillate to the surge tank for reprocessing.

**Concentrate Tanks and Ancillary Equipment.** Each of the two concentrate tanks has an approximate nominal capacity of 22,700 liters. Ancillary equipment includes overflow lines to a sump tank and pumps for recirculation and transfer.

**Sump Tanks.** Sump tanks 1 and 2 are located below floor level. Both sump tanks are double-walled, rectangular tanks, placed inside concrete vaults. Both tanks have a working volume of 4,000 liters each. The sump tanks are located in pits below grade to allow gravity drain of solutions to the tanks. Each sump tank has two vertical pumps for transfer of waste to the secondary waste receiving tanks or to the surge tank for reprocessing.

### C.4.1.4 Design Information for Effluent Treatment Facility Process Units

As with the 200 Area ETF tanks, process units that treat and/or store dangerous and/or mixed waste are maintained at or near atmospheric pressure. These units were constructed to meet a series of design standards, as discussed in the following sections. Table C.6 presents the materials of construction and the ancillary equipment associated with these process units. All piping systems are designed to withstand the effects of internal pressure, weight, thermal expansion and contraction, and any pulsating flow. The design and integrity of these units are presented in the engineering assessment (Mausshardt 1995).

**Filters**. The load-in fine and rough filter vessels (including the influent and auxiliary filters) are designed to comply with the ASME Section VIII, Division I, Pressure Vessels (ASME 1992a). The application of these standards to the construction of the 200 Area ETF filter system and independent inspection ensure that the filter and filter supports have sufficient structural strength and that the seams and connections are adequate to ensure the integrity of the filter vessels.

**Ultraviolet Oxidation System.** The UV/OX reaction chamber is designed to comply with manufacturers standards.

**Degasification System.** The codes and standards applicable to the design, fabrication, and testing of the degasification column are identified as follows:

- ASME - B31.3, Chemical Plant and Petroleum Refinery Piping (ASME 1990)
- AWS - D1.1, Structural Welding Code - Steel (AWS 1992)
- ANSI - B16.5, Pipe Flanges and Flanged Fittings (ANSI 1992)

**Reverse Osmosis System.** The pressure vessels in the RO unit are designed to comply with ASME Section VIII, Division I, Pressure Vessels (ASME 1992a), and applicable codes and standards.

**Ion Exchange (Polishers).** The IX columns are designed in accordance with ASME Section VIII, Division I, Pressure Vessels (ASME 1992a), and applicable codes and standards. Polisher piping is fabricated of type 304 stainless steel or polyvinyl chloride (PVC) and meets the requirements of ASME B31.3, Chemical Plant and Petroleum Refinery Piping (ASME 1990).

**Effluent Treatment Facility Evaporator.** The 200 Area ETF evaporator is designed to meet the requirements of ASME Section VIII, Division I, Pressure Vessels (ASME 1992a), and applicable codes and standards. The 200 Area ETF evaporator piping meets the requirements of ASME B31.3, Chemical Plant and Petroleum Refinery Piping (ASME 1990).

**Thin Film Dryer System.** The thin film dryer is designed to meet the requirements of ASME Section VIII, Division I, Pressure Vessels (ASME 1992a), and applicable codes and standards. The piping meets the requirements of ASME - B31.3, Chemical Plant and Petroleum Refinery Piping (ASME 1990).

### C.4.1.5 Integrity Assessments.

The integrity assessment for 200 Area ETF (Mausshardt 1995) attests to the adequacy of design and integrity of the tanks and ancillary equipment to ensure that the tanks and ancillary equipment will not collapse, rupture, or fail over the intended life considering intended uses. For the load-in tanks, a similar integrity assessment was performed (KEH 1995 and HNF 2009a). Specifically, the assessment documents the following considerations:

- Adequacy of the standards used during design and construction of the facility
- Characteristics of the solution in each tank
- Adequacy of the materials of construction to provide corrosion protection from the solution in each tank
- Results of the leak tests and visual inspections

The results of these assessments demonstrate that tanks and ancillary equipment have sufficient structural integrity and are acceptable for storing and treating dangerous and/or mixed waste. The assessments also state that the tanks and building were designed and constructed to withstand a design-basis earthquake. Independent, qualified registered professional engineers certified these tank assessments.

The scope of the 200 Area ETF tank integrity assessment was based on characterization data from process condensate. To assess the effect that other aqueous waste might have on the integrity of the 200 Area ETF tanks, the chemistry of an aqueous waste will be evaluated for its potential to corrode a tank (e.g., chloride concentrations will be evaluated). The tank integrity assessment for the load-in tanks was based on characterization data from several aqueous waste streams. The chemistry of an aqueous waste stream not considered in the load-in tank integrity assessment also will be evaluated for the potential to corrode a load-in tank.

Consistent with the recommendations of the integrity assessment, a corrosion inspection program was developed. Periodic integrity assessments are scheduled for those tanks predicted to have the highest potential for corrosion. These inspections are scheduled annually or longer, based on age of the tank system, materials of construction, characteristics of the waste, operating experience, and recommendations of the initial integrity assessment. These 'indicator tanks' include the concentrate tanks, secondary waste receiving tanks, and verification tanks. One of each of these tanks will be inspected yearly to determine if corrosion or coating failure has occurred. Should significant corrosion or coating failure be found, an additional tank of the same type would be inspected during the same year. In the case of the verification tanks, if corrosion or coating failure is found in the second tank, the third tank also will be inspected. If significant corrosion were observed in all three sets of tanks, the balance of the

200 Area ETF tanks would be considered for inspection. For tanks predicted to have lower potential for corrosion, inspections also are performed nonroutinely as part of the corrective maintenance program.

### C.4.2 Additional Requirements for New Tanks

Procedures for proper installation of tanks, tank supports, piping, concrete, etc., are included in *Construction Specification, Project C-018H, 242-A Evaporator/PUREX Plant Process Condensate Treatment Facility* (WHC 1992a). For the load-in tanks, procedures are included in the construction specifications in *Project W-291, 200 Area Effluent BAT/AKART Implementation ETF Truck Load-in Facility* (KEH 1994) and Purgewater Unloading Facility Project Documentation (HNF 2009b). Following installation, an independent, qualified, registered professional engineer inspected the tanks and secondary containment. Deficiencies identified included damage to the surge tank, damage to the verification tank liners, and 200 Area ETF secondary containment concrete surface cracking. All deficiencies were repaired to the satisfaction of the engineer. The tanks and ancillary equipment were leak tested as part of acceptance of the system from the construction contractor. Information on the inspections and leak tests are included in the engineering assessment (Mausshardt 1995). No deficiencies were identified during installation of the load-in tanks and ancillary equipment.

### C.4.3 Secondary Containment and Release Detection for Tank Systems

This section describes the design and operation of secondary containment and leak detection systems at the ETF.

#### C.4.3.1 Secondary Containment Requirements for All Tank Systems

The specifications for the preparation, design, and construction of the secondary containment systems at the 200 Area ETF are documented (WHC 1992a). The preparation, design, and construction of the secondary containment for the load-in tanks are provided in the construction specifications (KEH 1994 and HNF 2009b). All systems were designed to national codes and standards. Constructing the 200 Area ETF per these specifications ensured that foundations are capable of supporting tank and secondary containment systems and that uneven settling and failures from pressure gradients should not occur.

##### C.4.3.1.1 Common Elements

The following text describes elements of secondary containment that are common to all 200 Area ETF tank systems. Details on the secondary containment for specific tanks, including leak detection systems and liquids removal, are provided in Section 4C.4.4.1.2.

**Foundation and Construction.** For the tanks within the ETF, except for the sump tanks, secondary containment is provided by a coated concrete floor and a 15.2-centimeter rise (berm) along the containing walls. The double-wall construction of the sump tanks provides secondary containment. Additionally, trenches are provided in the floor that also provides containment and drainage of any liquid to a sump pit. For tanks outside the ETF, secondary containment also is provided with coated concrete floors in a containment pit (load-in tanks) or surrounded by concrete dikes (the surge and verification tanks).

The transfer piping that carries aqueous waste into the 200 Area ETF is pipe-within-a-pipe construction, and is buried approximately 1.2 meters below ground surface. The pipes between the verification tanks and the verification tank pumps within the 200 Area ETF are located in a concrete pipe trench.

For this discussion, there are five discrete secondary containment systems associated with the following tanks and ancillary equipment that treat or store dangerous waste:

- Load-in tanks
- Surge tank
- Process area (including sump tanks)
- Verification tanks
- Transfer piping and pipe trenches

All of the secondary containment systems are designed with reinforcing steel and base and berm thickness to minimize failure caused by pressure gradients, physical contact with the waste, and climatic conditions. Classical theories of structural analysis, soil mechanics, and concrete and structural steel design were used in the design calculations for the foundations and structures. These calculations are maintained at the ETF. In each of the analyses, the major design criteria from the following documents were included:

| | |
|---|---|
| V-C018HC1-001 | Design Construction Specification, Project C-018H, 242A Evaporator/PUREX Plant Process Condensate Treatment Facility (WHC 1992a) |
| DOE Order 6430.1A | General Design Criteria |
| SDC-4.1 | Standard Architectural-Civil Design Criteria, Design Loads for Facilities (DOE-RL 1988) |
| UCRL-15910 | Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards (UCRL 1987) |
| UBC-91 | Uniform Building Code, 1991 Edition (ICBO 1991) |
| UBC-97 | Uniform Building Code, 1997 Edition (ICC 1997, for Load-in tank 59A-TK-1) |

The design and structural analysis calculations substantiate the structural designs in the referenced drawings. The conclusions drawn from these calculations indicate that the designs are sound and that the specified structural design criteria were met. This conclusion is verified in the independent design review that was part of the engineering assessment (Mausshardt 1995, KEH 1994, and HNF 2009a).

**Containment Materials**. The concrete floor consists of cast-in-place and preformed concrete slabs. All slab joints and floor and wall joints have water stops installed at the mid-depth of the slab. In addition, filler was applied to each joint.

Except for the sump tank vaults, all of the concrete surfaces in the secondary containment system, including berms, trenches, and pits, are coated with a chemical-resistant, high-solids, epoxy coating that consists of a primer and a top coating. This coating material is compatible with the waste being treated, and with the sulfuric acid, sodium hydroxide, and hydrogen peroxide additives to the process. The coating protects the concrete from contact with any chemical materials that might be harmful to concrete and prevents the concrete from being in contact with waste material. Table C.8 summarizes the specific types of primer and top coats specified for the concrete and masonry surfaces in the ETF. The epoxy coating is considered integral to the secondary containment system for the tanks and ancillary equipment.

The concrete containment systems are maintained such that any cracks, gaps, holes, and other imperfections are repaired in a timely manner. Thus, the concrete containment systems do not allow spilled liquid to reach soil or groundwater. There are a number of personnel doorways and vehicle access points into the 200 Area ETF process areas. Releases of any spilled or leaked material to the environment from these access points are prevented by 15.2-centimeter concrete curbs, sloped areas of the floor (e.g., truck ramp), or trenches.

**Containment Capacity and Maintenance.** Each of these containment areas is designed to contain more than 100 percent of the volume of the largest tank in each respective system. Secondary containment systems for the surge tank, and the verification tanks, which are outside the ETF, also are large enough to include the additional volume from a 25-year, 24-hour storm event; i.e., 5.3 centimeters of precipitation.

**Sprinkler System.** The sprinkler system within the 200 Area ETF supplies firewater protection to the process area and the container storage area. This system is connected to a site wide water supply system and has the capacity to supply sufficient water to suppress a fire at the ETF. However, in the event of failure, the sprinkler system can be hooked up to another water source (e.g., tanker truck).

#### C.4.3.1.2 Specific Containment Systems

The following discussion presents a description of the individual containment systems associated with specific tank systems.

**Load-In Tank Secondary Containment.** The load-in tanks 59A-TK-109 and -117 are mounted on a 46-centimeter-thick reinforced concrete slab (Drawing H-2-817970). Secondary containment is provided by a pit with 30.5-centimeter-thick walls and a floor constructed of reinforced concrete. The load-in tank pit is sloped to drain solution to a sump. The depth of the pit varies with the slope of the floor, with an average thickness of about 1.1 meters. The volume of the secondary containment is about 73,000 liters, which is capable of containing the volume of at least one load-in tank (i.e., 34,200 liters). Leaks are detected by a leak detector that alarms locally, in the 200 Area ETF control room, and by visual inspection of the secondary containment.

Adjacent to the pit is a 25.4-centimeter-thick reinforced concrete pad that serves as secondary containment for the load-in tanker trucks, containers, transfer pumps, and filter system that serve as the first tanker truck unloading bay. The pad is inside the metal Load-in building and is 15.2 centimeters below grade with north and south walls gently sloped to allow truck access. The pad has a 3-inch drain pipe to route waste solution to the adjacent load-in tank pit. The pad does not have protective coating because it would experience excessive wear from the vehicle traffic.

Load-in tank 59A-TK-1 is located on a 25.4-centimeter-thick reinforced concrete slab (Drawing H-2-817970) inside the metal Load-in building. The tank has a flat bottom which sits on a concrete slab in the secondary containment. Secondary containment for the tank, filter system, and truck unloading piping is provided by an epoxy coated catch basin with a capacity of about 3,400 liters. The catch basin is sloped to route solution from the catch basin through a 15.2-centimeter-wide by 14.3-centimeter-deep trench to the adjacent truck unloading pad. This pad drains to the Load-in tank pit discussed above. The volume of the combined secondary containment of these two systems is greater than 76,400 liters, which is capable of holding the volume of tank 59A-TK-1 (i.e., 26,000 liters).

Adjacent to tank 59A-TK-1 catch basin is a 25.4-centimeter-thick reinforced concrete pad that serves as the second tanker truck unloading bay. The pad is inside the metal Load-in building and has a 2.4-meter by 4.0-meter shallow, sloping pit to catch leaks during tanker truck unloading. The pit has a maximum depth of 6.0 centimeters and a 15.2-centimeter-wide by 6.0-centimeter-deep trench to route leaks to the adjacent tank 59A-TK-1 catch basin. The pad does not have protective coating because it would experience excessive wear from the vehicle traffic.

**Surge Tank Secondary Containment.** The surge tank is mounted on a reinforced concrete ringwall. Inside the ringwall, the flat-bottomed tank is supported by a bed of compacted sand and gravel with a high-density polyethylene liner bonded to the ringwall. The liner prevents galvanic corrosion between the soil and the tank. The secondary containment is reinforced concrete with a 15.2-centimeter thick floor and a 20.3-centimeter thick dike. The secondary containment area shares part of the southern wall of the main process area. The dike extends up 2.9 meters to provide a containment volume of 856,000 liters for the 462,000-liter surge tank.

The floor of the secondary containment slopes to a sump in the northwest corner of the containment area. Leaks into the secondary containment are detected by level instrumentation in the sump, which alarms in the 200 Area ETF control room, and/or by routine visual inspections. A sump pump is used to transfer solution in the secondary containment to a sump tank.

**Process Area Secondary Containment.** The process area contains the tanks and ancillary equipment of the primary and secondary treatment trains, and has a jointed, reinforced concrete slab floor. The concrete floor of the process area provides the secondary containment. This floor is a minimum of 15.2 centimeters thick. With doorsills 15.2 centimeter high, the process area has a containment volume of approximately 93,800 liters. The largest tanks in the process area are the secondary waste receiving tanks, which each have a maximum capacity of 73,800 liters.

The floor of the process area is sloped to drain liquids to two trenches that drain to a sump. Each trench is approximately 38.1 centimeters wide with a sloped trough varying from 39.4 to 76.2 centimeters deep. Leaks into the secondary containment are detected by routine visual inspections of the floor area near the tanks, ancillary equipment, and in the trenches.

A small dam was placed in the trench that comes from the thin film dryer room to contain minor liquid spills originating in the dryer room to minimize the spread of contamination into the process area. The dryer room is inspected for leaks in accordance with the inspection schedule in Addendum I. Operators clean up these minor spills by removing the liquid waste and decontaminating the spill area.

A small dam was also placed in the trench adjacent to the chemical feed skid when the chemical berm area was expanded to accommodate acid and caustic pumps, which were moved indoors from the top of the surge tank to resolve a safety concern. This dam was designed to contain minor spills originating in the chemical berm area and prevent them from entering the process sump.

The northwest corner of the process area consists of a pump pit containing the pumps and piping for transferring treated effluent from the verification tanks to SALDS. The pit is built 1.37 meters below the process area floor level and is sloped to drain to a trench built along its north wall that routes liquid to sump tank 1. Leaks into the secondary containment of the pump pit are detected by routine visual inspections.

**Sump Tanks.** The sump tanks support the secondary containment system, and collect waste from several sources, including:

- Process area drain trenches
- Tank overflows and drains
- Container washing water
- Resin dewatering solution
- Steam boiler blow down
- Sampler system drains.

These double-contained tanks are located within unlined, concrete vaults. The sump tank levels are monitored by remote level indicators or through visual inspections from the sump covers. These indicators are connected to high- and low-level alarms that are monitored in the control room. When a high-level alarm is activated, a pump is activated and the sump tank contents usually are routed to the secondary treatment train for processing. The contents also could be routed to the surge tank for treatment in the primary treatment train. In the event of an abnormally high inflow rate, a second sump pump is initiated automatically.

**Verification Tank Secondary Containment.** The three verification tanks are each mounted on ringwalls with high-density polyethylene liners similar to the surge tank. The secondary containment for the three tanks is reinforced concrete with a 15.2-centimeter thick floor and a 20.3-centimeter thick dike. The dike extends up 2.6 meters to provide a containment of approximately 3,390,000 liters exceeding the capacity of a single verification tank (See Table C.5).

The floor of the secondary containment slopes to a sump along the southern wall of the dike. Leaks into the secondary containment are detected by level instrumentation in the sump that alarms in the control room and/or by routine visual inspections. A sump pump is used to transfer solution in the secondary containment to a sump tank.

### C.4.3.2 Additional Requirements for Specific Types of Systems

This section addresses additional requirements in WAC 173-303-640 for double-walled tanks like the sump tanks and secondary containment for ancillary equipment and piping associated with the tank systems.

#### C.4.3.2.1 Double-Walled Tanks

The sump tanks are the only tanks in the 200 Area ETF classified as 'double-walled' tanks. These tanks are located in unlined concrete vaults and support the secondary containment system for the process area. The sump tanks are equipped with a leak detector between the walls of the tanks that provide continuous monitoring for leaks. The leak detector provides immediate notification through an alarm in the control room. The inner tanks are contained completely within the outer shells. The tanks are contained

completely within the concrete structure of the 200 Area ETF so corrosion protection from external galvanic corrosion is not necessary.

#### C.4.3.2.2 Ancillary Equipment

The secondary containment provided for the tanks and process systems also serves as secondary containment for the ancillary equipment associated with these systems.

**Ancillary Equipment.** Section D.4.3.1.2 describes the secondary containment systems that also serve most of the ancillary equipment within the 200 Area ETF. Between the 200 Area ETF and the verification tanks, a pipeline trench provides secondary containment for four pipelines connecting the transfer pumps (i.e., discharge and return pumps) in the 200 Area ETF with the verification tanks (Figure C.2). This concrete trench crosses under the road and extends from the verification tank pumps to the verification tanks. Treated effluent flows through these pipelines from the verification tank pumps to the verification tanks. The return pump is used to return effluent to the 200 Area ETF for use as service water or for reprocessing.

For all of the ancillary equipment housed within the ETF, the concrete floor, trenches, and berms form the secondary containment system. For the ancillary equipment of the surge tank and the verification tanks, secondary containment is provided by the concrete floors and dikes associated with these tanks. The concrete floor and pit provide secondary containment for the ancillary equipment of the load-in tanks.

**Transfer Piping and Pipe Trenches.** The two buried transfer lines between LERF and the surge tank have secondary containment in a pipe-within-a-pipe arrangement. The 4-inch transfer line has an 8-inch outer pipe, while the 3-inch transfer, line has a 6-inch outer pipe. The pipes are fiberglass and are sloped towards the surge tank. The outer piping ends with a drain valve in the surge tank secondary containment.

These pipelines are equipped with leak detection located in the annulus between the inner and outer pipes; the leak detection equipment can continuously 'inspect' the pipelines during aqueous waste transfers. The alarms on the leak detection system are monitored in the control room. A low-volume air purge of the annulus is provided to prevent condensation buildup and minimize false alarms by the leak detection system. In the event that these leak detectors are not in service, the pipelines are inspected during transfers by opening a drain valve to check for solution in the annular space between the inner and outer pipe.

The 3-inch transfer line between the load-in tanks and the surge tank has a 6-inch outer pipe in a pipe-within-a-pipe arrangement. The piping is made of fiberglass-reinforced plastic and slopes towards the load-in tank secondary containment pit. The drain valve and leak detection system for the load-in tank pipelines are operated similarly to the leak detection system for the LERF to 200 Area ETF pipelines.

As previously indicated, a reinforced concrete pipe trench provides secondary containment for piping under the roadway between the 200 Area ETF and the verification tanks. Three 15.2 centimeter thick reinforced concrete partitions divide the trench into four portions and support metal gratings over the trench. Each portion of the trench is 1.2 meters wide, 0.76 meter deep, and slopes To route any solution present to 4-inch drain lines through the north wall of the ETF building. These drain lines route solution to sump tank 2 in ETF. The floor of the pipe trench is 30.5 centimeters thick and the sides are 15.2 centimeters thick. The concrete trenches are coated with water sealant and covered with metal gratings at ground level to allow vehicle traffic on the roadway.

### C.4.4 Tank Management Practices

When an aqueous waste stream is identified for treatment or storage at 200 Area ETF, the generating unit is required to characterize the waste. Based on characterization data, the waste stream is evaluated to determine if the stream is acceptable for treatment or storage. Specific tank management practices are discussed in the following sections.

#### C.4.4.1 Rupture, Leakage, Corrosion Prevention

Most aqueous waste streams can be managed such that corrosion would not be a concern. For example, an aqueous waste stream with high concentrations of chloride might cause corrosion problems when concentrated in the secondary treatment train. One approach is to adjust the corrosion control measures in the secondary treatment train. An alternative might be to blend this aqueous waste in a LERF basin with another aqueous waste that has sufficient dissolved solids, such that the concentration of the chlorides in the secondary treatment train would not pose a corrosion concern.

Additionally, the materials of construction used in the tanks systems (Table C.5) make it unlikely that an aqueous waste would corrode a tank. For more information on corrosion prevention, refer to Addendum B, Waste Analysis Plan.

If operating experience suggests that most aqueous waste streams can be managed such that corrosion would not be a concern, operating practices and integrity assessment schedules and requirements will be reviewed and modified as appropriate.

When a leak in a tank system is discovered, the leak is immediately contained or stopped by isolating the leaking component. Following containment, the requirements of WAC 173-303-640(7), incorporated by reference, are followed. These requirements include repair or closure of the tank/tank system component, and certification of any major repairs.

#### C.4.4.2 Overfilling Prevention

Operating practices and administrative controls used at the 200 Area ETF to prevent overfilling a tank are discussed in the following paragraphs. The 200 Area ETF process is controlled by the MCS. The MCS monitors liquid levels in the 200 Area ETF tanks and has alarms that annunciate on high-liquid level to notify operators that actions must be taken to prevent overfilling of these vessels. As an additional precaution to prevent spills, many tanks are equipped with overflow lines that route solutions to sump tanks 1 and 2. These tanks include the pH adjustment tank; RO feed tanks, effluent pH adjustment tank, secondary waste receiving tanks, and concentrate tanks.

The following section discusses feed systems, safety cutoff devices, bypass systems, and pressure controls for specific tanks and process systems.

**Tanks.** All tanks are equipped with liquid level sensors that give a reading of the tank liquid volume. All of the tanks are equipped further with liquid level alarms that are actuated if the liquid volume is near the tank overflow capacity. In the actuation of the surge tank alarm, a liquid level switch trips, sending a signal to the valve actuator on the tank influent lines, and causing the influent valves to close.

The operating mode for each verification tank, i.e., receiving, holding, or discharging, can be designated through the MCS; modes also switch automatically. When the high-level set point on the receiving verification tank is reached, the flow to this tank is diverted and another tank becomes the receiver. The full tank is switched into verification mode. The third tank is reserved for discharge mode.

The liquid levels in the pH adjustment, first and second RO feed, and effluent pH adjustment tanks are maintained within predetermined operating ranges. Should any of these tanks overflow, the excess waste is piped along with any leakage from the feed pumps to a sump tank.

When waste in a secondary waste-receiving tank reaches the high-level set point, the influent flow of waste is redirected to the second tank. In a similar fashion, the concentrate tanks switch receipt modes when the high-level set point of one tank is reached.

**Filter Systems.** All filters at 200 Area ETF (i.e., the Load-In Station, rough, fine, and auxiliary filter systems) are in leak-tight steel casings. For the rough and fine filters, a high differential pressure, which could damage the filter element, activates a valve that shuts off liquid flow to protect the filter element from possible damage. To prevent a high-pressure situation, the filters are cleaned routinely with pulses of compressed air that force water back through the filter. Cleaning is terminated automatically by shutting off the compressed air supply if high pressure develops. The differential pressure across the

auxiliary filters also is monitored. A high differential pressure in these filters would result in a system shutdown to allow the filters to be changed out.

The Load-In Station filtration system has pressure gauges for monitoring the differential pressure across each filter. A high differential pressure would result in discontinuing filter operation until the filter is replaced.

**Ultraviolet Light/Oxidation System and Decomposers.** A rupture disk on the inlet piping to each of the UV/OX reaction vessels relieves to the pH adjustment tank in the event of excessive pressure developing in the piping system. Should the rupture disk fail, the aqueous waste would trip the moisture sensor, shut down the UV lamps, and close the surge tank feed valve. Also provided is a level sensor to protect UV lamps against the risk of exposure to air. Should those sensors be actuated, the UV lamps would be shut down immediately.

The piping and valving for the hydrogen peroxide decomposers are configured to split the waste flow: half flows to one decomposer and half flows to the other decomposer. Alternatively, the total flow of waste can be treated in one decomposer or both decomposers can be bypassed. A safety relief valve on each decomposer vessel can relieve excess system pressure to a sump tank.

**Degasification System.** The degasification column is typically supplied aqueous waste feed by the pH adjustment tank feed pump. This pump transfers waste solution through the hydrogen peroxide decomposer, the fine filter, and the degasification column to the first RO feed tank.

The degasification column is designed for operation at a partial vacuum. A pressure sensor in the outlet of the column detects the column pressure. The vacuum in the degasification column is maintained by a blower connected to the vessel off gas system. The column is protected from extremely low pressure developed by the column blower by the use of an intake vent that is maintained in the open position during operation. The column liquid level is regulated by a flow control system with a high- and low-level alarm. Plate-type heat exchanger cools the waste solution fed to the degasification column.

**Reverse Osmosis System.** The flow through the first and second RO stages is controlled to maintain constant liquid levels in the first and second stage RO feed tanks.

**Polisher.** Typically, two of the three columns are in operation (lead/lag) and the third (regenerated) column is in standby. When the capacity of the resin in the first column is exceeded, as detected by an increase in the conductivity of the column effluent, the third column, containing freshly regenerated IX resin, is brought online. The first column is taken offline, and the waste is rerouted to the second column, and to the third. Liquid level instrumentation and automatically operated valves are provided in the IX system to prevent overfilling.

**Effluent Treatment Facility Evaporator.** Liquid level instrumentation in the secondary waste receiving tanks is designed to preclude a tank overflow. A liquid level switch actuated by a high-tank liquid level causes the valves to reposition, closing off flow to the secondary waste receiving tanks. Secondary containment for these tanks routes liquids to a sump tank.

Valves in the 200 Area ETF evaporator feed line can be positioned to bypass the secondary waste around the 200 Area ETF evaporator and to transfer the secondary waste to the concentrate tanks.

**Thin Film Dryer.** The two concentrate tanks alternately feed the thin film dryer. Typically, one tank serves as a concentrate waste receiver while the other tank serves as the dryer feed tank. One tank may serve as both concentrate waste receiver and dryer feed tank. Liquid level instrumentation prevents tank overflow by diverting the concentrate flow from the full concentrate tank to the other concentrate tank. Secondary containment for these tanks routes liquids to a sump tank.

An alternate route is provided from the concentrate receiver tank to the secondary waste receiving tanks. Dilute concentrate in the concentrate receiver tank can be reprocessed through the 200 Area ETF evaporator by transferring the concentrate back to a secondary waste-receiving tank.

### C.4.5 Labels or Signs

Each tank or process unit in the 200 Area ETF is identified by a nameplate attached in a readily visible location. Included on the nameplate are the equipment number and the equipment title. Those tanks that store or treat dangerous waste at the 200 Area ETF (Section 4C.4.1.1) are identified with a label, which reads *PROCESS WATER/WASTE*. The labels are legible at a distance of at least fifty feet or as appropriate for legibility within the ETF. Additionally, these tanks bear a legend that identifies the waste in a manner, which adequately warns employees, emergency personnel, and the public of the major risk(s) associated with the waste being stored or treated in the tank system(s).

Caution plates are used to show possible hazards and warn that precautions are necessary. Caution signs have a yellow background and black panel with yellow letters and bear the word *CAUTION*. Danger signs show immediate danger and signify that special precautions are necessary. These signs are red, black, and white and bear the word *DANGER*.

Tanks and vessels containing corrosive chemicals are posted with black and white signs bearing the word *CORROSIVE*. *DANGER - UNAUTHORIZED PERSONNEL KEEP OUT* signs are posted on all exterior doors of the ETF, and on each interior door leading into the process area. Tank ancillary piping is also labeled *PROCESS WATER* or *PROCESS LIQUID* to alert personnel which pipes in the process area contains dangerous and/or mixed waste.

All tank systems holding dangerous waste are marked with labels or signs to identify the waste contained in the tanks. The labels or signs are legible at a distance of at least 50-feet and bear a legend that identifies the waste in a manner that adequately warns employees, emergency response personnel, and the public, of the major risk(s) associated with the waste being stored or treated in the tank system(s).

### C.4.6 Air Emissions

Tank systems that contain extremely hazardous waste that is acutely toxic by inhalation must be designed to prevent the escape of such vapors. To date, no extremely hazardous waste has been managed in 200 Area ETF tanks and is not anticipated. However, the 200 Area ETF tanks have forced ventilation that draws air from the tank vapor spaces to prevent exposure of operating personnel to any toxic vapors that might be present. The vapor passes through a charcoal filter and two sets of high-efficiency particulate air filters before discharge to the environment. The Load-in tanks and verification tanks are vented to the atmosphere.

### C.4.7 Management of Ignitable or Reactive Wastes in Tanks Systems

Although the 200 Area ETF is permitted to accept waste that is designated ignitable or reactive, such waste would be treated or blended immediately after placement in the tank system so that the resulting waste mixture is no longer ignitable or reactive. Aqueous waste received does not meet the definition of a combustible or flammable liquid given in National Fire Protection Association (NFPA) code number 30 (NFPA 1996). The buffer zone requirements in NFPA-30, which require tanks containing combustible or flammable solutions be a safe distance from each other and from public way, are not applicable.

### C.4.8 Management of Incompatible Wastes in Tanks Systems

The 200 Area ETF manages dilute solutions that can be mixed without compatibility issues. The 200 Area ETF is equipped with several systems that can adjust the pH of the waste for treatment activities. Sulfuric acid and sodium hydroxide are added to the process through the MCS for pH adjustment to ensure there will be no large pH fluctuations and adverse reactions in the tank systems.

## C.5 SURFACE IMPOUNDMENTS

This section provides specific information on surface impoundment operations at the LERF, including descriptions of the liners and secondary containment structures, as required by WAC 173-303-650 and WAC 173-303-806(4)(d).

The LERF consists of three lined surface impoundments (basins) with a design operating capacity of 29.5 million liters each. The maximum capacity of each basin is 34 million liters. The dimensions of each basin at the anchor wall are approximately 103 meters by 85 meters. The typical top dimensions of the wetted area are approximately 89 meters by 71 meters, while the bottom dimensions are approximately 57 by 38 meters. Total depth from the top of the dike to the bottom of the basin is approximately 7 meters. The typical finished basin bottoms lie at about 4 meters below the initial grade and 175 meters above sea level. The dikes separating the basins have a typical height of 3 meters and typical top width of 11.6 meters around the perimeter of the impoundments.

### C.5.1 List of Dangerous Waste

A list of dangerous and/or mixed aqueous waste that can be stored in LERF is presented in Addendum A. Addendum B, Waste Analysis Plan also provides a discussion of the types of waste that are managed in the LERF.

### C.5.2 Construction, Operation, and Maintenance of Liner System

General information concerning the liner system is presented in the following sections. Information regarding loads on the liner, liner coverage, UV light exposure prevention, and location relative to the water table are discussed.

#### C.5.2.1 Liner Construction Materials

The LERF employs a double-composite liner system with a leachate detection, collection, and removal system between the primary and secondary liners. Each basin is constructed with an upper or primary liner consisting of a high-density polyethylene geomembrane laid over a bentonite carpet liner. The lower or secondary liner in each basin is a composite of a geomembrane laid over a layer of soil/bentonite admixture with a hydraulic conductivity less than $10^{-7}$ centimeters per second. The synthetic liners extend up the dike wall to a concrete anchor wall that surrounds the basin at the top of the dike. A batten system bolts the layers in place to the anchor wall (Figure C.16).

Figure C.17 is a schematic cross-section of the liner system. The liner components, listed from the top to the bottom of the liner system, are the following:

- Primary 1.5-millimeter high-density polyethylene geomembrane
- Bentonite carpet liner
- Geotextile
- Drainage gravel (bottom) and geonet (sides)
- Geotextile
- Secondary 1.5-millimeter high-density polyethylene geomembrane
- Soil/bentonite admixture (91 centimeters on the bottom, 107 centimeters on the sides)
- Geotextile

The primary geomembrane, made of 1.5-millimeter high-density polyethylene, forms the basin surface that holds the aqueous waste. The secondary geomembrane, also 1.5-millimeter high-density polyethylene, forms a barrier surface for leachate that might penetrate the primary liner. The high-density polyethylene chemically is resistant to constituents in the aqueous waste and has a relatively high strength compared to other lining materials. The high-density polyethylene resin specified for the LERF contains carbon black, antioxidants, and heat stabilizers to enhance its resistance to the degrading effects of UV light. The approach to ensuring the compatibility of aqueous waste streams with the LERF liner materials and piping is discussed in Addendum B, Waste Analysis Plan.

Three geotextile layers are used in the LERF liner system. The layers are thin, nonwoven polypropylene fabric that chemically is resistant, highly permeable, and resistant to microbiological growth. The first two layers prevent fine soil particles from infiltrating and clogging the drainage layer. The second geotextile also provides limited protection for the secondary geomembrane from the drainage rock. The third geotextile layer prevents the mixing of the soil/bentonite admixture with the much more porous and granular foundation material.

A 30.5-centimeters-thick gravel drainage layer on the bottom of the basins between the primary and secondary liners provides a flow path for liquid to the leachate detection, collection, and removal system. A geonet (or drainage net) is located immediately above the secondary geomembrane on the basin sidewalls. The geonet functions as a preferential flow path for liquid between the liners, carrying liquid down to the gravel drainage layer and subsequently to the leachate sump. The geonet is a mesh made of high-density polyethylene, with approximately 13-millimeter openings.

The soil/bentonite layer is 91 centimeters thick on the bottom of the basins and 107 centimeters thick on the basin sidewalls; its permeability is less than $10^{-7}$ centimeters per second. This composite liner design, consisting of a geomembrane laid over essentially impermeable soil/bentonite, is considered best available technology for solid waste landfills and surface impoundments. The combination of synthetic and clay liners is reported in the literature to provide the maximum protection from waste migration (Forseth and Kmet 1983).

A number of laboratory tests were conducted to measure the engineering properties of the soil/bentonite admixture, in addition to extensive field tests performed on three test fills constructed near the LERF site. For establishing an optimum ratio of bentonite to soil for the soil/bentonite admixture, mixtures of various ratios were tested to determine permeability and shear strength. A mixture of 12 percent bentonite was selected for the soil/bentonite liner and tests described in the following paragraphs demonstrated that the admixture meets the desired permeability of less than 10-7 centimeters per second. Detailed discussion of test procedures and results is provided in Report of Geotechnical Investigation, 242-A Evaporation and PUREX Interim Storage Basins (Chen-Northern 1990).

Direct shear tests were performed according to ASTM D3080 test procedures (ASTM 1990) on soil/bentonite samples of various ratios. Based on these results, the conservative minimum Mohr-Coulomb shear strength value of 30 degrees was estimated for a soil/bentonite admixture containing 12 percent bentonite.

The high degree of compaction of the soil/bentonite layer [92 percent per ASTM D1557 (ASTM 1991)] was expected to maximize the bonding forces between the clay particles, thereby minimizing moisture transport through the liner. With respect to particle movement ('piping'), estimated fluid velocities in this low-permeability material are too low to move the soil particles. Therefore, piping is not considered a problem.

For the soil/bentonite layer, three test fills were constructed to demonstrate that materials, methods, and procedures used would produce a soil/bentonite liner that meets the EPA permeability requirement of less than $10^{-7}$ centimeters per second. All test fills met the EPA requirements. A thorough discussion of construction procedures, testing, and results is provided in *Report of Permeability Testing, Soil-bentonite Test Fill* (Chen-Northern 1991a).

The aqueous waste stored in the LERF is typically a dilute mixture of organic and inorganic constituents. Though isolated instances of soil liner incompatibility have been documented in the literature (Forseth and Kmet 1983), these instances have occurred with concentrated solutions that were incompatible with the geomembrane liners in which the solutions were contained. Considering the dilute nature of the aqueous waste that is and will be stored in LERF and the moderate pH, and test results demonstrating the compatibility of the high-density polyethylene liners with the aqueous waste [9090 Test Results (WHC 1991)], gross failure of the soil/bentonite layer is not probable.

Each basin also is equipped with a floating very low-density polyethylene cover. The cover is anchored and tensioned at the concrete wall at the top of the dikes, using a patented mechanical tensioning system. Figure C.16 depict the tension mechanism and the anchor wall at the perimeter of each basin. Additional information on the cover system is provided in Section C.5.2.5.

#### C.5.2.1.1 Material Specifications

Material specifications for the liner system and leachate collection system, including liners, drainage gravel, and drainage net are discussed in the following sections. Material specifications are documented

in the *Final Specifications 242-A Evaporator and PUREX Interim Retention Basins* (KEH 1990a) and *Construction Specifications for 242-A Evaporator and PUREX Interim Retention Basins* (KEH 1990b).

**Geomembrane Liners.** The high-density polyethylene resin for geomembranes for the LERF meets the material specifications listed in Table C.9. Key physical properties include thickness (1.5 millimeters [60 mil]) and impermeability (hydrostatic resistance of over 360,000 kilogram per square meter). Physical properties meet National Sanitation Foundation Standard 54 (NSF 1985). Testing to determine if the liner material is compatible with typical dilute waste solutions was performed and documented in *9090 Test Results* (WHC 1991).

**Soil/Bentonite Liner.** The soil/bentonite admixture consists of 11.5 to 14.5 percent bentonite mixed into well-graded silty sand with a maximum particle size of 4.75 millimeters (No. 4 sieve). Test fills were performed to confirm the soil/bentonite admixture applied at LERF has hydraulic conductivity less than $10^{-7}$ centimeters per second, as required by WAC 173-303-650(2)(j) for new surface impoundments.

**Bentonite Carpet Liner.** The bentonite carpet liner consists of bentonite (90 percent sodium montmorillonite clay) in a primary backing of woven polypropylene with nylon filler fiber, and a cover fabric of open weave spunlace polyester. The montmorillonite is anticipated to retard migration of solution through the liner, exhibiting a favorable cation exchange for adsorption of some constituents (such as ammonium). Based on composition of the bentonite carpet and of the type of aqueous waste stored at LERF, no chemical attack, dissolution, or degradation of the bentonite carpet liner is anticipated.

**Geotextile.** The nonwoven geotextile layers consist of long-chain polypropylene polymers containing stabilizers and inhibitors to make the filaments resistant to deterioration from UV light and heat exposure. The geotextile layers consist of continuous geotextile sheets held together by needle punching. Edges of the fabric are sealed or otherwise finished to prevent outer material from pulling away from the fabric or raveling.

**Drainage Gravel.** The drainage layer consists of thoroughly washed and screened, naturally occurring rock meeting the size specifications for Grading Number 5 in Washington State Department of Transportation construction specifications (WSDOT 1988). The specifications for the drainage layer are given in Table C.10. Hydraulic conductivity tests (Chen-Northern 1992a, 1992b, 1992c) showed the drainage rock used at LERF met the sieve requirements and had a hydraulic conductivity of at least 1 centimeter per second, which exceeded the minimum of at least 0.1 centimeters per second required by WAC 173-303-650(2)(j) for new surface impoundments.

**Geonet.** The geonet is fabricated from two sets of parallel high-density polyethylene strands, spaced 1.3 centimeters center-to-center maximum to form a mesh with minimum two strands per 2.54 centimeter in each direction. The geonet is located between the liners on the sloping sidewalls to provide a preferential flow path for leachate to the drainage gravel and subsequently to the leachate sump.

**Leachate Collection Sump.** Materials used to line the 3.0-meter by 1.8-meter by 0.30-meter-deep leachate sump, at the bottom of each basin in the northwest corner, include [from top to bottom (Figure C.18)]:

- 25 millimeter high-density polyethylene flat stock (supporting the leachate riser pipe)
- Geotextile
- 1.5-millimeter high-density polyethylene rub sheet
- Secondary composite liner:
  - 1.5-millimeter high-density polyethylene geomembrane
  - 91 centimeters of soil/bentonite admixture
  - Geotextile

Specifications for these materials are identical to those discussed previously.

**Leachate System Risers.** Risers for the leachate system consist of 10-inch and 4-inch pipes from the leachate collection sump to the catch basin northwest of each basin (Figure C.18). The risers lay below

the primary liner in a gravel-filled trench that also extends from the sump to the concrete catch basin (Figure C.19).

The risers are high-density polyethylene pipes fabricated to meet the requirements in ASTM D1248 (ASTM 1989). The 10-inch riser is perforated every 20.3 centimeters with 1.3-centimeter holes around the diameter. Level sensors and leachate pump are inserted in the 10-inch riser to monitor and remove leachate from the sump. To prevent clogging of the pump and piping with fine particulate, the end of the riser is encased in a gravel-filled box constructed of high-density polyethylene geonet and wrapped in geotextile. The 4-inch riser is perforated every 10.2 centimeters with 0.64-centimeter holes around the diameter. A level detector is inserted in the 4-inch riser.

**Leachate Pump.** A deep-well submersible pump, designed to deliver approximately 110 liters per minute, is installed in the 10-inch leachate riser in each basin. Wetted parts of the leachate pump are made of 316L stainless steel, providing both corrosion resistance and durability.

#### C.5.2.1.2 Loads on Liner System

The LERF liner system is subjected to the following types of stresses.

**Stresses from Installation or Construction Operations.** Contractors were required to submit construction quality control plans that included procedures, techniques, tools, and equipment used for the construction and care of liner and leachate system. Methods for installation of all components were screened to ensure that the stresses on the liner system were kept to a minimum.

Calculations were performed to estimate the risk of damage to the secondary high-density polyethylene liner during construction (*Calculations for LERF Part B Permit Application* [HNF 1997]). The greatest risk expected was from spreading the gravel layer over the geotextile layer and secondary geomembrane. The results of the calculations show that the strength of the geotextile was sufficiently high to withstand the stress of a small gravel spreader driving on a minimum of 15 centimeters of gravel over the geotextile and geomembrane. The likelihood of damage to the geomembrane lying under the geotextile was considered low.

To avoid driving heavy machinery directly on the secondary liner, a 28-meter conveyer was used to deliver the drainage gravel into the basins. The gravel was spread and consolidated by hand tools and a bulldozer. The bulldozer traveled on a minimum thickness of 30.5 centimeters of gravel. Where the conveyer assembly was placed on top of the liner, cribbing was placed to distribute the conveyer weight. No heavy equipment was allowed for use directly in contact with the geomembranes.

Additional calculations were performed to estimate the ability of the leachate riser pipe to withstand the static and dynamic loading imposed by lightweight construction equipment riding on the gravel layer (HNF 1997). Those calculations demonstrated that the pipe could buckle under the dynamic loading of small construction equipment; therefore, the pipe was avoided by equipment during spreading of the drainage gravel.

Installation of synthetic lining materials proceeded only when winds were less than 24 kilometers per hour, and not during precipitation. The minimum ambient air temperature for unfolding or unrolling the high-density polyethylene sheets was -10 C, and a minimum temperature of 0 C was required for seaming the high-density polyethylene sheets. Between shifts, geomembranes and geotextile were anchored with sandbags to prevent lifting by wind. Calculations were performed to determine the appropriate spacing of sandbags on the geomembrane to resist lifting caused by 130 kilometer per hour winds (HNF 1997). All of the synthetic components contain UV light inhibitors and no impairment of performance is anticipated from the short-term UV light exposure during construction. Section C.5.2.4 provides further detail on exposure prevention.

During the laying of the soil/bentonite layer and the overlying geomembrane, moisture content of the admixture was monitored and adjusted to ensure optimum compaction and to avoid development of cracks.

#### C.5.2.1.3 Static and Dynamic Loads and Stresses from the Maximum Quantity of Waste

When a LERF basin is full, liquid depth is approximately 6.4 meters. Static load on the primary liner is roughly 6,400 kilograms per square meter. Load on the secondary liner is slightly higher because of the weight of the gravel drainage layer. Assuming a density of 805 kilograms per square meter for the drainage gravel [conservative estimate based on specific gravity of 2.65 (Ambrose 1988)], the secondary high-density polyethylene liner carries approximately 7,200 kilograms per square meter when a basin is full.

Side slope liner stresses were calculated for each of the layers in the basin sidewalls and for the pipe trench on the northwest corner of each basin (HNF 1997). Results of these calculations indicate factors of safety against shear were 1.5 or greater for the primary geomembrane, geotextile, geonet, and secondary geomembrane.

Because the LERF is not located in an area of seismic concern, as identified in Appendix VI of 40 CFR 264 and WAC 173-303-282(6)(a)(I), discussion and calculation of potential seismic events are not required.

#### C.5.2.1.4 Stresses Resulting from Settlement, Subsidence, or Uplift

Uplift stresses from natural sources are expected to have negligible impact on the liner. Groundwater lies approximately 62 meters below the LERF, average annual precipitation is only 16 centimeters, and the average unsaturated permeability of the soils near the basin bottoms is high, ranging from about $5.5 \times 10^4$ centimeters per second to about 1 centimeter per second (Chen-Northern 1991b). Therefore, no hydrostatic uplift forces are expected to develop in the soil underneath the basins. In addition, the soil under the basins consists primarily of gravel and sand, and contains few or no organic constituents. Therefore, uplift caused by gas production from organic degradation is not anticipated.

Based on the design of the soil-bentonite liner, no structural uplift stresses are present within the lining system (Chen-Northern 1991b).

Regional subsidence is not anticipated because neither petroleum nor extractable economic minerals are present in the strata underlying the LERF basins, nor is karst (erosive limestone) topography present.

Dike soils and soil/bentonite layers were compacted thoroughly and proof-rolled during construction. Calculation of settlement potential showed that combined settlement for the foundation and soil/bentonite layer is expected to be about 2.7 centimeters. Settlement impact on the liner and basin stability is expected to be minimal (Chen-Northern 1991b).

#### C.5.2.1.5 Internal and External Pressure Gradients

Pressure gradients across the liner system from groundwater are anticipated to be negligible. The LERF is about 62 meters above the seasonal high water table, which prevents buildup of water pressure below the liner. The native gravel foundation materials of the LERF are relatively permeable and free draining. The 2 percent slope of the secondary liner prevents the pooling of liquids on top of the secondary liner. Finally, the fill rate of the basins is slow enough (average 190 liters per minute) that the load of the liquid waste on the primary liner is gradually and evenly distributed.

To prevent the buildup of gas between the liners, each basin is equipped with 21 vents in the primary geomembrane located above the maximum water level that allow the reduction of any excess gas pressure. Gas passing through these vents exit through a single pipe that penetrates the anchor wall into a carbon adsorption filter. This filter extracts nearly all of the organic compounds, ensuring that emissions to the air from the basins are not toxic.

### C.5.2.2 Liner System Location Relative to High-Water Table

The lowest point of each LERF basin is the northwest corner of the sump, where the typical subgrade elevation is 175 meters above mean sea level. Based on data collected from the groundwater monitoring wells at the LERF site, the seasonal high-water table is located approximately 62 meters or more below

the lowest point of the basins. This substantial thickness of unsaturated strata beneath the LERF provides ample protection to the liner from hydrostatic pressure because of groundwater intrusion into the soil/bentonite layer. Further discussion of the unsaturated zone and site hydrogeology is provided in Addendum D, Groundwater Monitoring Plan.

### C.5.2.3 Liner System Foundation

Foundation materials are primarily gravels and cobbles with some sand and silt. The native soils onsite are derived from unconsolidated Holocene sediments. These sediments are fluvial and glaciofluvial sands and gravels deposited during the most recent glacial and postglacial event. Grain-size distributions and shape analyses of the sediments indicate that deposition occurred in a high-energy environment (Chen-Northern 1990).

Analysis of five soil borings from the LERF site was conducted to characterize the natural foundation materials and to determine the suitability of onsite soils for construction of the impoundment dikes and determine optimal design factors. Well-graded gravel containing varying amounts of silt, sand, and cobbles comprises the layer in which the basins were excavated. This gravel layer extends to depths of 10 to 11 meters below land surface (Chen-Northern 1990). The basins are constructed directly on the subgrade. Excavated soils were screened to remove oversize cobbles (greater than 15 centimeters in the largest dimension) and used to construct the dikes.

Settlement potential of the foundation material and soil/bentonite layer was found to be low. The foundation is comprised of undisturbed native soils. The bottom of the basin excavation lies within the well-graded gravel layer, and is dense to very dense. Below the gravel is a layer of dense to very dense poorly graded and well-graded sand. Settlement was calculated for the gravel foundation soils and for the soil/bentonite layer, under the condition of hydrostatic loading from 6.4 meters of fluid depth. The combined settlement for the soils and the soil/bentonite layer is estimated to be about 2.7 centimeters. This amount of settlement is expected to have minimal impact on overall liner or basin stability (Chen-Northern 1991b). Settlement calculations are provided in *Calculations for Liquid Effluent Retention Facility Part B Permit Application* (HNF 1997).

The load bearing capacity of the foundation material, based on the soil analysis discussed previously, is estimated at about 48,800 kilograms per square meter [maximum advisable presumptive bearing capacity (Hough 1969)]. Anticipated static and dynamic loading from a full basin is estimated to be less than 9,000 kilograms per square meter (Section C.5.2.1.3), which provides an ample factor of safety.

When the basins are empty, excess hydrostatic pressure in the foundation materials under the liner system theoretically could result in uplift and damage. However, because the native soil forming the foundations is unsaturated and relatively permeable, and because the water table is located at a considerable depth beneath the basins, any infiltration of surface water at the edge of the basin is expected to travel predominantly downward and away from the basins, rather than collecting under the excavation itself. No gas is expected in the foundation because gas-generating organic materials are not present.

Subsidence of undisturbed foundation materials is generally the result of fluid extraction (water or petroleum), mining, or karst topography. Neither petroleum, mineral resources, nor karst are believed to be present in the sediments overlying the Columbia River basalts. Potential groundwater resources do exist below the LERF. Even if these sediments were to consolidate from fluid withdrawal, their depth most likely would produce a broad, gently sloping area of subsidence that would not cause significant strains in the LERF liner system. Consequently, the potential for subsidence related failures are expected to be negligible.

Borings at the LERF site, and extensive additional borings in the 200 East Area, have not identified any significant quantities of soluble materials in the foundation soil or underlying sediments (Last et al. 1989). Consequently, the potential for sinkholes is considered negligible.

### C.5.2.4 Liner System Exposure Prevention

Both primary and secondary geomembranes and the floating cover are stabilized with carbon black to prevent degradation from UV light. Furthermore, none of the liner layers experience long-term exposure to the elements. During construction, thin polyethylene sheeting was used to maintain optimum moisture content and provide protection from the wind for the soil/bentonite layer until the secondary geomembrane was laid in place. The secondary geomembrane was covered by the geonet and geotextile as soon as quality control testing was complete. Once the geotextile layer was completed, drainage material immediately was placed over the geotextile. The final (upper) geotextile layer was placed over the drainage gravel and immediately covered by the bentonite carpet liner. This was covered immediately, in turn, by the primary high-density polyethylene liner.

Both high-density polyethylene liners, geotextile layers, and geonet are anchored permanently to a concrete wall at the top of the basin berm. During construction, liners were held in place with many sandbags on both the basin bottoms and side slopes to prevent wind from lifting and damaging the materials. Calculations were performed to determine the amount of fluid needed in a basin to prevent wind lift damage to the primary geomembrane. Approximately 15 to 20 centimeters of solution are kept in each basin to minimize the potential for uplifting the primary liner (HNF 1997).

The entire lining system is covered by a very low-density polyethylene floating cover that is bolted to the concrete anchor wall. The floating cover prevents evaporation and intrusion from dust, precipitation, vegetation, animals, and birds. A patented tensioning system is employed to prevent wind from lifting the cover and automatically accommodate changes in liquid level in the basins. The cover tension mechanism consists of a cable running from the flexible geosynthetic cover over a pulley on the tension tower (located on the concrete anchor wall) to a dead man anchor. These anchors (blocks) simply hang from the cables on the exterior side of the tension towers. The anchor wall also provides for solid attachment of the liner layers and the cover, using a 6.4-millimeter batten and neoprene gasket to bolt the layers to the concrete wall, effectively sealing the basin from the intrusion of light, precipitation, and airborne dust (Figure C.16).

The floating cover, made of very low-density polyethylene with UV light inhibitors, is not anticipated to experience unacceptable degradation during the service life of the LERF. The very low-density polyethylene material contains carbon black for UV light protection, anti-oxidants to prevent heat degradation, and seaming enhancers to improve its ability to be welded. A typical manufacturer's limited warranty for weathering of very low-density polyethylene products is 20 years (Poly America, undated). This provides a margin of safety for the anticipated medium-term use of the LERF for aqueous waste storage.

The upper 3.4 to 4.6 meters of the sidewall liner also could experience stresses in response to temperature changes. Accommodation of thermal influences for the LERF geosynthetic layers is affected by inclusion of sufficient slack as the liners were installed. Calculations demonstrate that approximately 67 centimeters of slack is required in the long basin bottom dimension, 46 centimeters across the basin, and 34 centimeters from the bottom of the basin to the top of the basin wall (HNF 1997).

Thermal stresses also are experienced by the floating cover. As with the geomembranes, sufficient slack was included in the design to accommodate thermal contraction and expansion.

#### C.5.2.4.1 Liner Repairs During Operations

Should repair of a basin liner be required while the basin is in operation, the basin contents will be transferred to the 200 Area ETF or another available basin. After the liner around the leaking section is cleaned, repairs to the geomembrane will be made by the application of a piece of high-density polyethylene sheeting, sufficient in size to extend approximately 8 to 15 centimeters beyond the damaged area, or as recommended by the vendor. A round or oval patch will be installed using the same type of equipment and criteria used for the initial field installations.

#### C.5.2.4.2 Control of Air Emissions

The floating covers limit evaporation of aqueous waste and releases of volatile organic compounds into the atmosphere. To accommodate volumetric changes in the air between the fluid in the basin and the cover, and to avoid problems related to 'sealing' the basins too tightly, each basin is equipped with a carbon filter breather vent system. Any air escaping from the basins must pass through this vent, consisting of a pipe that penetrates the anchor wall and extends into a carbon adsorption filter unit.

### C.5.2.5 Liner Coverage

The liner system covers the entire ground surface that underlies the retention basins. The primary liner extends up the side slopes to a concrete anchor wall at the top of the dike encircling the entire basin (Figure C.16).

## C.5.3 Prevention of Overtopping

Overtopping prevention is accomplished through administrative controls and liquid-level instrumentation installed in each basin. The instrumentation includes local liquid-level indication as well as remote indication at the ETF. Before an aqueous waste is transferred into a basin, administrative controls are implemented to ensure overtopping will not occur during the transfer. The volume of feed to be transferred is compared to the available volume in the receiving basin. The transfer is not initiated unless there is sufficient volume available in the receiving basin or a cut-off level is established. The transfer into the basin would be stopped when this cut-off level is reached.

In the event of a 25-year, 24-hour storm event, precipitation would accumulate on the basin covers. Through the self-tensioning design of the basin covers and maintenance of adequate freeboard, all accumulated precipitation would be contained on the covers and none would flow over the dikes or anchor walls. The 25-year, 24-hour storm is expected to deliver 5.3 centimeters of rain or approximately 61 centimeters of snow. Cover specifications include the requirement that the covers be able to withstand the load from this amount of precipitation. Because the cover floats on the surface of the fluid in the basin, the fluid itself provides the primary support for the weight of the accumulated precipitation. Through the cover self-tensioning mechanism, there is ample 'give' to accommodate the overlying load without overstressing the anchor and attachment points.

Rainwater and snow evaporate readily from the cover, particularly in the arid Hanford Facility climate, where evaporation rates exceed precipitation rates for most months of the year. The black color of the cover further enhances evaporation. Thus, the floating cover prevents the intrusion of precipitation into the basin and provides for evaporation of accumulated rain or snow.

### C.5.3.1 Freeboard

Under current operating conditions, 0.61 meter of freeboard is maintained at each LERF basin, which corresponds to an operating level of 6.8 meters, or 29.5 million liters.

### C.5.3.2 Immediate Flow Shutoff

The mechanism for transferring aqueous waste is either through pump transfers with on/off switches or through gravity transfers with isolation valves. These methods provide positive ability to shut off transfers immediately in the event of overtopping. Overtopping a basin during a transfer is very unlikely because the low flow rate into the basin provides long response times. At a flow rate of 284 liters per minute, approximately 11 days would be required to fill a LERF basin from the 6.8-meter operating level (i.e., 0.61 meter of freeboard) to maximum capacity of 34 million liters (i.e., the 7.4-meter level).

### C.5.3.3 Outflow Destination

Aqueous waste in the LERF is transferred routinely to 200 Area ETF for treatment. However, should it be necessary to immediately empty a basin, the aqueous waste either would be transferred to the 200 Area ETF for treatment or transferred to another basin (or basins), whichever is faster. If necessary a temporary pumping system may be installed to increase the transfer rate.

### C.5.4 Structural Integrity of Dikes

The structural integrity of the dikes was certified attesting to the structural integrity of the dikes, signed by a qualified, registered professional engineer.

#### C.5.4.1 Dike Design, Construction, and Maintenance

The dikes of the LERF are constructed of onsite native soils, generally consisting of cobbles and gravels. Well-graded mixtures were specified, with cobbles up to 15 centimeters in the largest dimension, but not constituting more than 20 percent of the volume of the fill. The dikes are designed with a 3:1 (3 units horizontal to 1 unit vertical) slope on the basin side, and 2.25:1 on the exterior side. The dikes are approximately 8.2 meters high from the bottom of the basin, and 3 meters above grade.

Calculations were performed to verify the structural integrity of the dikes (HNF 1997). The calculations demonstrate that the structural strength of the dikes is such that, without dependence on any lining system, the sides of the basins can withstand the pressure exerted by the maximum allowable quantity of fluid in the impoundment. The dikes have a factor of safety greater than 2.5 against failure by sliding.

#### C.5.4.2 Dike Stability and Protection

In the following paragraphs, various aspects of stability for the LERF dikes and the concrete anchor wall are presented, including slope failure, hydrostatic pressure, and protection from the environment.

**Failure in Dike/Impoundment Cut Slopes.** A slope stability analysis was performed to determine the factor of safety against slope failure. The computer program 'PCSTABL5' from Purdue University, using the modified Janbu Method, was employed to evaluate slope stability under both static and seismic loading cases. One hundred surfaces per run were generated and analyzed. The assumptions used were as follows (Chen-Northern 1991b):

- Weight of gravel: 2,160 kilograms per cubic meter
- Maximum dry density of gravel: 2,315 kilograms per cubic meter
- Mohr-Coulomb shear strength angle for gravel: minimum 33 degrees
- Weight of soil/bentonite: 1,600 kilograms per cubic meter
- Mohr-Coulomb shear strength angle for soil/bentonite: minimum 30 degrees
- Slope: 3 horizontal: 1 vertical
- No fluid in impoundment (worst case for stability)
- Soils at in-place moisture (not saturated conditions)

Results of the static stability analysis showed that the dike slopes were stable with a minimum factor of safety of 1.77 (Chen-Northern 1991b).

The standard horizontal acceleration required in the *Hanford Plant Standards*, "Standard Architectural-Civil Design Criteria, Design Loads for Facilities" (DOE-RL 1988), for structures on the Hanford Site is 0.12 g. Adequate factors of safety for cut slopes in units of this type generally are considered 1.5 for static conditions and 1.1 for dynamic stability (Golder 1989). Results of the stability analysis showed that the LERF basin slopes were stable under horizontal accelerations of 0.10 and 0.15 g, with minimum factors of safety of 1.32 and 1.17, respectively (Chen-Northern 1991b). Printouts from the PCSTABL5 program are provided in *Calculations for Liquid Effluent Retention Facility Part B Permit Application* (HNF 1997).

**Hydrostatic Pressure.** Failure of the dikes due to buildup of hydrostatic pressure, caused by failure of the leachate system or liners, is very unlikely. The liner system is constructed with two essentially impermeable layers consisting of a synthetic layer overlying a soil layer with low-hydraulic conductivity. It would require a catastrophic failure of both liners to cause hydrostatic pressures that could endanger dike integrity. Routine inspections of the leachate detection system, indicating quantities of leachate removed from the basins, provide an early warning of leakage or operational problems that could lead to excessive hydrostatic pressure. A significant precipitation event (e.g., a 25-year, 24-hour storm) will not create a hydrostatic problem because the interior sidewalls of the basins are covered completely by the

liners. The covers can accommodate this volume of precipitation without overtopping the dike (Section C.5.3), and the coarse nature of the dike and foundation materials on the exterior walls provides for rapid drainage of precipitation away from the basins.

**Protection from Root Systems.** Risk to structural integrity of the dikes because of penetrating root systems is minimal. Excavation and construction removed all vegetation on and around the impoundments, and native plants (such as sagebrush) grow very slowly. The large grain size of the cobbles and gravel used as dike construction material do not provide an advantageous germination medium for native plants. Should plants with extending roots become apparent on the dike walls, the plants will be controlled with appropriate herbicide application.

**Protection from Burrowing Mammals.** The cobble size materials that make up the dike construction material and the exposed nature of the dike sidewalls do not offer an advantageous habitat for burrowing mammals. Lack of vegetation on the LERF site discourages foraging. The risk to structural integrity of the dikes from burrowing mammals is therefore minimal. Periodic visual inspections of the dikes provide observations of any animals present. Should burrowing mammals be noted onsite, appropriate pest control methods such as trapping or application of rodenticides will be employed.

**Protective Cover.** Approximately 7.6 centimeters of crushed gravel serve as the cover of the exterior dike walls. This coarse material is inherently resistant to the effect of wind because of its large grain size. Total annual precipitation is low (16 centimeters) and a significant storm event (e.g., a 25-year, 24-hour storm) could result in about 5.3 centimeters of precipitation in a 24-hour period. The absorbent capacity of the soil exceeds this precipitation rate; therefore, the impact of wind and precipitation run-on to the exterior dike walls will be minimal.

### C.5.5 Piping Systems

Aqueous waste from the 242-A Evaporator is transferred to the LERF using a pump located in the 242-A Evaporator and approximately 1,500 meters of pipe, consisting of a 3-inch carrier pipe within a 6-inch outer containment pipeline. Flow through the pump is controlled through a valve at flow rates from 150 to 300 liters per minute. The pipeline exits the 242-A Evaporator below grade and remains below grade at a minimum 1.2 meter depth for freeze protection, until the pipeline emerges at the LERF catch basin, at the corner of each basin. All piping at the catch basin that is less than 1.2 meters below grade is wrapped with electric heat tracing tape and insulated for protection from freezing.

The transfer line from the 242-A Evaporator is centrifugally cast, fiberglass-reinforced epoxy thermoset resin pressure pipe fabricated to meet the requirements of ASME D2997 (ASME 1984). The 3-inch carrier piping is centered and supported within 6-inch containment piping. Pipe supports are fabricated of the same material as the pipe, and meet the strength requirements of ANSI B31.3 (ANSI 1987) for dead weight, thermal, and seismic loads.A catch basin is provided at the northwest corner of each basin where piping extends from the basin to allow for basin-to-basin and basin-to-200 Area ETF liquid transfers. Drawing H-2-88766, Sheets 1 through 4, provide schematic diagrams of the piping system at LERF. Drawing H-2-79604 provides details of the piping from the 242-A Evaporator to LERF.

#### C.5.5.1 Secondary Containment System for Piping

The 6-inch containment piping encases the 3-inch carrier pipe from the 242-A Evaporator to the LERF. All of the piping and fittings that are not directly over a catch basin or a basin liner are of this pipe-within-a-pipe construction. A catch basin is provided at the northwest corner of each basin where the inlet pipes, leachate risers, and transfer pipe risers emerge from the basin. The catch basin consists of a 20-centimeter-thick concrete pad at the top of the dike. The perimeter of the catch basin has a 20-centimeter-high curb, and the concrete is coated with a chemical resistant epoxy sealant. The concrete pad is sloped so that any leaks or spills from the piping or pipe connections will drain into the basin. The catch basin provides an access point for inspecting, servicing, and operating various systems such as transfer valving, leachate level instrumentation and leachate pump. Drawing H-2-79593 provides a schematic diagram of the catch basins.

#### C.5.5.2 Leak Detection System

Single-point electronic leak detection elements are installed along the transfer line at 305-meter intervals. The leak detection elements are located in the bottom of specially designed test risers. Each sensor element employs a conductivity sensor, which is connected to a cable leading back to the 242-A Evaporator control room. If a leak develops in the carrier pipe, fluid will travel down the exterior surface of the carrier pipe or the interior of the containment pipe. As moisture contacts a sensor unit, a general alarm sounds in the 242-A Evaporator and 200 Area ETF control rooms and the zone of the Sensor unit causing the general alarm can be determined using the 242-A Evaporator leak detection monitoring panel. Upon verification of a leak, the pump located in the 242-A Evaporator is shut down, stopping the flow of aqueous waste through the transfer line. A low-volume air purge of the annulus between the carrier pipe and the containment pipe is provided to prevent condensation buildup and minimize false alarms by the leak detection elements.

The catch basins have conductivity leak detectors that alarm in the 242-A Evaporator and 200 Area ETF control rooms. Leaks into the catch basins drain back to the basin through a 5.1-centimeter drain on the floor of the catch basin.

#### C.5.5.3 Certification

Although an integrity assessment is not required for piping associated with surface impoundments, an assessment of the transfer liner was performed, including a hydrostatic leak/pressure test at 10.5 kilograms per square centimeter gauge. A statement by an independent, qualified, registered professional engineer attesting to the integrity of the piping system is included in *Integrity Assessment Report for the 242-A Evaporator/LERF Waste Transfer Piping, Project W105* (WHC 1993), along with the results of the leak/pressure test.

### C.5.6 Double Liner and Leak Detection, Collection, and Removal System

The double-liner system for LERF is discussed in Section C.5.2. The leachate detection, collection, and removal system (Figure C.18 and Figure C.19) was designed and constructed to remove leachate that might permeate the primary liner. System components for each basin include:

- 30.5-centimeter layer of drainage gravel below the primary liner at the bottom of the basin
- Geonet below the primary liner on the sidewalls to direct leachate to the gravel layer
- 3.0-meter by 1.8-meter by 0.30-meter-deep leachate collection sump consisting of a 25 millimeter high-density polyethylene flat stock, geotextile to trap large particles in the leachate, and 1.5-millimeter high-density polyethylene rub sheet set on the secondary liner
- 10-inch and 4-inch perforated leachate high-density polyethylene riser pipes from the leachate collection sump to the catch basin northwest of the basin
- Leachate collection sump level instrumentation installed in the 4-inch riser
- Level sensors, submersible leachate pump, and 1.5-inch fiberglass-reinforced epoxy thermoset resin pressure piping installed in the 10-inch riser
- Piping at the catch basin to route the leachate through 1.5-inch high-density polyethylene pipe back to the basins

The bottom of the basins has a two percent slope to allow gravity flow of leachate to the leachate collection sump. This exceeds the minimum of 1 percent slope required by WAC 173-303-650(j) for new surface impoundments. Material specifications for the leachate collection system are given in Section C.5.2.1.1.

Calculations demonstrate that fluid from a small hole (2 millimeter) (EPA 1989, p. 122) at the furthest end of the basin, under a low head situation, would travel to the sump in less than 24 hours (HNF 1997).

Additional calculations indicate the capacity of the pump to remove leachate is sufficient to allow time to readily identify a leak and activate emergency procedures (HNF 1997).

Automated controls maintain the fluid level in each leachate sump below 33 centimeters to prevent significant liquid backup into the drainage layer. The leachate pump is activated when the liquid level in the sump reaches about 28 centimeters, and is shut off when the sump liquid level reaches about 18 centimeters. This operation prevents the leachate pump from cycling with no fluid, which could damage the pump. Liquid level control is accomplished with conductivity probes that trigger relays selected specifically for application to submersible pumps and leachate fluids. A flow meter/totalizer on the leachate return pipe measures fluid volumes pumped and pumping rate from the leachate collection sumps, and indicates volume and flow rate on local readouts. Other instrumentation provided is real-time continuous level monitoring with readout at the catch basin and the 242-A Evaporator control room. A sampling port is provided in the leachate piping system at the catch basin. Leak detection is provided through inspections of the leachate flow totalizer readings. For more information on inspections, refer to Addendum I.

The stainless steel leachate pump is designed to deliver 110 liters per minute. The leachate pump returns draw liquid from the sump via 1.5-inch pipe and discharges into the basin through 1.5-inch high-density polyethylene pipe.

### C.5.7 Construction Quality Assurance

The construction quality assurance plan and complete report of construction quality assurance inspection and testing results are provided in *242-A Evaporator Interim Retention Basin Construction Quality Assurance Plan* (KEH 1991). A general description of construction quality assurance procedures is outlined in the following paragraphs.

For excavation of the basins and construction of the dikes, regular inspections were conducted to ensure compliance with procedures and drawings, and compaction tests were performed on the dike soils.

For the soil/bentonite layer, test fills were first conducted in accordance with EPA guidance to demonstrate compaction procedures and to confirm compaction and permeability requirements can be met. The ratio of bentonite to soil and moisture content was monitored; lifts did not exceed 15 centimeters before compaction, and specific compaction procedures were followed. Laboratory and field tests of soil properties were performed for each lift and for the completed test fill. The same suite of tests was conducted for each lift during the laying of the soil/bentonite admixture in the basins.

Geotextiles and geomembranes were laid in accordance with detailed procedures and quality assurance programs provided by the manufacturers and installers. These included destructive and nondestructive tests on the geomembrane seams, and documentation of field test results and repairs.

### C.5.8 Proposed Action Leakage Rate and Response Action Plan

An action leakage rate limit is established where action must be taken due to excessive leakage from the primary liner. The action leak rate is based on the maximum design flow rate the leak detection system can remove without the fluid head on the bottom liner exceeding 30 centimeters. The limiting factor in the leachate removal rate is the hydraulic conductivity of the drainage gravel. An action leakage rate (also called the rapid or large leak rate) of 20,000 liters per hectare per day was calculated for each basin (WHC 1992b).

When it is determined that the action leakage rate has been exceeded, the response action plan will follow the actions in WAC 173-303-650(11)(b) and (c), which includes notification of Ecology in writing within 7 days, assessing possible causes of the leak, and determining whether waste receipt should be curtailed and/or the basin emptied.

### C.5.9 Dike Structural Integrity Engineering Certification

The structural integrity of the dikes was certified attesting to the structural integrity of the dikes, signed by a qualified, registered professional engineer.

### C.5.10 Management of Ignitable, Reactive, or Incompatible Wastes

Although ignitable or reactive aqueous waste might be received in small quantities at LERF, such aqueous waste is mixed with dilute solutions in the basins, removing the ignitable or reactive characteristics. For compatibility requirements with the LERF liner, refer to Addendum B, Waste Analysis Plan.

## C.6 AIR EMISSIONS CONTROL

This section addresses the 200 Area ETF requirements of Air Emission Standards for Process Vents, under 40 CFR 264, Subpart AA (WAC 173-303-690 incorporated by reference) and Subpart CC. The requirements of 40 CFR 264, Subpart BB (WAC 173-303-691) is not applicable because aqueous waste with 10 percent or greater organic concentration would not be acceptable for processing at the ETF.

### C.6.1 Applicability of Subpart AA Standards

The 200 Area ETF evaporator and thin film dryer perform operations that specifically require evaluation for applicability of WAC 173-303-690. Aqueous waste in these units routinely contains greater than 10 parts per million concentrations of organic compounds and are, therefore, subject to air emission requirements under WAC 173-303-690. Organic emissions from all affected process vents on the Hanford Facility must be less than 1.4 kilograms per hour and 2.8 mega grams per year, or control devices must be installed to reduce organic emissions by 95 percent.

The vessel off gas system provides a process vent system. This system provides a slight vacuum on the 200 Area ETF process vessels and tanks (refer to Section C.2.5.2). Two vessel vent header pipes combine and enter the vessel off gas system filter unit consisting of a demister, electric heater, prefilter, high-efficiency particulate air filters, activated carbon absorber, and two exhaust fans (one fan in service while the other is backup). The vessel off gas system filter unit is located in the high-efficiency particulate air filter room west of the process area. The vessel off gas system exhaust discharges into the larger building ventilation system, with the exhaust fans and stack located outside and immediately west of the ETF. The exhaust stack discharge point is 15.5 meters above ground level.

The annual average flow rate for the 200 Area ETF stack (which is the combined vessel off gas and building exhaust flow rates) is 1600 cubic meters per minute with a total annual flow of approximately 8.4 E+08 cubic meters. During waste processing, the airflow through just the vessel off gas system is about 23 standard cubic meters per minute.

Organic emissions occur during waste processing, which occurs less than 310 days each year (i.e., 85 percent operating efficiency). This operating efficiency represents the maximum annual operating time for the ETF, as shutdowns are required during the year for planned maintenance outages and for reconfiguring the 200 Area ETF to accommodate different aqueous waste.

### C.6.2 Process Vents - Demonstrating Compliance

This section outlines how the 200 Area ETF complies with the requirements and includes a discussion of the basis for meeting the organic emissions limits, calculations demonstrating compliance, and conditions for reevaluation.

#### C.6.2.1 Basis for Meeting Limits/Reductions

The 242-A Evaporator and the 200 Area ETF are currently the only operating TSD units that contribute to the Hanford Facility volatile organic emissions under 40 CFR 264, Subpart AA. The combined release rate is currently well below the threshold of 1.4 kilograms per hour or 2,800 kilograms per year of volatile organic compounds. As a result, the 200 Area ETF meets these standards without the use of air pollution control devices.

The amount of organic emissions could change as waste streams are changed, or TSD units are brought online or are deactivated. The organic air emissions summation will be re-evaluated periodically as condition warrants. Operations of the TSD units operating under 40 CFR 264, Subpart AA, will be

controlled to maintain Hanford Facility emissions below the threshold limits or pollution control device(s) will be added, as necessary, to achieve the reduction standards specified under 40 CFR 264, Subpart AA.

#### C.6.2.2 Demonstrating Compliance

Calculations to determine organic emissions are performed using the following assumptions:

- Maximum flow rate from LERF to 200 Area ETF is 568 liters per minute.
- Emissions of organics from tanks and vessels upstream of the UV/OX process are determined from flow and transfer rates given in *Clean Air Act Requirements, WAC 173-400, As-built Documentation, Project C-018H, 242-A Evaporator/PUREX Plant Process Condensate Treatment Facility* (Adtechs 1995).
- UV/OX reaction rate constants and residence times are used to determine the amount of organics, which are destroyed in the UV/OX process. These constants are given in *200 Area Effluent Treatment Facility Delisting Petition* (DOE/RL 1992).
- All organic compounds that are not destroyed in the UV/OX process are assumed to be emitted from the tanks and vessels into the vessel off gas system.
- No credit for removal of organic compounds in the vessel off gas system carbon absorber unit is taken. The activated carbon absorbers are used if required to reduce organic emissions.

The calculation to determine organic emissions consists of the following steps:

1. Determine the quantity of organics emitted from the tanks or vessels upstream of the UV/OX process, using transfer rate values
2. Determine the concentration of organics in the waste after the UV/OX process using UV/OX reaction rates and residence times. If the 200 Area ETF is configured such that the UV/OX process is not used, a residence time of zero is used in the calculations (i.e., none of the organics are destroyed)
3. Assuming all the remaining organics are emitted, determine the rate which the organics are emitted using the feed flow rate and the concentrations of organics after the UV/OX process
4. The amount of organics emitted from the vessel off gas system is the sum of the amount calculated in steps 1 and 3.

The organic emission rates and quantity of organics emitted during processing are determined using these calculations and are included in the Hanford Facility Operating Record, LERF and 200 Area ETF file.

#### C.6.2.3 Reevaluating Compliance with Subpart AA Standards

Calculations to determine compliance with Subpart AA will be reviewed when any of the following conditions occur at the 200 Area ETF:

- Changes in the maximum feed rate to the 200 Area ETF (i.e., greater than the 568 liters per minute flow rate)
- Changes in the configuration or operation of the 200 Area ETF that would modify the assumptions given in Section C.6.2.2 (e.g., taking credit for the carbon absorbers as a control device)
- Annual operating time exceeds 310 days.

### C.6.3 Applicability of Subpart CC Standards

The air emission standards of 40 CFR 264, Subpart CC apply to tank, surface impoundment, and container storage units that manage wastes with average volatile organic concentrations equal to or exceeding 500 parts per million by weight, based on the hazardous waste composition at the point of origination (61 FR 59972). However, TSD units that are used solely for management of mixed waste are exempt. Mixed waste is managed at the LERF and 200 Area ETF and dangerous waste could be treated and stored at these TSD units.

TSD owner/operators are not required to determine the concentration of volatile organic compounds in a hazardous waste if the wastes are placed in waste management units that employ air emission controls that comply with the Subpart CC standards. Therefore, the approach to Subpart CC compliance at the LERF and 200 Area ETF is to demonstrate that the LERF and 200 Area ETF meet the Subpart CC control standards (40 CFR 264.1084 – 40 CFR 264.1086).

#### C.6.3.1 Demonstrating Compliance with Subpart CC for Tanks

Since the 200 Area ETF tanks already have process vents regulated under 40 CFR 264, Subpart AA (WAC 173-303-690), they are exempt from Subpart CC [40 CFR 264.1080(b)(8)].

#### C.6.3.2 Demonstrating Compliance with Subpart CC for Containers

Container Level 1 and Level 2 standards are met at the 200 Area ETF by managing all dangerous and/or mixed wastes in U.S. Department of Transportation containers [40 CFR 264.1086(f)]. Level 1 containers are those that store more than 0.1 cubic meters and less than or equal to 0.46 cubic meters. Level 2 containers are used to store more than 0.46 cubic meters of waste, which are in 'light material service'. Light material service is defined where a waste in the container has one or more organic constituents with a vapor pressure greater than 0.3 kilopascals at 20 C, and the total concentration of such constituents is greater than or equal to 20 percent by weight.

The monitoring requirements for Level 1 and Level 2 containers include a visual inspection when the container is received at the 200 Area ETF and when the waste is initially placed in the container. Additionally, at least once every 12 months when stored onsite for 1 year or more, these containers must be inspected.

If compliant containers are not used at the 200 Area ETF, alternate container management practices are used that comply with the Level 1 standards. Specifically, the Level 1 standards allow for a "container equipped with a cover and closure devices that form a continuous barrier over the container openings such that when the cover and closure devices are secured in the closed position there are no visible holes, gaps, or other open spaces into the interior of the container. The cover may be a separate cover installed on the container...or may be an integral part of the container structural design…" [40 CFR 264.1086(c)(1)(ii)]. An organic-vapor-suppressing barrier, such as foam, may also be used [40 CFR 264.1086(c)(1)(iii)]. Section C.3 provides detail on container management practices at the 200 Area ETF.

Container Level 3 standards apply when a container is used for the "treatment of a hazardous waste by a waste stabilization process" [40 CFR 264.1086(2)]. Because treatment in containers using the stabilization process is not provided at the 200 Area ETF, these standards do not apply.

#### C.6.3.3 Demonstrating Compliance with Subpart CC for Surface Impoundments

The Subpart CC emission standards are met at LERF using a floating membrane cover that is constructed of very-low-density polyethylene that forms a continuous barrier over the entire surface area [40 CFR 264.1085(c)]. This membrane has both organic permeability properties equivalent to a high-density polyethylene cover and chemical/physical properties that maintain the material integrity for the intended service life of the material. The additional requirements for the floating cover at the LERF have been met (Section C.5.2.4).

## C.7 ENGINEERING DRAWINGS

### C.7.1 Liquid Effluent Retention Facility

Drawings of the containment systems at the LERF are summarized in Table C.1. Because the failure of these containment systems at LERF could lead to the release of dangerous waste into the environment, modifications that affect these containment systems will be submitted to the Washington State Department of Ecology, as a Class 1, 2, or 3 Permit modification, as required by WAC 173-303-830.

**Table C.1. Liquid Effluent Retention Facility Containment System**

| LERF System | Drawing Number | Drawing Title |
|---|---|---|
| Bottom Liner | H-2-79590, Sheet 1 | Civil Plan, Sections and Details; Cell Basin Bottom Liner |
| Top Liner | H-2-79591, Sheet 1 | Civil Plan, Sections and Details; Cell Basin Bottom Liner |
| Catch Basin | H-2-79593, Sheet 1, 3-5 | Civil Plan, Section and Details; Catch Basin |

The drawings identified in Table C.2 illustrate the piping and instrumentation configuration within LERF, and of the transfer piping systems between the LERF and the 242-A Evaporator. These drawings are provided for general information and to demonstrate the adequacy of the design of the LERF as a surface impoundment.

**Table C.2. Liquid Effluent Retention Facility Piping and Instrumentation**

| LERF System | Drawing Number | Drawing Title |
|---|---|---|
| Transfer Piping to 242-A Evaporator | H-2-79604, Sheet 1 | Piping Plot and Key Plans; 242-A Evaporator Condensate Stream |
| LERF Piping and Instrumentation | H-2-88766, Sheet 1 | P&ID; LERF Basin and ETF Influent |
| | H-2-88766, Sheet 2 | P&ID; LERF Basin and ETF Influent |
| | H-2-88766, Sheet 3 | P&ID; LERF Basin and ETF Influent |
| | H-2-88766, Sheet 4 | P&ID; LERF Basin and ETF Influent |
| Legend | H-2-89351, Sheet 1 | Piping & Instrumentation Diagram - Legend |

### C.7.2 200 Area Effluent Treatment Facility

Drawings of the secondary containment systems for the 200 Area ETF containers, and tanks and process units, and for the Load-In Tanks are summarized in Table C.3. Because the failure of the secondary containment systems could lead to the release of dangerous waste into the environment, modifications, which affect the secondary containment systems, will be submitted to the Washington State Department of Ecology, as a Class 1, 2, or 3 Permit modification, as required by WAC 173-303-830.

**Table C.3. Effluent Treatment Facility and Load-In Station Secondary Containment Systems**

| 200 Area ETF Process Unit | Drawing Number | Drawing Title |
|---|---|---|
| Surge Tank, Process/ Container Storage Areas and Trenches - Foundation and Containment | H-2-89063, Sheet 1 | Architectural/structural – Foundation and Grade Beam Plan |
| Sump Tank Containment | H-2-89065, Sheet 1 | Architectural/structural – Foundation, Sections and Detail |
| Verification Tank Foundation and Containment | H-2-89068, Sheet 1 | Architectural/structural – Verification Tank Foundation |
| Load-In Facility Foundation and Containment | H-2-817970, Sheet 1 | Structural – ETF Truck Load-in Facility Plans and Sections |
| Load-In Facility Foundation and Containment | H-2-817970, Sheet 2 | Structural – ETF Truck Load-in Facility Sections and Details |

The drawings identified in Table C.4 provide an illustration of the piping and instrumentation configuration for the major process units and tanks at the ETF, and the Load-In Tanks. Drawings of the transfer piping systems between the LERF and200 Area ETF, and between the Load-In Station and the 200 Area ETF also are presented in this table. These drawings are provided for general information and to demonstrate the adequacy of the design of the tank systems.

**Table C.4. Major Process Units and Tanks at the Effluent Treatment Facility and Load-In Station**

| 200 Area ETF Process Unit | Drawing Number | Drawing Title |
|---|---|---|
| Load-In Facility | H-2-817974, Sheet 1 | P&ID – ETF Truck Load-In Facility |
| Load-In Facility | H-2-817974, Sheet 2 | P&ID – ETF Truck Load-In Facility |
| Surge Tank | H-2-89337, Sheet 1 | P&ID – Surge Tank System |
| UV/Oxidation | H-2-88976, Sheet 1 | P&ID – UV Oxidizer Part 1 |
| UV/Oxidation | H-2-89342, Sheet 1 | P&ID – UV Oxidizer Part 2 |
| Reverse Osmosis | H-2-88980, Sheet 1 | P&ID – 1st RO Stage |
| Reverse Osmosis | H-2-88982, Sheet 1 | P&ID – 2nd RO Stage |
| IX/Polishers | H-2-88983, Sheet 1 | P&ID – Polisher |
| Verification Tanks | H-2-88985, Sheet 1 | P&ID – Verification Tank System |
| ETF Evaporator | H-2-89335, Sheet 1 | P&ID – Evaporator |
| Thin Film Dryer | H-2-88989, Sheet 1 | P&ID – Thin Film Dryer |
| Transfer Piping from LERF to ETF | H-2-88768, Sheet 1 | Piping Plan/Profile 4"– 60M-002-M17 and 3"-60M-001-M17 |
| Transfer Piping from Load-In Facility to ETF | H-2-817969, Sheet 1 | Civil – ETF Truck Load-In Facility Site Plan |

## Table C.5. 200 Area Effluent Treatment Facility Tank Systems Information

| Tank Description | Material of Construction | Maximum Tank Capacity[1] liters | Inner diameter meters | Height meters | Shell Thickness [2] centimeters | Corrosion Protection [3] |
|---|---|---|---|---|---|---|
| Load-in tanks 59A-TK-109/-117 (2) | 304 SS | 34,350 | 3.6 | 4.7 | 0.64 | Type 304 SS |
| Load-in tank 59A-TK-1 | FRP | 26,000 | 3.0 | 3.8 | 0.48 (dome) 0.63 (walls & bottom) | FRP |
| Surge tank | 304 SS | 462,000 | 7.9 | 9.2 | 0.48 | Type 304 SS |
| pH adjustment tank | 304 SS | 16,700 | 3.0 | 2.5 | 0.64 | Type 304 SS |
| First RO feed tank | 304 SS | 20,600 | 3.0 | 3.2 | 0.64 | Type 304 SS |
| Second RO feed tank | 304 SS | 9,000 | Nonround tank 3.0 m x 1.5 m | 1.5 | 0.48 w/rib stiffeners | Type 304 SS |
| Effluent pH adjustment tank | 304 SS | 14,400 | 2.4 | 3.6 | 0.64 | Type 304 SS |
| Verification tanks (3) | Carbon steel with epoxy lining | 3,000,000 | 18.3 | 11.4 | 0.79 | epoxy coating |
| Secondary waste receiving tanks (2) | 304 SS | 73,800 | 4.3 | 5.7 | 0.64 | Type 304 SS |
| Concentrate tanks (2) | 316L SS | 24,900 | 3.0 | 3.8 | 0.64 | Type 316 SS |
| ETF evaporator (Vapor Body) | Alloy 625 | 20,000 | 2.4 | 6.8 | variable | Alloy 625 |
| Distillate flash tank | 304 SS | 950 | Horizontal tank 0.76 | Length 2.2 | 0.7 | 304 SS |
| Sump tank 1 | 304 SS | 6,900 | 1.5 x 1.5 | 3.4 | 0.48 | 304 SS |
| Sump tank 2 | 304 SS | 6,700 | 1.5 x 1.5 | 3.4 | 0.48 | 304 SS |

[1] The maximum operating volume of the tanks is identified.
[2] The nominal thickness of ETF tanks is represented.
[3] Type 304 SS, 304L, 316 SS and alloy 625 provide corrosion protection.
304 SS = stainless steel type 304 or 304L.
316L SS = stainless steel type 316L
FRP = Fiberglass-reinforced plastic.

**Table C.6. 200 Area Effluent Treatment Facility Additional Tank System Information**

| Tank Description | Liner Materials | Pressure Controls | Foundation Materials | Structural Support | Seams | Connections |
|---|---|---|---|---|---|---|
| Load-in tanks 59A-TK-109/-117 (2) | None | vent to atmosphere | concrete slab | SS skirt bolted to concrete | welded | flanged |
| Load-in tank 59A-TK-1 | None | vent to atmosphere | concrete slab | bolted to concrete | none | flanged |
| Surge tank | None | vacuum breaker valve/vent to VOG | reinforced concrete ring plus concrete slab | structural steel on concrete base | welded | flanged |
| pH adjustment tank | None | vent to VOG | concrete slab | carbon steel skirt | welded | flanged |
| First RO feed tank | None | vent to VOG | concrete slab | carbon steel skirt | welded | flanged |
| Second RO feed tank | None | vent to VOG | concrete slab | carbon steel frame | welded | flanged |
| Effluent pH adjustment tank | None | vent to VOG | concrete slab | carbon steel skirt | welded | flanged |
| Verification tanks (3) | Epoxy | filtered vent to atmosphere | reinforced concrete ring plus concrete slab | structural steel on concrete base | welded | flanged |
| Secondary waste receiving tanks (2) | None | vent to VOG | concrete slab | carbon steel skirt | welded | flanged |
| Concentrate tanks (2) | None | vent to VOG | concrete slab | carbon steel skirt | welded | flanged |
| ETF evaporator (vapor body) | None | pressure indicator/pressure relief valve vapor vent to DFT/VOG | concrete slab | carbon steel frame | welded | flanged |
| Distillate flash tank | None | Pressure relief valve/vent to vent gas cooler/VOG | concrete slab | carbon steel I-beam and cradle | welded | flanged |
| Sump tank 1 | None | vent to VOG | concrete containment | reinforced concrete containment basin | welded | flanged |
| Sump tank 2 | None | vent to VOG | concrete containment | reinforced concrete containment basin | welded | flanged |

DFT = distillate flash tank
VOG = vessel off gas system

## Table C.7. Ancillary Equipment and Material Data

| System | Ancillary Equipment | Number | Material |
|---|---|---|---|
| Load-in tanks | Load-in/transfer pumps (2) | 2025ED-P-103A/-103B | 316 SS |
| | | 2025ED-P-001A/-001B | Cast iron |
| | Load-in filters (6) | 59A-FL-001/-002/-003/ -004/-005/-006 | 304 SS |
| Surge tank | Surge tank pumps (3) | 2025E-60A-P-1A/-1B/-1C | 304 SS |
| Rough filter | Rough filter | 2025E-60B-FL-1 | 304 SS |
| UV/OX | UV oxidation inlet cooler | 2025E-60B-E-1 | 316 SS |
| | UV oxidizers (4) | 2025E-60D-UV-1A/-1B/-2A/-2B | 316 SS |
| pH adjustment | pH adjustment pumps (2) | 2025E-60C-P-1A/-1B | 304 SS |
| Peroxide decomposer | H2O2 decomposers (2) | 2025E-60D-CO-1A/-1B | CS with epoxy coating |
| Fine filter | Fine filter | 2025E-60B-FL-2 | 304 SS |
| Degasification | Degasification column inlet cooler | 2025E-60E-E-1 | 316 SS |
| | Degasification column | 2025E-60E-CO-1 | FRP |
| | Degasification pumps (2) | 2025E-60E-P-1A/-1B | 316 SS |
| RO | Feed/booster pumps (6) | 2025E-60F-P-1A/-1B/-2A/-2B/-3A/-3B | 304 SS |
| | Reverse osmosis arrays (21) | 2025E-60F-RO-01 through -21 | Membranes: polyamide<br>Outer piping: 304 SS |
| IX/Polishers | Polishers (3) | 2025E-60G-IX-1A/-1B-1C | CS with epoxy coating |
| | Resins strainers (3) | 2025E-60G-S-1A/-1B/-1C | 304 SS |
| Effluent pH adjustment | Recirculation/transfer pumps (2) | 2025E-60C-P-2A/-2B | 304 SS/PVC |
| Verification tanks | Return pump | 2025E-60H-P-1 | 304 SS |
| | Transfer pumps (2) | 2025E-60H-P-2A/-2B | |
| Secondary waste receiving tanks | Secondary waste feed pumps (2) | 2025E-60I-P-1A/-1B | 304 SS |
| ETF evaporator system | Feed/distillate heat exchanger | 2025E-60I-E-02 | Tubes: 316 SS<br>Shell: 304 SS |
| | Heater (reboiler) | 2025E-60I-E-01 | Tubes: alloy 625<br>Shell: 304 SS |
| | Recirculation pump | 2025E-60I-P-02 | 316 SS |
| | Concentrate transfer pump | 2025E-60I-P-04 | 316 SS |
| | Entrainment separator | 2025E-60I-DE-01 | Top section: 316 SS<br>Bottom section: alloy 625 |
| | Vapor compressor (incl. silencers) | 2025E-60I-C-01 | 304 SS |
| | Silencer drain pump | 2025E-60I-P-06 | 316 SS |
| | Level control tank | 2025E-60I-TK-5 | 304 SS |
| | Distillate flash tank pump | 2025E-60I-P-03 | 316 SS |
| Concentrate tanks | Concentrate circulation pumps (2) | 2025E-60J-P-1A/-1B | 316 SS |
| Thin film dryer | Concentrate feed pump | 2025E-60J-P-2 | 316 SS |
| | Thin film dryer | 2025E-60J-D-1 | Interior surfaces: alloy 625<br>Rotor and blades: 316 SS |
| | Powder hopper | 2025E-60J-H-1 | 316 SS |
| | Spray condenser | 2025E-60J-DE-01 | 316 SS |
| | Distillate condenser | 2025E-60J-CND-01 | Tubes: 304 SS<br>Shell: CS |
| | Dryer distillate pump | 2025E-60J-P-3 | 316 SS |
| Resin dewatering | Dewatering pump | 2025E-80E-P-1 | |

## Table C.8. Concrete and Masonary Coatings

| Location | Product Name | Applied Film Thickness, Estimated |
|---|---|---|
| **ETF Process and Container Storage Areas** | | |
| Floor: Topcoat | Steelcote Floor-Nu Finish[1] | 2 coats at 10-12 mils |
| Floor: Primer | Steelcote Monomid Hi-Build[1] | 2.0 mils |
| Walls to 7 feet, Doors & Jambs | Chemproof PermaCoat 4000 Vertical[2] | 2 coats at 12-16 mils |
| **Load-in Station Tank Pit** | | |
| Floor and Walls | Ameron Amercoat 351[3] | 2 coats at 8.0-12 mils |
| **Surge Tank and Verification Tank Berms** | | |
| Floors (and Walls at Surge Tank): Topcoat | KCC Corrosion Control Elasti-Liner I[4] | 80 mils |
| Floors (and Walls at Surge Tank): Primer | KCC Corrosion Control Techni-Plus E3[4] | 5.0-7.0 mils |

[1]Floor-Nu Finish and Monomid Hi-Build are trademarks of Steelcote Manufacturing, Incorporated
[2]PermaCoat is a trademark of Chemproof Polymers, Incorporated
[3]Amercoat is a trademark of Ameron International, Incorporated
[4]Elasti-Liner and Techni-Plus are trademarks of KCC Corrosion Control, Incorporated

## Table C.9. Geomembrane Material Specifications

| Property | Value |
|---|---|
| Specific gravity | 0.932 to 0.950 |
| Melt flow index | 1.0 g/10 min., maximum |
| Thickness (thickness of flow marks shall not exceed 200% of the nominal liner thickness) | 60 mil 310%<br>(1.5 mm 3 10%) |
| Carbon black content | 1.8 to 3%, bottom liner<br>2 to 3% top liner |
| **Tensile properties (each direction)** | |
| Tensile strength at yield | 21.5 kgf/cm width, minimum |
| Tensile strength at break | 32.2 kgf/cm width, minimum |
| Elongation at yield | 10%, minimum |
| Elongation at break | 500%, minimum |
| Tear resistance | 13.6 kgf, minimum |
| Puncture resistance | 31.3 kgf, minimum |
| Low temperature/brittleness | -400 C, maximum |
| Dimensional (%change each direction) | 32%, maximum |
| Environmental stress crack | 750 h, minimum |
| Water absorption | 0.1 maximum and weight change |
| Hydrostatic resistance | 316,000 kgf/m$^2$ |
| Oxidation induction time (200 C/l atm. $O_2$) | 90 minutes |

Reference: Construction Specifications (KEH 1990b). Format uses NSF 54 table for high-density polyethylene as a guide (NSF 1985). However, RCRA values for dimensional stability and environmental stress crack have been added.

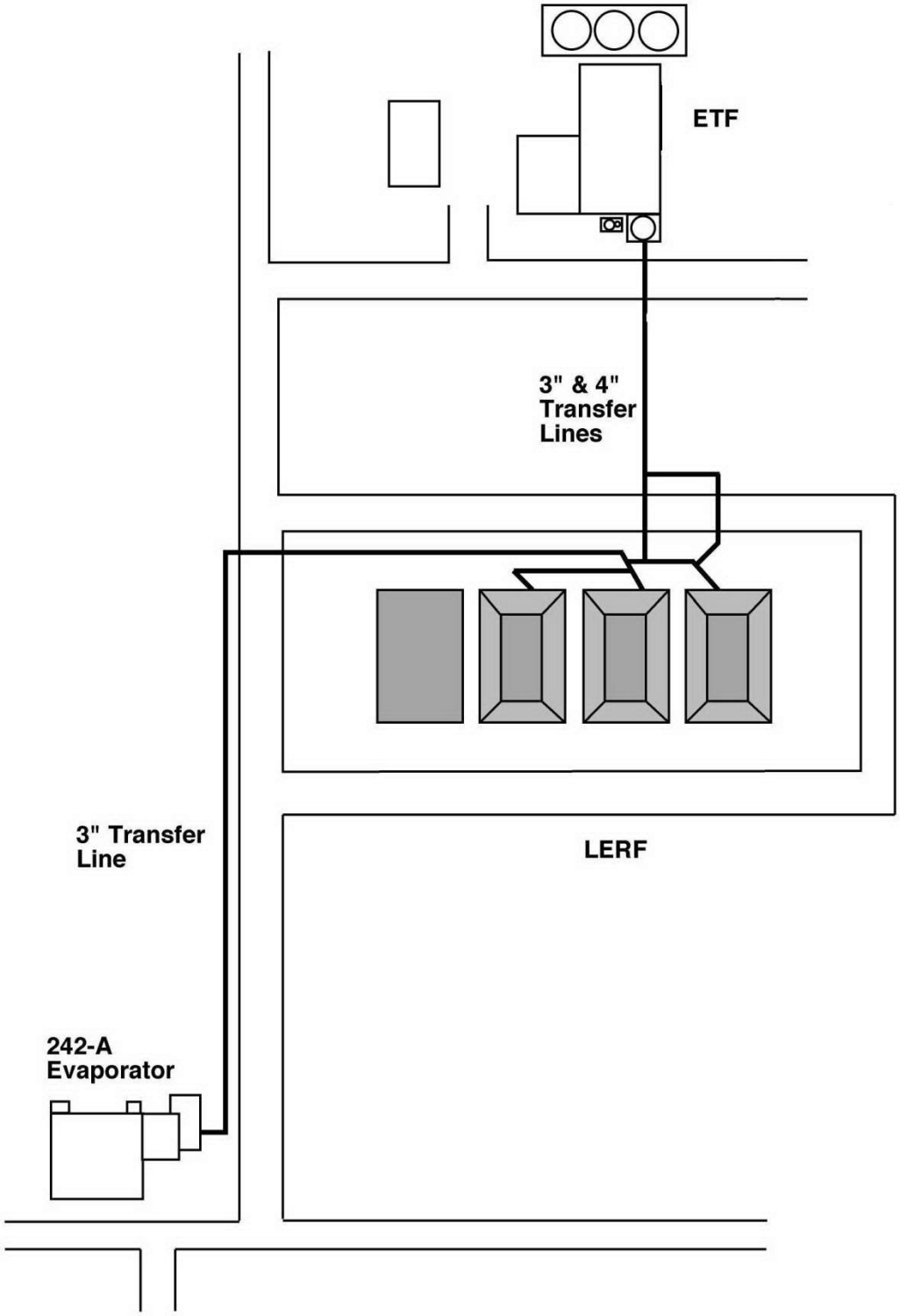
| | | | | | |
|---|---|---|---|---|---|
| % | = | percent | max | = | maximum |
| g | = | gram | kgf | = | kilograms force |
| min | = | minute | m | = | meters |
| h | = | hour | mm | = | millimeters |

**Table C.10. Drainage Gravel Specifications**

| Property | Value |
|---|---|
| **Sieve size** | |
| 25 millimeters | 100 wt% passing |
| 19 millimeters | 80 – 100 wt% passing |
| 9.5 millimeters | 10 – 40 wt% passing |
| 4.75 millimeters | 0 – 4 wt% passing |
| Permeability | 0.1 cm/sec, minimum |

Reference: Sieve size is from WSDOT M41-10-88, Section 9.03.1(3)C for Grading No. 5 (WSDOT 1988). Permeability requirement is from WAC 173-303-650(2)(j) for new surface impoundments.

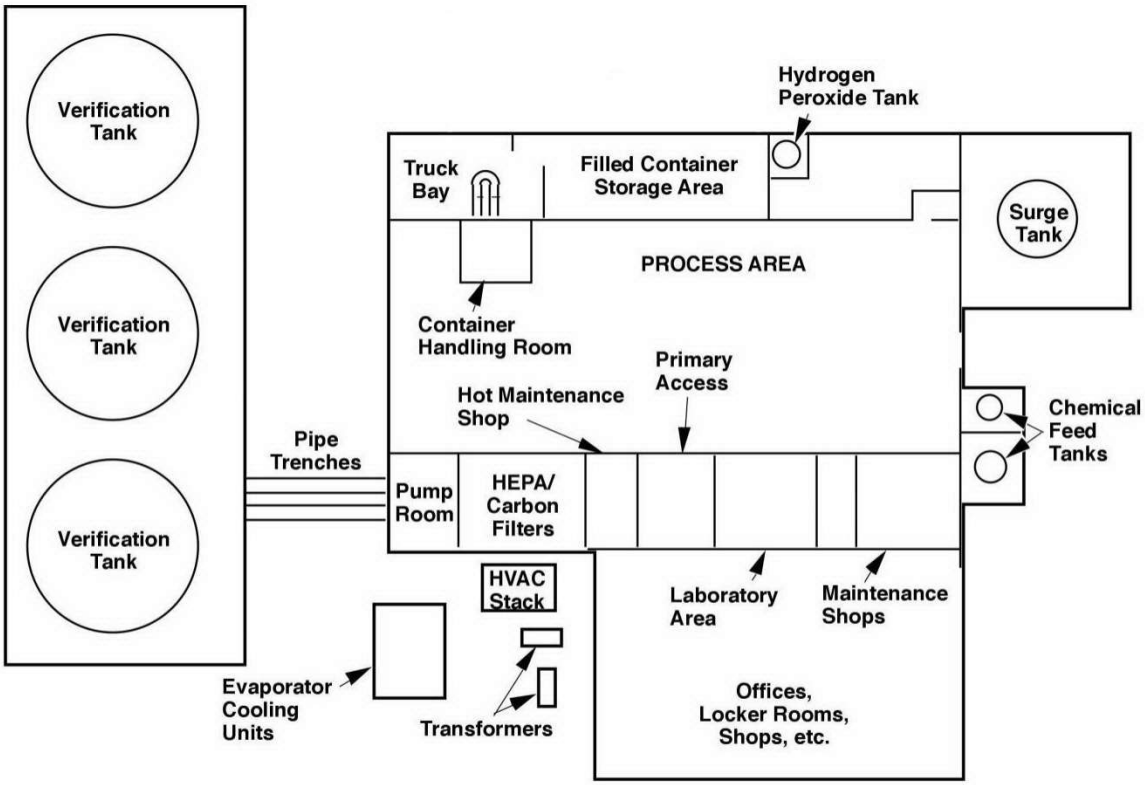
**Figure C.1. Liquid Effluent Retention Facility Layout**




**ETF = Effluent Treatment Facility**
**LERF = Liquid Effluent Retention Facility**

**M0704-3.5**
**4-21-07**

**Figure C.2. Plan View of the 200 Area Effluent Treatment Facility**




HEPA = High-efficiency particulate air
HVAC = Heating, ventilation, and air conditioning

M0704-3.6
4-24-07

**Figure C.3. 200 Area Effluent Treatment Facility Layout**

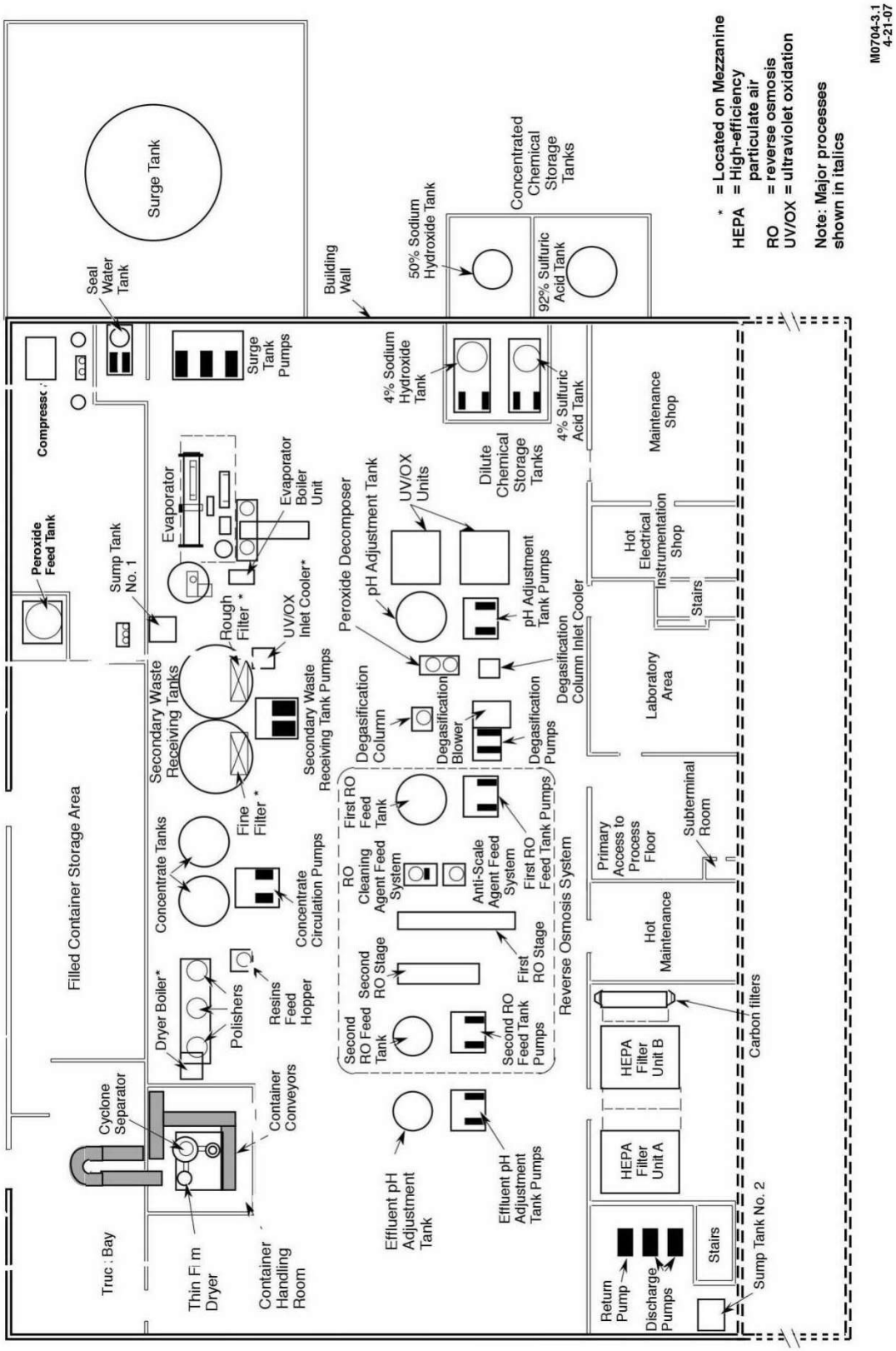


**Figure C.4. 200 Area Effluent Treatment Facility**

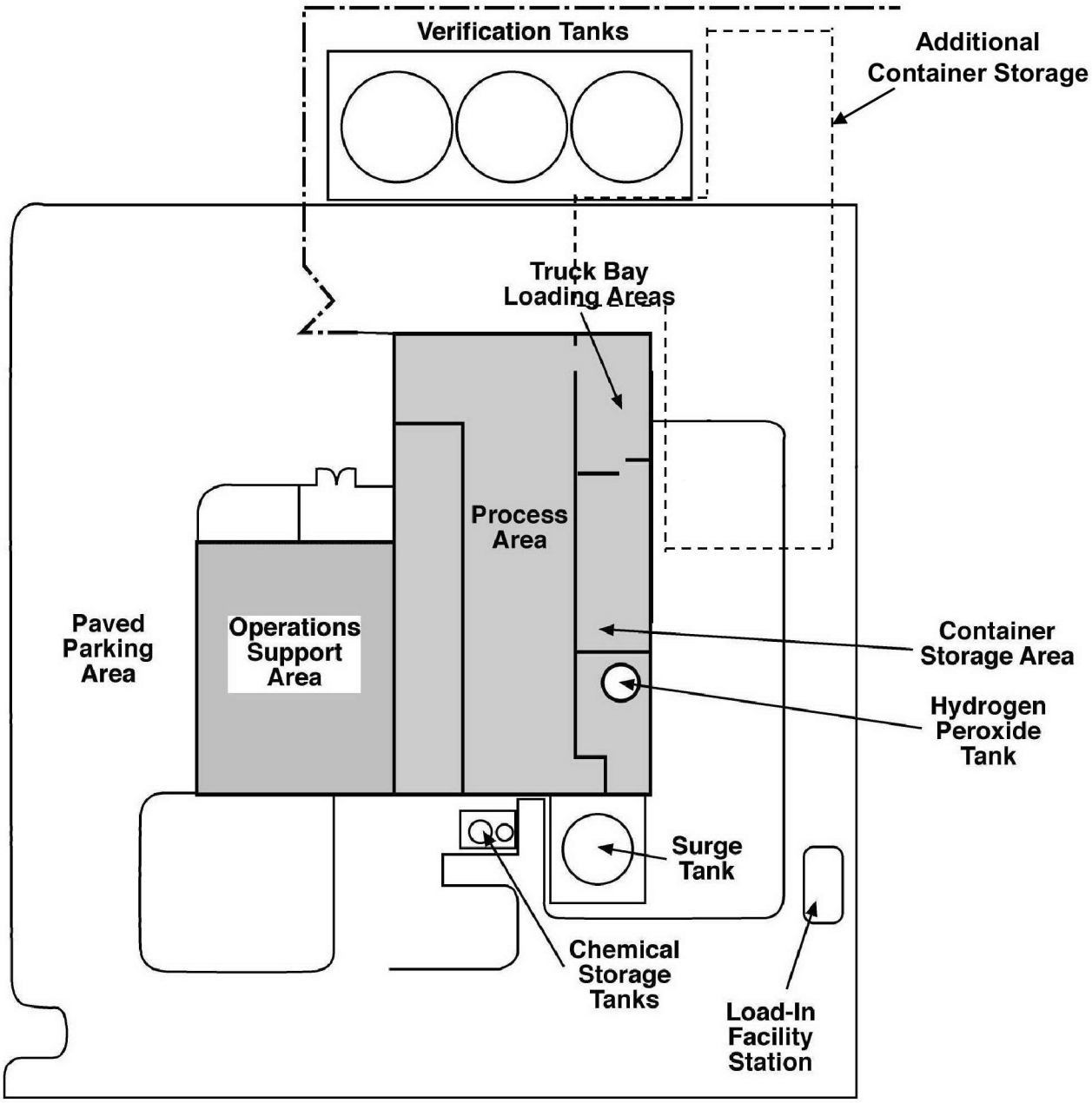
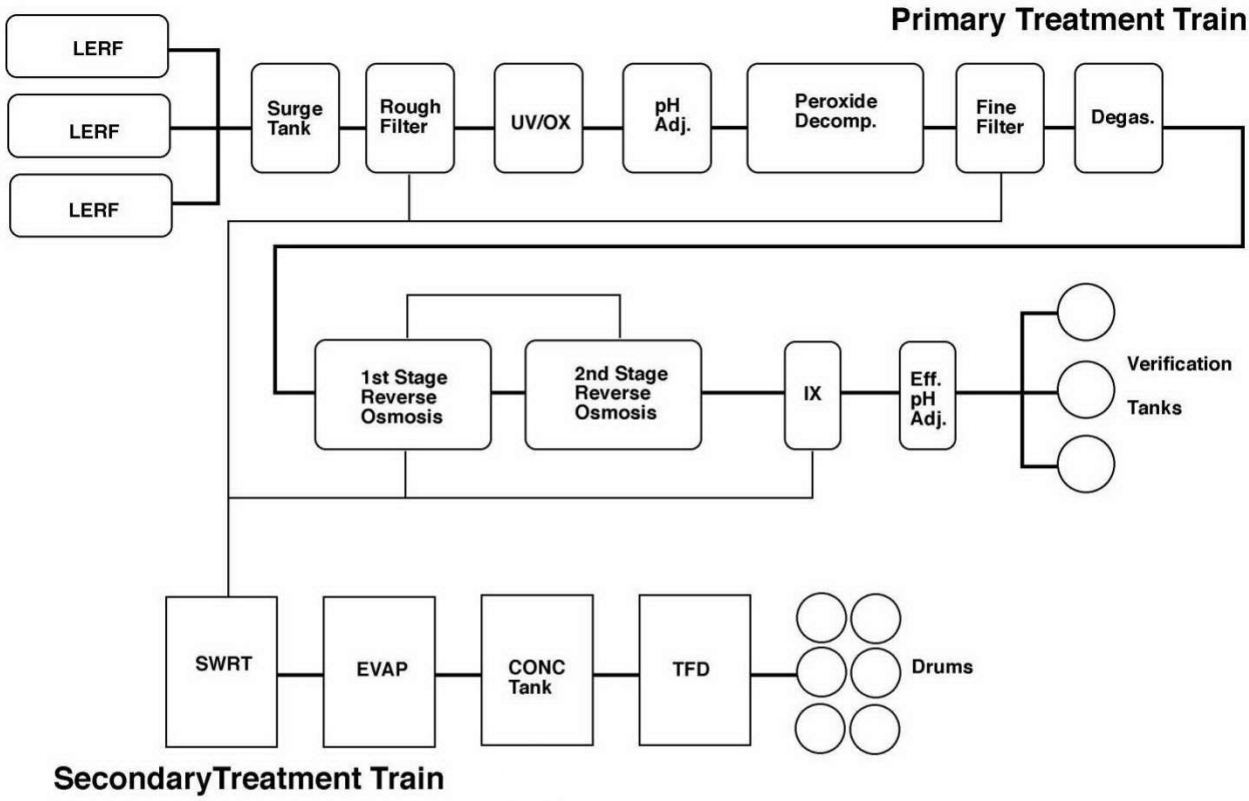


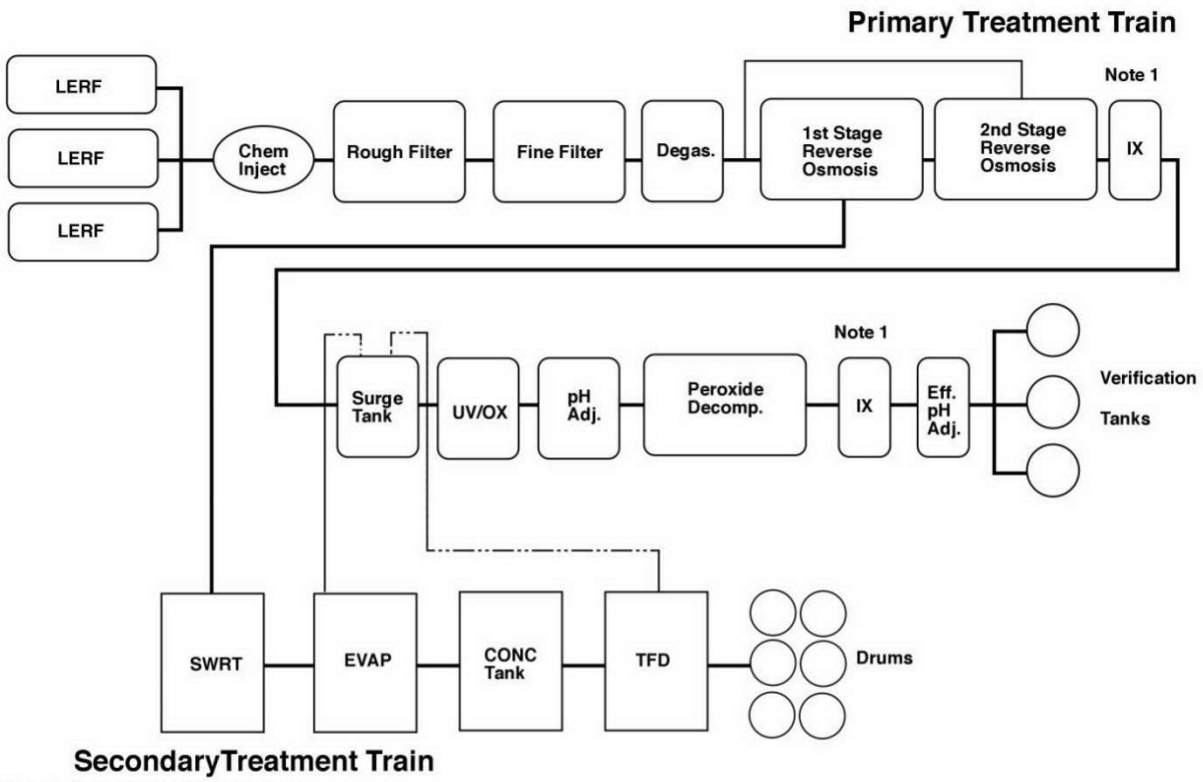
**Figure C.5. Example - 200 Area Effluent Treatment Facility Configuration 1**




CONC Tank = Concentrate tank
Degas. = Degasification column
Eff. pH Adj. = Effluent pH adjustment tank
EVAP = Evaporator
IX = Ion Exchange
LERF = Liquid Effluent Retention Facility
pH Adj. = pH adjustment tank
SWRT = Secondary waste receiving tank
TFD = Thin film dryer
UV/OX = Ultraviolet Oxidation

M0704-3.8
4-21-07

**Figure C.6. Example - 200 Area Effluent Treatment Facility Configuration 2**




Note1: IX can be in either location
CONC Tank = Concentrate tank
Degas. = Degasification column
Eff. pH Adj. = Effluent pH adjustment tank
Evap = Evaporator
IX = Ion exchange
pH Adj. = pH adjustment tank
SWRT = Secondary waste receiving tank
TFD = Thin film dryer
UV/OX = Ultraviolet Oxidation

M0704-3.2
4-21-07

**Figure C.7. Surge Tank**

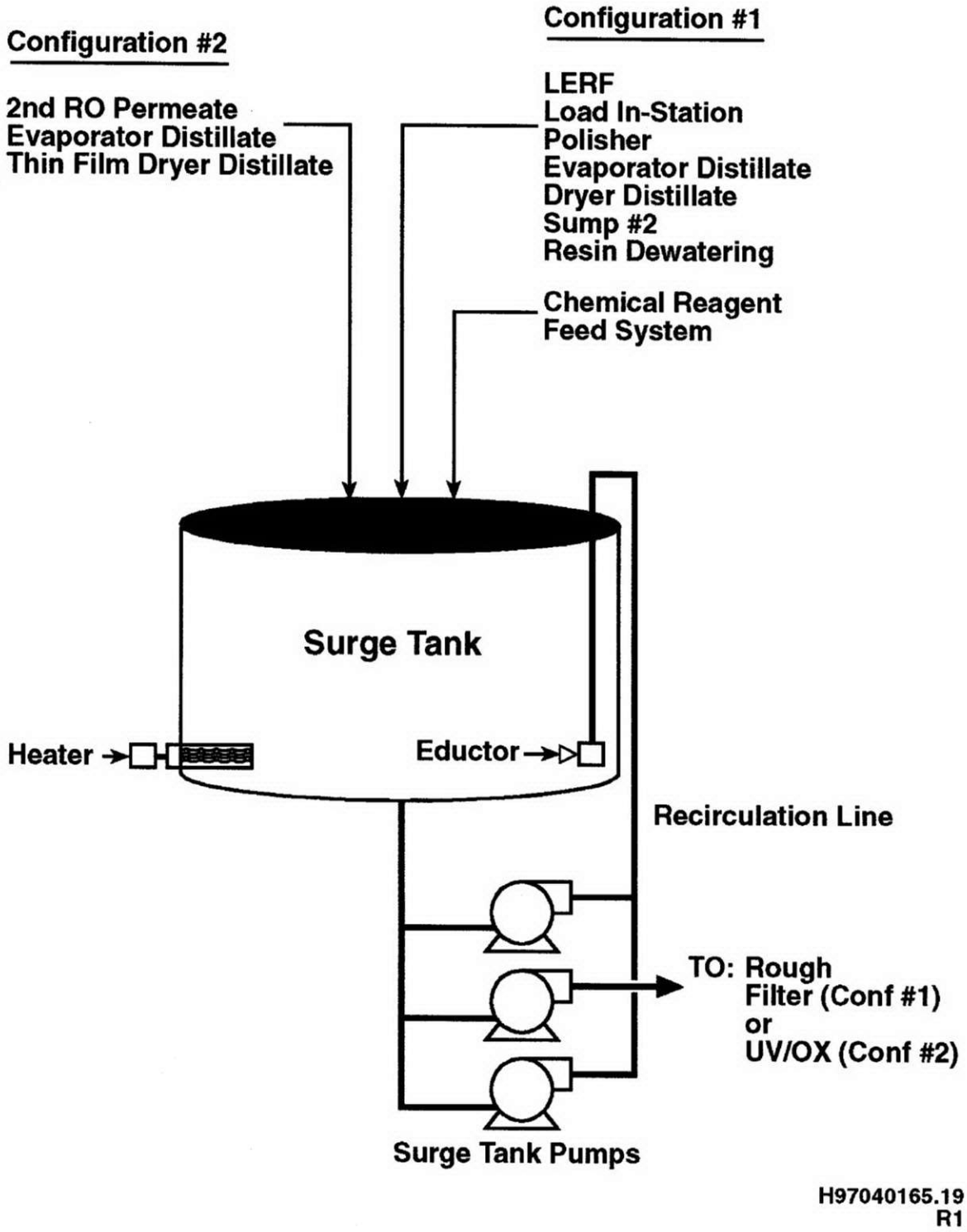


**Figure C.8. Ultraviolet Light/Oxidation Unit**

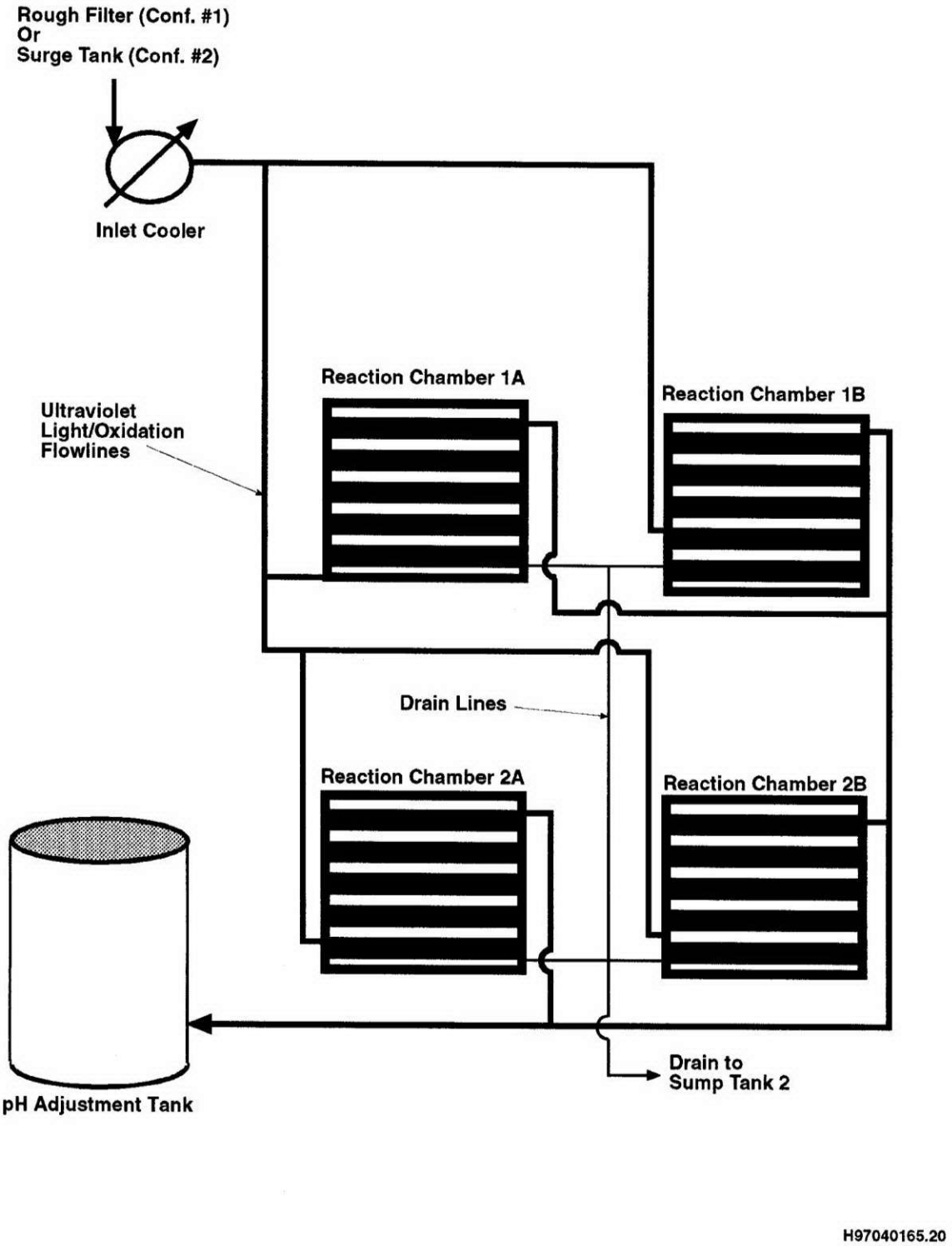


**Figure C.9. Reverse Osmosis Unit**

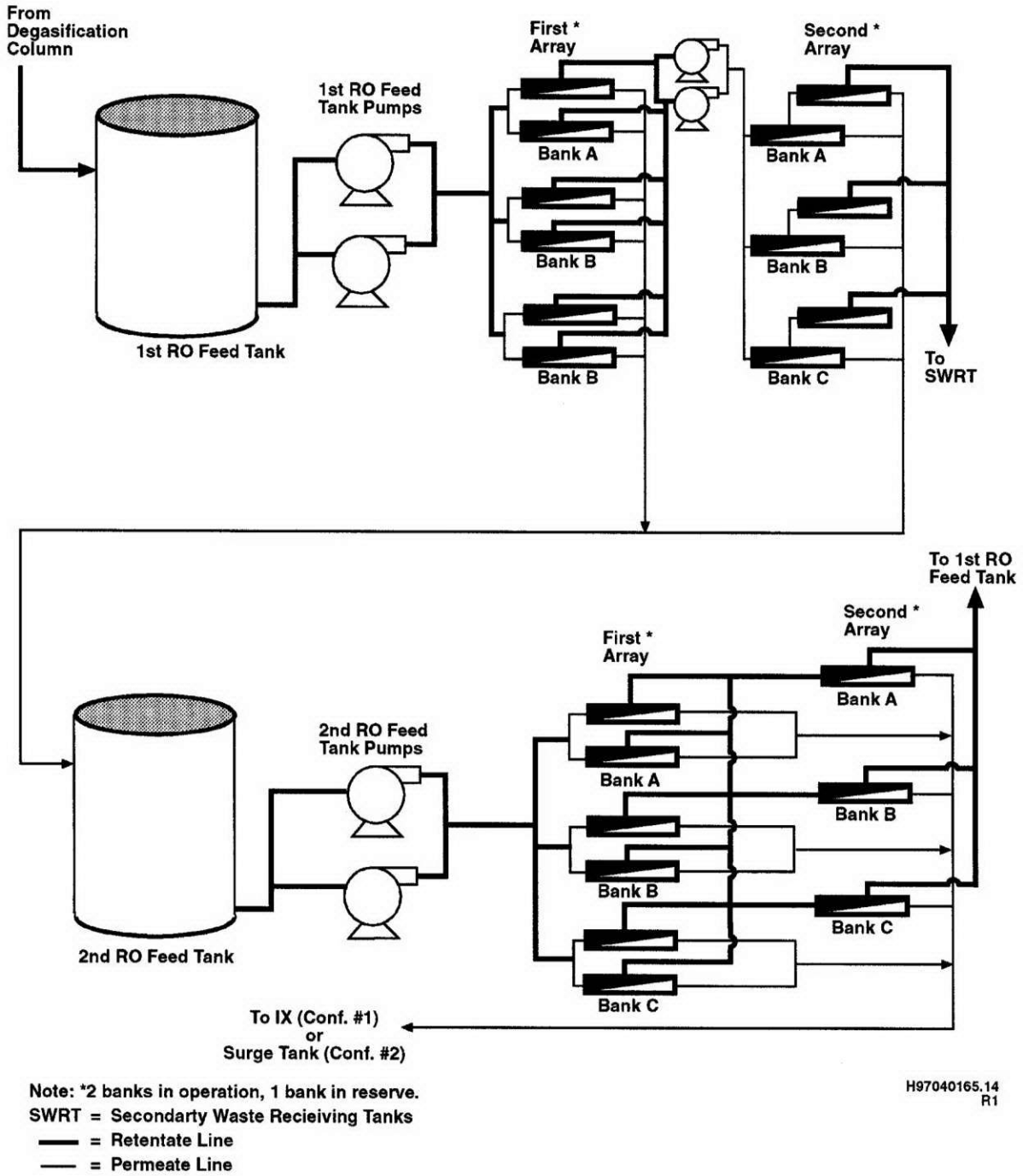
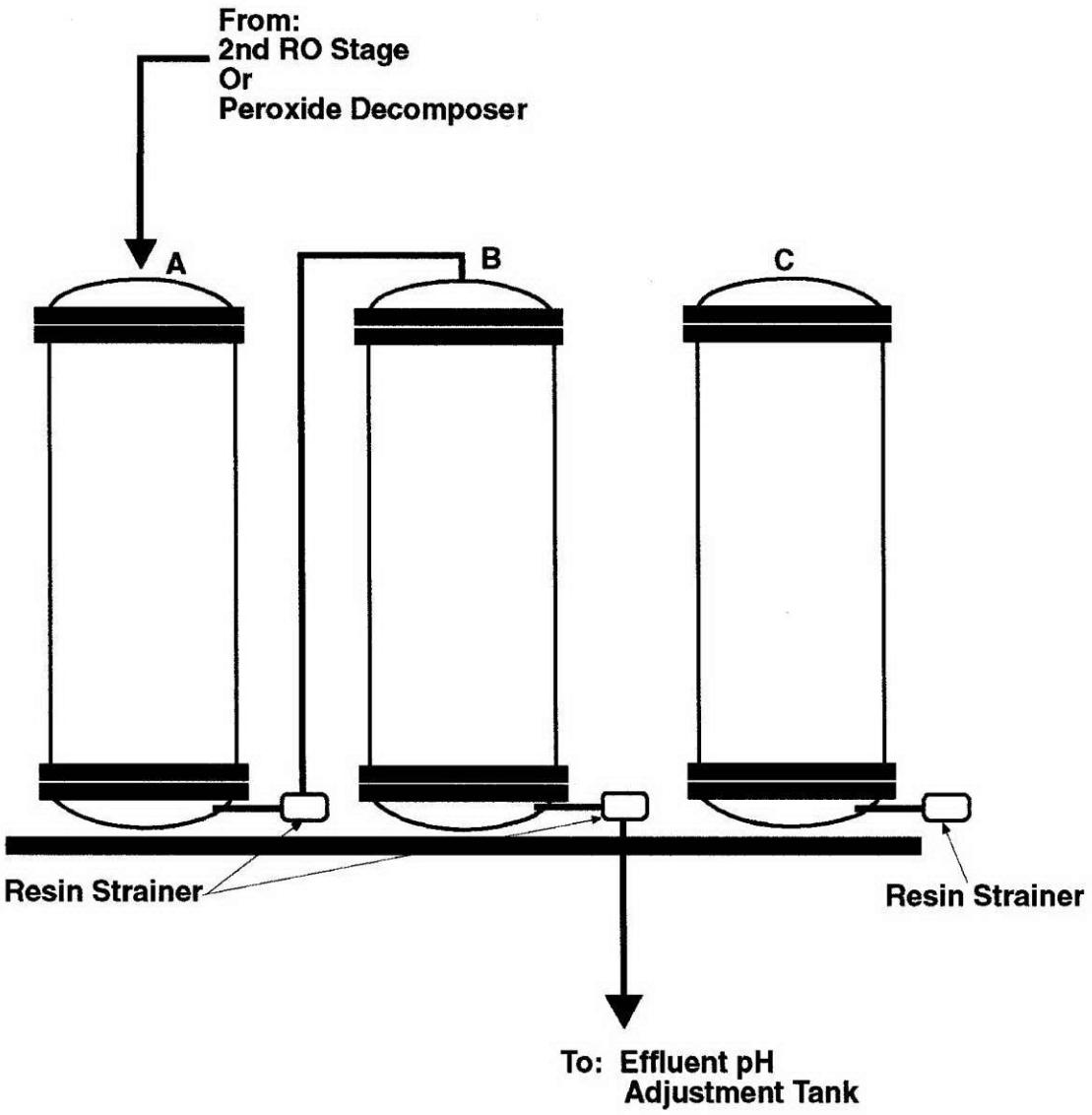


**Figure C.10. Ion Exchange Unit**




**NOTE: Example Configuration- Column A and B in Operation, Column C in Standby Mode**

H97040165.18

**Figure C.11. Verification Tanks**

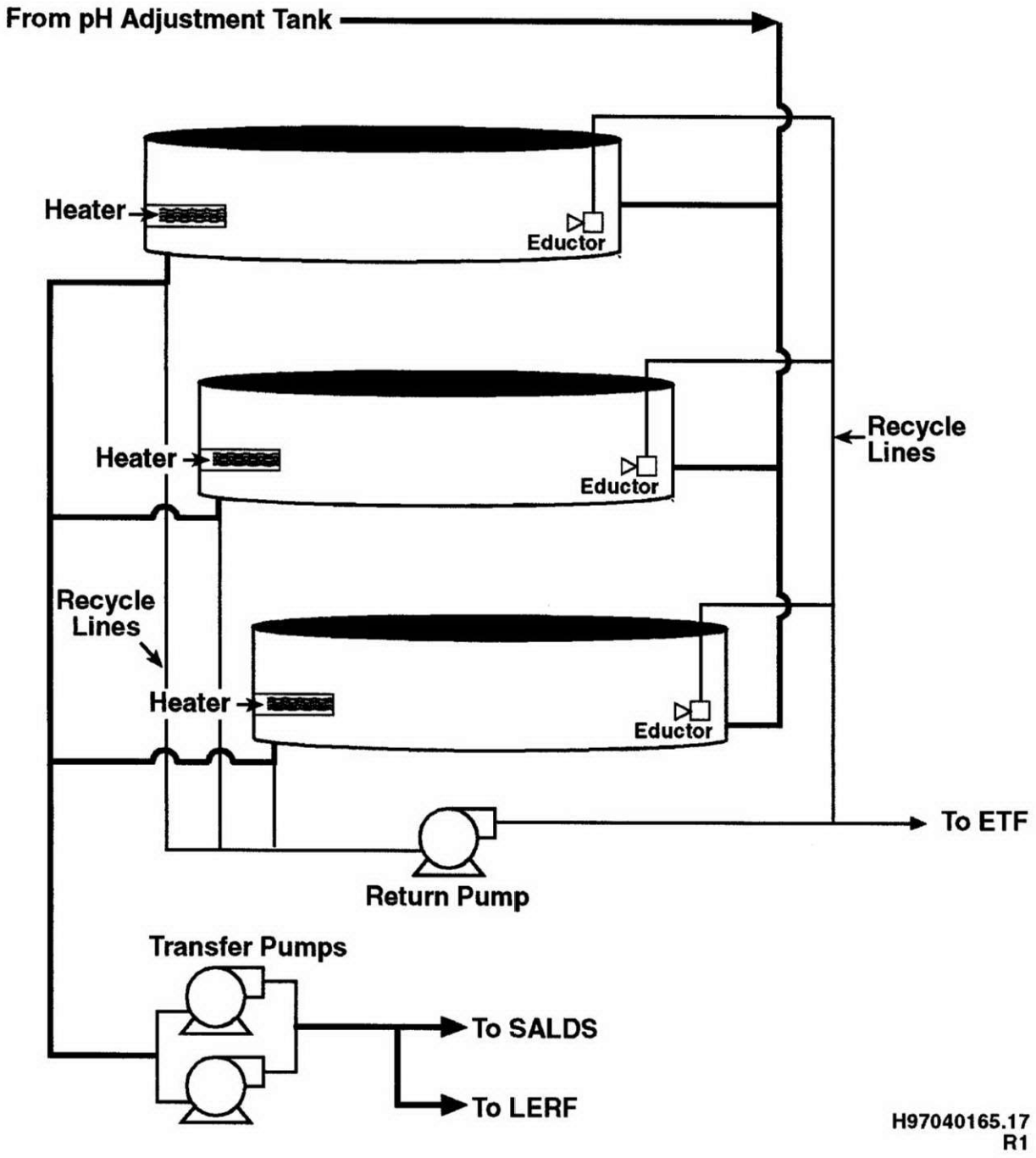


**Figure C.12. Effluent Treatment Facility Evaporator**

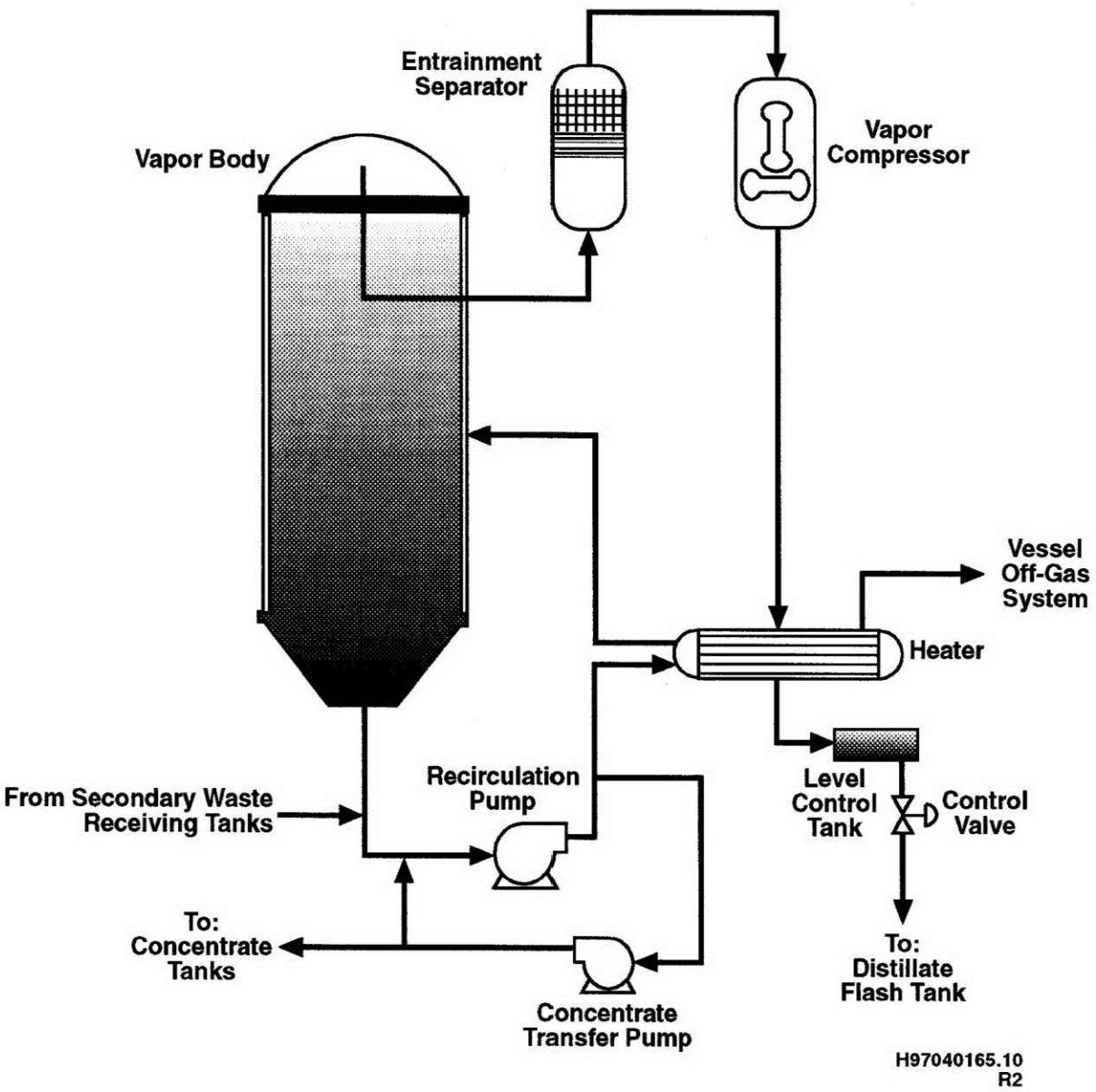


**Figure C.13. Thin Film Dryer**

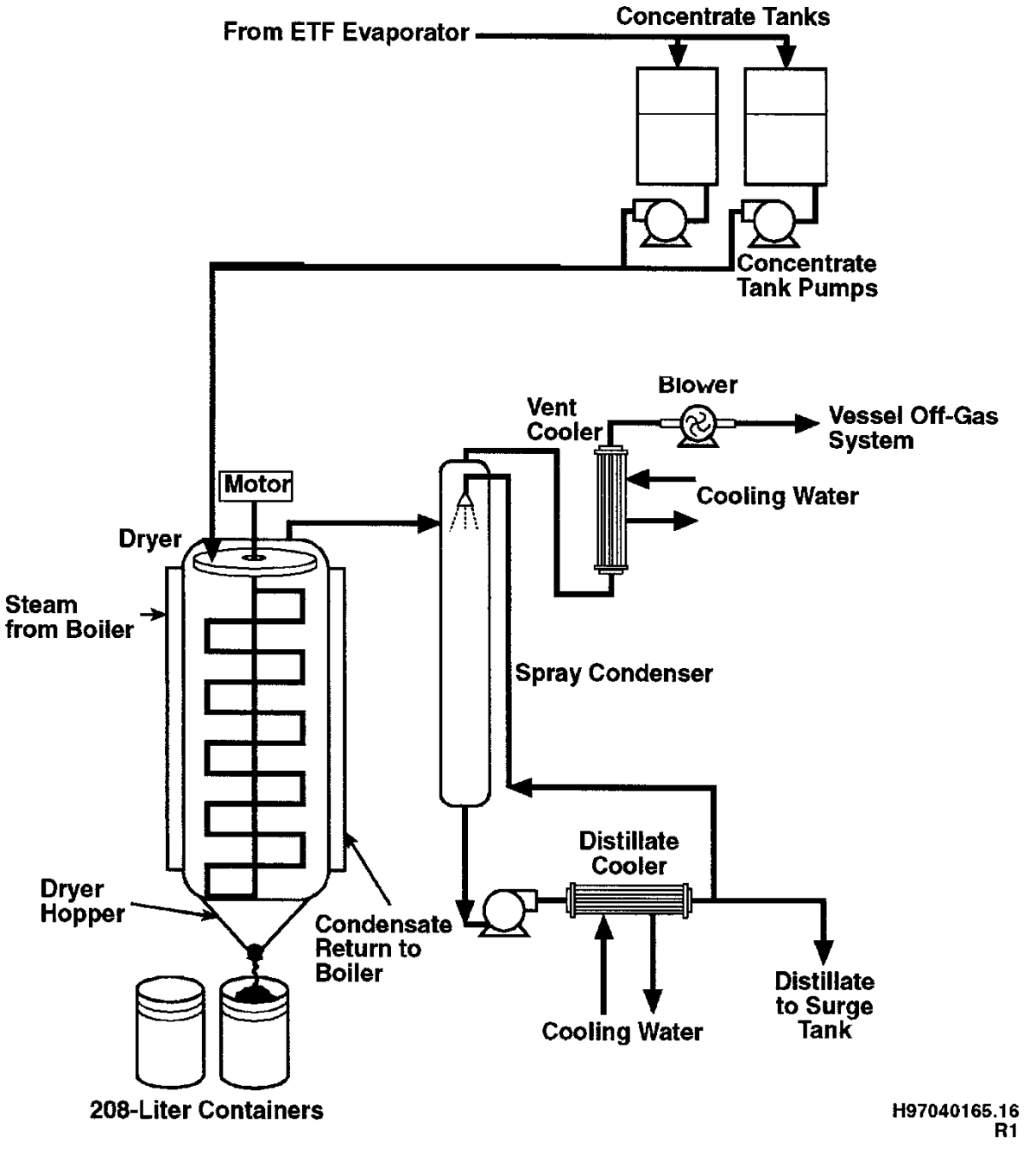
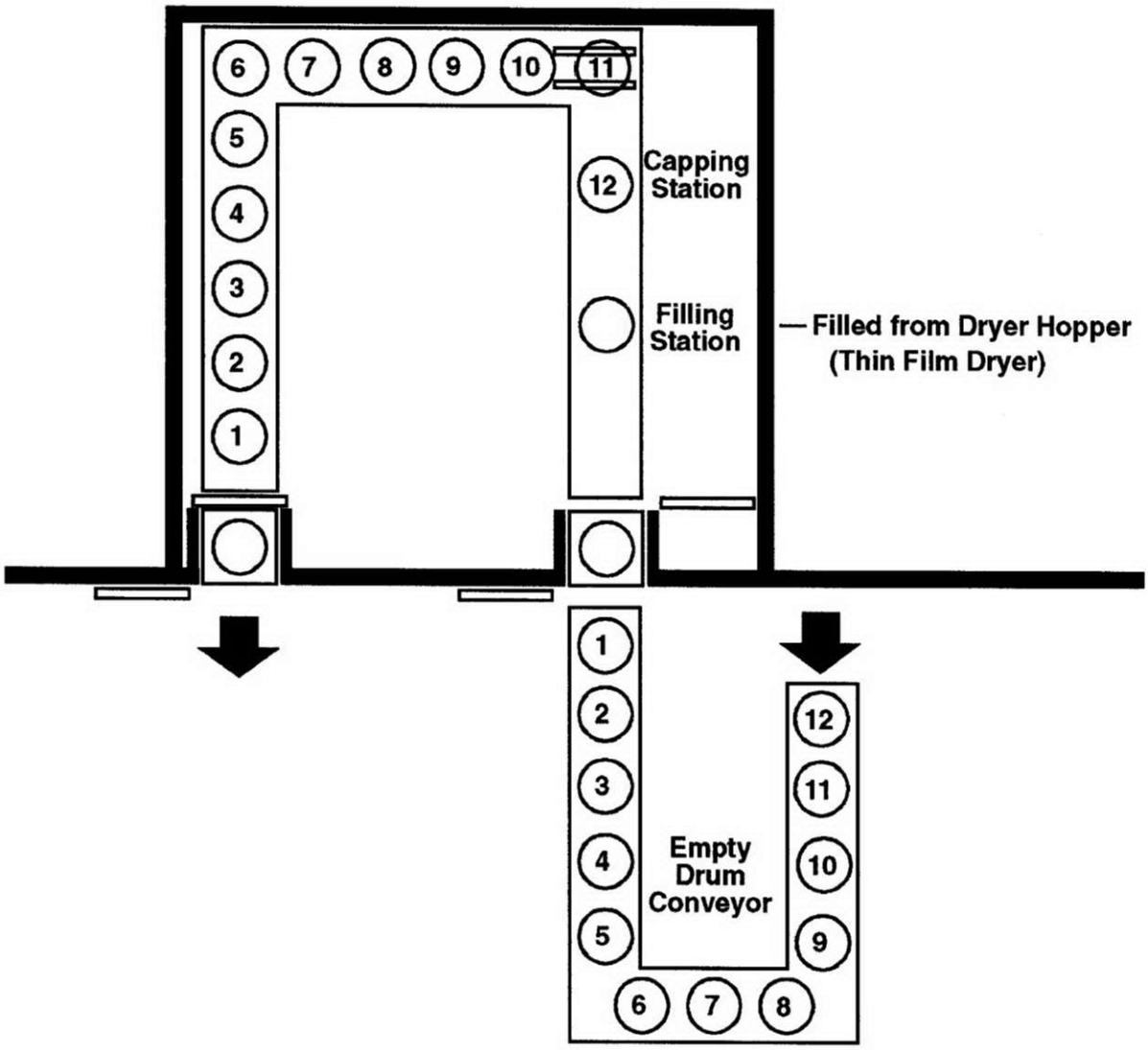


**Figure C.14. Container Handling System**




H97040165.15
R1

**Figure C.15. Effluent Treatment Facility Sump Tanks**

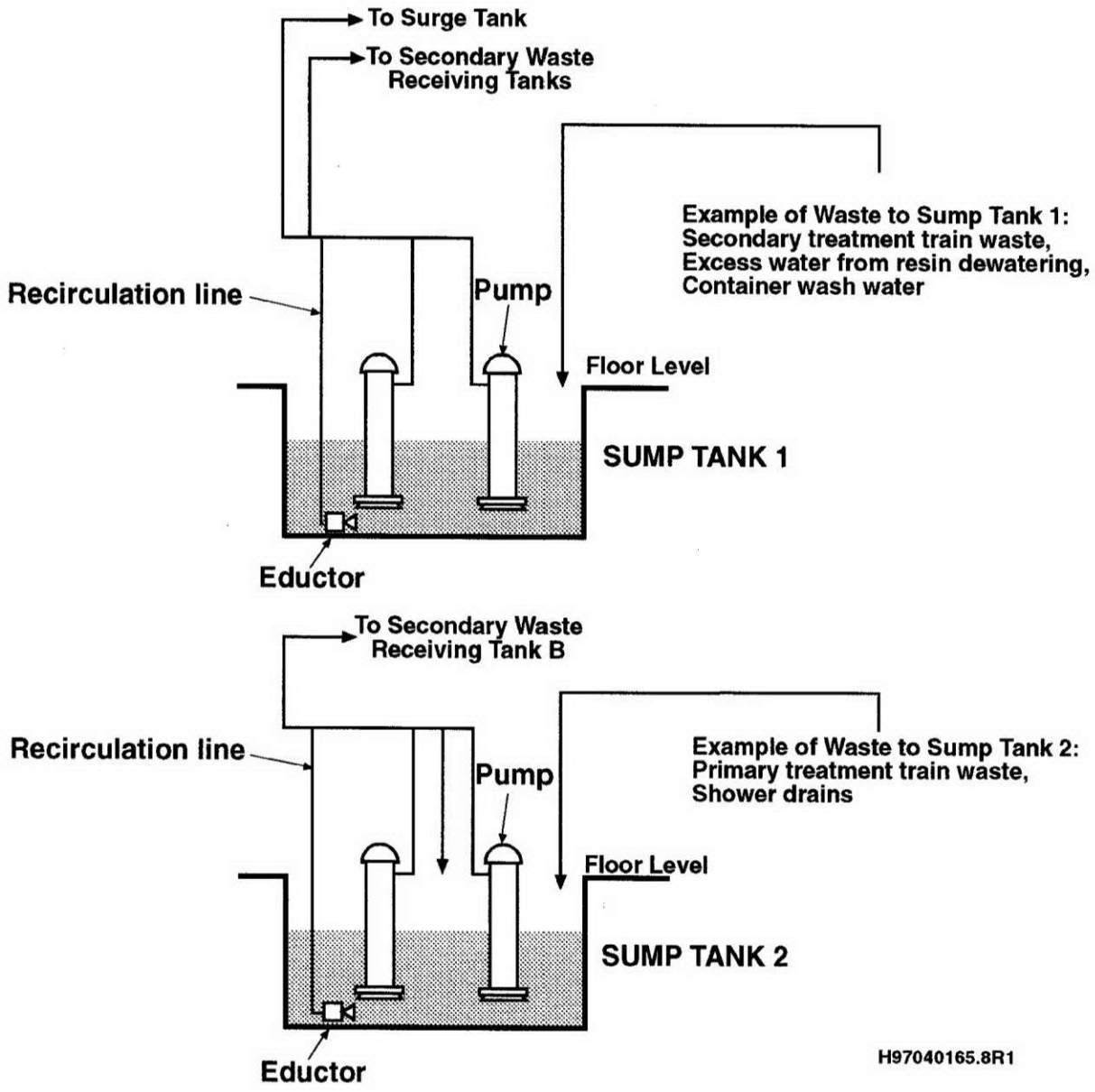


**Figure C.16. Liner Anchor Wall and Cover Tension System**

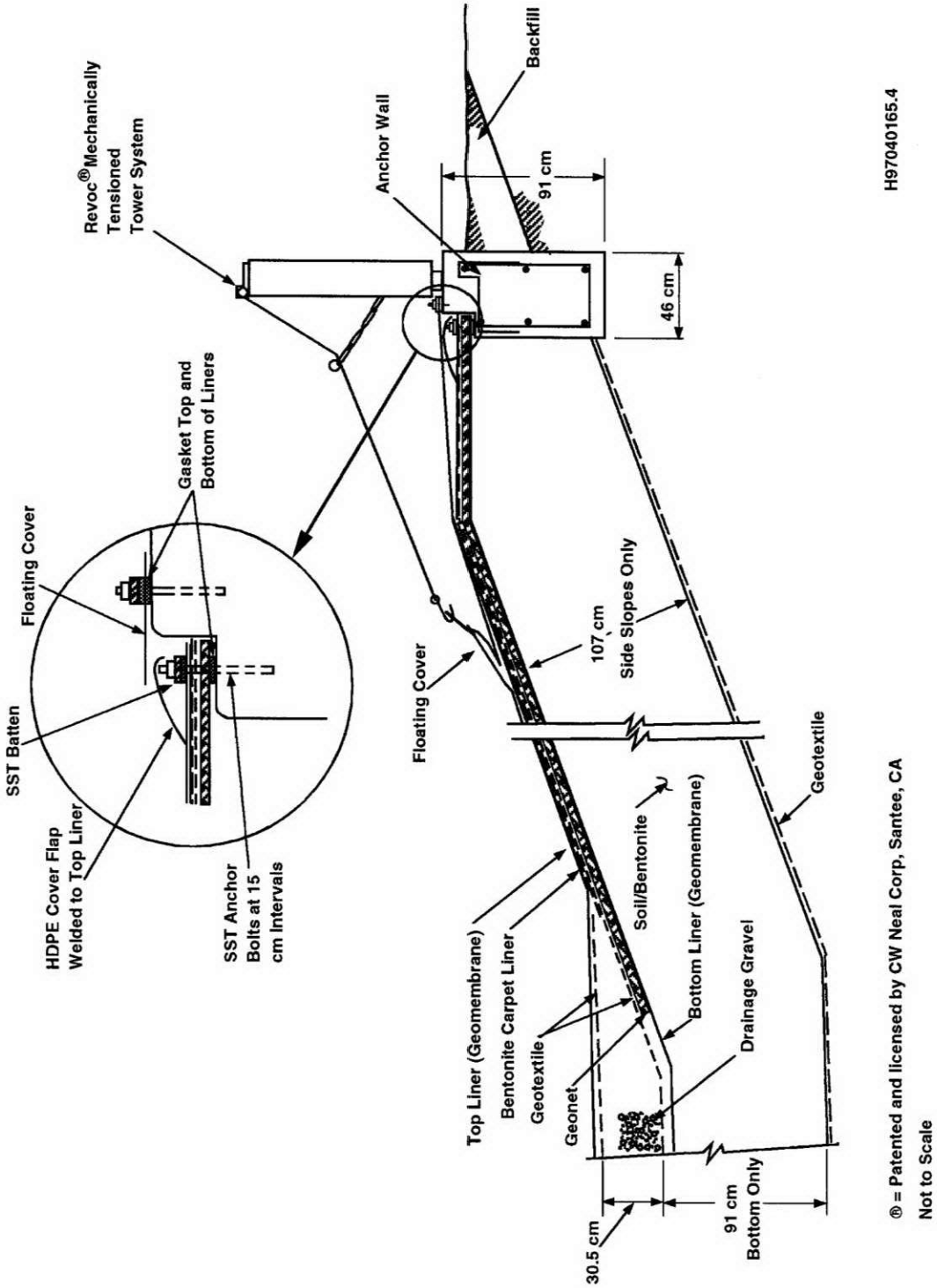


**Figure C.17. Liner System Schematic**

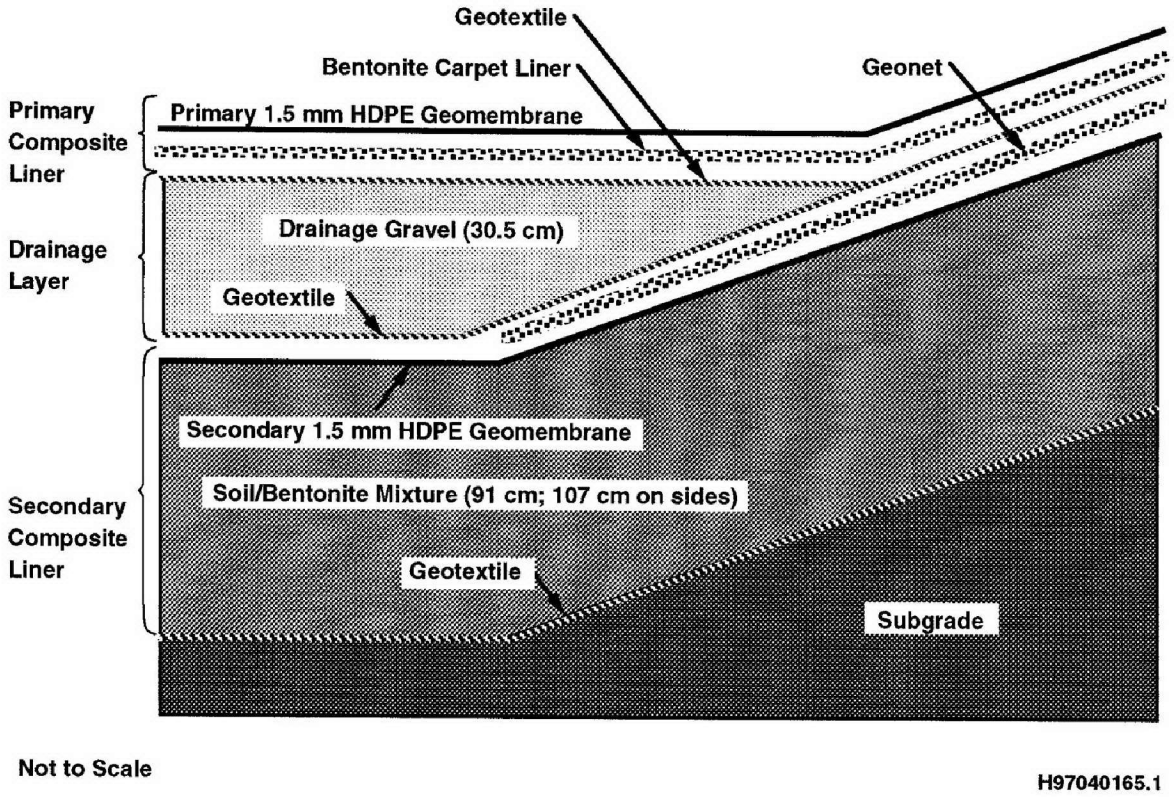
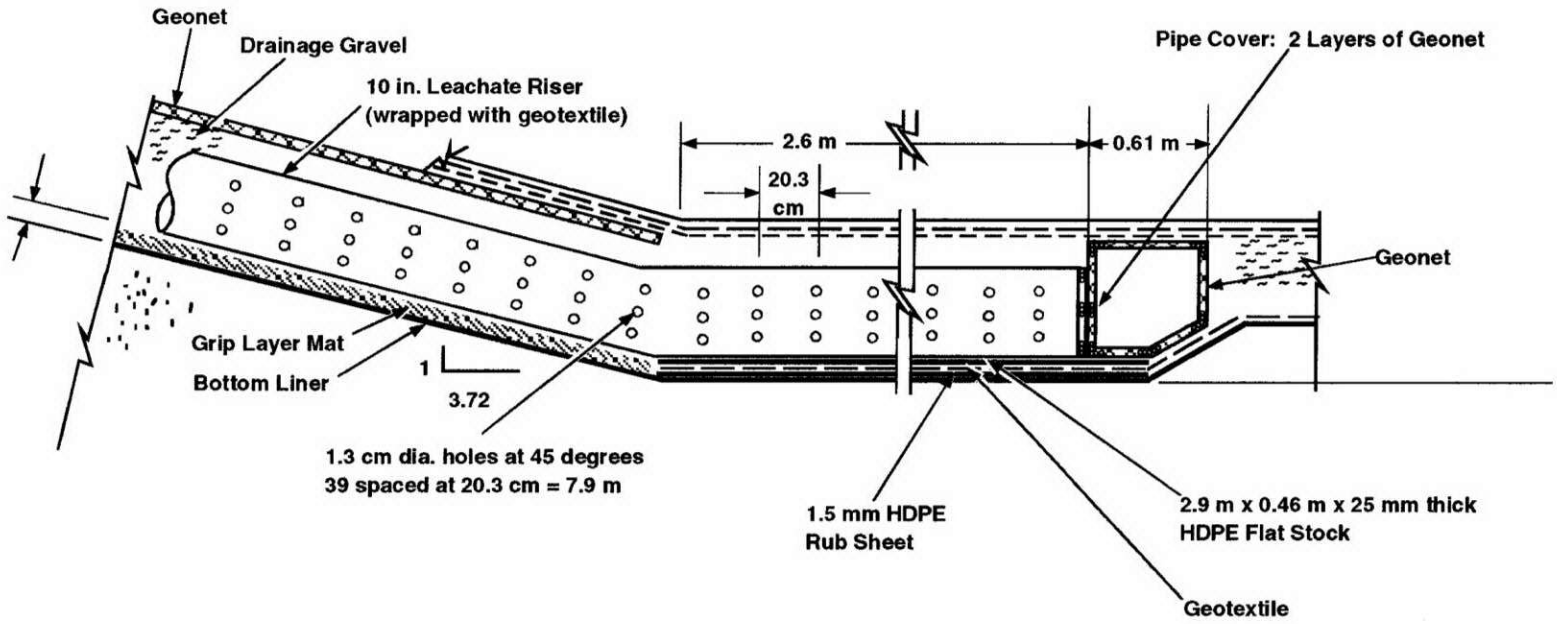


**Figure C.18. Detail of Leachate Collection Sump**




## Section View

HDPE: High Density Polyethylene

Not to Scale

H97040165.3

## Addendum I Inspection Requirements

I. INSPECTION REQUIREMENTS ..... I.1

I.1 INSPECTION PLAN ..... I.1
I.1.1 General Inspection Requirements ..... I.1
I.1.2 Specific Process Inspection Requirements ..... I.1
I.1.3 Inspection Log ..... I.4
I.1.4 Storage of Ignitable or Reactive Wastes ..... I.4

## Tables

Table I.1. Visual Inspection Schedule for the LERF and 200 Area ETF ..... I.5
Table I.2. Inspection Plan for Instrumentation Monitoring ..... I.7

This page intentionally left blank.

# I. INSPECTION REQUIREMENTS

## I.1 INSPECTION PLAN

This addendum describes the method and schedule for inspections of LERF and 200 Area ETF. The purpose of inspections is to help ensure that situations do not exist that might cause or lead to the release of dangerous and/or mixed waste that could pose a threat to human health and the environment. Abnormal conditions identified by an inspection will be corrected on a schedule that prevents hazards to workers, the public, and the environment.

### I.1.1 General Inspection Requirements

The content and frequency of inspections are described in this section. Inspection records are retained in the Hanford Facility Operating Record, LERF and 200 Area ETF file, or other approved locations, in accordance with Permit Condition II.I.1.

In certain areas of the 200 Area ETF, many inspections are performed remotely to maintain ALARA exposure. Monitoring instruments are connected to audible alarms and visual indicators track alarm status. The monitoring system provides trending of selected monitoring data, graphics, and equipment summary displays.

A preventive maintenance recall system is employed to direct preventive maintenance activities at the LERF and 200 Area ETF. Equipment requiring maintenance is checked as indicated by the maintenance history and the manufacturer's recommendations. The preventive maintenance of certain equipment might not be possible if the LERF or the 200 Area ETF is in an operational mode. Thus, the preventive maintenance could be performed slightly earlier or later than planned to minimize impact on operations.

Instrumentation at 200 Area ETF is calibrated regularly to ensure accuracy and reliability. All process control instrumentation is calibrated on a schedule depending on previous calibration experience. An instrument calibration and recall system is employed to manage calibrations.

#### I.1.1.1 Types of Problems

Key components of the LERF inspection program include the following areas:

- Structural integrity of the basins
- Catch basin secondary containment system integrity
- Evidence of release from basins
- Safety, communications, and emergency equipment

Key components of the 200 Area ETF inspection program include the following areas:

- Condition of tanks and ancillary piping
- Condition of containers
- Condition of the process control equipment
- Condition of emergency equipment
- Condition of secondary containment

Table I.1 and Table I.2 provide a description of LERF and 200 Area ETF items to be inspected.

#### I.1.1.2 Frequency of Inspections

The frequency of inspections is based on the rate of possible deterioration of equipment and the probability of a threat to human health or the environment.

The LERF and 200 Area ETF is inspected as indicated in Table I.1 and Table I.2.

### I.1.2 Specific Process Inspection Requirements

The following sections describe the specific process inspections performed at LERF and 200 Area ETF.

#### I.1.2.1 Container Inspections

Containers are used at the 200 Area ETF to store solidified secondary waste, such as the powder waste from the thin film dryer and maintenance and operations waste. When containers are being held in container storage areas, the following inspection schedule is maintained:

- Daily visual inspection of container storage area for leaks, spills, accumulated liquids, and open or improperly sealed containers
- Weekly visual inspection of container labels to ensure labels are not obscured, removed, or otherwise unreadable
- Weekly visual inspection for deterioration of containers, containment systems, or cracks in protective coating or foundations caused by corrosion, mishandling, or other factors.

Following the inspections, an inspection datasheet is signed and dated by the inspector and supervisor.

#### I.1.2.2 Tank Inspections

A description of the tank systems and ancillary equipment at the 200 Area ETF is given in Addendum C. Inspections and frequencies are given in Table I.1 and Table I.2. This section includes a brief discussion of the inspections.

##### I.1.2.2.1 Overfill Protection

Tanks that have the possibility of being overfilled have level instrumentation that alarms before the tanks reach overflow. High tank level alarms annunciate in the control room, allowing operating personnel to take immediate action to stop the vessels from overfilling. These alarms are monitored continuously in the control room during solution transfers.

##### I.1.2.2.2 Visual Inspections

Visual inspections of tanks and secondary containments are performed to check for leaks, signs of corrosion or damage, and malfunctioning equipment. Inspections are performed on tanks, secondary containment within the 200 Area ETF, surge tank, and verification tank, and associated secondary containment.

##### I.1.2.2.3 Secondary Containment Leak Detectors

The surge tank and verification tank secondary containment systems have sloped floors that drain solution to sumps equipped with leak detectors that alarm in the control room. These alarms are monitored continuously in the control room. If an alarm is activated, further investigation is performed to determine if the source is a tank leak or other solution (i.e., precipitation).

##### I.1.2.2.4 Integrity Assessments

The initial integrity assessment was issued in 1995 (Addendum C). Consistent with the recommendations of the integrity assessment, a periodic integrity assessment program was developed for the 200 Area ETF tanks and is discussed in detail in Addendum C, Section C.4.2.

##### I.1.2.2.5 Effluent Treatment Facility Piping

The 200 Area ETF employs an extensive piping system. During inspections at the 200 Area ETF, any aboveground piping is inspected visually for signs of leakage and for general structural integrity. During the visual inspection, particular attention is paid to valves and fittings for signs of cracking, deformation, and leakage.

#### I.1.2.3 Surface Impoundments and Condition Assessment

The following describes the surface impoundment inspections performed at LERF.

#### I.1.2.3.1 Overtopping Control

Under current operating conditions, 1.34 meters of freeboard is maintained at each LERF basin, which corresponds to a normal operating level of 6.1 meters, or 24.6 million liters. Level indicators at each basin are monitored to confirm that this level is not exceeded.

Before an aqueous waste is transferred into a basin, administrative controls are implemented to ensure overtopping will not occur during the transfer. The volume of feed to be transferred is compared to the available volume in the receiving basin. The transfer is not initiated unless there is sufficient volume available in the receiving basin or a cut-off level is established. The transfer into the basin would be stopped when this cut-off level is reached.

The LERF basins also are provided with floating very low-density polyethylene covers that are designed and constructed to prevent overtopping by the introduction of precipitation and dust into the basins. Overtopping and flow control also are discussed in Addendum C.

#### I.1.2.3.2 Impoundment Contents

The LERF basins are inspected weekly to assess whether the contents are escaping from a basin. Level indicators are inspected weekly to check for unaccountable change in the level of the basins.

#### I.1.2.3.3 Leak Detection

The leachate detection, collection, and removal system is described in Addendum C. The leachate collection sump pump is activated automatically when the liquid level in the leachate sump reaches a preset level. A flow meter and totalizer measure the amount of leachate removed. An inspection is performed weekly where the totalizer reading and basin level reading are used to determine the leak rate per wetted surface area. The leak rate is compared to previous rates to see if leakage has increased.

The LERF employs a double walled transfer piping between 242-A Evaporator and LERF and between LERF and 200 Area ETF. The WAC 173-303-650 regulations do not require a discussion of piping for surface impoundments. However, for the purposes of comprehensive coverage of the LERF, inspections and integrity assessments are performed on the piping system. Aqueous waste (e.g., process condensate) is transferred from the 242-A Evaporator to the LERF via a buried pipeline. Likewise, aqueous waste is transferred to the 200 Area ETF via buried pipelines. At the LERF dikes, aboveground piping serves to transfer waste from one basin to another.

The buried pipelines normally are continuously monitored during transfers by a leak detection system (Addendum C). The alarms on the leak detection system are monitored in the 200 Area ETF control rooms. As an alternative to continuous leak detection, the transfer lines can be inspected daily during transfers by opening the secondary containment drain lines at the LERF catch basins (for 242-A Evaporator transfers to LERF) and the surge tank (for LERF transfers to 200 Area ETF) to inspect for leakage. During the routine inspections at LERF, the aboveground piping system is inspected for signs of leakage and for general structural integrity. During the visual inspection, particular attention is paid to valves and fittings for signs of cracking, deformation, and leakage.

#### I.1.2.3.4 Dike Erosion

The LERF basins and dikes are visually inspected weekly and after significant precipitation events for run-on, run-off, cover integrity, erosion problems, or other signs of deterioration in the dikes from precipitation, wind, burrowing mammals, or vegetation.

#### I.1.2.3.5 Structural Integrity

A written certification attesting to the structural integrity of the basin dikes, signed by a qualified, registered professional engineer, is provided in Addendum C.

#### I.1.2.3.6 Container Inspection

Normal operation of the LERF does not involve the storage of dangerous waste in containers. Therefore, the inspection requirements of this section normally are not applicable to the LERF. Any containerized dangerous waste generated at LERF will be brought to the 200 Area ETF and managed in accordance with WAC 173-303-630 and is discussed in Section I.1.3.

### I.1.3 Inspection Log

Observations made and deficiencies noted during an inspection are recorded on inspection log sheets (also called turnover sheets). On completion, the log sheet includes the inspector's printed name, signature, date, and time; the log sheet is submitted for review and approval by LERF and200 Area ETF management or their designee, as required by operating procedures. Once approved, the log sheet is kept in the Hanford Facility Operating Record, LERF and 200 Area ETF files. Inspection records are retained in the Hanford Facility Operating Record, LERF and 200 Area ETF files, or other approved locations, in accordance with Permit Condition II.I.1. The inspection records are used to help determine any necessary corrective actions. Problems identified during the inspections are prioritized and addressed in a timely fashion to mitigate health risks to workers, maintain integrity of the TSD units, and prevent hazards to public health and the environment.

If while performing an inspection, a leak or spill is discovered, facility operations responds per the emergency response procedures action is taken to stop the leak and determine the cause. The waste is removed from the secondary containment in a timely manner that prevents harm to human health and the environment.

### I.1.4 Storage of Ignitable or Reactive Wastes

The LERF could receive an aqueous waste that is designated reactive or ignitable. Any aqueous waste exhibiting these characteristics is managed (e.g., through blending in LERF) such that the waste no longer exhibits the reactive or ignitable characteristics.

Though unlikely, the 200 Area ETF secondary wastes might have the characteristics of being reactive or ignitable. A qualified inspector performs annual fire inspections of the 200 Area ETF using a checklist developed specifically for facilities that handle dangerous and/or mixed waste.

## Table I.1. Visual Inspection Schedule for the LERF and 200 Area ETF

| Item | Inspection | Frequency |
|---|---|---|
| **Load-In Facility** | | |
| Load-In tank system | Inspect area for leaks. Note any unusual noises or vibration from the system pumps. Inspect secondary containment system for signs of deterioration. | Daily |
| **Main Treatment Train** | | |
| Surge tank system | Inspect area for leaks. Note any unusual noises or vibration from the system pumps. Inspect secondary containment system for signs of deterioration. | Daily |
| Rough filter | Inspect for leaks. | Daily* |
| Ultraviolet oxidation system | Inspect module for leaks<br>Inspect peroxide storage tank, ancillary equipment for leaks. | Daily* |
| pH adjustment tank | Inspect tank and ancillary equipment for leaks | Daily* |
| $H_2O_2$ decomposer | Inspect tank and ancillary equipment for leaks | Daily* |
| Fine filter | Inspect module for leaks | Daily* |
| Degasification system | Inspect module for leaks. Note any unusual noises or vibration from the degasification blower. | Daily* |
| Reverse osmosis system | Inspect tanks and ancillary equipment for leaks. Note any unusual noises or vibration from the system pumps. | Daily* |
| Polishers | Inspect tanks and ancillary equipment for leaks. | Daily* |
| Effluent pH adjustment tank | Inspect tank and ancillary equipment for leaks. | Daily* |
| Verification tanks | Inspect tanks and ancillary equipment for leaks. Note any unusual noises or vibration from the system pumps. Inspect secondary containment system for signs of deterioration. | Daily |
| **Secondary Treatment Train** | | |
| Secondary waste receiving tank | Inspect tank and ancillary equipment for leaks | Daily |
| ETF evaporator | Inspect tank and equipment for leaks. Note any unusual noises or vibration from the system pumps or compressor. | Daily* |
| Concentrate tank | Inspect tank and ancillary equipment for leaks. | Daily* |
| Thin film dryer | Inspect tanks and ancillary equipment for leaks (viewed through camera). Note any unusual noises or vibration from the system pumps or blower. | Daily* |
| Container handling | Inspect area for spills, leaks, accumulated liquids. | Daily |
| Container handling | Inspect for deterioration of containers and secondary containment, including corrosion and cracks in secondary containment foundation and coating. Inspect container labels to ensure that they are readable. | Weekly |
| **Support Systems** | | |
| Vessel ventilation system | Inspect filters (HEPA and pre-filters), check vessel off gas pressures, system flow, and discharge temperatures. | Daily |
| Sump tank system | Inspect sump trenches for unexpected liquids, which indicate spills or leaks from process equipment. | Daily |
| **Safety Systems** | | |
| Eye wash stations | Check status; check for adequate pressure | Monthly |
| Safety showers | Check status; check for adequate pressure | Monthly |
| **Emergency Systems** | | |
| Fire extinguishers | Check for adequate charge. | Monthly |
| Emergency lighting | Test operability. | Monthly |
| **Processing Area** | | |
| Uninterruptible power supply | Check output voltage and visually inspect battery pack for corrosion and leakage. Check indicator lights for fault conditions. | Annually |

| Item | Inspection | Frequency |
|---|---|---|
| **LERF (Surface Impoundment)** | | |
| LERF basins and dikes | Check to overtopping controls and integrity of the basins and dikes | Weekly |
| LERF contents | Determine the leak rate per wetted surface area | Weekly |
| LERF basins | Check for run-on, run-off, cover integrity, and erosion problems | Daily & After significant precipitation events |
| **Ignitable and Reactive** | | |
| Ignitable and reactive waste | Storage in compliance with Hanford Site fire protection standards and WAC 173-303-630(8) | Annually† |
| **Container Storage Areas Other Than Secondary Treatment Train** | | |
| Container Storage | Container labels to ensure labels are not obscured, removed, or otherwise unreadable | Weekly |
| | Deterioration of containers, containment systems, or cracks in protective coating or foundations caused by corrosion, mishandling, or other factors | Weekly |
| | Leaks, spills, and accumulated liquids | Daily* |

* Stated Inspection frequency to be performed only when system is in service during 200 Area ETF operations. HEPA – High efficiency particulate air

† When waste management activities occur

## Table I.2. Inspection Plan for Instrumentation Monitoring

| Item | Inspection | Frequency |
|---|---|---|
| Load-In Facility | | |
| Level alarm LAHH-59A-109/-117 | Monitor liquid level in load-in tanks TK-109 and TK-117 to prevent overflow | Continuously |
| Level alarm LSH-59A-003 | Monitor liquid level in load-in tanks TK-1 to prevent overflow | Continuously |
| Leak detector | Monitor for leakage in the load-in tank pit sump | Continuously |
| **Main Treatment Train** | | |
| Leak detector LAH-20B009 | Monitor for leakage in the surge tank drainage sump | Continuously |
| Level alarm LAH-60A013 | Monitor surge tank level to prevent overflow | Continuously |
| Level alarm LAHL-60C-111 | Monitor liquid levels in the pH adjustment tank to prevent overflow | Continuously |
| Level alarm LAHL-60F-101 | Monitor liquid levels in the first RO feed tank to prevent overflow | Continuously |
| Level alarm LAHL-60F-201 | Monitor liquid levels in the second RO feed tank to prevent overflow | Continuously |
| Level alarms LAHL-60F-211 | Monitor liquid levels in the effluent pH adjustment tank to prevent overflow | Continuously |
| Level transmitter LAHX-60H001A/B/C | Monitor liquid level in verification tanks to prevent overflow | Continuously |
| Leak detector LAH-20B010 | Monitor for leakage in the verification tank drainage sump | Continuously |
| **Secondary Treatment Train** | | |
| Level alarm LAHL-60I-001A/B | Monitor liquid levels in secondary waste receiver tanks A and B to prevent overflow. | Continuously |
| Level alarm LAHL-60J-001A/B | Monitor liquid levels in concentrate tanks A and B to prevent overflow. | Continuously |
| Level alarm LAHL-60I-107 | Monitor liquid levels in the evaporator tank to prevent overflow. | Continuously |
| Level alarm LAHL-60J-036 | Monitor liquid levels in the spray condenser tank to prevent overflow. | Continuously |
| Level alarm LAHL-60I-108 | Monitor liquid levels in the distillate flash tank to prevent overflow. | Continuously |
| Level alarm LAH-60I-119 | Monitor liquid levels in the entrainment separator tank to prevent overflow. | Continuously |
| Level transmitter LAH-20B001 | Monitor liquid level in sump tank No. 1 to prevent overflow. | Continuously |
| Level transmitter LAH-20B002 | Monitor liquid level in sump tank No. 2 to prevent overflow. | Continuously |
| Leak detector LAH-20B003 | Monitor for leakage to sump No. 1. | Continuously* |
| Leak detector LAH-20B005 | Monitor for leakage to sump No. 2. | Continuously* |
| Leak detector | Monitor for leakage from pipeline between 200 Area ETF and load in station. | Continuously* |
| Leak detector | Monitor for leakage from pipeline between 200 Area ETF and LERF. | Continuously* |
| Leak detector | Monitor for leakage from pipeline between LERF and the 242-A Evaporator. | Continuously* |

*In the event of a malfunction of one of the electronic leak detectors, daily visual inspections will be performed while the facilities are in operation.

This page intentionally left blank.

# Hanford Facility RCRA Permit Modification Notification Forms

## Part III, Operating Unit 4

## 242-A Evaporator

### Index


| | | | | |
|---|---|---|---|---|
| Page 2 of 29 | Hanford Facility RCRA Permit III.4 Conditions | | Page 16 of 29 | Chapter 7.0, Section 7.3.2.2 |
| Page 3 of 29 | Chapter 2.0 | | Page 17 of 29 | Chapter 7.0, Section 7.3.2.3 |
| Page 4 of 29 | Chapter 4.0, Section 4.1.3 | | Page 18 of 29 | Chapter 7.0, Section 7.3.2.4 |
| Page 5 of 29 | Chapter 4.0, Section 4.1.6.2.4 | | Page 19 of 29 | Chapter 7.0, Section 7.3.2.5 |
| Page 6 of 29 | Chapter 4.0, Section 4.1.6.2.5 | | Page 20 of 29 | Chapter 7.0, Section 7.4 |
| Page 7 of 29 | Chapter 4.0, Section 4.1.7 | | Page 21 of 29 | Chapter 7.0, Section 7.7 |
| Page 8 of 29 | Chapter 4.0, Figure 4.1 | | Page 22 of 29 | Chapter 7.0, Figure 7.1 |
| Page 9 of 29 | Chapter 7.0 | | Page 23 of 29 | Chapter 8.0 |
| Page 10 of 29 | Chapter 7.0, Table 7.1 | | Page 24 of 29 | Chapter 8.0, Table 8.1 |
| Page 11 of 29 | Chapter 7.0, Table 7.1 | | Page 25 of 29 | Chapter 8.0 |
| Page 12 of 29 | Chapter 7.0, Section 7.2 | | Page 26 of 29 | Chapter 11.0 |
| Page 13 of 29 | Chapter 7.0, Section 7.2 | | Page 27 of 29 | Chapter 11.0, Section 11.1 |
| Page 14 of 29 | Chapter 7.0, Section 7.3.1.1 | | Page 28 of 29 | Chapter 11.0, Section 11.2.5 |
| Page 15 of 29 | Chapter 7.0, Section 7.3.1.1 | | Page 29 of 29 | Chapter 11.0, Section 11.4 |


Submitted by Co-Operator: _____ 9/24/13 Date

Reviewed by ~~RL~~ ORP Program Office: _____ 9/24/13 Date

| Hanford Facility RCRA Permit Modification Notification Form | |
|---|---|
| Unit: **242-A Evaporator** | Permit Part **Part III, Operating Unit 4** |

Description of Modification:
Hanford Facility RCRA Permit III.4:

**PART III, OPERATING UNIT 4 UNIT-SPECIFIC CONDITIONS**
**242-A Evaporator**

## UNIT DESCRIPTION

The 242-A Evaporator is a mixed .....

## III.4.A COMPLIANCE WITH UNIT SPECIFIC PERMIT CONDITIONS

The Permittees shall comply with .....

## CHAPTERS SPECIFIC TO OPERATING UNIT GROUP 4:

Chapter 1.0 Part A Form, dated October 1, 2008
~~Chapter 2.0 Unit Description, dated August 2004~~
Chapter 3.0 Waste Analysis Plan, dated September 30, 2007
Chapter 4.0 Process Information, dated September 30, 2013~~June 30, 2013~~
Appendix 4B Tank Integrity Assessment, dated December 31, 2002
Chapter 5.0 Groundwater Monitoring, dated (not applicable)
Chapter 6.0 Procedures to Prevent Hazards, dated June 30, 2010
Chapter 7.0 Contingency Plan, dated September 30, 2013~~June 30, 2010~~
Chapter 8.0 Personnel Training, dated September 30, 2013~~June 30, 2010~~
Chapter 11.0 Closure~~ and Post Closure Requirements~~, dated September 30, 2013~~June 30, 2013~~

| WAC 173-303-830 Modification Class [1 2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1
Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. Changes are needed to update chapter revision dates and to delete Chapter 2 pursuant to the changes shown on subsequent pages of this modification package.

| Modification Approved: [X] Yes [ ] No (state reason for denial) | Reviewed by Ecology: |
|---|---|
| Reason for denial: | S. L. Dahl-Crumpler — Date 9/23/13 |

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 2.0:

**DELETE ENTIRE CHAPTER**

~~**2.0 UNIT DESCRIPTION**~~

~~The 242-A Evaporator unit description and general provisions were provided in the Part B permit application, Chapter 2.0 (DOE/RL-90-42, Rev 0). Washington Administrative Code (WAC) 173-303 was used to prepare the Part B permit application and does not require this information to be included in the unit-specific operating Permit. The exception to this is the topographic map (refer to Section 2.1). DOE/RL-90-42, Chapter 2.0 was used for the sole purpose of permitting the 242-A Evaporator and as such has not been updated since the time of permit issuance. A brief unit description is provided in Attachment 35, Chapter 1.0 and further detail is provided in Attachment 35, Chapter 4.0, Process Description of this Permit. Seismic consideration information is provided in Attachment 33, Chapter 2.0, §2.3 (DOE/RL-91-28, General Information Portion). Traffic information is provided in Attachment 33, Chapter 2.0, §2.4 (DOE/RL-91-28, *General Information Portion*).~~

~~**2.1 TOPOGRAPHIC MAP**~~

~~Topographic map Drawing H-13-000039, Rev 2, 200 Area Liquid Waste Processing Facilities, 242-A Evaporator, Liquid Effluent Retention Facility, Effluent Treatment Facility, Sheet 1 of 2, and Sheet 2 of 2.~~

| WAC 173-303-830 Modification Class [1] [2] | Class 1 | Class 1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1

Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. The unit description, seismic information, and traffic information, although included in the permit application (DOE/RL-90-42 and DOE/RL-91-28), are typically not included in a permit. The topographic map is located in the Ecology Library as stated in the Part A Form Section XV. Unit detail is maintained in Chapter 4, Process Description.

Modification Approved: [X] Yes [ ] No (state reason for denial)

Reason for denial:

Reviewed by Ecology:

S.L. Dahl-Crumpler — Date: 9/23/13

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class 1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 4.0, Section 4.1.3:

### 4.1.3 Vapor-Liquid Separator (C-A-1) and Ancillary Equipment

The following sections describe the vapor-liquid separator (C-A-1) and ancillary equipment.

**Waste Feed System**. Feed to the 242-A Evaporator is supplied via a pump located in the 241-AW-102 feed tank. The feed pump transfers the waste to the 242-A Evaporator through a 3-inch diameter carbon steel transfer pipeline encased in a 6-inch diameter carbon steel pipe to provide secondary containment. The feed pipeline is equipped with a leak detection system.

Waste feed will be sampled from 241-AW-102 or identified candidate feed tanks as described in the Waste Analysis Plan. The feed sampler (SAMP-F-1) located in a sample enclosure located in the hot equipment storage room has been isolated and blanked, and will be closed in accordance with the approved Closure Plan.

~~The feed sampler (SAMP-F-1) is located in a sample enclosure located in the hot equipment storage room.~~

| WAC 173-303-830 Modification Class [1,2] | Class 1 | Class 1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1

Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. The change is made to be consistent with the 6/30/2013 modification. The purpose of the 6/30/2013 modification was to approve isolation of the feed sampler and this sentence was inadvertently retained when it was modified in the previous paragraph.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:

S. L. Dahl-Crumpler — Date 9/23/13

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class 1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 4.0, Section 4.1.6.2.4:

**4.1.6.2.4 Load out and Hot Equipment Storage Rooms**

The load out and hot equipment storage rooms secondary containment walls are 0.30- to 0.56-meter (0.98- to 1.84-feet) thick reinforced concrete. The secondary containment floors are 0.15-meter (0.49-feet) thick reinforced concrete. The room contains two recirculation lines and samplers used to sample the feed and slurry streams. The feed sampler has been isolated and is no longer capable of sampling feed. The lines and samplers are located in a shielded enclosure adjacent to the pump room wall.

The load out and hot equipment storage room contains two sumps: the drain sump and decontamination sump. The sumps are 0.91 meter in diameter, about 1.2 meters deep, and lined with stainless steel. Both sumps drain via a 3-inch drain line to the pump room sump described in Section 4.1.6.2.1. The sumps, floor, and walls of the load out and hot equipment storage room up to an elevation of 3.8 meters are painted with a special protective coating.

Leaks in the sampler piping, flow into two drains in the sample enclosure, which drain via a 2-inch line to the decontamination sump, which drains to the pump room sump (described in 4.1.6.2.1). Leak detectors in the sampler enclosures or a rise in the pump room sump level detects leaks in the sampler piping.

| WAC 173-303-830 Modification Class [1,2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | | X | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: : -830(4)(d)
Enter wording of WAC 173-303-830, Appendix I Modification citation: Other Modifications
The change is made to be consistent with the 6/30/2013 modification. The 6/30/2013 modification approved isolation of the feed sampler. This additional change was inadvertently omitted.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:

S. L. Dahl-Crumpler for 9/23/13
S. L. Dahl-Crumpler Date

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 4.0, Section 4.1.6.2.5:

**4.1.6.2.5 242-A Building Drain Lines**

Figure 4.6 provides a simplified process flow schematic ..... Four lines serve to drain the 242-A Building and equipment to feed tank 241-AW-102:

- Pump room sump drain line (DR-334).....
- Vapor-liquid separator vessel drain line (DR-335): a 10-inch carbon steel line that allows gravity drain of the vessel to the feed tank
- Condenser room drain line (DR-343): a 6-inch carbon steel line that drains potential leakage from the condenser room.
- Diverted process condensate drain line (DR-338): process condensate liquid drains through DR-338 into sump drain line (DR-334) which drains to 241-AW-102.

The four lines are sloped to drain about 170 meters to feed tank 241-AW-102 via the drain pit (241-AW-02D). Although WAC 173-303-640(1)(c) exempts systems that serve as secondary containment from requiring secondary containment, drain lines DR-334, DR-335, and DR-338 have outer encasement piping.

The drain lines are connected to a cathodic protection system to prevent external corrosion from contact with the soil. The cathodic protection system consists of:

- A rectifier that converts supplied alternating current voltage to an adjustable direct current voltage
- Numerous anodes buried near the underground piping and connected to the rectifier.
- Return wiring that connects the piping to the rectifier, completing the circuit.
- The rectifiers are inspected to ensure component degradation has not occurred. Test stations along the system are checked annually to verify they meet the performance criteria established ~~0.85 volt is maintained on the system, as required~~ by the National Association of Corrosion Engineers (RP-02-85). The criteria used to determine compliance will be documented in the Hanford Facility Operating Record, 242-A Evaporator unit specific portion.

| WAC 173-303-830 Modification Class [1 2] | Class 1 | Class '1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | | X | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: -830(4)(d)
Enter wording of WAC 173-303-830, Appendix I Modification citation: Other Modifications.
This method is functionally equivalent to the method currently in place in the permit. Cathodic protection systems need to meet the requirements of WAC-173-303- 640(3)(a)(iii) and 6(c). WAC 173-303-640(6)(c) states that NACE standard RP-02-85 may be used as a guideline in maintaining and inspecting CP systems. The three criteria noted in NACE RP-02-85 are considered to provide adequate and equivalent corrosion protection. The new language provided is correct and as stringent as the current text.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:

C. J. Wheeler for 9/23/13
S.L. Dahl-Crumpler Date

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class '1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 4.0, Section 4.1.7:

### 4.1.7 Variances from Secondary Containment Requirements

The integrity assessment report (Appendix 4B) discusses the following three deficiencies associated with the secondary containment system:

**Pump Room Sump.** The pump room sump does not comply with secondary containment requirements because liquid must be kept in the sump to provide a seal to prevent airflow between the pump room and feed tank 241-AW-102. Although the sump has a 0.63-centimeter (0.25-inch)-thick stainless steel liner to prevent corrosion of the concrete floor, the sump does not have secondary containment.

**Routine Discharges through Secondary Containment.** The configuration of the 242-A Evaporator process requires routine, batch discharges of dangerous waste through secondary containment drain lines. These routine discharges include the following.

- Steam condensate, cooling water, and process condensate sample stations drain to the feed tank, 241-AW-102, through drain line DR-343. Total discharge is about 38 liters (10 gallons) per month during operation.
- Sample bottle water sprays down in the ~~feed and~~ slurry sample station~~s~~ drain~~s~~ to the decontamination sump in the load out and hot equipment storage room. The decontamination sump then drains to the pump room sump. Total discharge is about 76 liters per month during operation.

| WAC 173-303-830 Modification Class [1,2] | Class 1 | Class 1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | | X | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: -830(4)(d)
Enter wording of WAC 173-303-830, Appendix I Modification citation: Other Modifications.
The change is made to be consistent with the 6/30/2013 modification. The 6/30/2013 modification approved isolation of the feed sampler. This additional change was inadvertently omitted.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:

S. J. Dahl-Crumpler 9/23/13
Date

[1] Class 1 modifications requiring prior Agency approval.

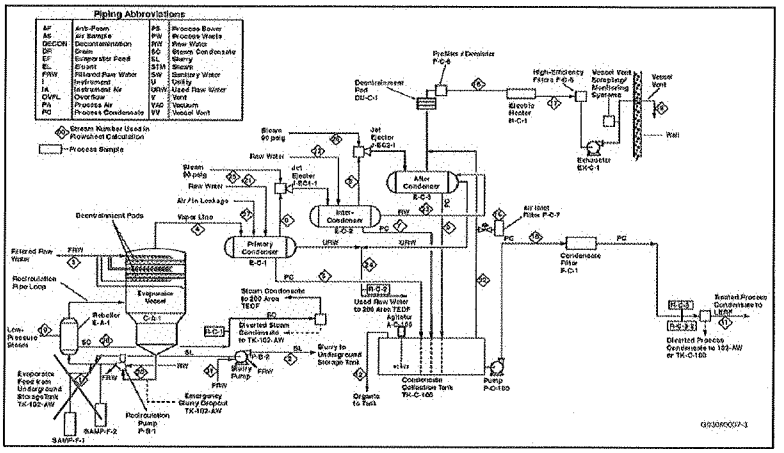
[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class 1, if appropriate.

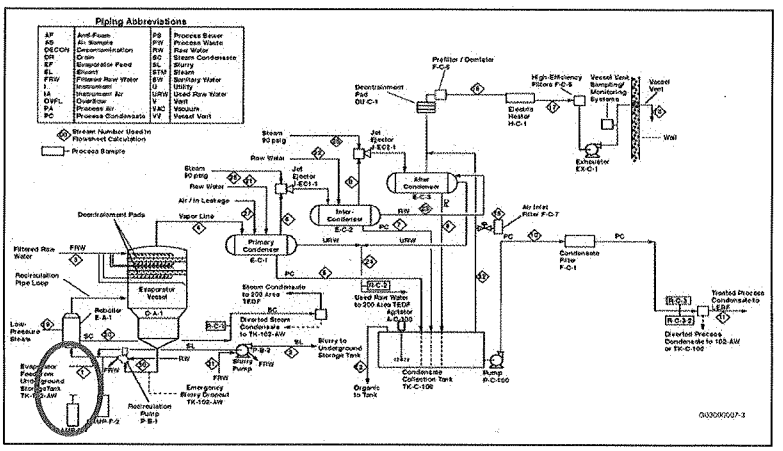
## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 4.0, Figure 4.1:

**Figure 4.1. 242-A Evaporator Simplified Process Flow Diagram**




| WAC 173-303-830 Modification Class [1,2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | | X | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: -830(4)(d)
Enter wording of WAC 173-303-830, Appendix I Modification citation: Other Modifications.
The change to show isolation of the sample in the figure is made to be consistent with the 6/30/2013 modification. The 6/30/2013 modification approved isolation of the feed sampler. This additional change was inadvertently omitted.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:

S.L. Dahl-Crumpler 9/23/13
Date

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 7.0:
**DELETE "OFFICIAL USE ONLY" AT THE BOTTOM OF EVERY PAGE OF CHAPTER 7.0**

**Chapter 7.0** **Contingency Plan**


7.0 CONTINGENCY PLAN ..... 7.1
7.1 BUILDING EVACUATION ROUTING (BUILDING LAYOUT) ..... 7.3
7.2 BUILDING EMERGENCY DIRECTOR ..... 7.3
7.3 IMPLEMENTATION OF THE CONTINGENCY PLAN ..... 7.3
7.3.1 Protective Actions Responses ..... 7.4
7.3.2 Response to Facility Operations Emergencies ..... 7.5
7.3.3 Prevention of Recurrence or Spread of Fires, Explosions, or Releases ..... 7.7
7.3.4 Incident Recovery and Restart of Operations ..... 7.7
7.3.5 Incompatible Waste ..... 7.7
7.3.6 Post Emergency Equipment Maintenance and Decontamination ..... 7.7
7.4 EMERGENCY EQUIPMENT ..... 7.8
7.4.1 Fixed Emergency Equipment ..... 7.8
7.4.2 Portable Emergency Equipment ..... 7.8
7.4.3 Communications Equipment/Warning Systems ..... 7.8
7.4.4 Personal Protective Equipment ..... 7.9
7.4.5 Spill Control and Containment Supplies ..... 7.9
7.4.6 Incident Command Post ..... 7.9
7.5 REQUIRED REPORTS ..... 7.9
7.6 PLAN LOCATION AND AMENDMENTS ..... 7.9
7.7 FACILITY/BUILDING EMERGENCY RESPONSE ORGANIZATION ..... 7.9


**Figure**


Figure 7.1. 242 A Evaporator Evacuation Routes ..... 7.10
Figure 7.2. 242 A Evaporator Staging Areas ..... 7.11


**Table**


Table 7.1 Hanford Facility Documents Containing Contingency Plan Requirements of WAC 173 303 350(3) ..... 7.1


~~OFFICIAL USE ONLY~~

~~May be exempt from public release under the Freedom of Information Act~~

~~(5 U.S.C. 552)Exemption number(s) and category:~~ ~~Exemption 2~~

~~Circumvention of Statute~~

~~Department of Energy review required before public release~~

| WAC 173-303-830 Modification Class [1][2] | Class 1 | Class 1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1

Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. Current Official Use Only review criteria no longer classified the content of this chapter as OUO.

Modification Approved: [✓] Yes [ ] No (state reason for denial)

Reason for denial:

Reviewed by Ecology:

S. L. Dahl-Crumpler for 9/23/13

S. L. Dahl-Crumpler Date

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class 1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 7.0, Table 7.1:

**Table 7.1 Hanford Facility Documents Containing Contingency Plan Requirements of WAC 173-303-350(3)**

| Requirement | Permit Attachment 4 Hanford Emergency Management Plan (DOE/RL-94-02) | Building Emergency Plan[1] (HNF-IP-0263-242A) | Chapter 7.0 |
|---|---|---|---|
| -350(3)(a) - A description of the actions which facility personnel must take to comply with this section and WAC 173-303-360 | X[2] Section 1.3.4 | X[2] Sections 7.1, 7.2 through 7.2.5, and 7.3[1] Sections 4.0, 8.2, 8.3, 8.4, and 11.0 | X[2] Sections 7.3.1, 7.3.2, through 7.3.2.5, and 7.3.3[3] Sections 7.3, 7.3.4, 7.3.5, 7.3.6, and 7.5 |
| -350(3)(b) - A description of the actions which shall be taken in the event that a dangerous waste shipment, which is damaged or otherwise presents a hazard to the public health and the environment, arrives at the facility, and is not acceptable to the owner or operator, but cannot be transported pursuant to the requirements of WAC 173-303-370(65), Manifest system, reasons for not accepting dangerous waste shipments | X[2] Section 1.3.4 | X[2,4] Section 7.2.5.1 | X[2,4] Section 7.3.2.5.1 |
| -350(3)(c) - A description of the arrangements agreed to by local police departments, fire departments, hospitals, contractors, and state and local emergency response teams to coordinate emergency services as required in WAC 173-303-340(4). | X Sections 3.2.3, 3.3.1, 3.3.2, 3.4, 3.4.1.1, 3.4.1.2, 3.4.1.3, 3.7, and Table 3.1 | | |

| WAC 173-303-830 Modification Class [1 2] | Class 1 | Class '1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1

Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. The regulatory citation was amended in a previous update to WAC 173-303-350(3)(b). This change corrects an outdated regulatory citation reference. The citation change is needed to maintain consistency with the June 2009 WAC 173-303 rule change (Publication Number 09-04-018, comment number 11, and WSR 09-14-105/Order 07-12).

Modification Approved: [X] Yes [ ] No (state reason for denial)

Reason for denial:

Reviewed by Ecology:

S. L. Dahl-Crumpler 9/23/13 Date

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class '1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 7.0, Table 7.1:

**Table 7.1 Hanford Facility Documents Containing Contingency Plan Requirements of WAC 173-303-350(3)**

| Requirement | Permit Attachment 4 Hanford Emergency Management Plan (DOE/RL-94-02) | Building Emergency Plan[1] (HNF-IP-0263-242A) | Chapter 7.0 |
|---|---|---|---|
| -350(3)(a) - A description of the actions which facility personnel must take to comply with this section and WAC 173-303-360 | X[2] Section 1.3.4 | X[2] Sections 7.1, 7.2 through 7.2.5, and 7.3[1] Sections 4.0, 8.2, 8.3, 8.4, and 11.0 | X[2] Sections 7.3.1, 7.3.2, through 7.3.2.5, and 7.3.3[3] Sections 7.3, 7.3.4, 7.3.5, 7.3.6, and 7.5 |
| ... | ... | ... | ... |
| -350(3)(e) - A list of all emergency equipment at the facility (such as fire extinguishing systems, spill control equipment, communications and alarm systems, and decontamination equipment), where this equipment is required. This list must be kept up to date. In addition, the plan must include the location and a physical description of each item on the list, and a brief outline of its capabilities. | ~~X~~ ~~Hanford Fire Department: Appendix C~~ | X Section 9.0 | X Section 7.4 |
| -350(3)(f) - An evacuation plan for facility personnel where there is a possibility that evacuation could be necessary. This plan must describe the signal(s) to be used to begin evacuation, evacuation routes, and alternate evacuation routes. | X[6] Figure 7.3 and Table 5.1 | X[7] Section 1.5 | X[7] Section 7.1 |

| WAC 173-303-830 Modification Class [1 2] | Class 1 | Class 1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1

Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. In the 6/30/2010 modification package, reference to Appendix C was removed from Attachment A of Permit Attachment 4. As noted in permit condition II.A.1, Appendix A of Permit Attachment 4 identifies the sections of Permit Attachment 4 enforceable under the permit. Therefore, by removing reference to Appendix C, it rendered Appendix C no longer enforceable. Emergency response equipment remains enforceable as stated in Attachment A to Permit Attachment 4 for WAC 173-303-350(3)(e) by identifying Section 11.2.8 of Permit Attachment 4. No requirements are being removed. Portions of Permit Attachment 4 are enforceable, per Permit Condition II.A.1.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:

S. L. Dahl-Crumpler Date 9/23/13

Hanford Facility RCRA Permit Modification Notification Form

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class 1, if appropriate.

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 7.0, Section 7.2:

**7.2 BUILDING EMERGENCY DIRECTOR**

Emergency response will be directed by the BED until the Incident Commander (IC) arrives. The ~~incident command system (ICS)~~IC and staff with supporting on call personnel fulfill the responsibilities of the Emergency Coordinator as discussed in WAC 173-303-360.

| WAC 173-303-830 Modification Class [1 2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1
Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. The Incident Commander (IC) is more accurate to describe fulfilling responsibilities than the Incident Command System (ICS). The Incident Commander is part of the Incident Command System.

| Modification Approved: ☒ Yes ☐ No (state reason for denial)<br>Reason for denial: | Reviewed by Ecology:<br>CJ Whale for 9/23/13<br>S. L. Dahl-Crumpler Date |
|---|---|

**Hanford Facility RCRA Permit Modification Notification Form**

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 7.0, Section 7.2:

## 7.2 BUILDING EMERGENCY DIRECTOR

Emergency response will be directed by the BED until the Incident Commander (IC) arrives. The incident command system (ICS) and staff with supporting on call personnel fulfill the responsibilities of the Emergency Coordinator as discussed in WAC 173-303-360.

During events, facility personnel perform response duties under the direction of the BED. The Incident Command Post (ICP) is managed by either the senior Hanford Fire Department member present on the scene or senior Hanford Patrol member present on the scene (security events only). These individuals are designated as the IC and as such, have the authority to request and obtain any resources necessary for protecting people and the environment. The BED becomes a member of the ICP and functions under the direction of the IC. In this role, the BED continues to manage and direct facility operations.

A listing of BEDs by title, work location, and work telephone numbers is contained in Section 7.7~~13.0~~. The BED is on the premises or is available through an "on call" list 24 hours a day. Names and home telephone numbers of the BEDs are available from the Patrol Operations Center (POC) in accordance with Permit Condition II.A.4.

| WAC 173-303-830 Modification Class [1 2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.2
Enter wording of WAC 173-303-830, Appendix I Modification citation: Correction of typographical errors. Correcting an incorrect section reference. Section 13.0 is the section number of the Building Emergency Plan and was inadvertently not converted to Chapter 7 numbering.

| Modification Approved: [X] Yes [ ] No (state reason for denial)<br>Reason for denial: | Reviewed by Ecology:<br>CR Wheeler for 9/23/13<br>S.L. Dahl-Crumpler Date |
|---|---|

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 7.0, Section 7.3.1.1:

### 7.3.1.1 Evacuation

The objective of a facility evacuation order is to limit personnel exposure to hazardous materials or dangerous/mixed waste by increasing the distance between personnel and the hazard. The scope of the evacuation includes evacuation of the facility due to an event at the facility as well as evacuation of the facility in response to a site evacuation order. Evacuation is directed by the BED when conditions warrant and applies to all personnel not actively involved in the event response or in emergency plan related activities.

The BED initiates the evacuation by directing an announcement be made to evacuate along with the evacuation location over the public address system and facility radios~~, and, as conditions warrant, by activating the 200 Area evacuation alarms by calling the POC using 911 from site office phones/373-0911 from cellular phones~~. Personnel proceed to a predetermined staging area (shown in Figure 7.2), or other safe upwind location, as determined by the BED. The BED determines the operating configuration of the facility and identifies any additional protective actions to limit personnel exposure to the hazard.

Emergency organization personnel or assigned operations personnel conduct a sweep of occupied buildings to ensure that all personnel and visitors have evacuated. For an immediate evacuation, accountability is performed at the staging area. The BED assigns personnel as accountability aides and staging area managers with the responsibility to ensure that evacuation actions are taken at the 242-A Evaporator. All implementing actions executed by the aides/managers are directed by the emergency response procedures. When evacuation actions are complete, the aides/managers provide a status report to the BED. The BED provides status to the Incident Commander.

| WAC 173-303-830 Modification Class [1 2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | | X | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: -830(4)(d)
Enter wording of WAC 173-303-830, Appendix I Modification citation: Other Modifications.
The sentence being deleted is not accurate with current processes. The text is being deleted rather than updated because the relationship of the 242-A Evaporator personnel and the Hanford Site Emergency Response Organization is discussed in Section 7.3.2. Calling 911 activates the Hanford Site Emergency Response Organization so the language in Section 7.3.2 is functionally equivalent to the language being deleted in this section. The language in this section is therefore not needed.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:
S. L. Dahl-Crumpler for 9/23/13
Date

[1] Class 1 modifications requiring prior Agency approval.
[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 7.0, Section 7.3.1.1:

### 7.3.1.1 Evacuation

The objective of a facility evacuation order is to limit personnel exposure to hazardous materials or dangerous/mixed waste by increasing the distance between personnel and the hazard. The scope of the evacuation includes evacuation of the facility due to an event at the facility as well as evacuation of the facility in response to a site evacuation order. Evacuation is directed by the BED when conditions warrant and applies to all personnel not actively involved in the event response or in emergency plan related activities.

The BED initiates the evacuation by directing an announcement be made to evacuate along with the evacuation location over the public address system and facility radios, and, as conditions warrant, by activating the 200 Area evacuation alarms by calling the POC using 911 from site office phones/373-0911 from cellular phones. Personnel proceed to a predetermined staging area (shown in Figure 7.2), or other safe upwind location, as determined by the BED. The BED determines the operating configuration of the facility and identifies any additional protective actions to limit personnel exposure to the hazard.

Emergency organization personnel or assigned operations personnel conduct a sweep of occupied buildings to ensure that all personnel and visitors have evacuated. For an immediate evacuation, accountability is performed at the staging area. The BED assigns personnel as accountability aides and staging area managers with the responsibility to ensure that evacuation actions are taken at the 242-A Evaporator. All implementing actions executed by the aides/managers are directed by the emergency response procedures. When evacuation actions are complete, the aides/managers provide a status report to the BED. The BED provides status to the IC~~Incident Commander~~.

| WAC 173-303-830 Modification Class [1,2] | Class 1 | Class 1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1
Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. The term has already been acronymed in the chapter.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:

S. L. Dahl-Crumpler Date 9/23/13

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class 1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 7.0, Section 7.3.2.2:

### 7.3.2.2 Major Process Disruption/Loss of Plant Control

Upon loss of the MCS, the Shift Manager is notified while an attempt is made to return the MCS to service. If a dump of the vapor-liquid separator (C-A-1) vessel does occur, AW Tank Farm personnel are notified of impending over pressurization of DST system tank 241-AW-102, and all personnel in the AW Tank Farm evacuate to the change trailer. Non-essential personnel exit the 242-A Evaporator facility.

The system condition is assessed, and corrective actions are implemented. Operations are placed on recirculation by securing the slurry pump and waste feed to the plant. Facility shutdown is accomplished by performing manual, localized actions such as system isolation, equipment shutdown, etc.

| WAC 173-303-830 Modification Class [1,2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1
Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. Technical editing of the 242-A Evaporator component. No change to requirements or components. Modification is just adding title to the vessel identifier number.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:
S. L. Dahl-Crumpler for 9/23/13
S. L. Dahl-Crumpler Date

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 7.0, Section 7.3.2.3:

**7.3.2.3 Pressure Release**

If mixed waste release occurs, perform actions identified in Section 7.3.2.5.

| WAC 173-303-830 Modification Class [1 2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.2
Enter wording of WAC 173-303-830, Appendix I Modification citation: Correction of typographical errors. Correcting an incorrect section reference. The numbering is not correct to reference the hazardous material, dangerous and/or mixed waste spill section of the contingency plan.

Modification Approved: [Y] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:

S. L. Dahl-Crumpler for — Date 9/23/13

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 7.0, Section 7.3.2.4:

### 7.3.2.4 Fire and/or Explosion

In the event of a fire, the discoverer activates a fire alarm; calls 911 from site office phones/373-0911 from cellular phones or verifies that 911 has been called. Automatic initiation of a fire alarm (by~~through~~ the smoke detectors, sprinkler systems, and pull boxes) is also possible.

- Unless otherwise instructed, personnel shall evacuate the area/building by the nearest safe exit and proceed to the designated staging area for accountability.
- On actuation of the fire alarm, ONLY if time permits, personnel should shut down equipment, secure waste, and lock up classified materials (or hand carry them out). The alarm automatically signals the Hanford Fire Department.

| WAC 173-303-830 Modification Class [1,2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1
Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. The change in term from "through" to "by" is more accurate to describe how a fire alarm is initiated.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:

S. L. Dahl-Crumpler for — Date 9/23/13

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 7.0, Section 7.3.2.5:

### 7.3.2.5 Hazardous Material, Dangerous and/or Mixed Waste Spill

Spills can result from many sources including process leaks, container spills or leaks, damaged packages or shipments, or personnel error. Spills of mixed waste are complicated by the need to deal with the extra hazards posed by the presence of radioactive materials.

- The discoverer notifies BED and initiates SWIMS response:
  - Stops work
  - Warns others in the vicinity
  - Isolates the area
  - Minimizes the spill if possible
  - Requests the BED Secure ventilation
- The BED determines if emergency conditions exist requiring response from the Hanford Fire Department based on classification of the spill and injured personnel, and evaluates need to perform additional protective actions.
- If the Hanford Fire Department resources are not needed, the spill is mitigated with resources identified in Section 7.4~~9.0~~ and proper notifications are made.
- If the Hanford Fire Department resources are needed, the BED calls 911 from site office phones/373-0911 from cellular phones.

| WAC 173-303-830 Modification Class [1,2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.2
Enter wording of WAC 173-303-830, Appendix I Modification citation: Correction of typographical errors. Correcting an incorrect section reference. Section 9.0 is the section number of the Building Emergency Plan and was inadvertently not converted to Chapter 7 numbering.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:

S. L. Dahl-Crumpler 9/23/13 Date

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 7.0, Section 7.4:

### 7.4 EMERGENCY EQUIPMENT

~~Hanford Site emergency resources and equipment are described and listed in Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02, Appendix C).~~ Emergency resources and equipment for the 242-A Evaporator are presented in this section.

| WAC 173-303-830 Modification Class [1 2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1

Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. In the 6/30/2010 modification package, reference to Appendix C was removed from Attachment A of Permit Attachment 4. As noted in permit condition II.A.1, Appendix A of Permit Attachment 4 identifies the sections of Permit Attachment 4 enforceable under the permit. Therefore, by removing reference to Appendix C, it rendered Appendix C no longer enforceable. Emergency response equipment remains enforceable as stated in Attachment A to Permit Attachment 4 for WAC 173-303-350(3)(e) by identifying Section 11.2.8 of Permit Attachment 4. No requirements are being removed. Portions of Permit Attachment 4 are enforceable under Permit Condition II.A.1.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:

CDWhale for 9/23/13
S. L. Dahl-Crumpler Date

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 7.0, Section 7.7:

### 7.7 FACILITY/BUILDING EMERGENCY RESPONSE ORGANIZATION

| 242-A Evaporator Building Emergency Directors | | | |
|---|---|---|---|
| **Title** | | **Work Location** | **Work Phone** |
| Primary | ~~Senior~~Central Shift Manager | 200 Areas. Primary location is the Base Operations Shift Office~~MO-268~~ | 373-2689 |
| Alternate | ~~Shift Manager~~Alternate BED | ~~MO-268~~200 Areas | 373-2689 |

Names and home telephone numbers of the BEDs are available from the POC (373-3800) in accordance with Permit Condition II.A.4.

| WAC 173-303-830 Modification Class [1 2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: B.6.d

Enter wording of WAC 173-303-830, Appendix I Modification citation: Changes in name, address, or phone number of coordinators or other persons or agencies identified in the plan. The updated titles and work location reflect the current information for 242-A Evaporator Building Emergency Directors. Personnel can call the phone number to identify the location of the Base Operations Shift Office. The work number is forwarded to the BED cell phone if the BED is not in the Base Operations Shift Office.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:

S. L. Dahl-Crumpler — Date 9/23/13

[1] Class 1 modifications requiring prior Agency approval.

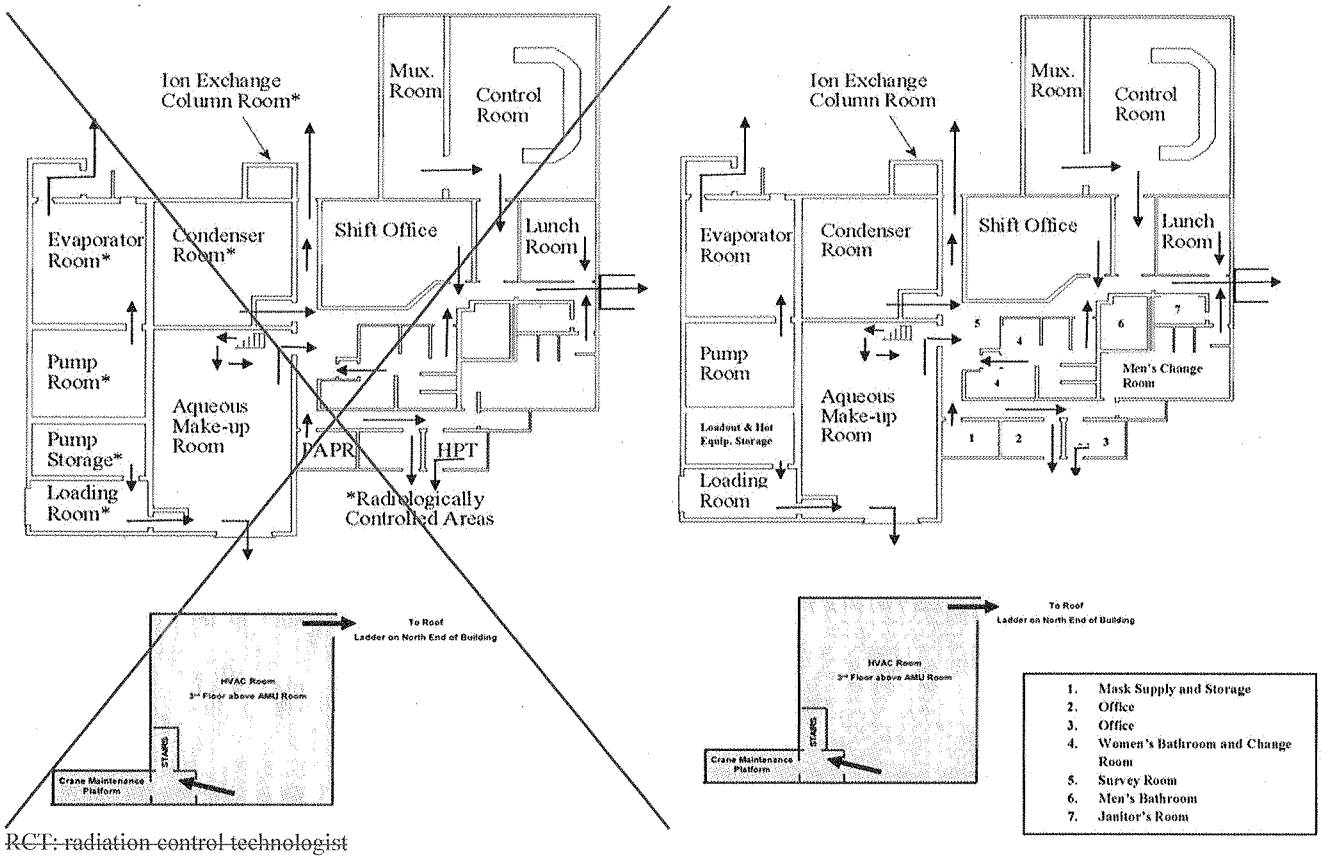
[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 7.0, Figure 7.1:

**Figure 7.1. 242 A Evaporator Evacuation Routes**




~~RCT: radiation control technologist~~
~~HVAC: heating, ventilation, and air conditioning~~

| WAC 173-303-830 Modification Class [1 2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1
Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. The figure is being updated to rename the rooms and delete the radiologically controlled area asterisk. No information on evacuation routes is being changed.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:

S. L. Dahl-Crumpler 9/23/13
Date

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:

Chapter 8.0, Section 8.0 is revised as shown below. Sections 8.1, 8.2, and 8.3 are deleted.

### 8.0 PERSONNEL TRAINING

~~This chapter discusses personnel training requirements based on WAC 173-303 and the Hanford Facility RCRA Permit, WA7 89000 8967 (Permit). In accordance with WAC 173-303-806(4)(a)(xii), the Hanford Facility Dangerous Waste Part B permit application must contain two items: (1) an outline of both the introductory and continuing training programs by owners or operators to prepare persons to operate or maintain the TSD facility in a safe manner as required to demonstrate compliance with WAC 173-303-330, and (2) a brief description of how training will be designed to meet actual job tasks in accordance with the requirements in WAC 173-303-330(1)(d). Permit Condition II.C, Personnel Training contains training requirements applicable to Hanford Facility personnel and non-Facility personnel.~~

~~Compliance with these requirements at 242-A Evaporator is contained in Permit Attachment 33, Chapter 8.0 and this chapter. This chapter supplements Permit Attachment 33, Chapter 8.0.~~

Specific requirements for the Hanford Facility Personnel Training program are described in Permit Attachment 5, incorporated by reference. The Permittees will comply with the training matrix below which provides training requirements for Hanford Facility personnel associated with the 242-A Evaporator. Refer to the 242-A Evaporator Dangerous Waste Training Plan (DWTP) for a complete description of the personnel training requirements. A copy of the 242-A Evaporator DWTP will be placed in the Hanford Facility Operating Record, 242-A Evaporator unit-specific portion, and will be updated by the Permittee as unit-specific conditions change. Training received by Hanford Facility personnel will be commensurate with the duties they perform. Individuals are not required to receive training for work/duties they do not perform.

Waste management duties include those specified in Attachment 5 as well as those contained in WAC 173-303-330(1)(d). Training elements of WAC 173-303-330(1)(d) applicable to the 242-A Evaporator operations include the following:

- Procedures for using, inspecting, repairing, and replacing emergency and monitoring equipment
- Key parameters for automatic waste feed cut-off systems
- Communications or alarm systems
- Response to fires or explosions
- Shutdown of operations.

**Sections 8.1 and 8.2 are deleted. With these changes section numbering will be altered; Section 8.3 will become Section 8.1.**

| WAC 173-303-830 Modification Class [1,2] | Class 1 | Class 1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1
Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. The text under Sections 8.0, 8.1 and 8.2 duplicate text contained in Attachment 5, *Hanford Facility Personnel Training Program*. Delete duplicative text. New information in Section 8.0 was previously provided in Section 8.2. The text is being relocated to Section 8.0. This text needs to be retained. In addition, text is being converted from the matrix footnotes into paragraph text in Section 8.0 to improve readability.

| Modification Approved: [X] Yes [ ] No (state reason for denial)<br>Reason for denial: | Reviewed by Ecology:<br>S. L. Dahl-Crumpler 9/23/13<br>Date |
|---|---|

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class 1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 8.0, Table 8.1:

**Table 8.1. 242-A Evaporator Training Matrix**

| | Training Category | | | | |
|---|---|---|---|---|---|
| Attachment ~~5~~3 ~~Chapter 8~~ Training Category | General Hanford Facility Training | Contingency Plan Training | Emergency Coordinator Training | Operations Training | |
| **Operating Unit 4: 242A Evaporator** | Orientation Program | Emergency Hazards Check List | Building Emergency Training | General Waste Management | Tank System Management |
| **Dangerous Waste Worker Categories**[~~1~~] | | | | | |
| Waste Worker | X | X | X[~~2~~] | X | X[~~2~~] |
| Waste Worker Supervisor/ Manager | X | X | X[~~2~~] | X | |
| Advanced Waste Worker | X | X | X[~~2~~] | X | |
| Building Emergency Director | X | X | X[~~2~~] | | |

~~[1]Dangerous Waste Worker categories are defined in the Tank Operations Contractor Dangerous Waste Training Plan (TFC-PLN-07 current revision) in the operating record~~
~~[1]Training received is commensurate with the duties performed. Individuals in this category who do not perform these duties are not required to receive this training.~~

| WAC 173-303-830 Modification Class [1 2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1
Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. Corrected reference to Attachment 5, *Hanford Facility Personnel Training Program.* Deleted footnotes are addressed in the text preceding the table (see modifications on page 23 of 29). A reference to the training plan identification number does not need to be specified in the permit; the training plan can be requested by Ecology at any time.

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:
S. L. Dahl-Crumpler 8/03/13
Date

[1] Class 1 modifications requiring prior Agency approval.
[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

| Hanford Facility RCRA Permit Modification Notification Form | |
|---|---|
| Unit: **242-A Evaporator** | Permit Part **Part III, Operating Unit 4** |

Description of Modification:

Chapter 8.0, Section 8.3 (Note, Section 8.3 will become Section 8.1 per changes reflected on other pages within this modification package)

## ~~8.3~~8.1 DESCRIPTION OF TRAINING PLAN

In accordance with Permit Condition II.C.3, the unit-specific portion of the Hanford Facility Dangerous Waste permit application must contain a description of the training plan. .....

A description of how training plan documentation meets the three items in WAC 173-303-330(2) is as follows:

1. -330(2)(a): "The job title, job description.....

2. -330(2)(b): "A written description of the type and amount of both introductory and continuing training required for each position."

   Description: In addition to the outline provided in ~~Section 8.1~~ Attachment 5, Section 5.1, training courses developed to comply with the introductory and continuing training programs are identified and described in the training plan documentation. The type and amount of training is specified in the training plan documentation as shown in Table 8.1.

3. -330(2)(c): "Records documenting that personnel have received and completed the training required by this section. The Department may require, on a case-by-case basis, that training records include employee initials or signature to verify that training was received."

   Description: Training records are maintained consistent with ~~Attachment 33, Chapter 8.0, Section 8.4.~~ Attachment 5, Section 5.3.

| WAC 173-303-830 Modification Class [1 2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1

Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. Updating text to provide correct references. Information previously located in Section 8.1 is now found in Attachment 5, as noted in the justification on page 23 of 29. Also, Attachment 33 no longer exists as part of the permit; information is found Attachment 5.

| Modification Approved: [X] Yes [ ] No (state reason for denial)<br>Reason for denial: | Reviewed by Ecology:<br>S. L. Dahl-Crumpler — Date: 9/23/13 |
|---|---|

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 11.0:

### 11.0 CLOSURE ~~AND FINANCIAL ASSURANCE~~

This chapter describes the planned activities and performance standards for closing the 242-A Evaporator. Final closure will begin when the 242-A Evaporator is no longer needed.

~~Where information regarding treatment, management, and disposal of the radioactive source byproduct material and/or special nuclear components of mixed waste (as defined by the Atomic Energy Act of 1954 as amended) has been incorporated into this document, it is not incorporated for the purpose of regulating the radiation hazards of such components under the authority of this permit or chapter 70.105 RCW and its implementing regulations but is provided for information purposes only.~~

| WAC 173-303-830 Modification Class [1,2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1

Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. The obligations under WAC 173-303-620(1)(c), (3), and (5) to provide cost estimates for facility closure and post closure monitoring and maintenance are being satisfied by the U.S. Department of Energy's compliance with the HFFACO requirement (as currently contained in the M-36 Milestone series) to produce an annual scope, schedule, and cost report. Radionuclide disclaimer text is being deleted because duplicative language is provided in the introduction section of the permit (i.e., eliminate duplicative language).

Modification Approved: [X] Yes [ ] No (state reason for denial)
Reason for denial:

Reviewed by Ecology:

S. L. Dahl-Crumpler for — Date 8/23/13

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

**Hanford Facility RCRA Permit Modification Notification Form**

| Unit: | Permit Part |
|---|---|
| **242-A Evaporator** | **Part III, Operating Unit 4** |

Description of Modification:
Chapter 11.0, Section 11.1:

## 11.1 CLOSURE PLAN/~~FINANCIAL ASSURANCE FOR CLOSURE~~

The 242-A Evaporator will be clean closed with respect to dangerous waste contamination that resulted from operation as a TSD unit. To facilitate closure, the 242-A Evaporator is being viewed as consisting of six components: tanks, ancillary equipment, piping, concrete floors/liners, structures, and underlying soil. Only areas that have treated, stored, or handled dangerous waste will undergo closure activities. Remedial actions with respect to contamination that was not a result of use of these areas for treatment, storage, or handling of dangerous waste are outside the scope of this closure plan.

Contaminated equipment, tanks, and piping removed from the 242-A Evaporator will be considered "debris" and transported to an appropriate permitted treatment, storage, or disposal unit for final disposition. Uncontaminated structures will be left for future use or disassembled, dismantled, and removed for disposal. Uncontaminated equipment and structures could include aqueous makeup, HVAC and piping, steam condensate and cooling water piping, the control room, change rooms and administrative/office areas.

The pipes located west and north of the 242-A Evaporator, which connect to A Farm and AW Farm, are in the same bundles with pipes used for transfers between tanks in the DST System. To minimize radiation exposure during closure, these pipes will be closed at the same time the piping for the DST System is closed. ~~Closure of these pipes will be performed per Double-Shell Tank System Dangerous Waste Permit Application (DOE/RL-90-39).~~Clean closure requires decontamination or removal and disposal of all dangerous waste, waste residues, contaminated equipment, soil, or other material established in accordance with the clean closure performance standards of WAC 173-303-610(2). This and future closure plan revisions will provide for compliance with these performance standards. All work will be performed ALARA with respect to worker exposure to dangerous and/or any other workplace hazards. Activities that are planned to achieve clean closure are presented in the following sections.

| WAC 173-303-830 Modification Class [1,2] | Class 1 | Class 1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1
Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. Changes to text with regard to financial assurance are addressed on page 26 of 29. Closure of the pipes is not addressed in the DST permit. Rather, closure of pipes is addressed in Section 11.2.3.

| Modification Approved: [X] Yes [ ] No (state reason for denial)<br>Reason for denial: | Reviewed by Ecology:<br>CDWm for<br>S. L. Dahl-Crumpler 9/23/13 Date |
|---|---|

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class 1, if appropriate.

| Hanford Facility RCRA Permit Modification Notification Form | |
|---|---|
| Unit: **242-A Evaporator** | Permit Part **Part III, Operating Unit 4** |

Description of Modification:
Chapter 11.0, Section 11.2.5:

### 11.2.5 Closure Standards for Underlying Soils

Clean closure of soil under the 242-A Evaporator will be accomplished by determining that the coated concrete floor and stainless steel liners, kept contaminants from reaching the soil. The coated concrete and liners provided secondary containment for all the tanks, process piping, and ancillary equipment within the building. Unless inspections identify potential through-thickness cracks indicating containment failure and a subsequent potential for soil contamination from TSD unit operations, the soil will be considered clean closed. However, if inspections identify such cracks, and there have been documented spills in the vicinity, potential soil contamination will be investigated. Soils will be sampled and analyzed for constituents of concerns. If the soil analytical results determine that, the constituents of concern are at or below agreed to regulatory cleanup levels, the soil will be considered clean closed. Permit Condition II.K defines regulatory cleanup levels. Sampling and disposal objectives will be determined at the time of closure activities through the data quality objectives process. If verification sampling is required, a sampling analysis plan will be prepared before closure in a manner consistent with Ecology guidance (Ecology publication #94-111 dated 2005~~1994~~) for achievement of clean closure.

| WAC 173-303-830 Modification Class [1,2] | Class 1 | Class 1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1
Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes. Updating reference to Ecology guidance document.

| Modification Approved: [X] Yes [ ] No (state reason for denial)<br>Reason for denial: | Reviewed by Ecology:<br>S. L. Dahl-Crumpler 9/23/13 Date |
|---|---|

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class 1, if appropriate.

| Hanford Facility RCRA Permit Modification Notification Form | |
|---|---|
| Unit: **242-A Evaporator** | Permit Part **Part III, Operating Unit 4** |

Description of Modification:
Chapter 11.0, Section 11.4:

## 11.4 MAXIMUM WASTE INVENTORY

The 242-A Evaporator is used to treat mixed waste from the DST System by removing water and most volatile organics. Two waste streams leave the 242-A Evaporator following the treatment process. The first waste stream, the concentrated slurry (in which approximately half the water content is removed and a portion of the volatile organics), is pumped back into the DST System. The second waste stream, process condensate (containing a portion of the volatile organics removed from~~orm~~ the mixed waste during the evaporation process), is routed through condensate filters before being transferred to LERF. The 242-A Evaporator is used to treat up to 870,642 liters of mixed waste per day.

The condensate collection tank (TK- C-100) receives process condensate and potentially contaminated drainage from the vessel vent system. The maximum design capacity for the C-100 tank is 67,380 liters.

Vapor-liquid separator, C-A-1, is located in the evaporator room and is used to separate vapor from the boiling slurry solution and deentrain liquid from the vapor before it enters the condensers in the condenser room. The maximum design capacity of C-A-1 is 103,217 liters.

| WAC 173-303-830 Modification Class [1,2] | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1 and A.2

Enter wording of WAC 173-303-830, Appendix I Modification citation: Administrative and informational changes and correction of typographical errors. Typo correction and updating tank nomenclature for consistency.

| | |
|---|---|
| Modification Approved: [X] Yes [ ] No (state reason for denial)<br>Reason for denial: | Reviewed by Ecology:<br>S. L. Dahl-Crumpler — Date 9/23/13 |

[1] Class 1 modifications requiring prior Agency approval.

[2] If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class [1]1, if appropriate.

## Remove and Replace the Following Sections:

Remove Part III Permit Conditions dated June 30, 2013, and replace with Permit Conditions dated September 30, 2013.

Remove Chapter 2.0 dated August 2004.

Remove Chapter 4.0 dated June 30, 2013, and replace with Chapter 4.0 dated September 30, 2013.

Remove Chapter 7.0 dated June 30, 2010, and replace with Chapter 7.0 dated September 30, 2013.

Remove Chapter 8.0 dated June 30, 2010, and replace with Chapter 8.0 dated September 30, 2013.

Remove Chapter 11.0 dated June 30, 2013, and replace with Chapter 11.0 dated September 30, 2013.

# PART III, OPERATING UNIT 4 UNIT-SPECIFIC CONDITIONS

## 242-A Evaporator

## UNIT DESCRIPTION

The 242-A Evaporator is a mixed waste treatment and storage unit consisting of a conventional forced-circulation, vacuum evaporation system to concentrate mixed-waste solutions located in the 200 East Area.

This document sets forth the operating conditions for the 242-A Evaporator.

## III.4.A COMPLIANCE WITH UNIT SPECIFIC PERMIT CONDITIONS

The Permittees shall comply with all requirements set forth in the Hanford Facility RCRA Permit (Permit) as specified in Permit Attachment 9, Permit Applicability Matrix, including all approved modifications. All chapters, subsections, figures, tables, and appendices included in the following unit-specific Permit Conditions are enforceable in their entirety.

In the event that the Part III-Unit-Specific Conditions for Operating Unit 4, 242-A Evaporator conflict with the Part I-Standard Conditions and/or Part II-General Facility Conditions of the Permit, the unit-specific conditions for Operating Unit 4, 242-A Evaporator prevail.

## CHAPTERS SPECIFIC TO OPERATING UNIT GROUP 4:

| | |
|---|---|
| Chapter 1.0 | Part A Form, dated October 1, 2008 |
| Chapter 3.0 | Waste Analysis Plan, dated September 30, 2007 |
| Chapter 4.0 | Process Information, dated September 30, 2013 |
| Appendix 4B | Tank Integrity Assessment, dated December 31, 2002 |
| Chapter 5.0 | Groundwater Monitoring, dated (not applicable) |
| Chapter 6.0 | Procedures to Prevent Hazards, dated June 30, 2010 |
| Chapter 7.0 | Contingency Plan, dated September 30, 2013 |
| Chapter 8.0 | Personnel Training, dated September 30, 2013 |
| Chapter 11.0 | Closure, dated September 30, 2013 |

## III.4.B COMPLIANCE WITH UNIT-SPECIFIC PERMIT CONDITIONS

III.4.B.1 Portions of Permit Attachment 4 (DOE/RL-94-02) that are not made enforceable by inclusion in the applicability matrix for that document are not made enforceable by reference in this document.

This page intentionally left blank.

## Chapter 4.0 Process Information

4.0 PROCESS INFORMATION ..... 4.1

4.1 TANK SYSTEMS ..... 4.2
4.1.1 Design Requirements ..... 4.2
4.1.2 PC-5000 Transfer line ..... 4.3
4.1.3 Vapor-Liquid Separator (C-A-1) and Ancillary Equipment ..... 4.3
4.1.4 Integrity Assessments ..... 4.7
4.1.5 Additional Requirements for Existing Tanks ..... 4.8
4.1.6 Secondary Containment and Release Detection for Tank Systems ..... 4.8
4.1.7 Variances from Secondary Containment Requirements ..... 4.12
4.1.8 Tank Management Practices ..... 4.13
4.1.9 Labels or Signs ..... 4.14
4.1.10 Air Emissions ..... 4.14
4.1.11 Management of Ignitable or Reactive Wastes in Tank Systems ..... 4.14
4.1.12 Management of Incompatible Wastes in Tank Systems ..... 4.14

4.2 AIR EMISSIONS CONTROL ..... 4.14
4.2.1 Applicability of Subpart AA Standards ..... 4.14
4.2.2 Process Vents - Demonstrating Compliance ..... 4.15

4.3 ENGINEERING DRAWINGS ..... 4.16

## Figures

Figure 4.1. 242-A Evaporator Simplified Process Flow Diagram ..... 4.17

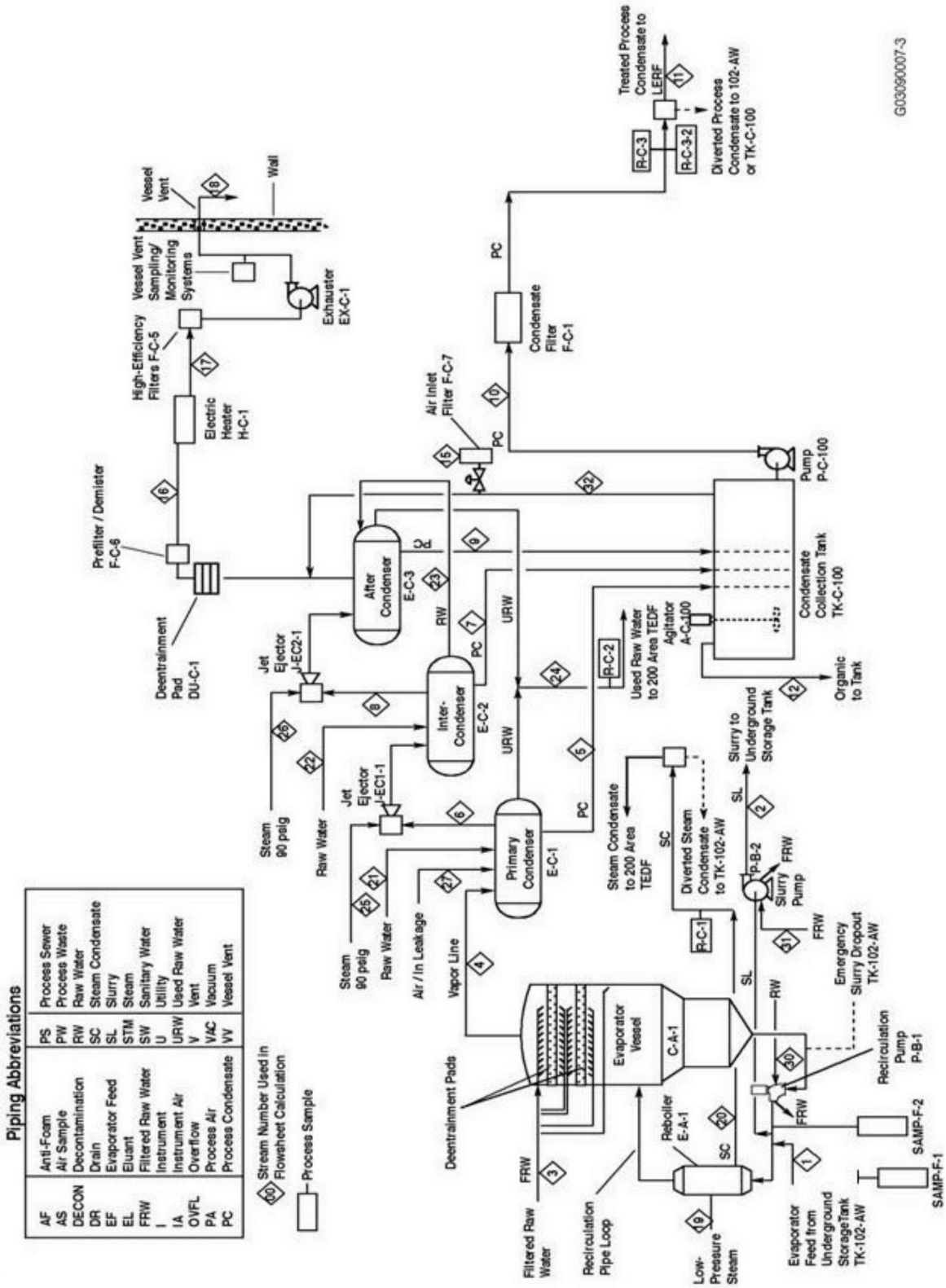



Figure 4.2. 242-A Evaporator Process Loop..... 4.17

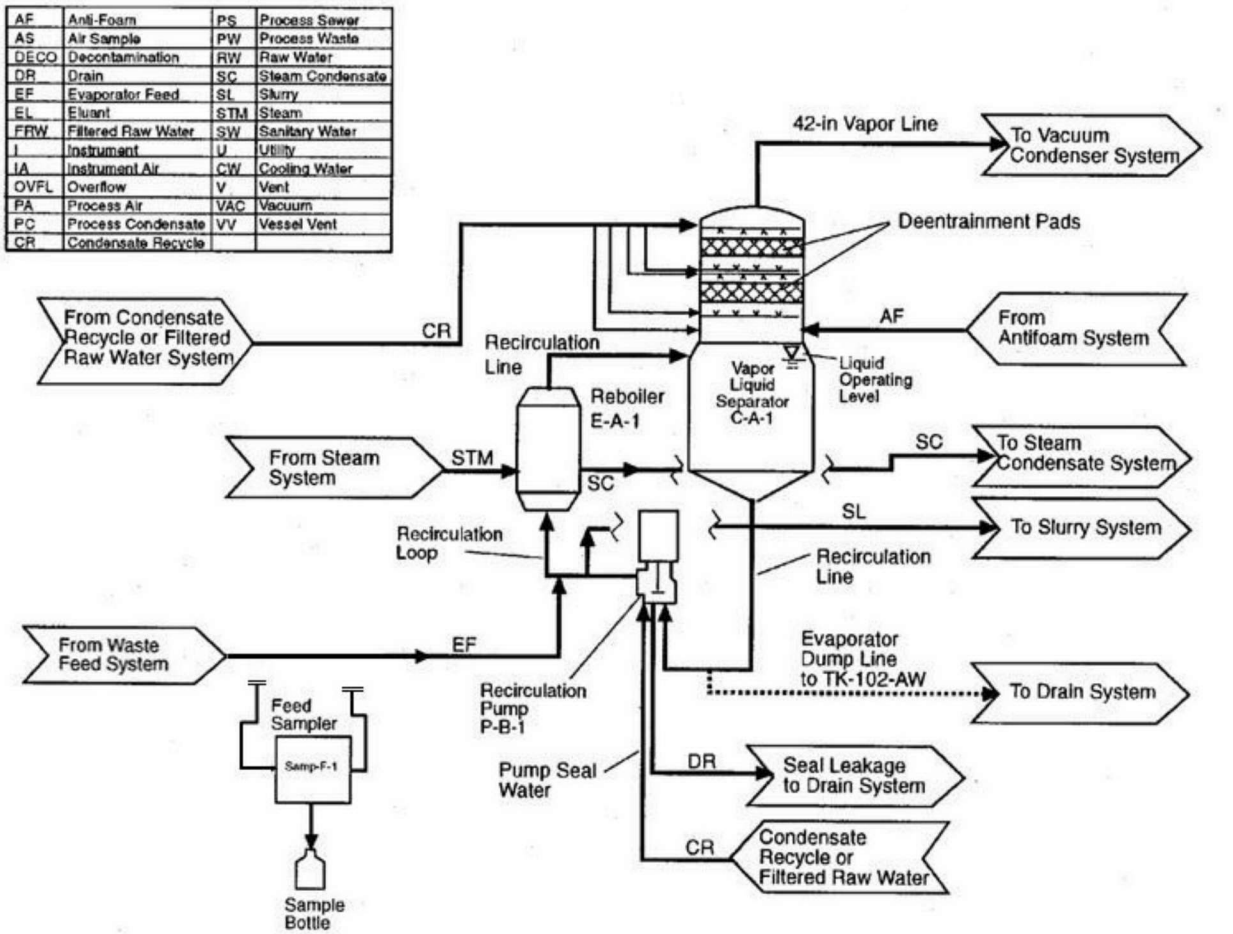



Figure 4.3. 242-A Evaporator Slurry System ..... 4.18
Figure 4.4. 242-A Evaporator Process Condensate System ..... 4.20
Figure 4.5. 242-A Evaporator Vacuum Condenser System ..... 4.20
Figure 4.6. 242-A Evaporator Drain System ..... 4.22

## Table

Table 4.1. Process and Instrumentation Diagrams ..... 4.16
Table 4.2. 242-A Evaporator Secondary Containment Systems Drawings ..... 4.16

This page intentionally left blank.

# 4.0 PROCESS INFORMATION

Where information regarding treatment, management, and disposal of the radioactive source byproduct material and/or special nuclear components of mixed waste (as defined by the Atomic Energy Act of 1954 as amended) has been incorporated into this document, it is not incorporated for the purpose of regulating the radiation hazards of such components under the authority of this permit or chapter 70.105 RCW and its implementing regulations but is provided for information purposes only.

The 242-A Evaporator receives mixed waste from the DST System that contains inorganic and organic constituents and radionuclides. A 242-A Evaporator simplified process flow diagram is given in Figure 4.1. The 242-A Evaporator separates the mixed waste received from the DST System, generating the following waste streams:

- A concentrated aqueous waste stream (slurry) containing the nonvolatile components, including most of the radionuclides, inorganic constituents, and nonvolatile organics such as tri-butyl phosphate
- A dilute aqueous waste stream (process condensate) containing the volatile components, primarily water with low concentrations of radionuclides, inorganic constituents, and volatile constituents such as ammonia and acetone.

The slurry is routed back to the DST System pending further treatment. The process condensate is transferred to the LERF for storage until processed through the ETF.

The 242-A Evaporator process employs a conventional forced circulation, vacuum evaporation system to concentrate the DST System waste solution. The major components of this system include the reboiler, vapor-liquid separator, recirculation pump and pipe loop, slurry product pump, condenser, jet vacuum system, and condensate collection tank

The vapor-liquid separator, C-A-1, also called the evaporator vessel, and the condensate collection tank, C-100, meet the definition of a tank in WAC 173-303-040. Other process equipment associated with these tank systems is considered ancillary equipment. Drawings that aid in understanding the systems are provided in Section 4.3.

The 242-A Evaporator receives waste from a DST System tank, 241-AW-102 that serves as the 242-A Evaporator feed tank. The feed enters the recirculation line and blends with the main process slurry stream, which is pumped to the reboiler.

In the reboiler, the mixture is heated to the specified operating temperature, normally 38 to 77EC, using 21 to 69 kilopascals gauge pressure steam. The low-pressure steam provides adequate heat input, and the resulting low-temperature differential across the reboiler minimizes scale formation on the heat transfer surfaces. The static pressure of the waste in the reboiler is sufficient to suppress the boiling point so the waste does not boil in the reboiler tubes. Boiling occurs only near or at the liquid surface in the vapor liquid separator.

The heated slurry stream is discharged from the reboiler to the vapor-liquid separator (C-A-1) that typically is maintained at an absolute pressure of 5.3 to 10.7 kilopascals. Under this reduced pressure, a fraction of the water in the heated slurry flashes to steam and the steam is drawn through two, wire mesh deentrainer pads into a 42-inch diameter vapor line that leads to the primary condenser, leaving behind a more concentrated slurry solution in the vapor-liquid separator.

After a brief residence time in the vapor-liquid separator, the slurry exits from the bottom through the lower portion of the recirculation line and is recirculated by the recirculation pump (P-B-1). The pump discharges the slurry back to the reboiler via the upper portion of the recirculation line, thus completing the recirculation loop.

The specific gravity of the waste liquid is monitored closely to ensure that the target density, established before the beginning of the campaign, is not exceeded. A portion of the slurry is removed from the upper

portion of the recirculation line using the slurry pump (P-B-2) and transferred through an encased underground pipeline (pipe-within-a-pipe) to a designated slurry receiver tank in the DST System.

The vapors are drawn from the vapor-liquid separator, through a 42-inch diameter vapor line and enter a series of three condensers, where the vapors are condensed using raw water. The condensed vapors, called process condensate, are collected in tank C-100. Steam jets are used to create a vacuum on the vapor liquid separator drawing the process vapors into and through the condensers. Noncondensable vapors are drawn from the condensers, then through a series of particulate filters and vented to the atmosphere. The air discharges are monitored continuously when the 242-A Evaporator is operating to verify that standards for radionuclide and ammonia emissions standards are met.

Process condensate contains the volatile constituents of the waste and trace quantities of inorganic materials and radionuclides. The process condensate is pumped from tank C-100 through an encased underground pipeline (pipe-within-a-pipe) to the LERF.

During a campaign, the evaporation process is continuous with typical feed flow rates of 260 to 450 liters per minute, process condensate flow rates of 150 to 230 liters per minute, and slurry flow rates of 110 to 230 liters per minute. The evaporator process is shutdown when the desired endpoint concentration of the slurry is met. Endpoints are established at the beginning of the campaign, based on the target specific gravity of the waste, or allowable waste volume reduction (WVR) and defined operating limits. If the evaporation rate cannot achieve the desired endpoint, slurry in the DST System serving as the slurry receiver is transferred to the feed tank for one or more passes through the 242-A Evaporator. At the end of each campaign, the 242-A Evaporator process equipment is shutdown, emptied, flushed with raw water, and placed in a safe standby mode.

Other discharges during 242-A Evaporator processing include condensate from the steam used to heat the waste and cooling water used to condense the vapors. The 242-A Evaporator is designed to prevent contamination of these streams. The fluids on the uncontaminated side of the heat exchangers are maintained at a higher pressure than the waste stream so that uncontaminated fluid migrates toward the contaminated waste if a leak were to occur. The steam condensate and the cooling water are monitored continuously for radiation, pH, conductivity, and discharged to TEDF as long as none of the discharge limits are exceeded. The steam condensate and cooling water streams were assessed in the stream specific reports (WHC 1990a and WHC 1990b) and are not dangerous waste in accordance with WAC 173-303.

The 242-A Evaporator process is controlled by the MCS. The MCS computer monitors process parameters and controls the parameters where required. Once the configuration parameters and other process control inputs are set, the MCS maintains the process parameters within specified ranges by sending output signals that operate specific pieces of equipment (e.g., control valves).

## 4.1 TANK SYSTEMS

This section discusses information associated with design requirements, integrity assessments, and any additional requirements for tanks used to treat and store mixed waste in the 242-A Evaporator.

### 4.1.1 Design Requirements

The following design requirements were addressed in the 242-A Evaporator/Crystallizer Tank System Integrity Assessment Report (IAR) (Appendix 4B):

- Minimum design wall thicknesses and measured wall thicknesses at various points throughout the tank systems
- Design standards used in construction, including references
- Waste characteristics
- Materials of construction and compatibility of materials with the waste being processed
- Corrosion protection

- Seismic design basis evaluation

The conclusion of the integrity assessment report is that the 242-A Evaporator system is not leaking and is fit for use. The inspections, tests, and analyses performed provide assurance that the tank system has adequate design, sufficient structural strength, and sufficient compatibility with the waste to not collapse, rupture, or fail during operation. The report also states that a review of construction files indicates that the building structure was designed and constructed to withstand a design-basis earthquake.

### 4.1.2 PC-5000 Transfer line

Process condensate from the 242-A Evaporator is transferred to the LERF using a pump located in the 242-A Evaporator and approximately 1,500 meters of pipe, consisting of a 3-inch carrier pipe within a 6-inch outer containment pipeline. Flow through the pump is controlled through a valve at flow rates from 150 to 300 liters per minute.

The encased fiberglass transfer line (PC-5000) exits the 242-A Evaporator below grade and remains below grade at a minimum 1.2-meter depth for freeze protection, until the pipeline emerges at the LERF catch basin, at the corner of each basin. All piping at the catch basin that is less than 1.2 meters below grade is wrapped with electric heat tracing tape and insulated for protection from freezing. Additional detail including information on secondary containment, leak detection and integrity assessment for this line is provided in § 4.1.6.3.3 and §4.1.4.1.

### 4.1.3 Vapor-Liquid Separator (C-A-1) and Ancillary Equipment

The following sections describe the vapor-liquid separator (C-A-1) and ancillary equipment.

**Waste Feed System**. Feed to the 242-A Evaporator is supplied via a pump located in the 241-AW-102 feed tank. The feed pump transfers the waste to the 242-A Evaporator through a 3-inch diameter carbon steel transfer pipeline encased in a 6-inch diameter carbon steel pipe to provide secondary containment. The feed pipeline is equipped with a leak detection system.

Waste feed will be sampled from 241-AW-102 or identified candidate feed tanks as described in the Waste Analysis Plan. The feed sampler (SAMP-F-1) located in a sample enclosure located in the hot equipment storage room has been isolated and blanked, and will be closed in accordance with the approved Closure Plan.

**Evaporator Process Loop**. The 242-A Evaporator process loop equipment components are as follows:

- Reboiler (E-A-1)
- Vapor-liquid separator (C-A-1)
- Recirculation pump (P-B-1)
- Recirculation loop

Figure 4.2 is a simplified process flow diagram showing the major components of the process loop.

**Reboiler (E-A-1)**. Waste is heated as the waste passes through the reboiler before entering the vapor-liquid separator. The reboiler is a vertical tube unit with steam on the shell-side and process solution on the tube-side. The 364 tubes in the reboiler are enclosed in a 1.03-meter outside diameter, 4.6-meter-long stainless steel shell. Both the reboiler shell and tubes are constructed of 304L stainless steel. The shell is 0.64 centimeter thick and the tubes are 14-gauge steel. The reboiler is designed to distribute steam evenly and to prevent tube damage from water droplets that may be present in the steam.

**Vapor-Liquid Separator (C-A-1)**. Process solution from the reboiler enters the vapor-liquid separator via the upper recirculation line. Some of the solution flashes into vapor, which exits through a vapor line at the top of the vapor-liquid separator. The remaining solution (slurry) exits through the recirculation line at the bottom.

The separator consists of a lower and upper section. The lower (liquid) section is a stainless steel shell 4.3 meters in diameter having an 85,200 to 94,600 liter normal operating capacity (including recirculation loop and reboiler). The maximum design capacity is 103,000 liters. The upper (vapor) section is a

stainless steel shell 3.5 meters in diameter containing two deentrainment pads. These wire mesh pads remove liquids and solids that entrain into the vapor section of the vessel. Spray nozzles, using recycled process condensate or filtered raw water, wash collected solids from the deentrainment pads and vessel walls. Both sections of the vapor-liquid separator are constructed of 0.95-centimeter-thick stainless steel.

Operating parameters in the vapor-liquid separator are monitored to provide an indication of process problems such as slurry foaming, deentrainer flooding, or excessive vapor temperatures. Instrumentation also is available to monitor the liquid levels in the vapor-liquid separator. Interlocks are activated when high pressures or high- or low-liquid levels are detected, shutting down the evaporation process and placing the facility in a safe configuration.

The vapor-liquid separator and recirculation loop can be flushed to remove any residual solids from the system and/or to reduce radiation levels. The most common flush solution is water, but dilute nitric or citric acid solutions could be used. All acidic flush solutions are chemically adjusted to meet DST acceptance criteria before transfer to the DST System. Antifoam solution is added (at very low flow rates - approximately 0.04 to 0.4 liters per minute) to the vessel to prevent foaming. The antifoam solution is a noncorrosive, nonregulated silicone-based solution that is compatible with the evaporator components.

**Recirculation Pump**. The stainless steel recirculation pump (P-B-1), is constructed as part of the recirculation loop to the reboiler. The 28-inch diameter axial flow pump has 60,900 liters per minute output. The recirculation pump is designed to handle slurry up to 30 percent undissolved solids by volume at specific gravities up to 1.8. The recirculation pump moves waste at high velocities through the reboiler to improve heat transfer, keep solids in suspension, and reduce fouling of the heat transfer surfaces.

The recirculation pump is equipped with shaft seals with high-pressure recycled process condensate (or water) introduced between the seals to prevent the waste solution from leaking out of the system. Seal water pressure and flow are monitored and controlled to shut down the recirculation pump if conditions are not adequate to prevent waste liquid from migrating into the seal water. The used seal water is routed to the feed tank.

**Recirculation Loop**. The recirculation loop consists of a 28-inch diameter stainless steel pipe that connects the vapor-liquid separator to the recirculation pump and reboiler. The lower loop runs from the bottom of the vapor-liquid separator to the recirculation pump inlet. The upper loop connects the pump discharge to the reboiler and the reboiler to the vapor-liquid separator. The feed line from the feed tank and the slurry line to underground storage tanks are connected to the upper recirculation line.

**Slurry System**. The slurry system draws a portion of the concentrated waste from the upper recirculation loop and transfers it to the DST System. The major components of the slurry system are the slurry pump and the slurry transfer pipelines. Figure 4.3 shows a simplified flow diagram of the slurry system. These components are described in the following paragraphs.

The slurry pump (P-B-2) is used to transfer slurry from the recirculation loop to the underground storage tanks. The pump is driven by a variable speed motor and is constructed of 304L stainless steel. The slurry pump is designed to generate high pressures to alleviate the possibility of a transfer line plugging.

Interlocks control the operation of the slurry pump. The slurry pump (P-B-2) is shutdown if any of the following occur:

- Excessive pressure is detected in the slurry lines to 241-AW Tank Farm
- A leak is detected in the slurry transfer lines secondary containment
- A leak is detected in the 241-AW Tank Farm process pits where the transfer lines enter the DST System.

The slurry pump uses a shaft seal with recycled process condensate (or water) and pressure and flow controls similar to the system described above for the recirculation pump.

Transfer pipelines are 2-inch diameter, carbon steel encased lines which route slurry to a designated underground DST within the 200 East Area. All transfer pipelines are encased in a secondary containment pipe and equipped with leak detectors between the primary and encasement piping. The pipelines are sloped to drain to the valve pit. The detection of any leak by the automated leak detection system shuts off the slurry pump. In lieu of the MCS automated shutdown, the slurry pump (P-B-2) can be manually shutdown at the direction of the Shift manager or 242-A Evaporator Control Room operator if a leak occurs.

The flow rate of the slurry transfer to the DST System is monitored and a decrease in flow below a specified value automatically will shut down the slurry pump (P-B-2) and initiate a line flush with water. The objective of flushing the transfer line is to prevent settling of solids, which precludes plugging the slurry transfer lines.

Samples can be taken from the slurry line when needed via a sampler (SAMP-F-2) that is located near the feed sampler in the load out and hot equipment storage room.

#### 4.1.3.1 Condensate Collection Tank (C-100) and Ancillary Equipment

The following section discusses the condensate collection tank (C-100) and ancillary equipment. This equipment collects process condensate via the condensers in the vacuum condenser system, filters the condensate, and pumps the process condensate to LERF. Figure 4.4 provides a simplified process flow diagram showing the major components of the process condensate system. The following major components make up the process condensate system:

- Vacuum condenser system
- Condensate collection tank (C-100)
- Process condensate pump (P-C-100)
- Condensate filters (F-C-1, F-C-2, and F-C-3)
- Process condensate radiation monitoring, sampling system and diversion system (RC3)
- Seal pot
- Process condensate recycle system
- Vessel Vent System

**Vacuum Condenser System**. Vapors removed from the vapor-liquid separator flow to a series of three condensers where the vapors are condensed using raw water. Condensate drains to the condensate collection tank (C-100). The vacuum condenser system consists of the following major components:

- Primary condenser (E-C-1)
- Intercondenser (E-C-2)
- Aftercondenser (E-C-3)
- Steam jet ejectors (J-EC1-1 and J-EC2-2)

Figure 4.5 provides a simplified process flow diagram showing the major components of the vacuum condenser system. These system components are discussed in the following sections.

**Primary Condenser (E-C-1)**. Vapors drawn from the vapor-liquid separator flow through the 42-inch (3.5 feet) vapor line, into the E-C-1 condenser where the majority of the condensation takes place. Noncondensed vapors exit to the intercondenser (E-C-2) while the condensed vapors (process condensate) drain to the condensate collection tank (C-100). Cooling water passes through the cooling tubes and exits to TEDF.

The carbon steel condenser shell measures approximately 5.3 meters (17.4 feet) long and has a 2.2-meter (7.2 feet) inside diameter. The condenser consists of 2,950 equally spaced carbon steel tubes that are 3.6 meters (11.8 feet) long with a 1.9-centimeter (0.75 inches) outside diameter.

**Intercondenser (E-C-2)**. Noncondensed vapors from E-C-1 enter the intercondenser. The vapor stream contacts the cooling tubes in the condenser where cooling water provides additional condensation. The

condensate drains to the condensate collection tank (C-100). Noncondensed vapors and used cooling water are routed to the after condenser.

The carbon steel intercondenser measures 2.2 meters (7.2 feet) long with a 0.39 meter (1.3 feet) inside diameter. This heat exchanger contains 144 tubes that are 1.7 meters (5.6 feet) long with a 1.9-centimeter (0.75 inches) outside diameter.

**After condenser (E-C-3)**. Vapor discharged from the intercondenser enters the after condenser. Cooling is supplied to the after condenser by the cooling water from the intercondenser. Condensate is routed to the condensate collection tank (C-100), while the noncondensed vapors are filtered, monitored, and discharged to the atmosphere through the vessel ventilation system. The cooling water is discharged to TEDF.

The carbon steel after condenser measures 2.3 meters (7.5 feet) long and has a 0.20-meter (0.66 feet) inside diameter. This heat exchanger contains 45 tubes that are 1.8 meters (5.9 feet) long with a 1.9-centimeter (0.75 inches) outside diameter.

**Steam Jet Ejectors**. The vacuum that draws the vapors from C-A-1 into the condensers is created by a two-stage steam jet ejector system. The first-stage jet ejector (J-EC1-1) maintains a vacuum on the primary condenser, which in turn creates a vacuum on the vapor-liquid separator. The ejector consists of a steam jet, pressure controller, and air bleed-in valve. Steam and noncondensed vapors from the primary condenser are ejected from J-EC1-1 into the intercondenser. The desired vacuum is obtained by controlling steam pressure and bleeding ambient air as necessary into the vapor header through an air intake filter. The second-stage jet ejector (J-EC2-1) creates the vacuum that moves vapors from the intercondenser through the after condenser.

**Condensate Collection Tank (C-100)**. Process condensate from the primary condenser, intercondenser, after condenser, and the vessel ventilation system drain to the condensate collection tank (C-100). The tank is 4.3 meters in diameter, 5.8 meters high, and is constructed of 0.79-centimeter (0.31 inches)-thick stainless steel. The tank has a maximum design capacity of 67,400 liters (17,805 gallons). Normal operating volume is approximately 50 percent of the tank capacity. A carbon steel base supports the tank. An agitator is installed but not used.

In the event of a tank overflow, the solution is routed through an overflow line to the drain system, which returns waste to the feed tank (241-AW-102). Overflow occurs when the volume exceeds about 60,600 liters. The overflow line is equipped with a liquid filled trap to isolate the drain system from the tank.

Process feed samples are evaluated for the presence of a separate organic layer and process controls are used to reduce the risk of the condensate collection tank to receive small amounts of immiscible organics with the condensed waste. If detected, the organic layer is removed by overflowing tank C-100 back to the feed tank 241-AW-102. The liquid level in the tank is controlled well above the discharge pump intake point and a controlled overflow is conducted upon completion of each processing cycle (campaign) to ensure that an organic layer does not accumulate and cannot be pumped to LERF.

**Process Condensate Pump**. A pump (P-C-100) moves the process condensate from tank C-100 through the condensate filter to LERF. The process condensate pump is a centrifugal pump constructed of 316 stainless steel.

**Condensate Filters**. After leaving the condensate collection tank, the process condensate is filtered to remove solids. The primary condensate filter (F-C-1) has a welded steel housing. A second filter system (F-C-3), installed downstream is also used to filter the process condensate. This system has duplex in-line filters in cast iron housing. Both filters employ a filter material that is compatible with the process condensate.

**Process Condensate Radiation Monitoring, Sampling and Diversion System**. The process condensate transferred to LERF is monitored continuously for radiation. If radiation levels exceed established limits, an alarm is received and interlocks immediately divert the stream back to the condensate collection tank

(or the feed tank) and shut off the process condensate pump. This ensures process condensate containing excessive radionuclides due to an accidental carryover from the vapor-liquid separator is not transferred to LERF.

**Seal Pot**. The condensate collection tank receives condensed liquids from the vessel ventilation system. A seal pot collects the drainage before discharge into the condensate collection tank and isolates the tank from the vessel ventilation system.

**Condensate Recycle System**. For waste minimization, a portion of the process condensate from tank C-100 is recycled for use as decontamination solution for the deentrainment pad sprays and seal water for the recirculation pump (P-B-1) and slurry pump (P-B-2). Use of process condensate instead of raw water results in approximately 10 percent reduction in waste volume generated during continuous operation of the 242-A Evaporator. Filtered raw water also is available as a backup for sprays and seal water. A 2-inch (5.1 centimeters) diameter carbon steel line, stainless steel centrifugal pump (P-C106), and filters (F-C-5 and F-C-6) supply process condensate from tank C-100 to the pad sprays and pump seals. The filters are disposable cartridge filters in carbon steel housings arranged in parallel with one filter in service while the other is in standby.

### 4.1.4 Integrity Assessments

The integrity assessment report (Appendix 4B, Integrity Assessment Report) discusses:

- The standards used during design and construction of the 242-A Evaporator and the adequacy of those standards
- The characteristics of the DST waste processed
- The adequacy of the materials of construction to provide corrosion protection from the waste processed
- The age of the tanks and the affect of age on tank integrity
- The results of the leak tests, visual inspections, and tank wall thickness inspections
- The frequency and scope of future integrity assessment
- Deficiencies in secondary containment design. These deficiencies are discussed in-the integrity assessment report.

An independent, qualified, registered professional engineer certified the integrity assessment.

The inspections, tests, and analyses performed provide assurance that the 242-A Evaporator tank system has adequate design, sufficient structural strength, and sufficient compatibility with the waste to not collapse, rupture, or fail during operation. No evidence of degradation was noted during the visual test, ultrasonic test, or leak test. Both condensate collection tank C-100 and the vapor-liquid separator/reboiler loop passed leak tests. The frequency of subsequent integrity assessments has been established at every 10 years. This frequency is based on the results of the 1998 integrity assessment.

#### 4.1.4.1 PC-5000

An integrity assessment for PC-5000 was performed, including a hydrostatic leak/pressure test at 10.5 kilograms per square centimeter gauge (150 pounds per square inch). A statement by an independent, qualified, registered professional engineer attesting to the integrity of the piping system is included in *Integrity Assessment Report for the 242-A Evaporator/LERF Waste Transfer Piping, Project W105* (WHC 1993), along with the results of the leak/pressure test. The next integrity assessment for PC-5000 will be conducted in the calendar year 2008. The schedule for conducting integrity assessments will be at a frequency of every 10 (calendar) years unless otherwise required by an IQRPE or as required for system repairs and upgrades. All integrity assessments will be conducted in accordance with WAC 173-303-640.

### 4.1.5 Additional Requirements for Existing Tanks

Refer to information in Section 4.1.2 and the integrity assessment report, which includes measuring tank wall thicknesses, evaluating corrosion protection, and performing leak tests.

### 4.1.6 Secondary Containment and Release Detection for Tank Systems

This section describes the design and operation of secondary containment sumps, drain lines, and leak detection systems for the 242-A Evaporator.

#### 4.1.6.1 Requirements for All Tank Systems

The Construction Specification for 242-A Evaporator-Crystallizer Facilities Project B-100 (Vitro 1974) was used during preparation, design, and construction of the tank and secondary containment systems. The integrity assessment report details how the construction specification relates to the national codes and standards.

Constructing the building and vessels per this specification ensures that foundations are capable of supporting tank and secondary containment systems and that uneven settling and failures from pressure gradients do not occur. The integrity assessment report (Appendix 4B) states that the 242-A Evaporator has adequate design, sufficient structural strength, and sufficient compatibility with the wastes to not collapse, rupture, or fail during service loads associated with normal operations and that the building structure was designed and constructed to withstand a design basis earthquake".

The integrity assessment report (Appendix 4B) describes the building and secondary containment system. This system is designed to ensure any release is detected within 24 hours. The secondary containment system also is designed to contain 100 percent of the maximum operating capacity of the vapor-liquid separator/reboiler loop, and the drain systems are sloped to allow collection of solution and have sufficient capacity to drain this volume in less than the required 24 hours.

The integrity assessment report describes the protective coating material and sealant used to protect concrete and joints from attack by leaks to the secondary containment. The materials of construction for the sump and drain lines are also compatible with the waste processed at the 242-A Evaporator.

#### 4.1.6.2 242-A Building Secondary Containment

The 242-A Building serves as a secondary containment vault for the vapor-liquid separator (C-A-1), condensate collection tank (C-100), and ancillary equipment used for transferring mixed waste at the 242-A Evaporator. The concrete for the operating area was poured to form a monolithic structure. Where needed, joints in the concrete were fabricated with preformed filler conforming to the standards of the American Society of Testing and Materials. Joint filler is sealed with a polysulfide sealant per the requirements of the construction specifications (Vitro 1974).

Before restart in 1994, a new acrylic special protective coating was applied to the concrete in the pump, evaporator, and condenser rooms. The coating meets the requirements of the construction specifications (Vitro 1974), including resistance to very high radiations doses, temperatures of 77o C, and spills of 25 percent caustic solution.

The following six rooms contain equipment used to process or store*mixed waste:

- Pump room
- Evaporator room
- Condenser room
- Ion exchange room
- Load out room* (used for temporary storage of mixed waste)
- Hot equipment storage room.

#### 4.1.6.2.1 Pump Room

The pump room secondary containment walls are 0.38 to 0.56-meter (1.25 to 1.84-feet) thick reinforced concrete. The secondary containment floor is 0.51-meter-thick reinforced concrete. The pump room floor is lined with 0.64-centimeter (0.25-inch) stainless steel and the concrete walls and ceiling cover blocks are painted with a special protective coating. The pump room contains pipe jumpers used to transport feed and slurry solutions between the vapor-liquid separator and the DST System, and the process recirculation loop, recirculation pump (P-B-1), and slurry pump (P-B-2).

Leaks in the pump room collect in the pump room sump, a 1.5-meter (4.9-feet) by 1.5-meter (4.9-feet) by 1.8-meter (5.9 feet) deep sump with a 0.64-centimeter (0.25-inch) stainless steel liner. The pump room sump collects spills from various sources for transfer to the feed tank, 241-AW-102. Figure 4.6 provides a simplified process flow schematic of sources, which drain to the pump room sump. Drainage to the sump includes:

- Leaks to the pump room floor from equipment in the pump room
- Evaporator room floor drain
- Hot equipment storage room floor drain
- Load out room floor drain
- Raw water backflow preventer drain

Solution in the pump room sump is transferred to the feed tank (241-AW-102) using a steam jet. A 10-inch secondary containment overflow line is provided for draining large volumes of solution should a catastrophic tank failure occur. Because the overflow line provides a direct path between the air space of tank 241-AW-102 and the pump room, a minimum level of water must be maintained in the sump to prevent cross ventilation. A leak into the pump room sump would be detected by a rise in the sump level. Instrumentation provided alarms on high sump level.

The recirculation and slurry pumps in the pump room are equipped with mechanical seals having pressurized water introduced between the seals. The seal water is maintained at a pressure that exceeds the process pressure at the seal to ensure water leaks into the process solution, but waste solution does not leak out. Water from seal leakage is collected in funnels in the pump room and routed to feed tank 241-AW-102 via the 10-inch overflow line described previously.

#### 4.1.6.2.2 Evaporator Room

The evaporator room secondary containment walls are 0.56-meter-thick reinforced concrete. The secondary containment floor is 0.51-meter-thick reinforced concrete. The evaporator room contains the vapor-liquid separator vessel (C-A-1), part of the recirculation loop, the reboiler, the 42-inch vapor line, and line used to empty the vapor-liquid separator to feed tank 241-AW-102.

Leaks in the evaporator room flow to a floor drain that routes through a 3-inch line to the pump room sump described in Section 4.1.6.2.1. A leak in the evaporator room would be detected by a rise in the pump room sump level. The floor of the evaporator room and a portion of the pump room floor are 3.0 meters below grade to contain the entire contents of the vapor-liquid separator, reboiler, and recirculation loop in the event of a catastrophic failure. The floor and walls of the evaporator room up to an elevation of 1.8 meters are painted with a special protective coating.

#### 4.1.6.2.3 Condenser Room

The condenser room secondary containment walls are 0.36- to 0.56-meter-thick reinforced concrete. The secondary containment floor is 0.51-meter-thick reinforced concrete. The condenser room contains all the components of the process condensate system described in Section 4.1.3.1 (refer Figure 4.4), including tank C-100.

Leaks in the condenser room flow to two floor drains that join and route through a 6-inch line to feed tank 241-AW-102. Leaks in the condenser room are detected by the following:

- Unexpected changes in liquid level in tank C-100. Instrumentation is provided to monitor liquid level in the tank, including high- and low-level alarms.
- Daily visual inspections of process condensate system components and piping.

The floor and walls of the condenser room up to an elevation of 1.2 meters are painted with a special protective coating.

#### 4.1.6.2.4 Load out and Hot Equipment Storage Rooms

The load out and hot equipment storage rooms secondary containment walls are 0.30- to 0.56-meter (0.98- to 1.84-feet) thick reinforced concrete. The secondary containment floors are 0.15-meter (0.49-feet) thick reinforced concrete. The room contains two recirculation lines and samplers used to sample the feed and slurry streams. The feed sampler has been isolated and is no longer capable of sampling feed. The lines and samplers are located in a shielded enclosure adjacent to the pump room wall.

The load out and hot equipment storage room contains two sumps: the drain sump and decontamination sump. The sumps are 0.91 meter in diameter, about 1.2 meters deep, and lined with stainless steel. Both sumps drain via a 3-inch drain line to the pump room sump described in Section 4.1.6.2.1. The sumps, floor, and walls of the load out and hot equipment storage room up to an elevation of 3.8 meters are painted with a special protective coating.

Leaks in the sampler piping, flow into two drains in the sample enclosure, which drain via a 2-inch line to the decontamination sump, which drains to the pump room sump (described in 4.1.6.2.1). Leak detectors in the sampler enclosures or a rise in the pump room sump level detects leaks in the sampler piping.

#### 4.1.6.2.5 242-A Building Drain Lines

Figure 4.6 provides a simplified process flow schematic of sources routed to the 242-A Building drain lines. The 242-A TSD unit boundary includes these lines up until they exit the 242-A Building. At this point, the lines are considered DST system components. Four lines serve to drain the 242-A Building and equipment to feed tank 241-AW-102:

- Pump room sump drain line (DR-334): a 10-inch carbon steel line that transfers process condensate overflow/diverted liquids and empty out of the pump room sump to the feed tank
- Vapor-liquid separator vessel drain line (DR-335): a 10-inch carbon steel line that allows gravity drain of the vessel to the feed tank
- Condenser room drain line (DR-343): a 6-inch carbon steel line that drains potential leakage from the condenser room.
- Diverted process condensate drain line (DR-338): process condensate liquid drains through DR-338 into sump drain line (DR-334) which drains to 241-AW-102.

The four lines are sloped to drain about 170 meters to feed tank 241-AW-102 via the drain pit (241-AW-02D). Although WAC 173-303-640(1)(c) exempts systems that serve as secondary containment from requiring secondary containment, drain lines DR-334, DR-335, and DR-338 have outer encasement piping.

The drain lines are connected to a cathodic protection system to prevent external corrosion from contact with the soil. The cathodic protection system consists of:

- A rectifier that converts supplied alternating current voltage to an adjustable direct current voltage
- Numerous anodes buried near the underground piping and connected to the rectifier.
- Return wiring that connects the piping to the rectifier, completing the circuit.
- The rectifiers are inspected to ensure component degradation has not occurred. Test stations along the system are checked annually to verify they meet the performance criteria established by the National Association of Corrosion Engineers (RP-02-85). The criteria used to determine compliance

will be documented in the Hanford Facility Operating Record, 242-A Evaporator unit specific portion.

Further detail regarding design and construction of DR-334,-335,-338 and -343 is provided in DOE/RL-90-39 (Hanford Facility Dangerous Waste Permit Application Double-Shell Tank System). Further detail regarding the design, operation, maintenance, and inspection of the cathodic protect system for these lines are also provided in DOE/RL-90-39.

#### 4.1.6.3 Transfer Line Containment

This section describes the design and operation of secondary containment and leak detection systems for transfer lines between the DST System and the 242-A Evaporator, and from 242-A to LERF (one line only, PC-5000). The 242-A TSD boundary for lines running between 242A and the DST System ends at exterior wall of 242-A building. At this point, these lines (e.g., feed and slurry line piping) are DST System components. For further detail regarding SN-269, SN-270, SL-167, and SL-168 refer to DOE/RL-90-39.

The PC-5000 transfer line transfers process condensate (Section 4.1.2) from the 242-A building to LERF. The 242-A TSD unit boundary includes PC-5000 up to the LERF fence line (Chapter 1.0, topographic map, and Section 4.1.2, for the TSD unit boundary)

##### 4.1.6.3.1 Feed Line Piping

Two feed lines (SN-269 and SN-270) (one in service and one spare), each consist of 3-inch transfer piping within a 6-inch secondary containment encasement piping. Both the transfer and encasement pipes are constructed of Schedule 40 carbon steel. The lines run below grade about 120 meters from pump pit 241-AW-02E (above feed tank 241-AW-102) to the 242-A Building.

To detect transfer-piping failures, leak detector risers equipped with conductivity probes are installed on the encasement lines. The transfer piping and encasements are sloped towards the conductivity probe, which, on leak detection, annunciates an alarm in the 242-A Evaporator control room. A valve in the pump pit (241-AW-02E) can be opened to drain solution from the encasement pipe into the pit, which drains to feed tank 241-AW-102.

##### 4.1.6.3.2 Slurry Line Piping

The slurry pump (P-B-2) transfers solution through one of two transfer lines: SL-167, for transfer to valve pit 241-AW-B (standard configuration), or SL-168 for transfer to valve pit 241-AW-A (alternate configuration). Slurry solution can be routed via double-encased piping from these valve pits to any designated DST slurry receiver. Both slurry transfer lines consist of 2-inch transfer piping within a 4-inch secondary containment encasement piping. Both the transfer and encasement pipes are constructed of Schedule 40 carbon steel. The lines run below grade about 73 meters between the 242-A Building and the valve pits.

These slurry lines contain leak detector risers and conductivity probes similar to the feed line piping described in Section 4.1.6.3.1.

##### 4.1.6.3.3 PC-5000

The process condensate transfer line (PC-5000) from the 242-A Evaporator is centrifugally cast, fiberglass-reinforced epoxy thermoset resin pressure pipe fabricated to meet the requirements of ASME D2997 (ASME 1984). The 3-inch (7.6-cm) carrier piping is centered and supported within 6-inch (15.2-cm) containment piping. Pipe supports are fabricated of the same material as the pipe, and meet the strength requirements of ANSI B31.3 (ANSI 1987) for dead weight, thermal, and seismic loads.

Drawing H-2-79604 provides details of the piping from the 242-A Evaporator to LERF.

This permit includes the portion of the PC-5000 line leaving the 242-A Evaporator facility to the fence line of LERF (Chapter 1.0 and topographic maps for unit boundary).

Single-point electronic leak detection elements are installed along the transfer line at 305-meter (1000 foot) intervals. The leak detection elements are located in the bottom of specially designed test risers. Each sensor element employs a conductivity sensor, which provides a signal to the 242-A Evaporator control room when a potential leak is detected. If a leak develops in the carrier pipe, fluid will travel down the exterior surface of the carrier pipe or the interior of the containment pipe. As moisture contacts a sensor unit, a general alarm sounds in the 242-A Evaporator control room on the Monitoring Control System. In addition, the zone of the sensor unit causing the general alarm can be determined using the leak detection-monitoring panel. Upon verification of a leak, the pump located in the 242-A Evaporator is shut down, stopping the flow of aqueous waste through the transfer line. A low-volume air purge of the annulus between the carrier pipe and the containment pipe is provided to prevent condensation buildup and minimize false alarms by the leak detection elements.

If a leak is detected using visual inspection of the PC-5000 transfer line encasement at the encasement catch tank (TK-PC-101) in the LERF catch basin (242AL-43), the shift manager is notified. The Shift Manger will direct shutdown of the aqueous waste through the PC-5000 transfer line.

#### 4.1.6.4 Additional Requirements for Specific Types of Systems

Addressed in this section are additional requirements in WAC 173-303-640 for vault systems like the 242-A Building to ensure neither buildup of ignitable vapors nor does infiltration of precipitation occur. This section also addresses secondary containment for ancillary equipment and piping associated with the tank systems.

##### 4.1.6.4.1 Vault Systems

The 242-A Building is a vault constructed partially below ground, providing secondary containment for the tank systems. The DST System waste processed at the 242-A Evaporator is designated ignitable and reactive because of the presence of nitrite and nitrate salts, which are considered oxidizers per 49 CFR 173. Because of their low volatility, these compounds are unlikely to be present in the vapor phase of the tank systems at the 242-A Evaporator. However, to prevent the spread of contamination, the vapor-liquid separator (C-A-1) is ventilated and maintained at lower air pressure than the building air space. This ensures air leakage is from uncontaminated building air space into the tank vapor space. Vapors from the vapor-liquid separator flow to the vacuum condenser system described in Section 4.0.

The condensate collection tank (C-100), collects process condensate that is not designated ignitable or reactive.

The tank systems and ancillary equipment are located within the 242-A Building, which is completely enclosed to prevent run-on and infiltration of precipitation into the secondary containment system.

##### 4.1.6.4.2 Ancillary Equipment

The 242-A Building provides secondary containment for ancillary equipment. Double containment is provided for the feed and slurry transfer lines between the 242-A Building and the AW Tank Farm by pipe-in-pipe arrangements. Therefore, all ancillary equipment has secondary containment and the daily inspection requirements in WAC 173-303-640(4)(f) are not applicable.

### 4.1.7 Variances from Secondary Containment Requirements

The integrity assessment report (Appendix 4B) discusses the following three deficiencies associated with the secondary containment system:

**Pump Room Sump.** The pump room sump does not comply with secondary containment requirements because liquid must be kept in the sump to provide a seal to prevent airflow between the pump room and feed tank 241-AW-102. Although the sump has a 0.63-centimeter (0.25-inch)-thick stainless steel liner to prevent corrosion of the concrete floor, the sump does not have secondary containment.

**Routine Discharges through Secondary Containment.** The configuration of the 242-A Evaporator process requires routine, batch discharges of dangerous waste through secondary containment drain lines. These routine discharges include the following.

- Steam condensate, cooling water, and process condensate sample stations drain to the feed tank, 241-AW-102, through drain line DR-343. Total discharge is about 38 liters (10 gallons) per month during operation.
- Sample bottle water sprays down in the slurry sample station drains to the decontamination sump in the load out and hot equipment storage room. The decontamination sump then drains to the pump room sump. Total discharge is about 76 liters per month during operation.

**Transfer Piping Wall Penetrations.** Three dangerous waste transfer line piping sections passing through the 242-A Building wall are single-walled, i.e., no secondary confinement in the wall (about 56-centimeter-thick reinforced concrete).

These deficiencies were identified to Ecology, October 28, 1993. Ecology's response stated, "No physical revision of the pipe wall penetrations or the floor drains in the evaporator pump room will be required prior to evaporator restart". The response required the following.

- If at any time leakage is seen or detected from these installations, or if for any reason these installations are repaired or rebuilt, they will be rebuilt or repaired in accordance with regulations.
- Should a spill occur in the evaporator pump room the sump and the piping shall be rinsed three times as required in WAC 173-303-160. 'Appropriate' in this case means that the original regulation was written for a free container, not a sump, so that judgment will have to be used in the application of the regulation. The rinsate shall be transferred to the double-shell tanks.

### 4.1.8 Tank Management Practices

All waste to be processed at the 242-A Evaporator must be sampled to determine if the waste is compatible with the materials of construction at the 242-A Evaporator. Before each campaign, candidate feed tanks are sampled per the requirements of the waste analysis plan (Chapter 3.0). Based on the results, three possible options are implemented.

- The waste is acceptable for processing without further actions.
- The waste is unacceptable for processing as a single batch, but is acceptable if blended with other waste that is going to be processed.
- The waste is unacceptable for processing.

The 242-A Evaporator process is controlled by the MCS. The MCS computer monitors liquid levels in the vapor-liquid separator (C-A-1) and condensate collection tank (C-100). The MCS system manages liquid levels in the C-A-1 using an auto-cascade function that controls feed delivery to the C-A-1 vessel. The MCS system also manages liquid levels in the C-100 using an auto-cascade function to maintain the tank level at approximately 50-percent. The MCS has alarms that annunciate on high-liquid levels for both C-A-1 and C-100 to notify operators that actions must be taken to prevent overfilling of these vessels.

An interlock is activated when high-liquid level in the vapor-liquid separator (C-A-1) is detected, automatically shutting down the feed transfer pump at feed tank 241-AW-102, thereby preventing overfilling of the vessel and carryover of slurry into the process condensate system. The condensate collection tank (C-100) has an overflow line that routes solution to feed tank 241-AW-102 in case of overfilling.

Process and instrumentation drawings are listed in Section 4.3.

The MCS also provides an automated interlock to shutdown the recirculation pump (P-B-1) and slurry pump (P-B-2) if a leak is detected. The recirculation pump (P-B-1) and slurry pump (P-B-2) will be

shutdown automatically using the MCS interlock and/or manually at the direction of the Shift Manager or 242-A Evaporator Control Room Operator if a leak occurs. The process condensate pump (P-C-100) will be shut down manually at the direction of the Shift Manager or 242-A Evaporator Control Room Operator if a leak occurs.

### 4.1.9 Labels or Signs

A labeling upgrade was completed before restart in 1994 for tank C-100 to identify the waste contents and major risks associated with waste stored within the tank. Tank C-100 ancillary piping is labeled "PROCESS CONDENSATE" to alert trained personnel which pipes in the condenser room contain dangerous waste. The vapor-liquid separator (C-A-1) is located in the evaporator room, a normally unoccupied area. This area is posted as a high radiation area with ALARA access controlled and limited to trained personnel only. The tank labels are visible from the walls of the tank enclosure rooms, which are less than 15 meters from the tank systems; therefore, label visibility requirements are met.

### 4.1.10 Air Emissions

Tank systems that contain extremely hazardous waste, and is acutely toxic by inhalation must be designed to prevent the escape of such vapors. The DST System waste in the vapor-liquid separator, C-A-1, is designated extremely hazardous waste; however, no determination has been performed to determine if the waste is acutely or chronically toxic. Most of the toxic compounds in the DST waste are not volatile, but because of the high radioactivity of the waste, controls are included to prevent or mitigate the release of tank vapors. The vapor-liquid separator is maintained under vacuum to ensure air leakage is from uncontaminated building air space into the tank vapor space. The boiling vapor in C-A-1 passes through deentrainment pads and sprays to prevent liquid and solid carryover into the vapor section of the tank. The vapor stream passes through three condensers that remove the condensable components. The noncondensable vapors pass through HEPA filters before being discharged to the environment.

### 4.1.11 Management of Ignitable or Reactive Wastes in Tank Systems

Although the DST System waste reprocessed at the 242-A Evaporator is designated ignitable because of the presence of oxidizers (nitrates and nitrites), the waste does not meet the definition of a combustible or flammable liquid given in National Fire Protection Association (NFPA) code number 30 (NFPA 1996). The buffer zone requirements in NFPA-30, which require tanks containing combustible or flammable solutions be a safe distance from each other and from public way, are not applicable.

An analysis is performed on the DST System waste to be processed to verify the waste does not react exothermically at the elevated temperatures at the 242-A Evaporator. The waste analysis plan (Chapter 3.0) discusses waste acceptance requirements due to reactive waste designation.

### 4.1.12 Management of Incompatible Wastes in Tank Systems

Waste transferred to the 242-A Evaporator must be compatible before mixing. The waste analysis plan (Chapter 3.0) includes waste compatibility requirements.

## 4.2 AIR EMISSIONS CONTROL

This section addresses the requirements of Air Emission Standards for Process Vents, under Subpart AA (incorporated by reference in WAC 173-303-690).

### 4.2.1 Applicability of Subpart AA Standards

The 242-A Evaporator performs distillation that specifically requires evaluation of process vents for the applicability of 40 CFR 264 Subpart AA.

Waste processed at the 242-A Evaporator routinely contains greater than 10 parts per million organic concentrations; therefore, organic air emissions are subject to 40 CFR 264.1032, which requires organic emissions from all affected vents at the Hanford Facility be less than 1.4 kilograms per hour and 2.8 megagrams per year, or control devices be installed to reduce organic emissions by 95%.

The 242-A Evaporator has one process ventilation system that vents both the vapor-liquid separator (C-A-1) and the condensate collection tank (C-100). The vent lines from both tanks combine before entering an off-gas system consisting of a deentrainer, a prefilter/demister, HEPA filters, and an exhaust fan. The vessel vent off-gas system is located on the third floor of the condenser room, with the exhaust stack extending horizontally through the east wall of the building at an elevation of 14.7 meters above ground level. The exhaust stack bends to run vertically with the discharge point 18.6 meters above ground level.

The annual average flow rate for the vessel vent is given in *Radionuclide Air Emissions Report for the Hanford Site - Calendar* Year *1995* (DOE-RL 1996) as 18 cubic meters per minute and the total annual flow was 9.6 E+06 cubic meters. During waste processing, the airflow is about 20.5 cubic meters per minute, with about 4.3 cubic meters per minute ventilated from tank C-100 and the remainder from the vapor-liquid separator and air in leakage.

Organic emissions occur during waste processing, which is less than 6 months (182 days) each year. This is the maximum annual operating time for the 242-A Evaporator, as shutdowns are required during the year for maintenance outages, candidate feed tank analysis, and establishing transfer routes for staging waste in the DST System. The total operating time for the two campaigns in 1994 was 86 days.

### 4.2.2 Process Vents - Demonstrating Compliance

This section outlines how the 242-A Evaporator complies with the requirements of 40 CFR 264, Subpart AA, including a discussion of the basis for meeting the organic emission limits, calculations demonstrating compliance, and conditions for reevaluating compliance.

#### 4.2.2.1 Basis for Meeting Limits/Reductions

The TSD units at the Hanford Facility subject to 40 CFR 264, Subpart AA meet the organic air emission limits of 1.4 kilograms per hour and 2.8 megagrams per year, established in 40 CFR 264.1032, by the design of the facility. The 242-A Evaporator and the other TSD units collectively can meet these standards without the use of air pollution control devices.

#### 4.2.2.2 Demonstrating Compliance

Process vent organic air emissions are controlled by establishing limits for acceptance of waste at the 242-A Evaporator. Before startup of each campaign, the waste to be processed is sampled in the DST System to determine the organic content. If the concentrations of organic constituents are less than the limits in the waste analysis plan (Chapter 3.0), the waste can be processed, provided the Hanford Facility will not exceed 1.4 kilograms per hour and 2.8 megagrams per year. The waste acceptance limits in the waste analysis plan are based on equilibrium calculations and assumptions given in *Organic Emission Calculations for the 242-A Evaporator Vessel Vent System* (WHC 1996). The calculation to determine organic emissions consists of the following steps:

1. Determine the emission rate of each candidate feed tank organic constituent by multiplying the constituent concentration by the corresponding partition factor in *Organic Emission Calculations for the 242-A Evaporator Vessel Vent System* (WHC 1996).

2. Sum the emission rates of all organic constituents to determine the emission rate for the candidate feed tank. The maximum emission rate for the campaign is the rate from the candidate tank with the greatest emission rate.

3. Determine the total amount of emission during the campaign by using operating time and a weighted average emission rate, based on the volume of each candidate feed tank processed.

The organic emission rates and quantity of organics emitted during the campaign are determined using these calculations and are included in the operating record for each campaign, as required by 40 CFR 264.1035. The Hanford Facility has a system to ensure organic emissions from units subject to 40 CFR 264, Subpart AA are less than the limits of 1.4 kilograms per hour and 2.8 megagrams per year. Records documenting total organic emissions are available for Ecology review on request.

#### 4.2.2.3 Reevaluating Compliance with Subpart AA Standards

Calculations to determine compliance with Subpart AA will be reviewed when any of the following conditions occur at the 242-A Evaporator:

- Changes in the configuration or operation that affect the assumptions in the Organic Emission Calculations for the 242-A Evaporator Vessel Vent System (WHC 1996)
- Annual operating time exceeds 182 days

## 4.3 ENGINEERING DRAWINGS

The drawings in Table 4.1 are process and instrumentation diagrams for the systems at the 242-A Evaporator that contact mixed waste. These drawings are provided for general information, and demonstrate adequacy of the tank systems design.

**Table 4.1. Process and Instrumentation Diagrams**

| System | Drawing Number | Drawing Title |
|---|---|---|
| Vapor-Liquid Separator | H-2-98988 Sheet 1 | P & ID Evaporator Recirc System |
| Reboiler/Recirculation Line | H-2-98988 Sheet 2 | P & ID Evaporator Recirc System |
| Slurry System | H-2-98989 Sheet 1 | P & ID Slurry System |
| Condensate Collection Tank | H-2-98990 Sheet 1 | P & ID Process Condensate System |
| Secondary Containment Drain System | H-2-98995 Sheet 1 | P & ID Drain System |
| Secondary Containment Drain System | H-2-98995 Sheet 2 | P & ID Drain System |
| Condensers | H-2-98999 Sheet 1 | P & ID Vacuum Condenser System |
| Pump Room Sump | H-2-99002 Sheet 1 | P & ID Jet Gang Valve System |
| Condensate Recycle System | H-2-99003 Sheet 1 | P & ID Filtered Raw Water System |
| Process Condensate Line PC-5000 | H-2-79604 | Piping Plot for PC-5000 between 242 A and the LERF fence line |

The drawings in Table 4.2 are for secondary containment systems for the 242-A Evaporator. Because secondary containment systems are the final barrier for preventing the release of dangerous waste into the environment, modifications that affect the secondary containment systems will be submitted to the Washington State Department of Ecology, as a Class 1, 2, or 3 Permit modifications, as required by WAC 173-303-830.

**Table 4.2. 242-A Evaporator Secondary Containment Systems Drawings**

| System | Drawing Number | Drawing Title |
|---|---|---|
| 242-A Building | H-2-69277 Sheet 1 | Structural Foundation Plan Sections & General Notes - Areas 1 & 2 |
| | H-2-69278 Sheet 1 | Structural Foundation Elevations & Details - Areas 1 & 2 |
| | H-2-69279 Sheet 1 | Structural First Floor Plan & AMU - Areas 1 & 2 |
| Pump Room Sump Drainage | H-2-69352 Sheet 1 | Sections Process Waste Drainage |
| 242-A Building Drainage | H-2-69354 Sheet 1 | Plan Process Waste Drainage |
| Pump Room Sump | H-2-69369 Sheet 1 | Pump Room Sump Assembly & Details |

**Figure 4.1. 242-A Evaporator Simplified Process Flow Diagram**

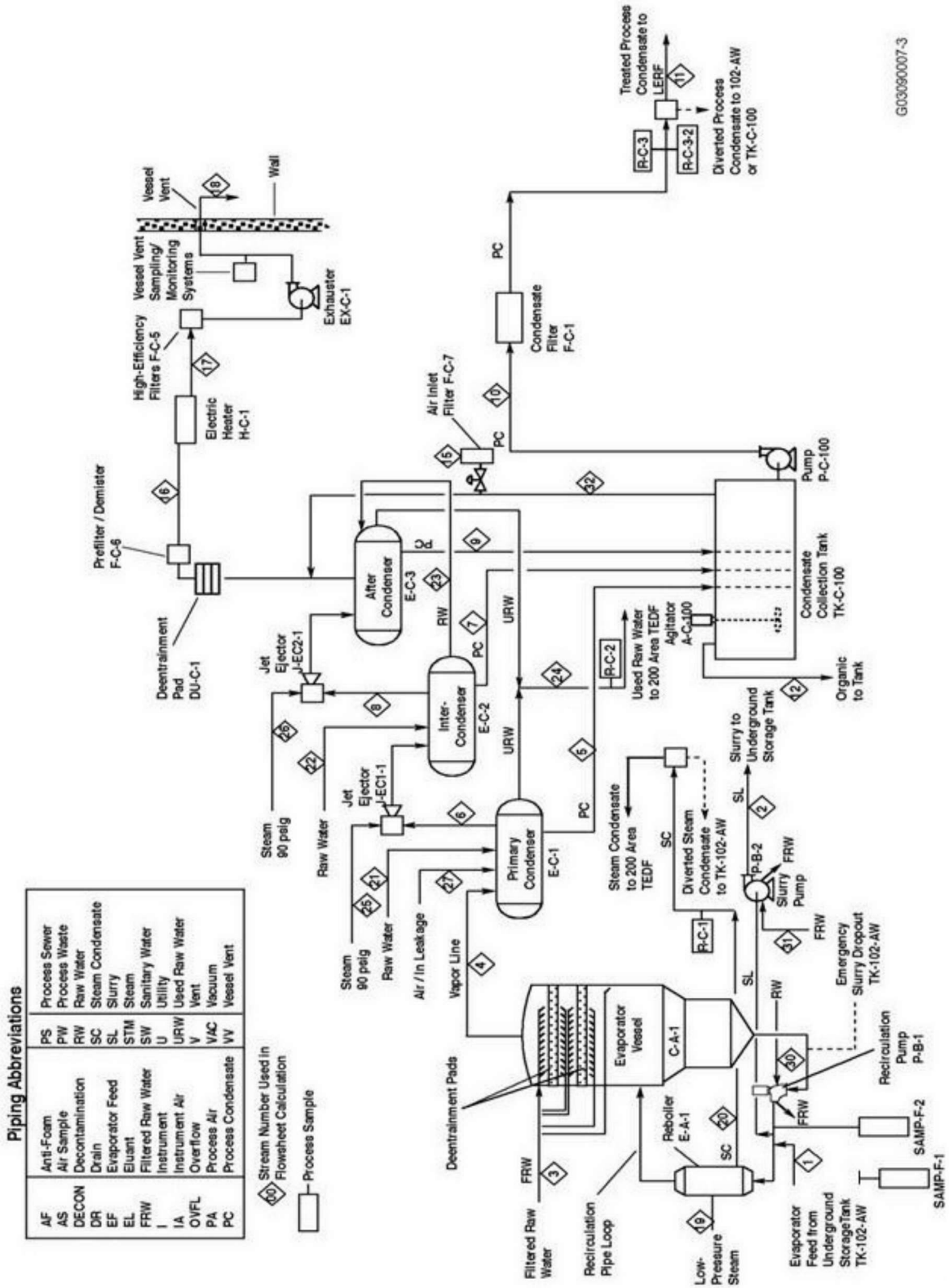


**Figure 4.2. 242-A Evaporator Process Loop**

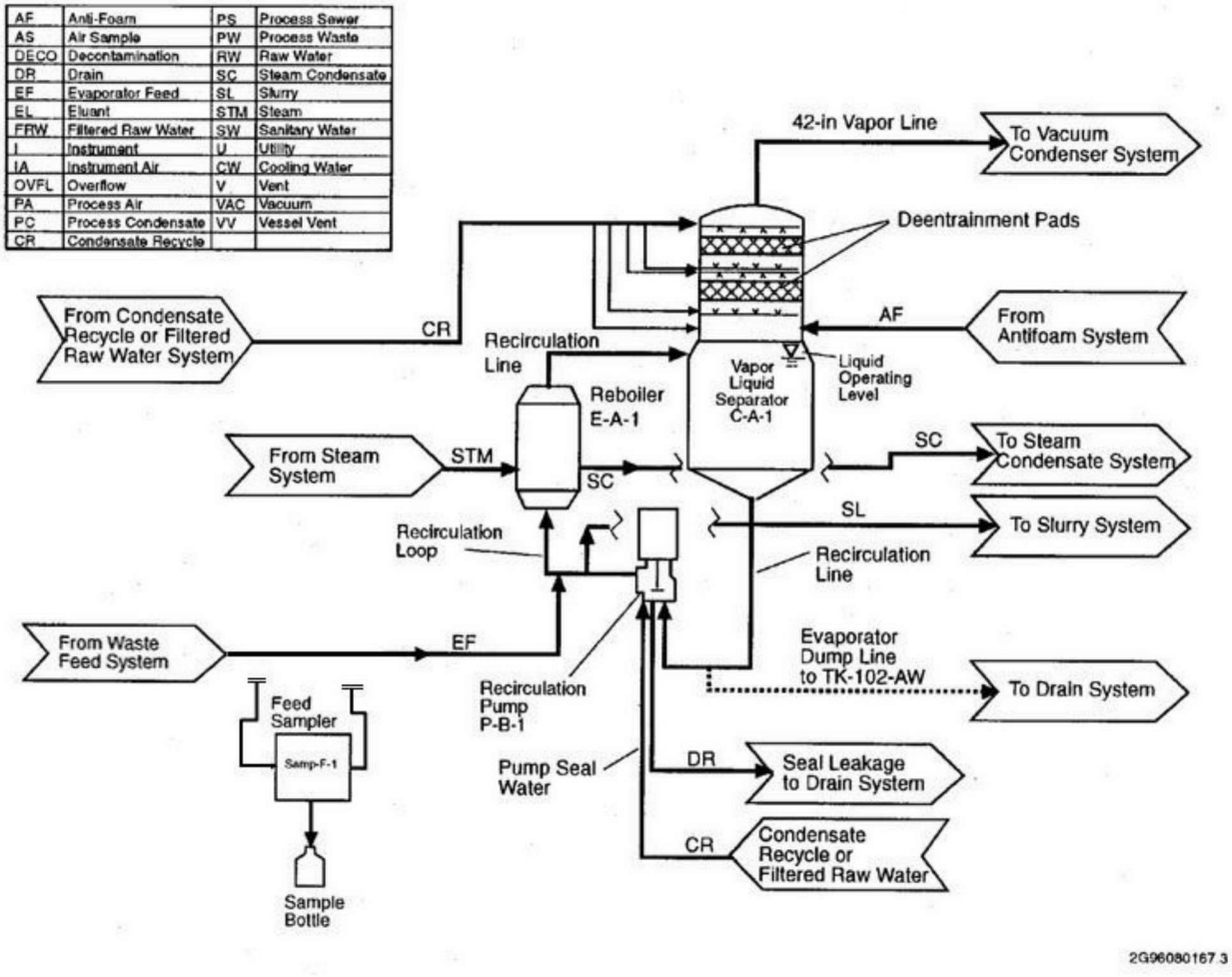


**Figure 4.3. 242-A Evaporator Slurry System**

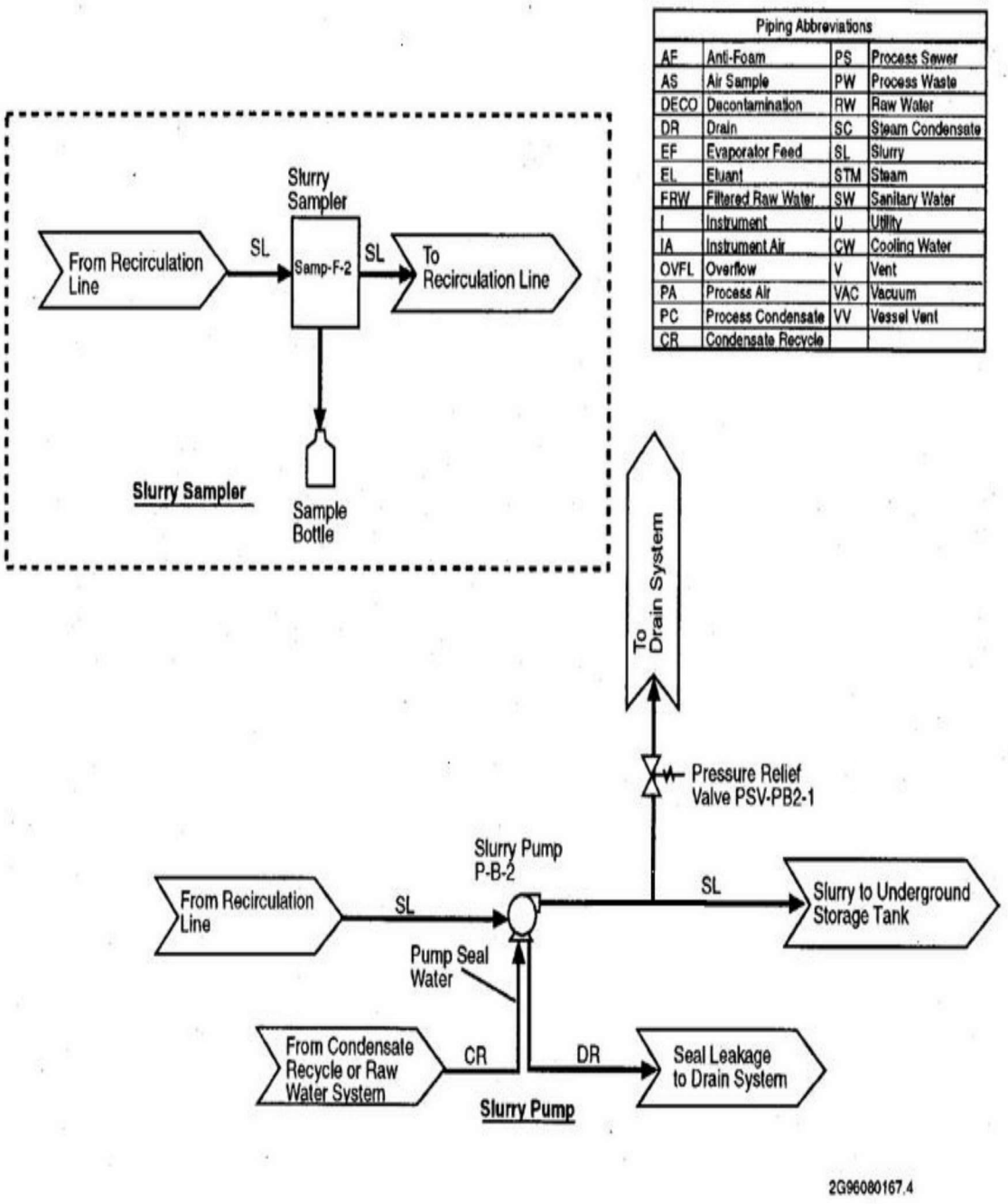
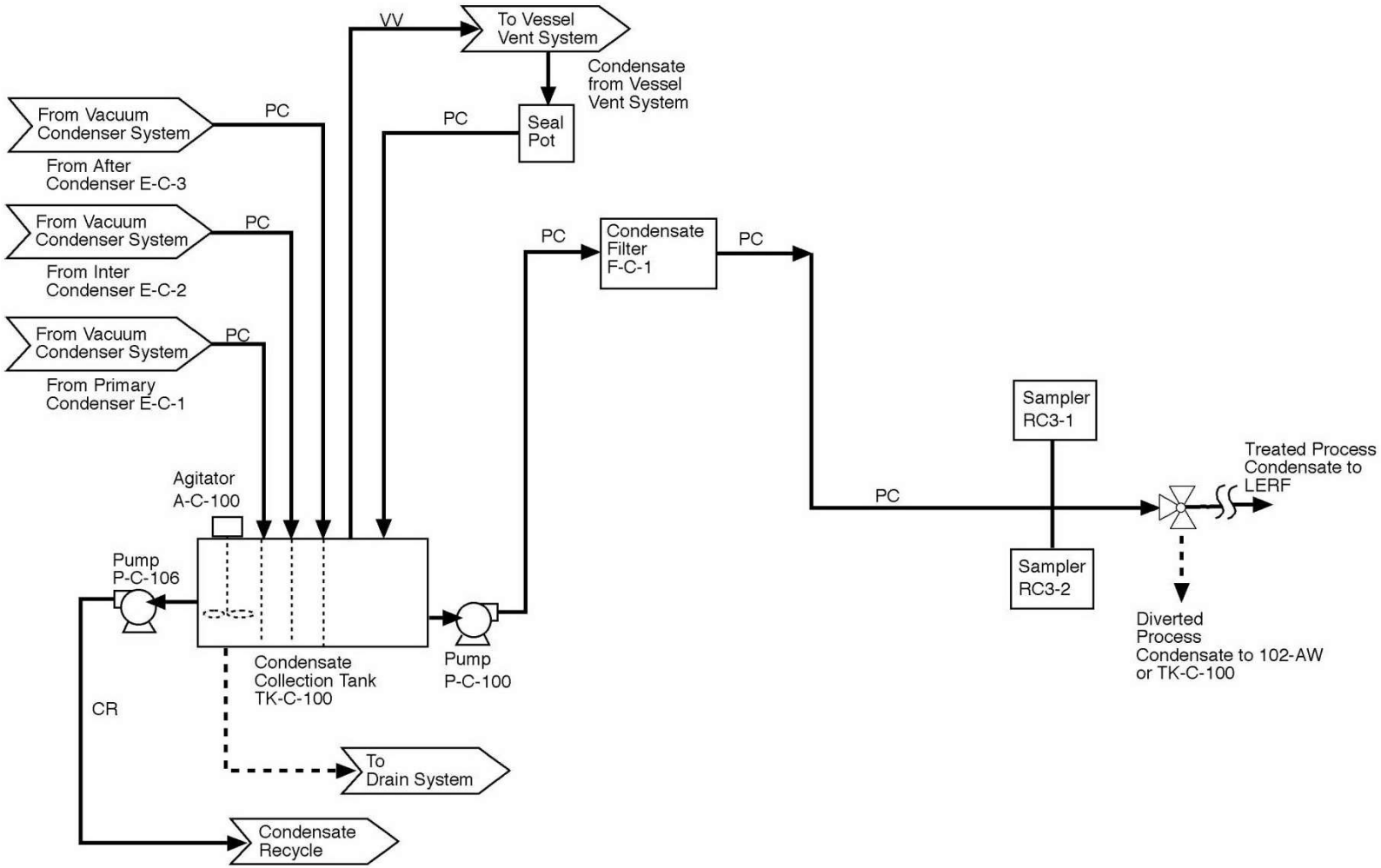


**Figure 4.4. 242-A Evaporator Process Condensate System**



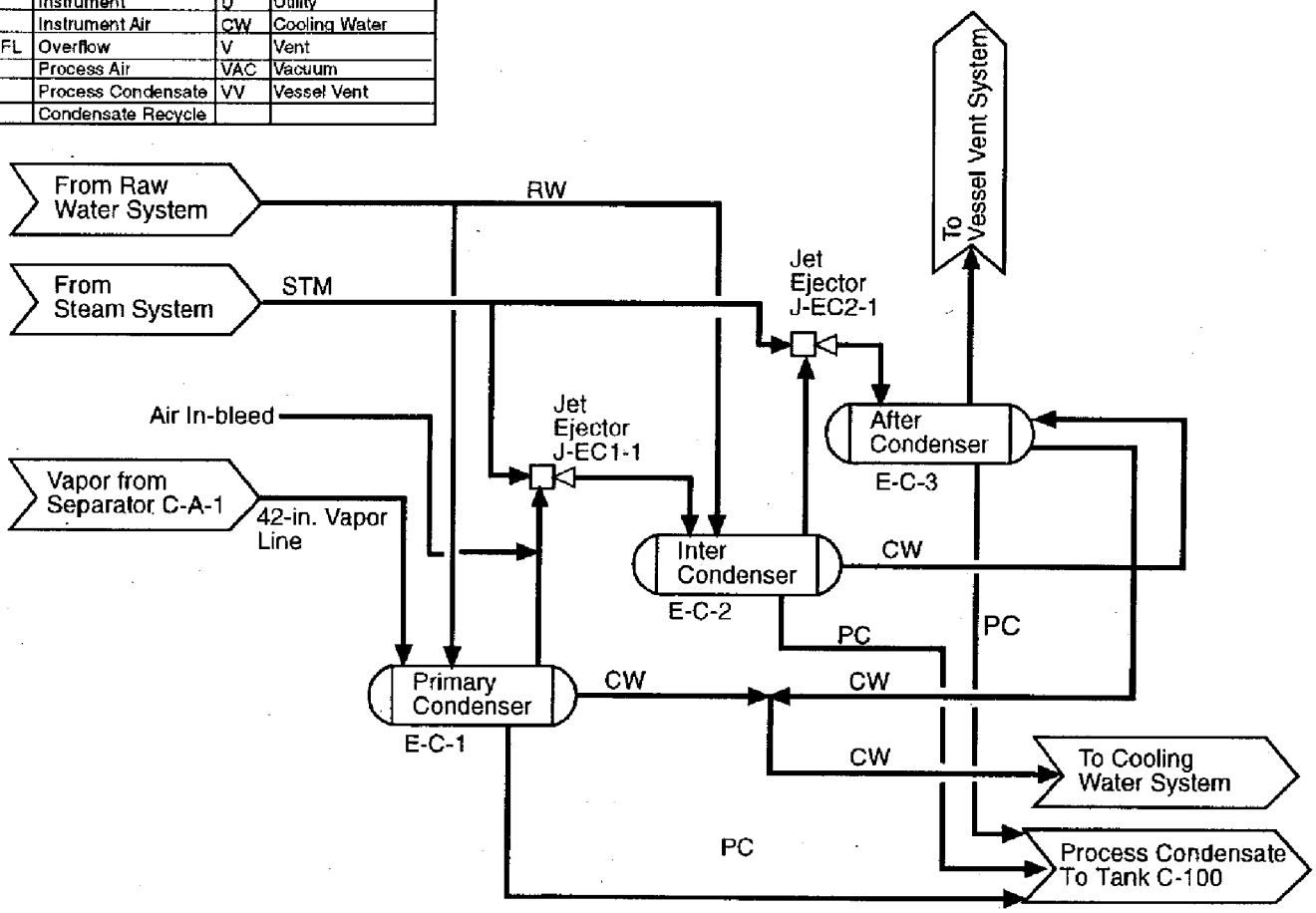

| Piping Abbreviations | | | | | | | |
|---|---|---|---|---|---|---|---|
| AF | Anti-Foam | I | Instrument | PW | Process Waste | CW | Cooling Water |
| AS | Air Sample | IA | Instrument Air | RW | Raw Water | V | Vent |
| DECO | Decontamination | OVFL | Overflow | SC | Steam Condensate | VAC | Vacuum |
| DR | Drain | PA | Process Air | SL | Slurry | VV | Vessel Vent |
| EF | Evaporator Feed | PC | Process Condensate | STM | Steam | | |
| EL | Eluant | CR | Condensate Recycle | SW | Sanitary Water | | |
| FRW | Filtered Raw Water | PS | Process Sewer | U | Utility | | |

LERF = Liquid Effluent Retention Facility.

M0312-2.1
12-9-03

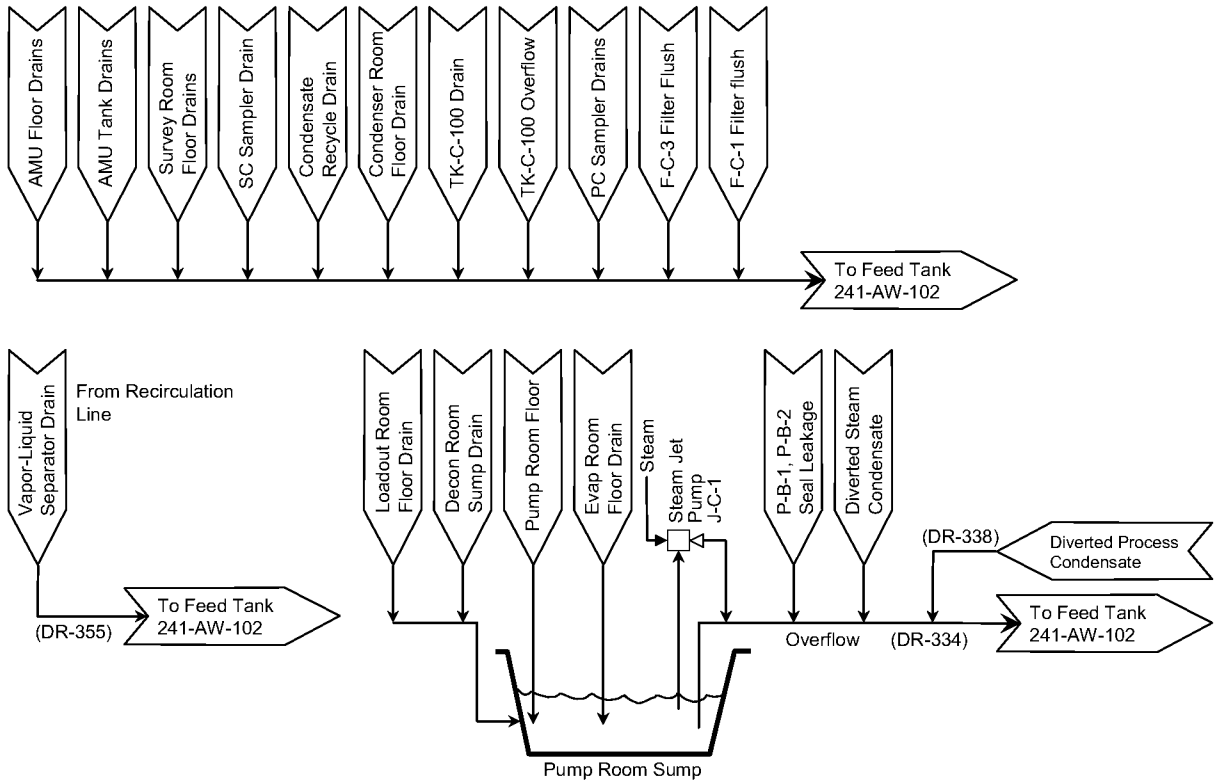
**Figure 4.5. 242-A Evaporator Vacuum Condenser System**

| Piping Abbreviations | | | |
|---|---|---|---|
| AF | Anti-Foam | PS | Process Sewer |
| AS | Air Sample | PW | Process Waste |
| DECO | Decontamination | RW | Raw Water |
| DR | Drain | SC | Steam Condensate |
| EF | Evaporator Feed | SL | Slurry |
| EL | Eluant | STM | Steam |
| FRW | Filtered Raw Water | SW | Sanitary Water |
| I | Instrument | U | Utility |
| IA | Instrument Air | CW | Cooling Water |
| OVFL | Overflow | V | Vent |
| PA | Process Air | VAC | Vacuum |
| PC | Process Condensate | VV | Vessel Vent |
| CR | Condensate Recycle | | |




2G96080167.6

**Figure 4.6. 242-A Evaporator Drain System**



## Chapter 7.0 Contingency Plan

7.0 CONTINGENCY PLAN ..... 7.1
7.1 BUILDING EVACUATION ROUTING (BUILDING LAYOUT) ..... 7.3
7.2 BUILDING EMERGENCY DIRECTOR ..... 7.3
7.3 IMPLEMENTATION OF THE CONTINGENCY PLAN ..... 7.3
7.3.1 Protective Actions Responses ..... 7.4
7.3.2 Response to Facility Operations Emergencies ..... 7.5
7.3.3 Prevention of Recurrence or Spread of Fires, Explosions, or Releases ..... 7.6
7.3.4 Incident Recovery and Restart of Operations ..... 7.7
7.3.5 Incompatible Waste ..... 7.7
7.3.6 Post Emergency Equipment Maintenance and Decontamination ..... 7.7
7.4 EMERGENCY EQUIPMENT ..... 7.7
7.4.1 Fixed Emergency Equipment ..... 7.8
7.4.2 Portable Emergency Equipment ..... 7.8
7.4.3 Communications Equipment/Warning Systems ..... 7.8
7.4.4 Personal Protective Equipment ..... 7.9
7.4.5 Spill Control and Containment Supplies ..... 7.9
7.4.6 Incident Command Post ..... 7.9
7.5 REQUIRED REPORTS ..... 7.9
7.6 PLAN LOCATION AND AMENDMENTS ..... 7.9
7.7 FACILITY/BUILDING EMERGENCY RESPONSE ORGANIZATION ..... 7.9

## Figure

Figure 7.1. 242 A Evaporator Evacuation Routes ..... 7.10
Figure 7.2. 242-A Evaporator Staging Areas ..... 7.11

## Table

Table 7.1 Hanford Facility Documents Containing Contingency Plan Requirements of WAC 173-303-350(3) ..... 7.1

This page intentionally left blank.

# 7.0 CONTINGENCY PLAN

The applicable WAC 173-303 requirements for a contingency plan at 242-A Evaporator are satisfied in the following documents: portions of the Hanford Facility RCRA Permit (Permit) Attachment 4 *Hanford Emergency Management Plan* (DOE/RL-94-02) and this Chapter.

The unit-specific building emergency plan also serves to satisfy a broad range of other requirements [e.g., Occupational Safety and Health Administration standards (29 CFR 1910), *Toxic Substances Control Act of 1976* (40 CFR 761), and U.S. Department of Energy Orders]. Therefore, revisions made to portions of this unit-specific building emergency plan that are not governed by the requirements of WAC 173-303 will not be considered as a modification subject to WAC 173-303-830 or Permit Condition I.C.3.

Table 7.1 identifies the sections of the unit-specific building emergency plan written to meet WAC 173-303-350(3) contingency plan requirements identified in this Chapter. In addition, Section 12.0 of the unit-specific 242-A Evaporator building emergency plan is written to meet WAC173-303 requirements identifying where copies of the *Hanford Emergency Management Plan* (DOE/RL-94-02) and the building emergency plan are located and maintained on the Hanford Facility. Therefore, revisions to Section 12.0 of the building emergency plan and the portions identified in Table 7.1 are considered a modification subject to WAC 173-303-830 or Permit Condition I.C.3.

**Table 7.1 Hanford Facility Documents Containing Contingency Plan Requirements of WAC 173-303-350(3)**

| Requirement | Permit Attachment 4 Hanford Emergency Management Plan (DOE/RL-94-02) | Building Emergency Plan[1] (HNF-IP-0263-242A) | Chapter 7.0 |
|---|---|---|---|
| -350(3)(a) - A description of the actions which facility personnel must take to comply with this section and WAC 173-303-360 | X[2]<br>Section 1.3.4 | X[2]<br>Sections 7.1, 7.2 through 7.2.5, and 7.3[1]<br>Sections 4.0, 8.2, 8.3, 8.4, and 11.0 | X[2]<br>Sections 7.3.1, 7.3.2, through 7.3.2.5, and 7.3.3[3]<br>Sections 7.3, 7.3.4, 7.3.5, 7.3.6, and 7.5 |
| -350(3)(b) - A description of the actions which shall be taken in the event that a dangerous waste shipment, which is damaged or otherwise presents a hazard to the public health and the environment, arrives at the facility, and is not acceptable to the owner or operator, but cannot be transported pursuant to the requirements of WAC 173-303-370(6), Manifest system, reasons for not accepting dangerous waste shipments | X[2]<br>Section 1.3.4 | X[2,4]<br>Section 7.2.5.1 | X[2,4]<br>Section 7.3.2.5.1 |
| -350(3)(c) - A description of the arrangements agreed to by local police departments, fire departments, hospitals, contractors, and state and local emergency response teams to coordinate emergency services as required in WAC 173-303-340(4). | X<br>Sections 3.2.3, 3.3.1, 3.3.2, 3.4, 3.4.1.1, 3.4.1.2, 3.4.1.3, 3.7, and Table 3.1 | | |

| Requirement | Permit Attachment 4 Hanford Emergency Management Plan (DOE/RL-94-02) | Building Emergency Plan[1] (HNF-IP-0263-242A) | Chapter 7.0 |
|---|---|---|---|
| -350(3)(d) - A current list of names, addresses, and phone numbers (office and home) of all persons qualified to act as the emergency coordinator required under WAC 173-303-360(1). Where more than one person is listed, one must be named as primary emergency coordinator, and others must be listed in the order in which they will assume responsibility as alternates. For new facilities only, this list may be provided to the department at the time of facility certification (as required by WAC 173-303-810 (14)(a)(I)), rather than as part of the permit application. | | X[1] Sections 3.1 and 13.0 | X[5] Sections 7.2 and 7.7 |
| -350(3)(e) - A list of all emergency equipment at the facility (such as fire extinguishing systems, spill control equipment, communications and alarm systems, and decontamination equipment), where this equipment is required. This list must be kept up to date. In addition, the plan must include the location and a physical description of each item on the list, and a brief outline of its capabilities. | | X Section 9.0 | X Section 7.4 |
| -350(3)(f) - An evacuation plan for facility personnel where there is a possibility that evacuation could be necessary. This plan must describe the signal(s) to be used to begin evacuation, evacuation routes, and alternate evacuation routes. | X[6] Figure 7.3 and Table 5.1 | X[7] Section 1.5 | X[7] Section 7.1 |

An 'X' indicates requirement applies.

[1] Portions of Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02) not enforceable through Appendix A of that document are not made enforceable by reference in the building emergency plan.

[2] Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02) contains descriptions of actions relating to the Hanford Site Emergency Preparedness System. No additional descriptions of actions are required at the site level. If other credible scenarios exist or if emergency procedures at the unit are different, the description of actions contained in the building emergency plan will be used during an event by a building emergency director.

[3] Sections 7.1, 7.2 through 7.2.5, and 7.3 of the building emergency plan are those sections subject to the Class 2 "Changes in emergency procedures (i.e., spill or release response procedures)" described in WAC 173-303-830, Appendix I, Section B.6.a.

[4] This requirement only applies to TSD units that receive shipment of dangerous or mixed waste defined as offsite shipments in accordance with WAC 173-303.

[5] Emergency Coordinator names and home telephone numbers are maintained separate from any contingency plan document on file in accordance with Permit Condition II.A.4 and are updated, at a minimum, monthly.

6 The Hanford Facility (site wide) signals are provided in this document. No unit/building signal information is required unless unique devices are used at the unit/building.

7 An evacuation route for the TSD unit must be provided. Evacuation routes for occupied buildings surrounding the TSD unit are provided through information boards posted within buildings.

## 7.1 BUILDING EVACUATION ROUTING (BUILDING LAYOUT)

Figures 7.1 and 7.2 provide identification of the primary and secondary staging areas and a general layout of the 242-A Evaporator. Alternate evacuation routes will be used on a case-by-case basis, based on meteorological conditions at the time of the event.

## 7.2 BUILDING EMERGENCY DIRECTOR

Emergency response will be directed by the BED until the Incident Commander (IC) arrives. The IC and staff with supporting on call personnel fulfill the responsibilities of the Emergency Coordinator as discussed in WAC 173-303-360.

During events, facility personnel perform response duties under the direction of the BED. The Incident Command Post (ICP) is managed by either the senior Hanford Fire Department member present on the scene or senior Hanford Patrol member present on the scene (security events only). These individuals are designated as the IC and as such, have the authority to request and obtain any resources necessary for protecting people and the environment. The BED becomes a member of the ICP and functions under the direction of the IC. In this role, the BED continues to manage and direct facility operations.

A listing of BEDs by title, work location, and work telephone numbers is contained in Section 7.7. The BED is on the premises or is available through an "on call" list 24 hours a day. Names and home telephone numbers of the BEDs are available from the Patrol Operations Center (POC) in accordance with Permit Condition II.A.4.

## 7.3 IMPLEMENTATION OF THE CONTINGENCY PLAN

The BED ensures that trained personnel identify the character, source, amount, and areal extent of the release, fire, or explosion to the extent possible. Identification of waste can be made by activities that can include, but are not limited to, visual inspection of involved containers, sampling activities in the field, reference to inventory records, or by consulting with facility personnel. Samples of materials involved in an emergency might be taken by qualified personnel and analyzed as appropriate. These activities must be performed with a sense of immediacy and shall include available information.

The BED shall use the following guidelines to determine if an event has met the requirements of WAC 173-303-360(2)(d):

1. The event involved an unplanned spill, release, fire, or explosion,

AND

2.a The unplanned spill or release involved a dangerous waste, or the material involved became a dangerous waste as a result of the event (e.g., product that is not recoverable.),

OR

2.b The unplanned fire or explosion occurred at the 242-A Evaporator or transportation activity subject to RCRA contingency planning requirements,

AND

3. Time urgent response from an emergency services organization was required to mitigate the event or a threat to human health or the environment exists.

As soon as possible, after stabilizing event conditions, the BED shall determine, in consultation with the Permittee environmental single point-of-contact, if notification to Ecology is needed to meet WAC 173 303-360(2)(d) reporting requirements. If all of the conditions under 1, 2, and 3 are met, notifications are to be made to Ecology. Additional information is found in Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02, Section 4.2).

If review of all available information does not yield a definitive assessment of the danger posed by the incident, a worst-case condition will be presumed and appropriate protective actions and notifications will

be initiated. The BED is responsible for initiating any protective actions based on their best judgment of the incident.

The BED must assess each incident to determine the response necessary to protect the personnel, facility, and the environment. If assistance from Hanford Patrol, Hanford Fire Department, or ambulance units is required, the Hanford Emergency Response Number (911 from site office phones/373-0911 from cellular phones) must be used to contact the POC and request the desired assistance.

### 7.3.1 Protective Actions Responses

Protective action responses are discussed in the following sections. The steps identified in the following description of actions do not have to be performed in sequence because of the unanticipated sequence of incident events.

#### 7.3.1.1 Evacuation

The objective of a facility evacuation order is to limit personnel exposure to hazardous materials or dangerous/mixed waste by increasing the distance between personnel and the hazard. The scope of the evacuation includes evacuation of the facility due to an event at the facility as well as evacuation of the facility in response to a site evacuation order. Evacuation is directed by the BED when conditions warrant and applies to all personnel not actively involved in the event response or in emergency plan related activities.

The BED initiates the evacuation by directing an announcement be made to evacuate along with the evacuation location over the public address system and facility radios. Personnel proceed to a predetermined staging area (shown in Figure 7.2), or other safe upwind location, as determined by the BED. The BED determines the operating configuration of the facility and identifies any additional protective actions to limit personnel exposure to the hazard.

Emergency organization personnel or assigned operations personnel conduct a sweep of occupied buildings to ensure that all personnel and visitors have evacuated. For an immediate evacuation, accountability is performed at the staging area. The BED assigns personnel as accountability aides and staging area managers with the responsibility to ensure that evacuation actions are taken at the 242-A Evaporator. All implementing actions executed by the aides/managers are directed by the emergency response procedures. When evacuation actions are complete, the aides/managers provide a status report to the BED. The BED provides status to the IC.

#### 7.3.1.2 Take Cover

The objective of the take cover order is to limit personnel exposure to hazardous or dangerous/mixed waste when evacuation is inappropriate or not practical. Evacuation might not be practical or appropriate because of extreme weather conditions or the material release might limit the ability to evacuate safely personnel.

The BED initiates the take cover by directing an announcement be made over the public address system and facility radios, and, as conditions warrant, by activating the 200 Area take cover alarms by calling the POC using 911 from site office phones/373-0911 from cellular phones. Actions to complete a facility take cover order are directed by the emergency response procedure. Protective actions associated with operations include configuring, or shutting down, the ventilation systems. Determination of additional take cover actions is based on operating configuration, weather conditions, amount and duration of release, and other conditions, as applicable to the event and associated hazard. As a minimum, personnel exposure to the hazard is minimized. The BED assigns personnel as accountability aides with responsibility to ensure that take cover actions are taken at all occupied buildings at the 242-A Evaporator. When take cover actions are complete, the aides/managers provide the BED with a status report.

### 7.3.2 Response to Facility Operations Emergencies

Depending on the severity of the event, the BED reviews the site wide procedures and 242-A Evaporator emergency response procedure(s) and, as required, categorizes and/or classifies the event. If necessary, the BED initiates area protective actions and Hanford Site Emergency Response Organization activation. The steps identified in the following description of actions do not have to be performed in sequence because of the unanticipated sequence of incident events.

#### 7.3.2.1 Loss of Utilities

A case-by-case evaluation is required for each event to determine loss of utility impacts. When a BED determines a loss of utility impact, actions are taken to ensure dangerous and/or mixed waste is being properly managed, to the extent possible given event circumstances. As necessary, the BED will stop operations and take appropriate actions until the utility is restored. If loss of utilities at the 242-A Evaporator results in a major process disruption/loss of plant control, notifications in Section 7.3.2.2 are performed.

#### 7.3.2.2 Major Process Disruption/Loss of Plant Control

Upon loss of the MCS, the Shift Manager is notified while an attempt is made to return the MCS to service. If a dump of the vapor-liquid separator (C-A-1) vessel does occur, AW Tank Farm personnel are notified of impending over pressurization of DST system tank 241-AW-102, and all personnel in the AW Tank Farm evacuate to the change trailer. Non-essential personnel exit the 242-A Evaporator facility.

The system condition is assessed, and corrective actions are implemented. Operations are placed on recirculation by securing the slurry pump and waste feed to the plant. Facility shutdown is accomplished by performing manual, localized actions such as system isolation, equipment shutdown, etc.

#### 7.3.2.3 Pressure Release

If mixed waste release occurs, perform actions identified in Section 7.3.2.5.

#### 7.3.2.4 Fire and/or Explosion

In the event of a fire, the discoverer activates a fire alarm; calls 911 from site office phones/373-0911 from cellular phones or verifies that 911 has been called. Automatic initiation of a fire alarm (by the smoke detectors, sprinkler systems, and pull boxes) is also possible.

- Unless otherwise instructed, personnel shall evacuate the area/building by the nearest safe exit and proceed to the designated staging area for accountability.
- On actuation of the fire alarm, ONLY if time permits, personnel should shut down equipment, secure waste, and lock up classified materials (or hand carry them out). The alarm automatically signals the Hanford Fire Department.
- The BED proceeds directly to the ICP, obtains all necessary information pertaining to the incident, and sends a representative to meet Hanford Fire Department.
- The BED provides a formal turnover to the IC when the IC arrives at the ICP.
- The BED informs the Hanford Site Emergency Response Organization as to the extent of the emergency (including estimates of dangerous waste, mixed waste, or radioactive material quantities released to the environment).
- If operations are stopped in response to the fire, the BED ensures that systems are monitored for leaks, pressure buildup, gas generation, and ruptures.
- Hanford Fire Department firefighters extinguish the fire as necessary.

NOTE: Following a fire and/or explosion, WAC 173-303-640(7) will be addressed for the 242-A Evaporator regarding fitness for use.

#### 7.3.2.5 Hazardous Material, Dangerous and/or Mixed Waste Spill

Spills can result from many sources including process leaks, container spills or leaks, damaged packages or shipments, or personnel error. Spills of mixed waste are complicated by the need to deal with the extra hazards posed by the presence of radioactive materials.

- The discoverer notifies BED and initiates SWIMS response:
  - **S**tops work
  - **W**arns others in the vicinity
  - **I**solates the area
  - **M**inimizes the spill if possible
  - Requests the BED **S**ecure ventilation
- The BED determines if emergency conditions exist requiring response from the Hanford Fire Department based on classification of the spill and injured personnel, and evaluates need to perform additional protective actions.
- If the Hanford Fire Department resources are not needed, the spill is mitigated with resources identified in Section 7.4 and proper notifications are made.
- If the Hanford Fire Department resources are needed, the BED calls 911 from site office phones/373-0911 from cellular phones.
- The BED sends a representative to meet the Hanford Fire Department.
- The BED provides a formal turnover to the IC when the IC arrives at the ICP.
- The BED informs the Hanford Site Emergency Response Organization as to the extent of the emergency (including estimates of dangerous waste, mixed waste, or radioactive material quantities released to the environment).
- If operations are stopped in response to the spill, the BED ensures that systems are monitored for leaks, pressure buildup, gas generation, and ruptures.
- Hanford Fire Department stabilizes the spill.

NOTE: For response to leaks or spills and disposition of leaking or unfit-for-use tank systems, refer to WAC 173-303-640(7).

##### 7.3.2.5.1 Damaged or Unacceptable Shipments

The 242-A Evaporator is designed to receive waste from the double-shell tank (DST) system through existing underground piping. The notifications required by WAC 173-303-360(2)(j) and the reporting requirements of WAC 173-303-640(7)(d)(i) may be made via telephone conference.

#### 7.3.2.6 Radiological Material Release

At a minimum, actions described in Section 7.3.2.5 are taken. Abnormal radiation actions also may be implemented if conditions are warranted.

#### 7.3.2.7 Criticality

A criticality is not a credible accident at the 242-A Evaporator.

### 7.3.3 Prevention of Recurrence or Spread of Fires, Explosions, or Releases

The BED, as part of the incident command system, takes the steps necessary to ensure that a secondary release, fire, or explosion does not occur. The BED will take measures, where applicable, to stop processes and operations, collect and contain released wastes and remove or isolate containers. The BED

shall also monitor for leaks, pressure buildups, gas generation, or ruptures in valves, pipes or other equipment, whenever this is appropriate.

### 7.3.4 Incident Recovery and Restart of Operations

A recovery plan is developed when necessary in accordance with Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02, Section 9.2). A recovery plan is needed following an event where further risk could be introduced to personnel, the 242-A Evaporator, or the environment through recovery action and/or to maximize the preservation of evidence.

If this plan was implemented according to Section 7.3, the Washington State Department of Ecology is notified before operations can resume. The Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02, Section 5.1) discusses different reports to outside agencies. This notification is in addition to those required reports and includes the following statements:

- There are no incompatibility issues with the waste and released materials from the incident.
- All the equipment has been cleaned, fit for its intended use, and placed back into service.

The notification required by WAC 173-303-360(2)(j) and WAC 173-303-640(7)(d)(i) may be made via telephone conference. Additional information that Ecology requests regarding these restart conditions will be included in the required 15-day report identified in Section 7.5.

For emergencies not involving activation of the Hanford EOC, the BED ensures that conditions are restored to normal before operations are resumed. If the Hanford Site Emergency Response Organization was activated and the emergency phase is complete, a special recovery organization could be appointed at the discretion of RL to restore conditions to normal. This process is detailed in RL and contractor emergency procedures. The makeup of this organization depends on the extent of the damage and the effects. The onsite recovery organization will be appointed by the appropriate contractor's management.

### 7.3.5 Incompatible Waste

After an event, the BED or the onsite recovery organization ensures that no waste that might be incompatible with the released material is treated, stored, and/or disposed of until cleanup is completed. Cleanup actions are taken by 242-A Evaporator personnel or other assigned personnel. Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02, Section 9.2.3), describes actions to be taken.

Waste from cleanup activities is designated and managed as newly generated waste. Perform as necessary, field checks for waste compatibility before storage. Incompatible wastes are not placed in the same container. Containers of waste are placed in storage areas appropriate for their compatibility class.

If incompatibility of waste was a factor in the incident, the BED or the onsite recovery organization ensures that the cause is corrected.

### 7.3.6 Post Emergency Equipment Maintenance and Decontamination

All equipment used during an incident is decontaminated (if practicable) or disposed of as spill debris. Decontaminated equipment is checked for proper operation before storage for subsequent use. Consumable and disposed materials are restocked. Fire extinguishers are recharged.

The BED ensures that all equipment is cleaned and fit for its intended use before operations are resumed. Depleted stocks of neutralizing and absorbing materials are replenished, self-contained breathing apparatus are cleaned, and refilled, protective clothing is cleaned or disposed of and restocked, etc.

## 7.4 EMERGENCY EQUIPMENT

Emergency resources and equipment for the 242-A Evaporator are presented in this section.

### 7.4.1 Fixed Emergency Equipment

| Type | Location | Capability |
|---|---|---|
| Safety shower/eye wash station | 1 - Aqueous makeup room -south side. Next to truck load in airlock and chemical storage tank<br>1 - Condenser room basement, SE corner<br>1 - Condenser room 4th floor | Assist in flushing chemicals/materials from body and/or eyes and face |
| Wet pipe sprinkler system | Located throughout the facility | Assist in the control of fire |
| Fire alarm pull boxes | Located throughout the facility | Activates the building fire alarm and notifies the HFD |
| Emergency lighting (lanterns) | Located throughout the facility | Provide 1 hour of temporary lighting |
| Back-up diesel generator | 50 ft SE of the 242-A main entrance | Provide back-up power |

### 7.4.2 Portable Emergency Equipment

| Type | Location | Capabilities |
|---|---|---|
| General purpose fire extinguishers | Throughout the 242-A Evaporator facility | Fire suppression for class A, B, C, fires |
| Halon fire extinguishers | Two in control room | Suppress electrical fires |

### 7.4.3 Communications Equipment/Warning Systems

| Type | Location | Capability |
|---|---|---|
| Fire alarms | Located throughout the facility in halls, corridors, and locker rooms | Audible throughout the 242-A Evaporator Building |
| Area siren (Permit Attachment 4, DOE/RL-94-02, §11.3) | 200 East area utility poles the nearest one is located along 4th street where it bends at 275EA to the southwest of 242-A Evaporator | Provide warning to personnel to take cover or evacuate. |
| Operations process alarms from MCS or hard wired alarm panels | 242-A Evaporator control room | Audible in the 242-A Evaporator control room |
| Public address system (PAX) | Located throughout the 242-A Evaporator Building (except in pump and evaporator rooms) | Provides communications and public address capabilities |
| Portable Radios | 242-A control room | Communication to the 242-A control room |
| Telephone | 242-A control room, office areas, AMU room, and condenser room. | Internal and external communications. Allows notification of outside resources (HFD, Hanford Patrol, etc.) |

### 7.4.4 Personal Protective Equipment

| Type | Location | Capability |
|---|---|---|
| Respirators | 242-A respirator storage room | Filtered air for recovery of known hazards |

### 7.4.5 Spill Control and Containment Supplies

| Type | Location | Capability |
|---|---|---|
| Spill kit | Survey area next to personnel protective equipment storage room (exterior wall to AMU room), wall mounted | Provides spill control materials |

### 7.4.6 Incident Command Post

The ICPs for 242-A Evaporator emergencies are the 242-A Evaporator or the Base Operations Shift Office. Emergency resource materials are stored at each location. The IC could activate the Hanford Fire Department Mobile Command Unit if necessary.

## 7.5 REQUIRED REPORTS

Post incident written reports are required for certain incidents on the Hanford Site. The reports are described in Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02, Section 5.1).

Facility management must note in the TSD unit-specific operating record, the time, date, and details of any incident that requires implementation of the contingency plan (refer to Section 7.3). Within fifteen (15) days after the incident, a written report must be submitted to Ecology. The report must include the elements specified in WAC 173-303-360(2)(k) and WAC 173-303-640(7)(d)(ii).

## 7.6 PLAN LOCATION AND AMENDMENTS

Copies of this plan are maintained at the following locations:

- 242-A Evaporator Control Room
- Base Operations Shift Office (M0-268)

This plan will be reviewed and immediately amended as necessary, in accordance with Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02, Section 14.3.1.1).

## 7.7 FACILITY/BUILDING EMERGENCY RESPONSE ORGANIZATION

| 242-A Evaporator Building Emergency Directors | | | |
|---|---|---|---|
| **Title** | | **Work Location** | **Work Phone** |
| Primary | Central Shift Manager | 200 Areas. Primary location is the Base Operations Shift Office | 373-2689 |
| Alternate | Alternate BED | 200 Areas | 373-2689 |

Names and home telephone numbers of the BEDs are available from the POC (373-3800) in accordance with Permit Condition II.A.4.

**Figure 7.1. 242 A Evaporator Evacuation Routes**

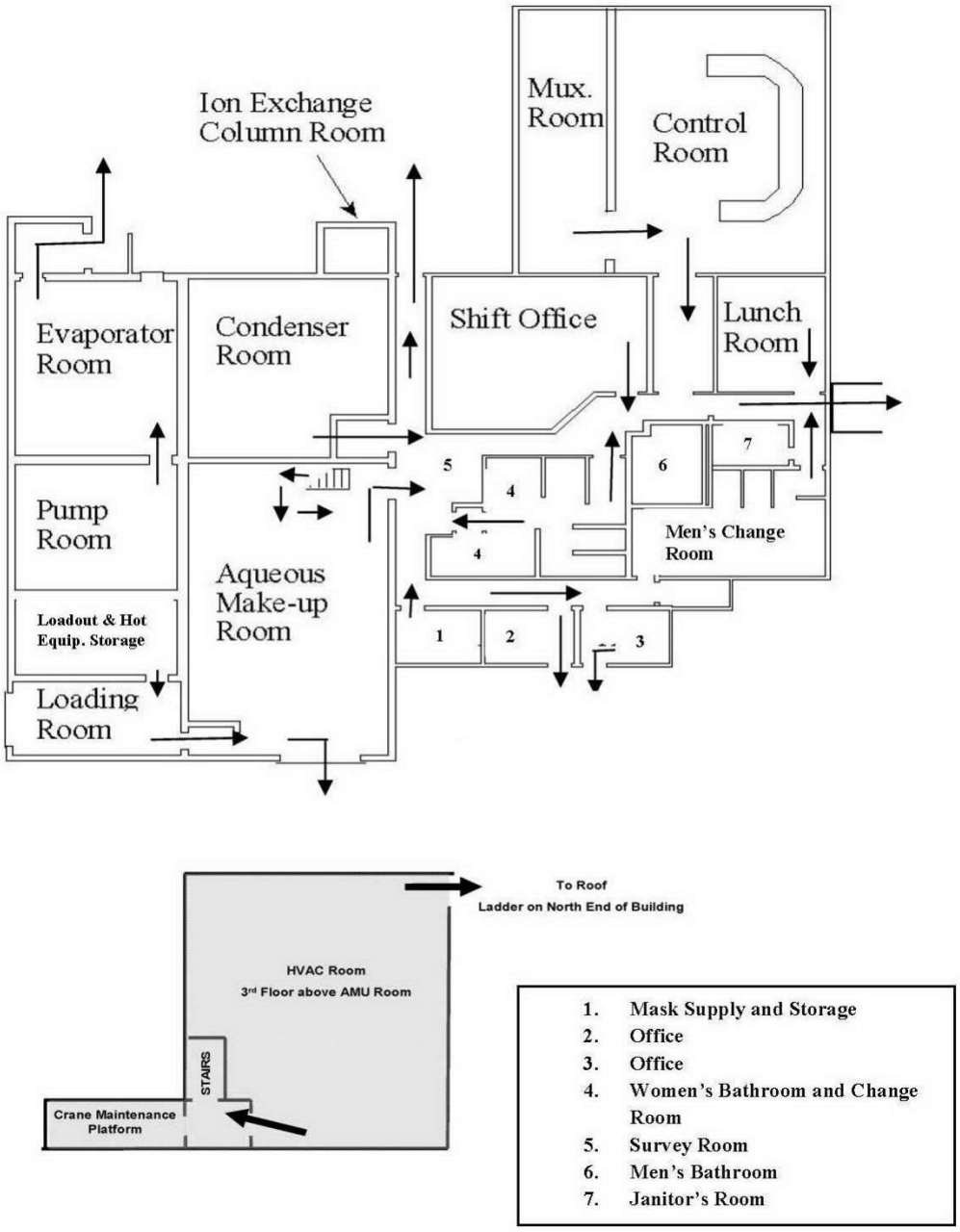
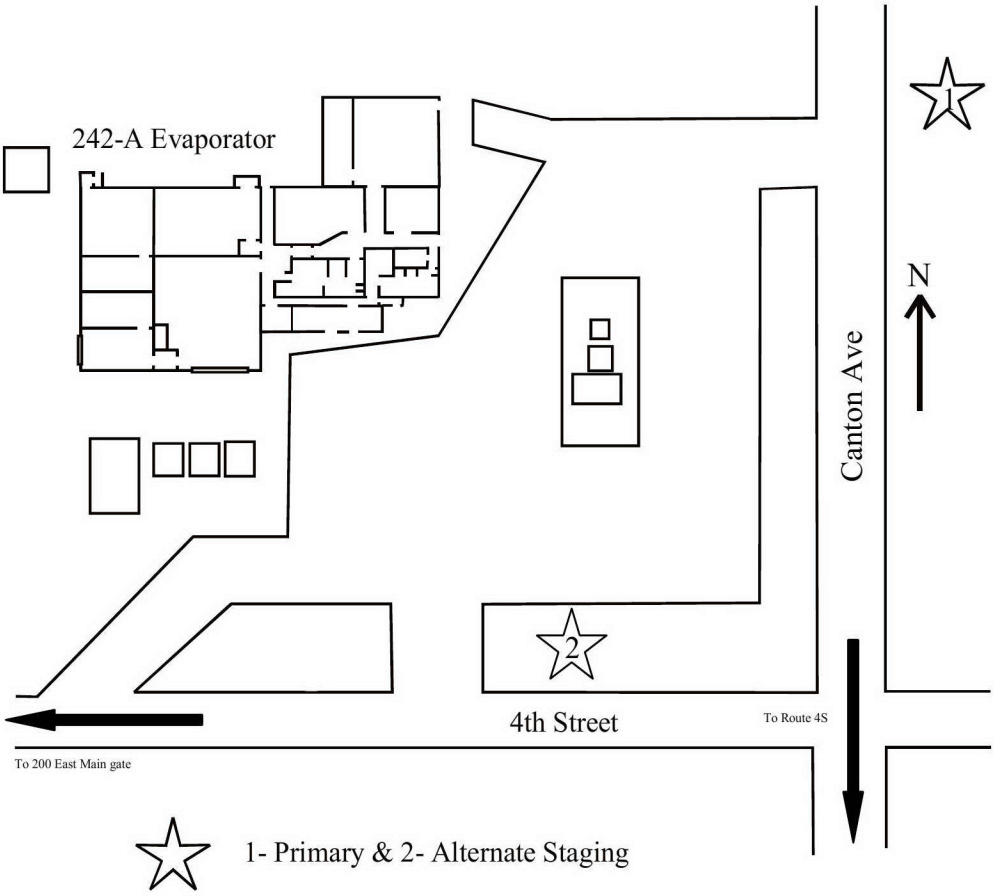


**Figure 7.2. 242-A Evaporator Staging Areas**



This page intentionally left blank.

## Chapter 8.0 Personnel Training

8.0 PERSONNEL TRAINING ..... 8.1
8.1 DESCRIPTION OF TRAINING PLAN ..... 8.1

## Table

Table 8.1. 242-A Evaporator Training Matrix ..... 8.2

This page intentionally left blank.

# 8.0 PERSONNEL TRAINING

Specific requirements for the Hanford Facility Personnel Training program are described in Permit Attachment 5, incorporated by reference. The Permittees will comply with the training matrix below which provides training requirements for Hanford Facility personnel associated with the 242-A Evaporator. Refer to the 242-A Evaporator Dangerous Waste Training Plan (DWTP) for a complete description of the personnel training requirements. A copy of the 242-A Evaporator DWTP will be placed in the Hanford Facility Operating Record, 242-A Evaporator unit-specific portion, and will be updated by the Permittee as unit-specific conditions change. Training received by Hanford Facility personnel will be commensurate with the duties they perform. Individuals are not required to receive training for work/duties they do not perform.

Waste management duties include those specified in Attachment 5 as well as those contained in WAC 173-303-330(1)(d). Training elements of WAC 173-303-330(1)(d) applicable to the 242-A Evaporator operations include the following:

- Procedures for using, inspecting, repairing, and replacing emergency and monitoring equipment
- Key parameters for automatic waste feed cut-off systems
- Communications or alarm systems
- Response to fires or explosions
- Shutdown of operations.

## 8.1 DESCRIPTION OF TRAINING PLAN

In accordance with Permit Condition II.C.3, the unit-specific portion of the Hanford Facility Dangerous Waste permit application must contain a description of the training plan. Training plan documentation is maintained outside of the Hanford Facility Dangerous Waste Part B permit application and the Permit. Therefore, changes made to the training plan documentation are not subject to the Permit modification process. However, the training plan documentation is prepared to comply with WAC 173-303-330(2).

Documentation prepared to meet the training plan consists of hard copy and/or electronic media as provided by Permit Condition II.C.1. The training plan documentation consists of one or more documents and/or a training database with all the components identified in the core document.

A description of how training plan documentation meets the three items in WAC 173-303-330(2) is as follows:

1. -330(2)(a): "The job title, job description, and name of the employee filling each job. The job description must include requisite skills, education, other qualifications, and duties for each position."

   Description: The specific Hanford Facility personnel job title/position is correlated to the waste management duties. Waste management duties relating to WAC 173-303 are correlated to training courses to ensure training is properly assigned.

   A listing of Hanford Facility personnel who carry out job duties relating to TSD unit waste management operations at the 242-A Evaporator are maintained. Individuals who are not performing duties of the Dangerous Waste Worker Category identified in Table 8.1 due to reassignment, medical restriction, or other limiting factors do not require current training for that category. These individuals must complete the required training for the Dangerous Waste Worker Category prior to resuming duties associated with that category.

   Information on requisite skills, education, and other qualifications for job titles/positions are addressed by providing a reference where this information is maintained (e.g., human resources). Specific information concerning job title, requisite skills, education, and other qualifications for personnel can be provided upon request.

2. -330(2)(b): "A written description of the type and amount of both introductory and continuing training required for each position."

   Description: In addition to the outline provided in Attachment 5, Section 5.1, training courses developed to comply with the introductory and continuing training programs are identified and described in the training plan documentation. The type and amount of training is specified in the training plan documentation as shown in Table 8.1.

3. -330(2)(c): "Records documenting that personnel have received and completed the training required by this section. The Department may require, on a case-by-case basis, that training records include employee initials or signature to verify that training was received."

   Description: Training records are maintained consistent with Attachment 5, Section 5.3.

**Table 8.1. 242-A Evaporator Training Matrix**

| | **Training Category** | | | | |
|---|---|---|---|---|---|
| Attachment 5 Training Category | General Hanford Facility Training | Contingency Plan Training | Emergency Coordinator Training | Operations Training | |
| **Operating Unit 4: 242A Evaporator** | Orientation Program | Emergency Hazards Check List | Building Emergency Training | General Waste Management | Tank System Management |
| **Dangerous Waste Worker Categories** | | | | | |
| Waste Worker | X | X | X | X | X |
| Waste Worker Supervisor/ Manager | X | X | X | X | |
| Advanced Waste Worker | X | X | X | X | |
| Building Emergency Director | X | X | X | | |

# Chapter 11.0 Closure

11.0 CLOSURE ..... 11.1
11.1 CLOSURE PLAN ..... 11.1
11.2 CLOSURE PERFORMANCE STANDARD ..... 11.1
11.2.1 Closure Standards for Metal Surfaces, and Concrete ..... 11.1
11.2.2 Closure Standards for Tanks ..... 11.2
11.2.3 Closure Standards for Internal and/or External Piping ..... 11.2
11.2.4 Closure Standards for Ancillary Equipment ..... 11.2
11.2.5 Closure Standards for Underlying Soils ..... 11.2
11.3 CLOSURE ACTIVITIES ..... 11.3
11.3.1 General Closure Activities ..... 11.3
11.3.2 Constituents of Concern for Closure for 242-A Evaporator ..... 11.3
11.3.3 Removing Dangerous Waste ..... 11.3
11.3.4 Decontaminating Structures, Equipment, and Soils ..... 11.3
11.4 MAXIMUM WASTE INVENTORY ..... 11.6
11.5 CLOSURE OF TANKS ..... 11.6
11.6 SCHEDULE FOR CLOSURE ..... 11.7

This page intentionally left blank.

# 11.0 CLOSURE

This chapter describes the planned activities and performance standards for closing the 242-A Evaporator. Final closure will begin when the 242-A Evaporator is no longer needed.

## 11.1 CLOSURE PLAN

The 242-A Evaporator will be clean closed with respect to dangerous waste contamination that resulted from operation as a TSD unit. To facilitate closure, the 242-A Evaporator is being viewed as consisting of six components: tanks, ancillary equipment, piping, concrete floors/liners, structures, and underlying soil. Only areas that have treated, stored, or handled dangerous waste will undergo closure activities. Remedial actions with respect to contamination that was not a result of use of these areas for treatment, storage, or handling of dangerous waste are outside the scope of this closure plan.

Contaminated equipment, tanks, and piping removed from the 242-A Evaporator will be considered "debris" and transported to an appropriate permitted treatment, storage, or disposal unit for final disposition. Uncontaminated structures will be left for future use or disassembled, dismantled, and removed for disposal. Uncontaminated equipment and structures could include aqueous makeup, HVAC and piping, steam condensate and cooling water piping, the control room, change rooms and administrative/office areas.

The pipes located west and north of the 242-A Evaporator, which connect to A Farm and AW Farm, are in the same bundles with pipes used for transfers between tanks in the DST System. To minimize radiation exposure during closure, these pipes will be closed at the same time the piping for the DST System is closed. Clean closure requires decontamination or removal and disposal of all dangerous waste, waste residues, contaminated equipment, soil, or other material established in accordance with the clean closure performance standards of WAC 173-303-610(2). This and future closure plan revisions will provide for compliance with these performance standards. All work will be performed ALARA with respect to worker exposure to dangerous and/or any other workplace hazards. Activities that are planned to achieve clean closure are presented in the following sections.

## 11.2 CLOSURE PERFORMANCE STANDARD

Clean closure, as provided for in this plan, and in accordance with WAC 173-303-610(2), will eliminate future maintenance and will be protective of human health and the environment.

After closure, the appearance of the land where the 242-A Evaporator is located will be consistent with the appearance and future use of the surrounding land areas. This closure plan proposes to leave clean structures and equipment in place after closure for potential future operations. This need will be evaluated at the time of closure.

### 11.2.1 Closure Standards for Metal Surfaces, and Concrete

This closure plan proposes use of a 'clean debris surface' (defined in the following paragraph) as the clean closure performance standard for the metal surfaces, and concrete that will remain after closure. This approach is consistent with Ecology guidance (Ecology 1994) for achievement of clean closure.

Attainment of a clean debris surface can be verified visually in accordance with the standard that states, "A clean debris surface means the surface, when viewed without magnification, shall be free of all visible contaminated soil and hazardous waste except residual staining from soil and waste consisting of light shadows, slight streaks, or minor discolorations and soil and waste in cracks, crevices, and pits may be

present provided that such staining and waste and soil in cracks, crevices, and pits shall be limited to no more than 5% of each square inch of surface area" (40 CFR 268.45).

Decontamination of concrete, per the 'debris rule' is based on a physical extraction method (40 CFR 268.45, Table 1). The performance standard is based on removal of the contaminated layer of debris. The physical extraction performance standard for concrete is removal of 0.6 centimeter of the surface layer and treatment to a clean debris surface.

### 11.2.2 Closure Standards for Tanks

Using the 242-A Evaporator's decontamination system, the tank system could be flushed and decontaminated. The rinsate will be sampled and analyzed. Results of the analysis with less than designation limits for the constituents of concern will be accepted as indicating that the tanks are clean with respects to dangerous waste residues. An alternative to decontaminating the tanks is to remove and dispose of the tanks accordingly.

### 11.2.3 Closure Standards for Internal and/or External Piping

The internal and/or external piping of 242-A Evaporator will be flushed and drained as part of closure. For piping where the contaminated surfaces can be inspected, an inspection will be performed to see if the piping meets the clean debris surface standard in 40 CFR 268.45 incorporated by reference and can be declared non-dangerous in accordance with WAC 173-303-071(3)(qq). If it is not possible to inspect the contaminated surfaces or meet the clean debris surface performance standard, the particular piping of concern will be removed, designated, and disposed of accordingly.

The feed sampler (SAMP-F-1) located in a sample enclosure in the Hot Equipment Storage room has been isolated and blanked and will be closed during closure of the 242-A Evaporator. The feed sampler line was designed so that the piping does not contain any level/flat segments and thus facilitates active gravity drainage of liquids. The remaining portion of the feed sampler line that exists between Nozzles J and K is sloped 1° from Nozzle J to a 180° bend and sloped 1° from the 180° bend to Nozzle K.

Dangerous and/or mixed-waste materials generated during closure activities will be managed in accordance with WAC 173-303-610(5). Removal of any dangerous wastes or dangerous constituents during partial or final closure will be handled in accordance with applicable requirements of WAC 173-303-610(5).

### 11.2.4 Closure Standards for Ancillary Equipment

Ancillary equipment is defined as pumps and other miscellaneous equipment not otherwise specified in this closure plan. Ancillary equipment will be removed and disposed.

### 11.2.5 Closure Standards for Underlying Soils

Clean closure of soil under the 242-A Evaporator will be accomplished by determining that the coated concrete floor and stainless steel liners, kept contaminants from reaching the soil. The coated concrete and liners provided secondary containment for all the tanks, process piping, and ancillary equipment within the building. Unless inspections identify potential through-thickness cracks indicating containment failure and a subsequent potential for soil contamination from TSD unit operations, the soil will be considered clean closed. However, if inspections identify such cracks, and there have been documented spills in the vicinity, potential soil contamination will be investigated. Soils will be sampled and analyzed for constituents of concerns. If the soil analytical results determine that, the constituents of

concern are at or below agreed to regulatory cleanup levels, the soil will be considered clean closed. Permit Condition II.K defines regulatory cleanup levels. Sampling and disposal objectives will be determined at the time of closure activities through the data quality objectives process. If verification sampling is required, a sampling analysis plan will be prepared before closure in a manner consistent with Ecology guidance (Ecology publication #94-111 dated 2005) for achievement of clean closure.

## 11.3 CLOSURE ACTIVITIES

At the time of closure, the closure plan will be modified as necessary to reflect current regulations and information. If it is determined that clean closure is not possible, the closure plan will be modified to address required postclosure activities.

### 11.3.1 General Closure Activities

Closure of the 242-A Evaporator will include removal of accumulated liquid waste (i.e., liquid remaining from evaporator campaigns) by transferring the waste to the DST System and/or LERF. After the waste has been removed, clean closure of the tanks, process equipment, the piping, concrete/liners, and the structures will be accomplished by decontaminating the components, if required and demonstrating that clean closure performance standards are met in accordance with WAC 173-303-610. Clean closure of the soil will be accomplished by demonstrating that the concrete and liners kept the contaminants from reaching the soil. If it is determined that soil contamination is possible, investigation and cleanup of the soils will also be managed in accordance with WAC 173-303-610(2)(b).

Equipment or materials (personnel protective equipment, steam cleaners, etc.) used in performing closure activities will be decontaminated or disposed at a permitted TSD facility as appropriate.

### 11.3.2 Constituents of Concern for Closure for 242-A Evaporator

Based on process knowledge and the risk to human health and the environment, the constituents of concern for closure will be selected from the list of dangerous waste numbers in Chapter 1.0 through the data quality objective process.

### 11.3.3 Removing Dangerous Waste

All of the waste inventory at the 242-A Evaporator will be processed before closure. Any residue remaining in piping and equipment will be removed to an appropriate TSD unit.

### 11.3.4 Decontaminating Structures, Equipment, and Soils

Before closure activities begin, all waste inventories will be removed. To facilitate closure, tanks, internal and/or external piping, ancillary equipment, concrete floors/liners, structures, and soil directly beneath the structure will be decontaminated, as necessary, to demonstrate that the clean closure performance standards are met.

Removal and disposal of most of the components will be determined at the time of closure. Clean closure of the soil will be accomplished by demonstrating that the concrete/liners kept contaminants from reaching the soil.

#### 11.3.4.1 Tanks

In accordance with WAC 173-303-640 (8) at closure all pumpable waste will be removed from the interior of the tanks, including the internal components such as the process condensate agitator. Both

interior and exterior tanks surfaces will be decontaminated by flushing or spraying with steam, a water-soluble cleaner, or other approved method, or removed as debris and disposed appropriately.

If the tanks are decontaminated, the tanks will be inspected visually for compliance with the clean debris surface standard (40 CFR 268.45, Table 1, Extraction Technologies). If any areas are found not to meet the clean debris surface performance standard, these areas will be decontaminated in-place. Per the debris rule, only removal of contaminants from the surface layer is necessary for metal surfaces. Contamination will be removed as specified in 40 CFR 268.45, Table 1, Extraction Technologies and/or other Ecology approved methods.

If the decontamination option is used, the outside of the tanks also will be inspected for compliance to the clean debris surface standard. Any areas found not to meet this performance standard will be decontaminated in-place. Contamination will be removed from the surface layer using any of the methods described for internal tank decontamination as specified in *Alternate Treatment Standards for Hazardous Debris* (40 CFR 268.45, Table 1, Extraction Technologies and/or other Ecology approved methods).. Before using decontamination solutions on the outside of the tanks, the floor will be inspected for cracks or other openings that could provide a pathway to soil. This inspection will be performed as described in Section 11.2.1 of this chapter in conjunction with mapping of potential through-thickness cracks. Any such cracks will be mapped. The cracks will be sealed before beginning treatment or other engineered containment devices (e.g., collection basins) will be used to collect and contain solutions.

Decontamination waste will be generated as a result of decontamination activities. Decontamination waste may include but not be limited to the following: contaminated rags, and decontamination residue (liquids and solvents used in the decontamination process). This waste will be collected, designated, and managed in accordance with WAC 173-303. If it is not possible to meet the closure by removal or decontamination (clean closure) performance standard, contaminated portions of the tanks could be removed, designated, and disposed of in accordance with 40 CFR 268, incorporated by reference by WAC 173-303-140 as appropriate. The inspections for a clean debris surface will be documented on an inspection record.

#### 11.3.4.2 Internal and/or External Piping and Ancillary Equipment

The internal piping and ancillary equipment for the 242A Evaporator will be flushed and drained as part of closure. For piping where the contaminated surfaces can be inspected, an inspection will be performed to see if the piping meets the clean debris surface standard in 40 CFR 268.45 and can be declared non-dangerous. If it is not possible to meet the clean debris surface standard or the piping cannot be inspected, portions of the internal piping will be removed, designated, and disposed of accordingly.

External piping (transfer lines) and ancillary equipment between 242A and LERF consists of below grade and above grade piping. Below grade piping will be dispositioned at closure either by removal, designation and disposal in accordance with WAC 173-303-610(5) and 40 CFR 268 or closed in accordance with another Ecology approved process. For above grade piping, it will be dispositioned consistent with the provisions for internal piping.

Rinsate from the external piping and internal piping will be processed through ETF. Details regarding the process for rinsing any internal and external piping and ancillary equipment will be provided in the closure plan in accordance with WAC 173-303-610(3)(a)(v) upon modification as stated in Section 11.6 Dangerous and/or mixed-waste generated during closure activities will be managed in accordance with WAC 173-303-610(5). Removal of any dangerous wastes or dangerous constituents during partial or final closure will be handled in accordance with applicable requirements of WAC 173-303-610(5).

If the performance standards are not met, the interior surfaces will be cleaned using an appropriate decontamination method and the method repeated until the surfaces meet the clean closure performance standard.

The 207-A pump pit, located east of the 242-A Evaporator, will be closed using the performance standards for pipes and concrete (e.g., WAC 173-303-610(5) and 40 CFR 268 debris rule standards Table 1, Extraction technologies.). A visual inspection will be performed. If the interior surfaces meet the performance standards (clean debris surface), the 207-A pump pit will be considered clean closed.

If the performance standards are not met for any components described above, the interior surfaces will be cleaned using an Ecology approved decontamination method and the method repeated until the surfaces meet the clean closure (clean debris surface) performance standard; or a decision will be made to remove, designate and dispose of piping and equipment in accordance with WAC 173-303.

#### 11.3.4.3 Concrete/Liner

The coated concrete floor and the pump room sump liner provide secondary containment for all the tanks, process piping, and ancillary equipment. All concrete and liners will be inspected visually and surveyed radiologically before any decontamination. The purpose of the inspection will be twofold: to identify and map any cracks in the concrete that might have allowed contaminants a pathway to the soil below and to identify areas that potentially are contaminated with dangerous waste or dangerous waste residues. The inspection standard will be a clean debris surface as defined in Section 11.2 .1. The inspection of the concrete for a clean debris surface will be documented on an inspection record. Those areas already meeting the standard will be clean closed as is.

Those potentially contaminated areas will undergo decontamination to meet the clean closure standard of a clean debris surface. The concrete will be washed down; the rinsate collected, designated, and disposed of accordingly. The concrete will be re-inspected for a clean debris surface. Concrete surfaces indicated by visual examination, as potentially still being contaminated will have the surface layer removed to a depth of 0.6 centimeter by scabbing or other approved methods. This will not threaten the environment, even if potential through-thickness cracks had been found during the inspection, because concrete decontamination (scabbing) will not employ liquid solutions that could enter cracks and because scabbing residues will be vacuumed away from cracks as any residue is generated.

Achievement of a clean debris surface will be documented on an inspection record. Decontamination residues will be collected, designated, and managed as appropriate.

#### 11.3.4.4 Structures

If contaminated with either dangerous or mixed waste constituents, structures will be decontaminated and/or disassembled, if necessary, packaged, and disposed in accordance with existing land disposal restrictions (WAC 173-303-140).

Closure steps could include the following activities.

- Containerize (as necessary and practicable) and remove any remaining waste.
- Review operating records for spillage incidents and visually inspect area surfaces for evidence of contamination or for cracks that could harbor contamination or allow the escape of decontamination solutions. Inspect storage area surfaces for visible evidence of contamination (e.g., discoloration, material degradation, wetness, and odor). If contamination is evident, the affected area(s) will be decontaminated.

- Decontaminate walls and floors to minimize the potential for loose contamination and to facilitate any required radiation surveys and/or chemical field screening. Wash down could be by water rinse or high-pressure, low-volume steam cleaning coupled with a detergent wash. After decontamination, the building walls and floor will be compared to closure performance standards.
- Collect rinsate and manage as dangerous waste for appropriate disposal.
- Secure (lock) personnel entries into building and post doors with appropriate warning signs.

Clean closure of structures will occur in accordance with WAC 173-303-610. Remediation of soil contamination beneath or around containment buildings will be performed in conjunction soil closure requirements.

#### 11.3.4.5 Underlying Soils

Clean closure of soil under the 242-A Evaporator will be accomplished by demonstrating that the coated concrete floor and stainless steel liners kept contaminants from reaching the soil. The coated concrete floor provided secondary containment for all the tanks, process piping, and ancillary equipment. Unless inspections identify potential through-thickness cracks indicating containment failure and a subsequent potential for soil contamination from TSD unit operations, the soil will be considered clean closed. However, if inspections identify such cracks, and there have been documented spills in the vicinity, potential soil contamination will be investigated.

Where it is possible to inspect visually directly beneath the tanks, a visual inspection will be performed. Where it is not possible to inspect visually beneath the tanks, an evaluation of the tank integrity will be made. The condition of the tank will be evaluated to determine if there was any potential for leakage. If no cracks, severe corrosion, or evidence of leaks is observed, it will be reasoned that mixed or dangerous waste solutions could not have penetrated to the soil directly below the tank.

## 11.4 MAXIMUM WASTE INVENTORY

The 242-A Evaporator is used to treat mixed waste from the DST System by removing water and most volatile organics. Two waste streams leave the 242-A Evaporator following the treatment process. The first waste stream, the concentrated slurry (in which approximately half the water content is removed and a portion of the volatile organics), is pumped back into the DST System. The second waste stream, process condensate (containing a portion of the volatile organics removed from the mixed waste during the evaporation process), is routed through condensate filters before being transferred to LERF. The 242-A Evaporator is used to treat up to 870,642 liters of mixed waste per day.

The condensate collection tank (TK-C-100) receives process condensate and potentially contaminated drainage from the vessel vent system. The maximum design capacity for the C-100 tank is 67,380 liters.

Vapor-liquid separator, C-A-1, is located in the evaporator room and is used to separate vapor from the boiling slurry solution and deentrain liquid from the vapor before it enters the condensers in the condenser room. The maximum design capacity of C-A-1 is 103,217 liters.

## 11.5 CLOSURE OF TANKS

Clean closure of 242-A Evaporator will consist of the removal and disposal of all dangerous waste and the decontamination and/or removal and disposal of contaminated equipment, including tanks.

## 11.6 SCHEDULE FOR CLOSURE

Closure of 242-A Evaporator is not anticipated to occur within the next 15 to 20 years. The actual year of closure will depend on the time required for current waste to be processed and what role the 242-A Evaporator will play in processing additional waste generated during future activities in the 200 Areas. Other factors affecting the year of closure include changes in operational requirements, lifetime extension upgrades, and unforeseen factors. When a definite closure date is established, a revised closure plan will be submitted to Ecology. The activities required to complete closure are planned to be accomplished within 180 days in accordance with WAC 173-303-640(4)(c). Should a modified schedule be necessary, a revised schedule will be presented and agreed to before closure in accordance with WAC 173-303-640(4)(b).

This page intentionally left blank.

Quarter Ending 9/30/2013 24590-HLW-PCN-ENV-13-005

# Hanford Facility RCRA Permit Modification Notification Form
## Part III, Operating Unit 10
## Waste Treatment and Immobilization Plant

Index

Page 2 of 3: Hanford Facility RCRA Permit, Part III, Operating Unit 10, Waste Treatment and Immobilization Plant
Update HLW Vitrification Building Piping and Instrumentation Diagrams (P&ID) for the HLW Concentrate Receipt Process System (HCP) in Appendix 10.2 of the Dangerous Waste Permit.

Submitted by Co-Operator:

Donna Busche 7/22/13
D. M. Busche Date

Reviewed by ORP Program Office:

8/19/13
D. L. Noyes Date

Quarter Ending 9/30/2013 24590-HLW-PCN-ENV-13-005

| Hanford Facility RCRA Permit Modification Notification Form | |
|---|---|
| Unit: | Permit Part: |
| **Waste Treatment and Immobilization Plant** | **Part III, Operating Unit 10** |

Description of Modification:

The purpose of this Class 1 modification is to update the following Piping and Instrumentation Diagrams (P&ID) for the HLW Concentrate Receipt Process System (HCP). The following P&IDs are submitted to replace those currently in Appendix 10.2.

| Appendix 10.2 | | | |
|---|---|---|---|
| Replace: | 24590-HLW-M6-HCP-00001001, Rev. 0 | With: | 24590-HLW-M6-HCP-00001001, Rev. 1 |
| | 24590-HLW-M6-HCP-00002001, Rev. 0 | | 24590-HLW-M6-HCP-00002001, Rev. 1 |

The referenced P&IDs have been revised. They incorporate changes provided in applicable document change forms (e.g., DCN, SCN, SDDR, FCN, FCR, etc.) and changes associated with the resolution to comments on change documents since the issuance of the last revision of the permitted drawing. This modification requests Ecology approval and incorporation into the permit, the specific changes to these P&IDs that are indicated by notes and clouds. Revisions are the result of ongoing design changes.

There are no design changes presented in the P&IDs.

The following identifies the types of changes on the attached drawings.

24590-HLW-M6-HCP-00001001 and 24590-HLW-M6-HCP-00002001

- Updated note 11 for incorporation of DCN 24590-HLW-M6N-30-00037, which added a hold on HCP valves and lines for evaluation to change safety classification from safety significant (SS) to safety class (SC). The evaluation was completed and the classification of SS was determined to be correct, and DCN 24590-HLW-M6N-30-00038 removed the hold placed by 24590-HLW-M6N-30-00037.
- Deleted hold

This PCN updates information in Appendix 10.2 to reflect current design. This DWP component may be re-evaluated to confirm design adequacy. If the re-evaluation results in future design changes, the changes will be reviewed by Ecology in subsequent permit modifications.

The following outstanding change documents have been submitted to Ecology pursuant to permit condition III.10.C.9.h and are maintained in the WTP Operating Record.
None

In accordance with Permit Condition III.10.C.2.e, this permit modification sent to Ecology may include page changes to the Permit, attachments, and permit application supporting documentation.

Quarter Ending 9/30/2013

24590-HLW-PCN-ENV-13-005

| WAC 173-303-830 Modification Class: | Class 1 | Class 1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | X | | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1.

Enter wording of WAC 173-303-830, Appendix I Modification citation:

A. General Permit Provisions

1. Administrative and informational changes

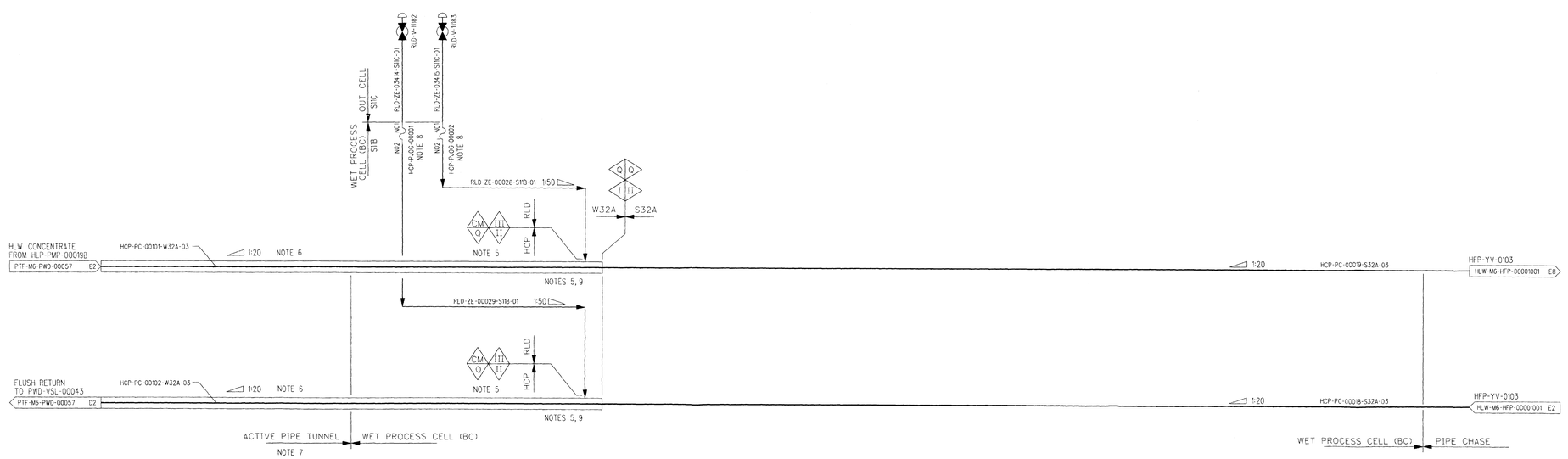
Modification Approved/Concur: [X] Yes [ ] Denied (state reason below)

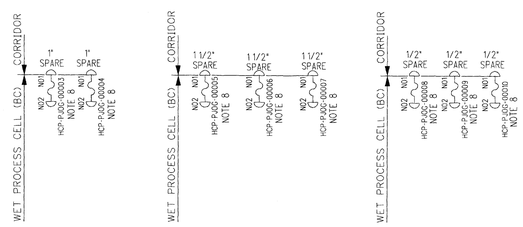
Reason for denial:

Reviewed by Ecology:

S. Dahl — Date: 9/3/13

for S Dahl




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL COMPONENTS ON THIS DRAWING IS QUALITY LEVEL Q AND SEISMIC CATEGORY SC-I, UNLESS OTHERWISE NOTED.
4. ALL LINES SHOWN ON THIS DRAWING SHALL BE FREE DRAINING, ULESS OTHERWISE NOTED.
5. THE PRESSURE BOUNDARY FOR THE INNER AND OUTER PIPE OF THE DOUBLE CONTAINMENT TRANSFER LINES ARE QUALITY LEVEL Q. THE INNER PIPE IS SEISMIC CATEGORY SC-I. THE OUTER PIPE IS SEISMIC CATEGORY SC-II.
6. PRE-TREATMENT IS RESPONSIBLE FOR COAXIAL PIPE LEAK DETECTION. SEE DRAWING 24590-PTF-M6-PWD-00057.
7. A FLANGED SPOOL PIECE IS REQUIRED FOR THE INNER PIPE IN THE ACTIVE PIPE TUNNEL. SPOOL PIECE SHALL BE REMOVED AND PIPING IS TO BE RESTORED TO DOUBLE CONTAINED PIPING AFTER THE PLANT STARTUP PHASE IS COMPLETE.
8. THE GEOMETRY OF JOGGLED (OFFSET) PENETRATIONS IS QUALITY LEVEL Q FOR RADIATION PROTECTION. THE QUALITY LEVEL AND SEISMIC CATEGORY DESIGNATIONS OF PIPING WITHIN JOGGLES ARE THE SAME AS CONNECTING PIPING. PIPING WITHIN SPARE JOGGLES IS QUALITY LEVEL Q AND SEISMIC CATEGORY SC-I.
9. WHEN POSSIBLE, FLUSH LINE CONNECTION OF ENCASEMENT PIPE SHALL BE AT THE HIGHEST POINT (ON TOP) OF OUTER PIPE.
10. THIS DRAWING SUPERSEDES 24590-HLW-M6-HCP-00001, REV. 5. THIS DRAWING INCLUDES INFORMATION FROM 24590-HLW-M6N-HCP-00043 AND 24590-HLW-M6PR-HCP-00001.
11. REVISION 1: INCORPORATED 24590-HLW-M6N-30-00037 AND -00038. THIS P&ID HAS BEEN REVIEWED BY E&NS FOR ALL LIMITED AND PHYSICALIZATION CHANGE DOCUMENTS THAT WERE PREVIOUSLY ISSUED (SEE CCN 255808).

## HOLD/OPEN ITEMS

1. DELETED

## REFERENCES

1. 24590-HLW-3YD-HFP-00001, SYSTEM DESCRIPTION FOR HLW CONCENTRATE RECEIPT PROCESS AND HLW MELTER FEED PROCESS SYSTEMS (HCP AND HFP).

DRAWING INDEX

| DWG NO | TITLE |
|---|---|
| 24590-HLW-M6-HCP-00001001 | HCP SYS MELTER 1 TRANSFER PIPING |

Q
QUALITY DESIGNATOR

REVISION HISTORY

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 1 | REVISED PER NOTE 11 | PP | RR | JL/JK | LPK | 5/23/13 |
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 10 | ML | ST | SK/SS | RS/SD | 10/08/10 |

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

ISSUED BY RPP-WTP PDC
ISSUE STAMP

| | |
|---|---|
| PROJECT No. | 24590 |
| SITE | HANFORD |
| AREA | 200E |
| BUILDING No. | 30 |

| | BY | DATE |
|---|---|---|
| ORIGINATOR | LARRICK, MYLON | 10/08/10 |
| CHECKER | THAKKAR, SURENDRA | 10/08/10 |
| APPROVER | R STEVENS/S CRUZ | 10/08/10 |
| REVIEWER | KRETZSCHMAR/S SMITH | 10/08/10 |

CONTENT APPLICABLE TO ALARA? [X] YES [ ] NO
ADR NO. 24590 HLW-ADR-M-02-018 REV: 1
E&NS SCREENING REQUIRED? [X] YES [ ] NO E&NS INITIAL IF YES

BECHTEL
RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - HLW CONCENTRATE RECEIPT PROCESS SYSTEM MELTER 1 TRANSFER PIPING

SCALE: NONE
24590-HLW-M6-HCP-00001001
REV 1

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GPP-SRED-002

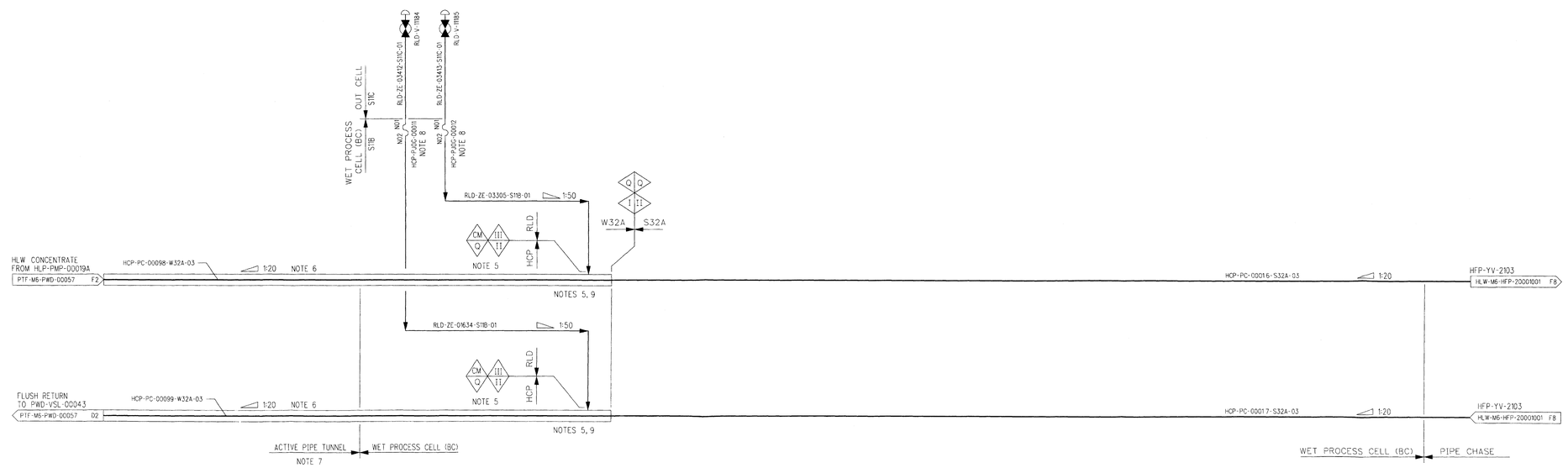
"E" SIZE - 44x34
COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED

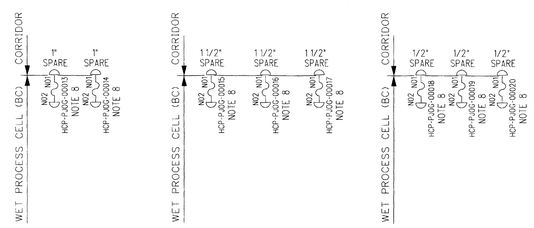
R11600615

5/23/2013 10:18:11 AM

PLOTTED BY: gpacker C:\Work\gpacker\dms03839\HLW\M6\HCP00001001.dgn

FORM E_SDN.DGN 02/2009




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL COMPONENTS ON THIS DRAWING IS QUALITY LEVEL Q AND SEISMIC CATEGORY SC-I, UNLESS OTHERWISE NOTED.
4. ALL LINES SHOWN ON THIS DRAWING SHALL BE FREE DRAINING, UNLESS OTHERWISE NOTED.
5. THE PRESSURE BOUNDARY FOR THE INNER AND OUTER PIPE OF THE DOUBLE CONTAINMENT TRANSFER LINES ARE QUALITY LEVEL Q. THE INNER PIPE IS SEISMIC CATEGORY SC-I. THE OUTER PIPE IS SEISMIC CATEGORY SC-II.
6. PRE-TREATMENT IS RESPONSIBLE FOR COAXIAL PIPE LEAK DETECTION. SEE DRAWING 24590-PTF-M6-PWD-00057.
7. A FLANGED SPOOL PIECE IS REQUIRED FOR THE INNER PIPE IN THE ACTIVE PIPE TUNNEL. SPOOL PIECE SHALL BE REMOVED AND PIPING IS TO BE RESTORED TO DOUBLE CONTAINED PIPING AFTER THE PLANT STARTUP PHASE IS COMPLETE.
8. THE GEOMETRY OF JOGGLED (OFFSET) PENETRATIONS IS QUALITY LEVEL Q FOR RADIATION PROTECTION. THE QUALITY LEVEL AND SEISMIC CATEGORY DESIGNATIONS OF PIPING WITHIN JOGGLES ARE THE SAME AS CONNECTING PIPING. PIPING WITHIN SPARE JOGGLES IS QUALITY LEVEL Q AND SEISMIC CATEGORY SC-I.
9. WHEN POSSIBLE, FLUSH LINE CONNECTION OF ENCASEMENT PIPE SHALL BE AT THE HIGHEST POINT (ON TOP) OF OUTER PIPE.
10. THIS DRAWING SUPERSEDES 24590-HLW-M6-HCP-00002, REV 5. THIS DRAWING INCLUDES INFORMATION FROM 24590-HLW-M6N-HCP-00043 AND 24590-HLW-M6PR-HCP-00001.
11. REVISION 1: INCORPORATED 24590-HLW-M6N-30-00037, AND -00038. THIS P&ID HAS BEEN REVIEWED BY E&NS FOR ALL LIMITED AND PHYSICALIZATION CHANGE DOCUMENTS THAT WERE PREVIOUSLY ISSUED (SEE CCN 255808).

## HOLD/OPEN ITEMS

1. DELETED

## REFERENCES

1. 24590-HLW-3YD-HFP-00001, SYSTEM DESCRIPTION FOR HLW CONCENTRATE RECEIPT PROCESS AND HLW MELTER FEED PROCESS SYSTEMS (HCP AND HFP).

| DRAWING INDEX | |
|---|---|
| DWG NO | TITLE |
| 24590-HLW-M6-HCP-00002001 | HCP SYS MELTER 2 TRANSFER PIPING |

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 1 | REVISED PER NOTE 11 | PP | RR | JL/JK | DPK | 5/23/13 |
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 10 | ML | ST | SK/SS | RS/SQ | 10/08/10 |

REVISION HISTORY

Q
QUALITY DESIGNATOR

ISSUED BY RPP-WTP PDC

ISSUE STAMP

| | | |
|---|---|---|
| PROJECT No. | 24590 | |
| SITE | HANFORD | |
| AREA | 200E | |
| BUILDING No. | 30 | |
| | BY | DATE |
| ORIGINATOR | LARRICK, MYLON | 10/08/10 |
| CHECKER | THAKKAR, SURENDRA | 10/08/10 |
| APPROVER | R STEVENS/S CRUZ | 10/08/10 |
| REVIEWER | KRETZSCHMAR/S SMITH | 10/08/10 |

CONTENT APPLICABLE TO ALARA? [X] YES [ ] NO
ADR NO. 24590-HLW-ADR-M-02-038 REV. 1
E&NS SCREENING REQUIRED? [X] YES [ ] NO E&NS INITIAL IF YES

BECHTEL

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - HLW CONCENTRATE RECEIPT PROCESS SYSTEM MELTER 2 TRANSFER PIPING

SCALE: NONE

24590-HLW-M6-HCP-00002001

REV 1

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GPP-SREG-002

E SIZE - 44x34
COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED

R11G00516

5/23/2013 10:20:09 AM

PLOTTED BY: spoukes C:\Work\spoukes\ems\03839-HLW\HCP\00002001.dgn

FORM E_SDN.DGN 02/2009

1
2

**Table III.10.E.C – HLW Vitrification Plant Tank Systems Description**

| Mixed Waste Tank Systems Name | Unit Designation | Engineering Description (Drawing Nos, Specification Nos, etc.) | Narrative Description, Tables & Figures | Maximum Capacity (gallons) |
|---|---|---|---|---|
| **HLW Concentrate Receipt Process System**<br><br>The HCP System has ancillary equipment only. | HCP | **24590-HLW**<br>-M5-V17T-P0001, Rev 4<br>-M6-HCP-00001001, Rev ~~0~~1<br>-M6-HCP-00002001, Rev ~~0~~1 | Section 4.1.4.1; Tables 4-4 and 4-6; Figures C1-1 and C1-4 of Operating Unit Group 10, Addendum C of this Permit. | |
| **HLW Melter Feed Process System**<br><br>HFP-VSL-00001 (Melter 1 Feed Preparation Vessel) | HFP | **24590-HLW**<br>-3YD-HFP-00001[a]<br>-M5-V17T-P0001, Rev 4<br>-P1-P01T-00002, Rev 7<br>-M6-HFP-00001001, Rev 0<br>-M6-HFP-00001002, Rev 0<br>-M6-HFP-00001003, Rev 0<br>-M6-HFP-00001004, Rev 0<br>-M6-HFP-00007001, Rev 0<br><br>**24590-WTP**<br>-3PS-G000-T0002, Rev 8<br>-3PS-MV00-T0001, Rev 4<br>-3PS-MV00-T0002, Rev 3<br>-3PS-MV00-T0003, Rev 3 | Section 4.1.4.1; Tables 4-4 and 4-6; Figures C1-1 and C1-4 of Operating Unit Group 10, Addendum C of this Permit. | HFP-VSL-00001 = 8,311 |
| **Melter Feed Process System cont.**<br><br>HFP-VSL-00002 (Melter 1 Feed Vessel) | HFP | **24590-HLW**<br>-3YD-HFP-00001[a]<br>-M5-V17T-P0001, Rev 4<br>-P1-P01T-00002, Rev 7<br>-M6-HFP-00002001, Rev 0<br>-M6-HFP-00002002, Rev 0<br>-M6-HFP-00002003, Rev 0<br>-M6-HFP-00008001, Rev 0 | Section 4.1.4.1; Tables 4-4 and 4-6; Figures C1-1 and C1-4 of Operating Unit Group 10, Addendum C of this Permit. | HFP-VSL-00002 = 8,311 |

Quarter Ending June 30, 2013 24590-PTF-PCN-ENV-12-008

# Hanford Facility RCRA Permit Modification Notification Form
## Part III, Operating Unit 10
## Waste Treatment and Immobilization Plant

Index

Page 2 of 4: Hanford Facility RCRA Permit, Part III, Operating Unit 10, Waste Treatment and Immobilization Plant

Replace Permit Mechanical Datasheets 24590-PTF-MVD-CNP-00006 (Cesium Evaporator Separator Vessel CNP-EVAP-00001), 24590-PTF-MVD-FEP-00006 (Waste Feed Evaporator Separator Vessel FEP-SEP-00001A), 24590-PTF-MVD-FEP-00007 (Waste Feed Evaporator Separator Vessel FEP-SEP-00001B), and 24590-PTF-MVD-TLP-00005 (Treated LAW Evaporator Separator Vessel TLP-SEP-00001) in Appendix 8.6 of the Dangerous Waste Permit (DWP).

Submitted by Co-Operator:

Donna Busche 6/10/13

D. M. Busche Date

Reviewed by ORP Program Office:

7/22/13

D. L. Noyes Date

Quarter Ending June 30, 2013 24590-PTF-PCN-ENV-12-008

| Hanford Facility RCRA Permit Modification Notification Form | |
|---|---|
| Unit: **Waste Treatment and Immobilization Plant** | Permit Part: **Part III, Operating Unit 10** |

Description of Modification:

The purpose of this Class 1 prime modification is to update PTF Mechanical Datasheets for the Cesium Evaporator Separator Vessel (CNP-EVAP-00001), Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A and FEP-SEP-00001B), and Treated LAW Evaporator Separator Vessel (TLP-SEP-00001). The following data sheets are submitted to replace the permitted data sheets currently in Appendix 8.6:

| Appendix 8.6 | | | |
|---|---|---|---|
| Replace: | 24590-PTF-MVD-CNP-P0006, Rev. 0 | With: | 24590-PTF-MVD-CNP-00006, Rev. 6 |
| | 24590-PTF-MVD-FEP-P0006, Rev. 3 | | 24590-PTF-MVD-FEP-00006, Rev. 5 |
| | 24590-PTF-MVD-FEP-P0007, Rev. 2 | | 24590-PTF-MVD-FEP-00007, Rev. 5 |
| | 24590-PTF-MVD-TLP-P0005, Rev. 2 | | 24590-PTF-MVD-TLP-00005, Rev. 7 |

This modification requests Ecology approval and incorporation into the permit the specific changes to these datasheets that are identified by revision notes and revision triangles shown on the datasheets that have been issued since the last revision of the permitted version. Revisions are the result of ongoing design (changes from vendor preliminary data to more detailed vendor design). The following is a summary of the significant changes on the attached datasheets:

24590-PTF-MVD-CNP-00006

- Updated P&ID reference
- Updated process data sheet reference
- Added vessel drawing reference
- Updated quality level from QL-1 to Q
- Added maximum operating volume
- Updated fabrication specifications
- Updated seismic design specification
- Updated internal design data
- Updated Materials of Construction section
- Updated notes
- Added equipment qualification datasheet

24590-PTF-MVD-FEP-00006

- Updated P&ID reference
- Updated process data reference
- Updated quality level from QL-1 to Q
- Revised maximum operating and total volumes
- Updated fabrication specifications
- Updated design data
- Updated seismic design specifications
- Updated Materials of Construction section
- Updated notes
- Added equipment qualification datasheet

24590-PTF-MVD-FEP-00007

- Updated P&ID reference
- Updated process data reference
- Updated quality level from QL-1 to Q

- Revised maximum operating and total volumes
- Updated fabrication specifications
- Updated design data
- Updated seismic design references
- Updated Materials of Construction section
- Updated notes
- Added equipment qualification datasheet

24590-PTF-MVD-TLP-00005

- Updated P&ID reference
- Updated process data reference
- Updated quality level from QL-1 to Q
- Updated fabrication specifications
- Revised maximum operating volume, total volume, and vessel size (length)
- Updated seismic design reference
- Updated Materials of Construction section
- Updated notes
- Added equipment qualification datasheet

This modification requests Ecology approval and incorporation of the following outstanding change documents into the permit. Although not yet incorporated into the revised documents included in this PCN, the listed outstanding change documents are intended to be incorporated into the permit: The following outstanding change documents have been submitted to Ecology pursuant to Permit Condition III.10.C.9.h and are maintained in the WTP Operating Record:

24590-PTF-MVD-FEP-00006

- 24590-WTP-SDDR-MS-12-00177

24590-PTF-MVD-FEP-00007

- 24590-WTP-SDDR-MS-12-00177

24590-PTF-MVD-TLP-00005

- 24590-WTP-SDDR-MS-12-00177

This PCN updates information in Appendix 8.6 to reflect current design. This DWP component may be re-evaluated to confirm design adequacy. If the re-evaluation results in future design changes, the changes will be reviewed by Ecology in subsequent permit modifications.

In accordance with Permit Condition III.10.C.2.e, this permit modification sent to Ecology may include page changes to the Permit, attachments, and permit application supporting documentation.

Quarter Ending June 30, 2013 24590-PTF-PCN-ENV-12-008

| WAC 173-303-830 Modification Class: | Class 1 | Class [1] 1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | | X | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: NA

Enter wording of WAC 173-303-830, Appendix I Modification citation:

In accordance with WAC-173-303-830(4)(d)(i), this modification notification is requested to be reviewed and approved as a Class [1] 1 modification. WAC 173-303-830(4)(d)(ii)(A) states, "Class 1 modifications apply to minor changes that keep the permit current with routine changes to the facility or its operation. These changes do not substantially alter the permit conditions or reduce the capacity of the facility to protect human health or the environment. In the case of Class 1 modifications, the director may require prior approval."

| Modification Approved/Concur: ☑ Yes ☐ Denied (state reason below) | Reviewed by Ecology: |
|---|---|
| Reason for denial: | S. Dahl 8/21/13 |
| | S. Dahl Date |

by G. K. SKINNARLAND

| | | |
|---|---|---|
| BECHTEL | **MECHANICAL SYSTEMS DATA SHEET: VESSEL** | PLANT ITEM No.<br>*24590-PTF-ME-CNP-EVAP-00001*<br>Data Sheet No.<br>*24590-PTF-MVD-CNP-00006* |

R11105817

| | | | |
|---|---|---|---|
| Project: | *RPP-WTP* | P&ID: | *24590-PTF-M6-CNP-00008,*<br>*24590-QL-POA-MEVV-00002-07-22* 6 |
| Project No: | *24590* | Process Information: | *24590-PTF-MVC-CNP-00015* 6 |
| Project Site: | *Hanford* | Vessel Drawing: | *24590-QL-POA-MEVV-00002-07-07* |
| Description: | *Cesium Evaporator Separator Vessel CNP-EVAP-00001* 6 | | |

## Reference Data

| | |
|---|---|
| Charge Vessels (Tag Numbers) | *None* |
| Pulsejet Mixers / Agitators (Tag Numbers) | *None* |
| RFDs/Pumps (Tag Numbers) | *None* |

ISSUED BY RPP-WTP DOC

## Design Data

| | | | | |
|---|---|---|---|---|
| Quality Level | | *Q (Note 8 & 16)* 6 | Fabrication Specs | *24590-WTP-3PS-MV00-T0001* |
| Seismic Category | | *SC-I (Note 16)* 6 | Design Code | *ASME VIII Div 1* |
| Service/Contents | | *Radioactive Liquid* | Code Stamp | *Yes* |
| Design Specific Gravity | | *1.37* | NB Registration | *Yes* |
| Maximum Operating Volume | gal | * *1200* 6 | Wind Design | *None* |
| Total Volume | gal | * | Snow/Ash Design | *None* |
| Postweld Heat Treat | | *Not Required* | Seismic Design | *24590-WTP-3PS-MV00-T0002*<br>*24590-WTP-3PS-SS90-T0001* |
| Seismic Base Moment | ft*lb | * | | |

| | | | | | |
|---|---|---|---|---|---|
| Inside Diameter | inch | *4'-6" (Upper), 6'-5" (Lower)* | | Corrosion Allowance inch | *0.04* |
| Length/Height (TL-TL) | inch | *286-5/8"* | | | |
| | | Vessel Operating | Vessel Design | Coil / Jacket Design | Notes |
| Internal Pressure | psig | *1.45 psia* | *50* | *N/A* | |
| External Pressure | psig | *0* | *14.7* | *N/A* | |
| Temperature | °F | 6 *140* | *230* | *N/A* | |
| Min. Design Metal Temp. | °F | *40* | | Hydrostatic Test Pressure PSIG | *65 - Horizontal* |

## Materials of Construction

| Component | Material | Containment | Notes |
|---|---|---|---|
| Top Head | *SB575 (Hastelloy)*<br>*UNS N06022* | *Auxiliary* | *1/2" Nom. thickness; maximum carbon content of 0.030% for welded components* |
| Shell | *SB575 (Hastelloy)*<br>*UNS N06022* | *Primary* | *1/2" thickness; maximum carbon content of 0.030% for welded components* |
| Bottom Head | *SB575 (Hastelloy)*<br>*UNS N06022* | *Primary* | *1/2" thickness; maximum carbon content of 0.030% for welded components* |
| Vessel Support | *SA 240 TP 304*<br>*Note 12* | *N/A* | *Maximum carbon content of 0.030% for welded components* |
| Jacket/Coils/Half-Pipe Jacket | *N/A* | *N/A* | |
| Internals | *SB575 (Hastelloy)*<br>*UNS N06022* | *N/A* | *Maximum carbon content of 0.030% for welded components* |
| Pipe | *Internal*<br>*SB622 (Hastelloy)*<br>*UNS N06022*<br>*External SA 312* 6<br>*304 seamless SS* | *Note 4* | *Maximum carbon content of 0.030% for welded components* |
| Forgings/ Bar stock | *SB564*<br>*(Hastelloy C-22)* | | *Maximum carbon content of 0.030% for welded components* |
| Gaskets | *SB575 (Hastelloy)*<br>*UNS N06022* | *Auxiliary* | *Spiral wound with Thermiculite Filler* |
| Bolting | *Nitronic 60 w/400*<br>*Series SS nuts* | *Auxiliary* | *SA-193 B8S S21800 (Nitronic 60)* |

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

## Miscellaneous Data

| | |
|---|---|
| Orientation | ***Vertical*** |
| Support Type | ***Stainless Steel Legs, see note 12.*** |
| Insulation Function | ***None*** |
| Insulation Thickness (inch) | ***None*** |
| Insulation Material | ***None*** |
| External Finish | ***Welds Descaled as Laid*** |
| Internal Finish | ***Welds Ground Smooth; polished to a #4 finish below liquid level.*** |

## Notes

**** To be determined / confirmed by Seller.***

***(1) Weld surface finish shall be de-scaled as laid. 6***
***(2) Design Life is 40 years.***
***(3) Nozzle tolerance +/- 1/4".***
***(4) Nozzles located below the top of the overflow nozzle are primary containment. See 24590-WTP-3PS-MV00-T0001.***
***(5) NDE for this vessel must meet requirements per para 6.1, 6.2 and 7.2 of specification 24590-WTP-3PS-MV00-T0001.***
***(6) This vessel requires a fatigue analysis.***
***(7) This vessel is in a Black Cell. 6***
***(8) Vendor will provide Item at BNI quality level Q specifications, which correlate to the vendors quality level of QL-2.***
***(9) Equipment Cyclic Data is from document 24590-QL-POA-MEVV-00002-10-00002.***
***(10) Vendor Design information is from document 24590-QL-POA-MEVV-00002-10-00011.***
***(11) Contents of this document are Dangerous Waste Permit affecting.***
***(12) Connection points of frame to WTP building steel shall be carbon steel.***
***(13) When combining vessel loading with seismic, seller should 6 use design pressure. Seller has the option to use 2 psi or 15% over maximum operating pressure, whichever is greatest, not to exceed vessel design pressure and full vacuum in lieu of vessel design pressure.***
***(14) For Nozzle Loads, see document 24590-PTF-3PS-MEVV-T0002, Rev. 004 (Appendix J; Attachment 4). 6***
***(15) Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.***
***(16) For commercial reasons, safety and seismic classification may be higher than elsewhere documented, and 6 therefore conservative.***

***Safety screening/evaluation required? ☒Yes ☐No If yes per 24590-WTP-GPP-SREG-002, E&NS signature required below.***

## Revision History

| Rev | Description | By | Checked | EN&S | Approved | Date |
|---|---|---|---|---|---|---|
| 6 | Updated to reflect WSGM analysis, 24590-PTF-U0D-W16T-00001 changes, and update other information. | D. Tate | S. Thakkar | B Hall | J. Julyk | 8/27/07 |
| 5 | Update safety function to reflect current SED and update datasheet for Permit Use. | R. Rickenbach | E. Le | B. Hall | J. Julyk | 09/23/08 |
| 4 | Incorporated vendor design information and Equipment Qualification Data. Incorporated SDDR 24590-WTP-SDDR-M-06-00189. | R. Rickenbach | S. Thakkar | S. Woolfolk | J. Julyk | 07/15/2008 |
| 3 | Issued for Purchase | J. Hickman | K. Sadle | N/A | J. Julyk | 08/12/2004 |
| 2 | Issued for Purchase | K. Eager | J. Hickman | N/A | J. Julyk | 05/11/2004 |
| 1 | Issued for Purchase | J. Hickman | E. Le | N/A | J. Julyk | 02/12/2004 |
| 0 | Issued for Purchase | M. Pratt | J. Hickman | N/A | S. Kirk | 07/24/2002 |

# EQUIPMENT QUALIFICATION DATASHEET (EQD)



## Equipment Identification

| | | | |
|---|---|---|---|
| Component Tag Number | 24590-PTF-ME-CNP-EVAP-00001 | Safety Classification | ☒ SC ☐ SS ☐ APC ☐ SDC ☐ SDS ☐ RRC Note 13 6 |
| Manufacturer / Supplier | AREVA NP INC. | | |
| Requisition Number | 24590-QL-POA-MEVV-00002 | | |
| Model | N/A | Seismic Category | ☒ SC-I ☐ SC-II ☐ SC-III ☐ SC-IV Note 13 6 |
| Description (Include descriptive text [e.g., location, elevation]) | Cs EVAPORATOR SEPARATOR VESSEL LOCATED IN PTF, ELEVATION 28'-0', ROOM P-0112. | | |
| Safety Function(s) | Prevent spills of large quantities of high activity process liquid into the Hot Cell. 6<br>Prevent evaporator piping rupture and sudden air intrusion, resulting in burp, or waste carryover to the Cs evaporator nitric acid rectifier. 6 | | |

| | | | |
|---|---|---|---|
| Seismic Safety Function | ☒ Yes ☐ No | Room Number(s): P-0112 | |
| Maintenance Accessible | ☐ Yes ☒ No | Method of Maintenance Access: 6 ☒ Remote (NOTE 14) ☐ Hands On ☐ None | |
| Seismic Operability Requirements: | 6 ☐ During Seismic Event | 6 ☐ After Seismic Event | |
| ITS Equipment Type: | ☒ Passive Mechanical | ☐ Active Mechanical | ☐ Electrical |

## Equipment Environmental Qualification (EEQ)

| | | |
|---|---|---|
| Environment 6 ☒ Mild ☐ Harsh<br>Contamination Class: C5<br>Radiation Class: R5 | Hi Rad Service ☒ Yes ☐ No | Design Life (yrs) ☒ 40 ☐ Other ____<br>Note 14 6 |

| Parameter Type/Units | Parameter Value | Time Duration (number) | Time Units | WTP Document Number (BUYER) | Submittal Number (SELLER) |
|---|---|---|---|---|---|
| **Normal** | | | | | |
| Normal High Temperature (°F) | 113 | 40 | yrs | 24590-PTF-U0D-W16T-00001, Note 8 | NOTE 1 |
| Normal Low Temperature (°F) | 59 | 40 | yrs | 24590-PTF-U0D-W16T-00001, Note 8 | NOTE 1 |
| Normal High Relative Humidity (%RH) | 100 | 40 | yrs | 24590-PTF-U0D-W16T-00001 | NOTE 1 |
| Normal Low Relative Humidity (%RH) | 5 | 40 | yrs | 24590-PTF-U0D-W16T-00001 | NOTE 1 |
| Normal High Pressure (in.-w.g.) | 0 | 40 | yrs | 24590-PTF-U0D-W16T-00001 | NOTE 1 |
| Normal Low Pressure (in.-w.g.) | -1.4 | 40 | yrs | 24590-PTF-U0D-W16T-00001 | NOTE 1 |
| Normal Radiation Dose Rate (mR/hr) 6 | 2.2 x 10^8 Note 10 | 40 | yrs | Note 10 | NOTE 1 |
| Vibration Magnitude (g) | N/A | N/A | N/A | N/A 6 | NOTE 1 |
| Vibration Frequency (Hz) | N/A | N/A | N/A | N/A 6 | NOTE 1 |
| Additional Normal Information: | See Note 2 for pressure units. | | | | |

# EQUIPMENT QUALIFICATION DATASHEET (EQD)

6

## Equipment Environmental Qualification (EEQ) *(continued)*

| Parameter Type/Units | Parameter Value | Time Duration (number) | Time units | WTP Document Number (BUYER) | Submittal Number (SELLER) |
|---|---|---|---|---|---|
| **Abnormal** | | | | | |
| Abnormal High Temperature (°F) | 6 118 | 8 | hr/yr | 24590-PTF-U0D-W16T-00001, Note 8 6 | NOTE 1 |
| Abnormal Low Temperature (°F) | 6 Note 11 40 | 8 | hr/yr | 24590-PTF-U0D-W16T-00001, Notes 8 & 11 6 | NOTE 1 |
| Abnormal High Relative Humidity (%RH) | 100 | 24 | hr/yr | 24590-PTF-U0D-W16T-00001 | NOTE 1 |
| Abnormal Low Relative Humidity (%RH) | 4 | 22 | hr/yr | 24590-PTF-U0D-W16T-00001, Note 12 6 | NOTE 1 |
| Abnormal High Pressure (in.-w.g.) | 4 | 8 | hr/yr | 24590-PTF-U0D-W16T-00001 | NOTE 1 |
| Abnormal Low Pressure (in.-w.g.) | -7.3 | 8 | hr/yr | 24590-PTF-U0D-W16T-00001 | NOTE 1 |
| Abnormal Radiation Dose Rate (mR/hr) | 6 Note 5&10 | 0 | hr/yr | N/A 6 | NOTE 1 |
| Wet Sprinkler System Present | NO | N/A | N/A | 24590-PTF-U0D-W16T-00001 | NOTE 1 |
| Additional Abnormal Information | See Note 2 for pressure units. | | | | |
| **Design Basis Events (DBE)** | | | | | |
| DBE High Temperature (°F) | 144 | 1000 | hrs | 24590-PTF-U0D-W16T-00001, Note 8 & 12 6 | NOTE 1 |
| DBE Low Temperature (°F) | 40 | 1000 | hrs | 24590-PTF-U0D-W16T-00001, Note 8 | NOTE 1 |
| DBE High Relative Humidity (%RH) | 100 | 482 | 6 hrs | 24590-PTF-U0D-W16T-00001 | NOTE 1 |
| DBE Low Relative Humidity (%RH) | 2 | 1000 | hrs | 24590-PTF-U0D-W16T-00001, Note 12 6 | NOTE 1 |
| DBE High Pressure (in.-w.g.) | 4 | 1000 | hrs | 24590-PTF-U0D-W16T-00001 | NOTE 1 |
| DBE Low Pressure (in.-w.g.) | -7.3 | 1000 | hrs | 24590-PTF-U0D-W16T-00001 | NOTE 1 |
| DBE Radiation Dose Rate (mR/hr) | 6 Note 5&10 | 0 | hrs | N/A 6 | NOTE 1 |
| Flood Height (ft) | 2.08 | 1000 | hrs | 24590-PTF-U0D-W16T-00001 | NOTE 1 |
| Submergence (ft) | 0, Note 6 | 6 N/A | 6 N/A | 6 24590-QL-POA-MEVV-00002-07-00031 | NOTE 1 |
| Chemical/Spray Exposure | Yes, Note 9 | 6 1000 | hrs | 24590-PTF-U0D-W16T-00001 | NOTE 1 |
| Additional DBE Information | See Note 2 for pressure units. | | | | |

# EQUIPMENT QUALIFICATION DATASHEET (EQD)



| DBE Chemical Exposure Details | |
|---|---|
| DBE Chemical Types/Concentrations | 0.1M, 0.25M Sodium Hydroxide 6<br>2M, 5M, 8M Nitric Acid 6<br>Recovered Nitric Acid |

| Interfaces (Electrical) | |
|---|---|
| Power Supply Voltage (VAC, VDC) | N/A |
| Power Supply Frequency (Hz) | N/A |
| Power Connection Method | N/A |
| I/O Signals to/from Equipment | N/A |
| I/O Connection Method | N/A |

| Interfaces (Mechanical) | |
|---|---|
| Mounting Configuration (orientation) | Vertical 6 |
| Mounting Method (bolts, welds, etc.) | Welded to embeds in the walls and floor beams, see drawings 24590-PTF-SS-S15T-00033, 24590-PTF-DB-S13T-00100, 24590-PTF-DB-S13T-00113, 24590-PTF-DB-S13T-00163, 24590-PTF-DD-S13T-00201 |
| Auxiliary Devices | N/A |

**Equipment Seismic Qualification (ESQ)**

| Parameter | Title | Reference/Document Number | Version / Revision | Remarks |
|---|---|---|---|---|
| WTP Seismic Design Specification (BUYER) | Engineering Specification for Seismic Qualification Criteria for Pressure Vessels | 24590-WTP-3PS-MV00-T0002 | 001 6 | N/A |
| Specified Seismic Load (BUYER) | Seismic Analysis of Pretreatment Building - WSGM In-Structure Response Spectre (ISRS) 6 | 24590-PTF-S0C-S15T-00057 6 | 00A 6 | Calculation is not included in MR, see attached figures 37, 38, 49, 50, 51 and 114 per CCN 185267. 6 |
| Design Seismic Load (SELLER | 6 | 6 | 6 | Note 1 6 |
| Qualification Method (SELLER) | 6 | 6 | 6 | Note 1 6 |
| Qualification Report Number (SELLER) | 6 | 6 | 6 | Note 1 6 |
| Submittal Number (BUYER) | TBD 6 | TBD 6 | TBD 6 | None 6 |

## Notes and Additional Information

Notes:

1. Data to be provided by seller through the submittal process as required on the G-321-E form.
2. Where pressure is given in inches of water column (in.-w.c.) in the source document, it is generally assumed that this is in reference to atmospheric pressure and is therefore equivalent to inches of water gage (in.-w.g.)
3. deleted. 6
4. The equipment qualification will be documented in accordance with the requirements in Appendix D of Engineering Specification for Environmental Qualification of Mechanical Equipment, document number 24590-WTP-3PS-G000-T0015 for the passive and active safety functions.
5. Abnormal and DBE radiation dose rates are set equal to normal and do not contribute to the total integrated dose. 6
6. Submergence depth is the difference between the lowest point on the equipment and the flood depth above the floor. The submergence depth is set to zero if the lowest section of the equipment is above the flood depth.
7. Environmental data from calculation 24590-PTF-U0D-W16T-00001 is for room environment only.
8. For application of AISC N690, 6 abnormal temperatures shall be applied as Normal Operation Temperature, $T_O$, with seismic effects, $E_S$. The Design basis event temperatures shall be applied as a Thermal Load generated by a postulated accident, $T_A$, without seismic effects, $E_s$. 6
9. See DBE Chemical Exposure Details. 6
10. This contact dose rate is preliminary (CCN 167203; Notes - General), and is subject to confirmation prior to shipment. 6
11. Abnormal minimum temperature is set equal to the normal minimum temperature (59F) for the purposes of seismic 6 analysis. A DBE seismic event coincident with an extreme low abnormal temperature is not a credible scenario. [The probability of an abnormal minimum temperature is estimated as follows: temperatures <40 F occur 31% of the year (average historical weather data, 0.31 probability); a loss of heating is assumed to occur 8 hrs/yr (0.001 probability); combined probability is 0.31 x 0.001 = 0.00031 (3.1E-4). The combination of this event with a seismic DBE (4 E-04 probability) is not credible (<1 E-06 probability).]
12. Parameter value used on data sheet has been previously established and determined to provide more conservative 6 constraint than values derived from 24590-PTF-U0D-W16T-00001.
13. For commercial reasons, safety and seismic classification may be higher than elsewhere documented, and therefore 6 conservative.
14. Design life is 40 years, however, the demister may need to be replaced. A shield plug is provided above the vessel for 6 access to the demister pad section of the vessel. Due to the expected radiation source term, remote handling and replacement capability would be needed for demister or demister component replacement. Seller's responsibility for remote handling of the demister extends only to the ability for the demister to be accessed and removed / replaced remotely. The buyer retains the responsibility for any remote handling operations and equipment.

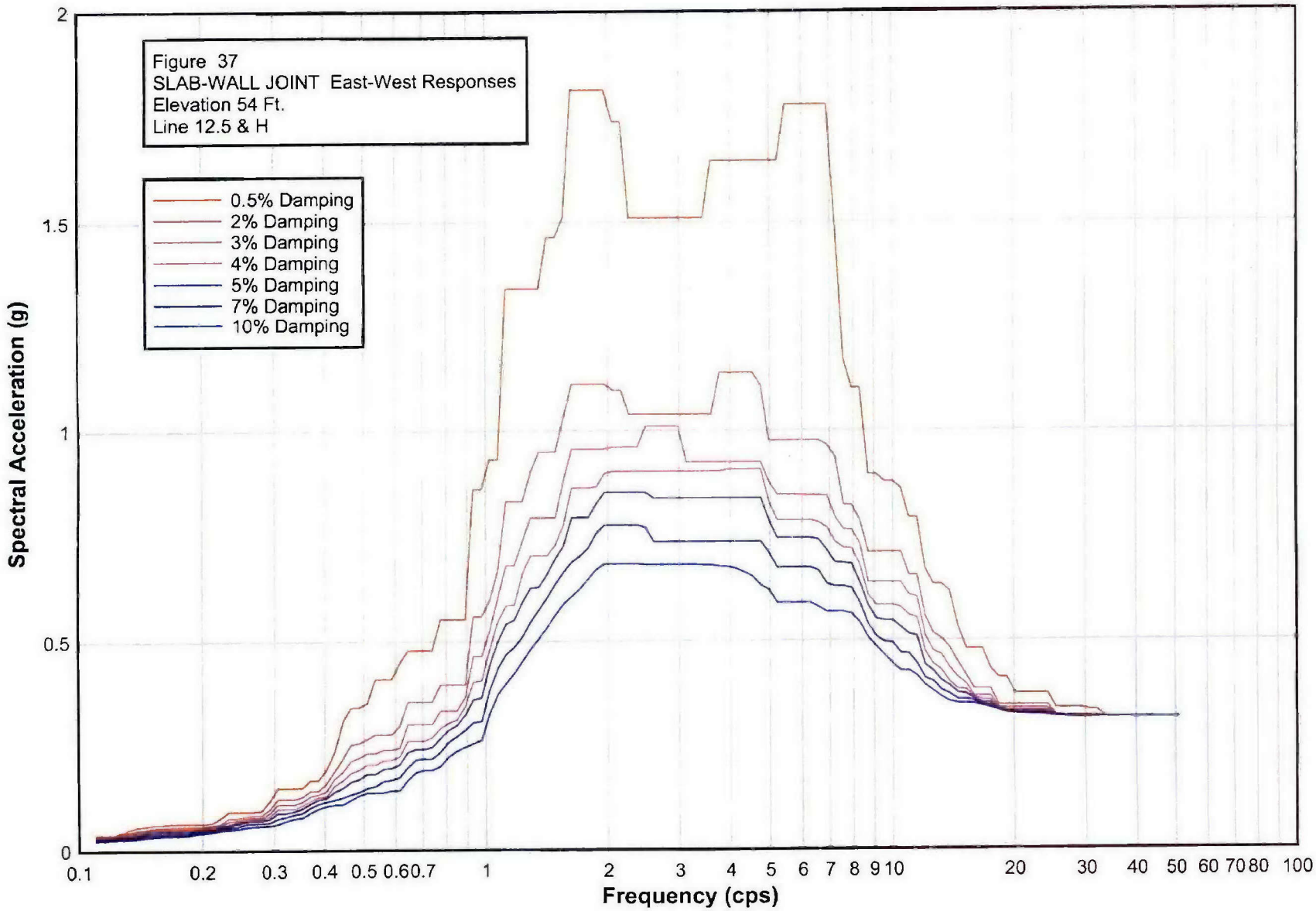
References:

1. 24590-WTP-PSAR-ESH-01-002-02, Rev. 04E, Preliminary Documented Safety Analysis to Support Construction 6 Authorization; PT Facility Specific Information.
2. deleted. 6
3. 24590-PTF-M6-CNP-00008, Rev. 2, P&ID - PTF Cesium Nitric Acid Recovery Process System Evaporator Vessel. 6
4. 24590-PTF-U0D-W16T-00001, Rev. 0, PTF Room Environment Datasheet [Including DCNs: 24590-PTF-U0N-W16T-6 00001, 24590-PTF-U0N-W16T-00003, & 24590-PTF-U0N-W16T-00004].
5. 24590-WTP-DB-ENG-01-001, Rev. 1N, Basis Of Design. 6
6. 24590-QL-POA-MEVV-00002-07-07, Rev. 00F, DRAWING - EVAPORATOR PROJECT #2 SEPARATOR VESSEL 6 CNP-EVAP-00001.
7. CCN 167203; PTF RADIATION DOSE RATES. 6
8. 24590-PTF-M6X-CNP-00012 Rev. 002, MS LINE LIST FOR P&ID 24590-PTF-M6-CNP-00008, REV. 2 6

# RPP-WTP Pretreatment Facility ISRS

6

**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**

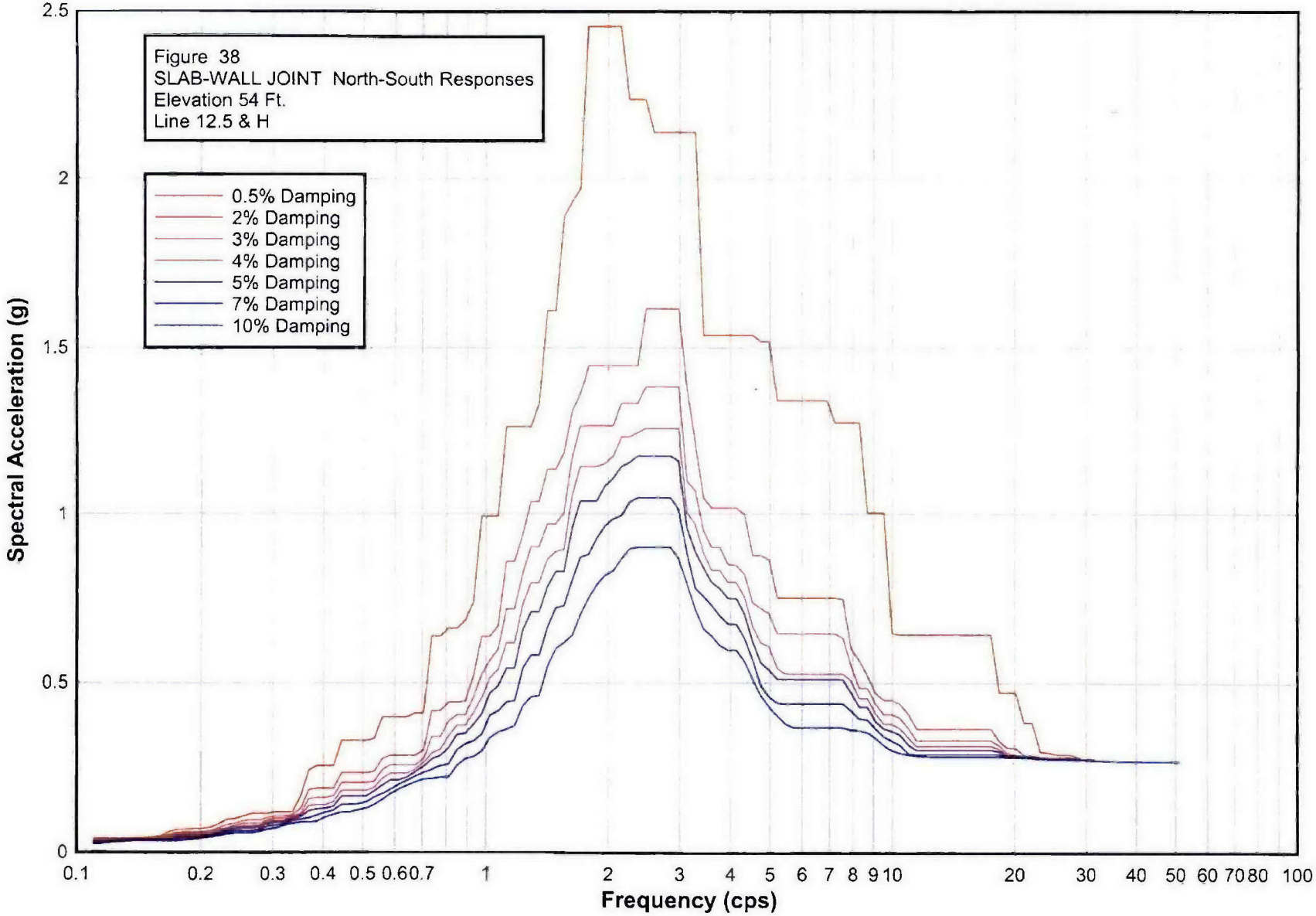





6

# 6 RPP-WTP Pretreatment Facility ISRS

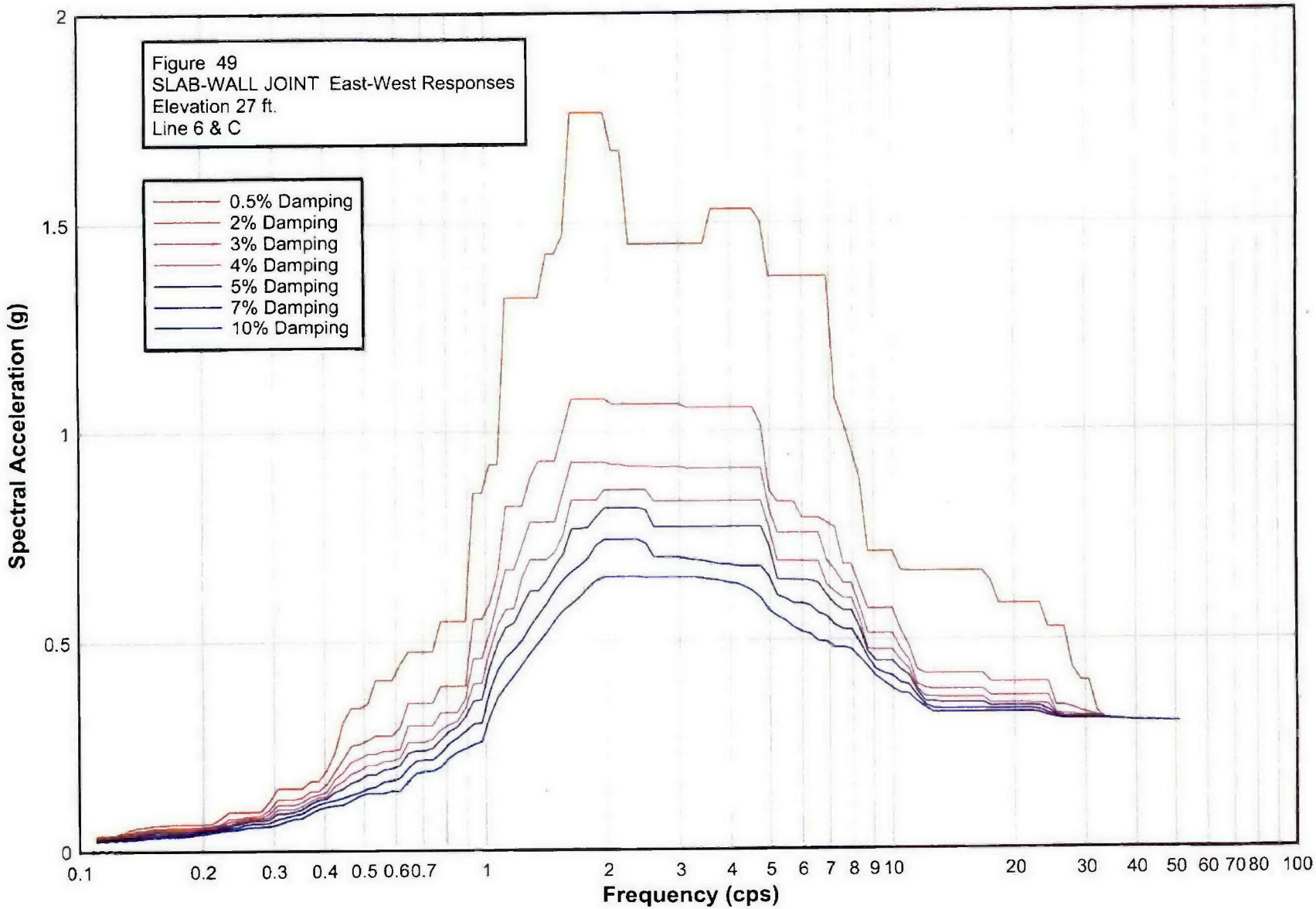
**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



# RPP-WTP Pretreatment Facility ISRS

6

**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



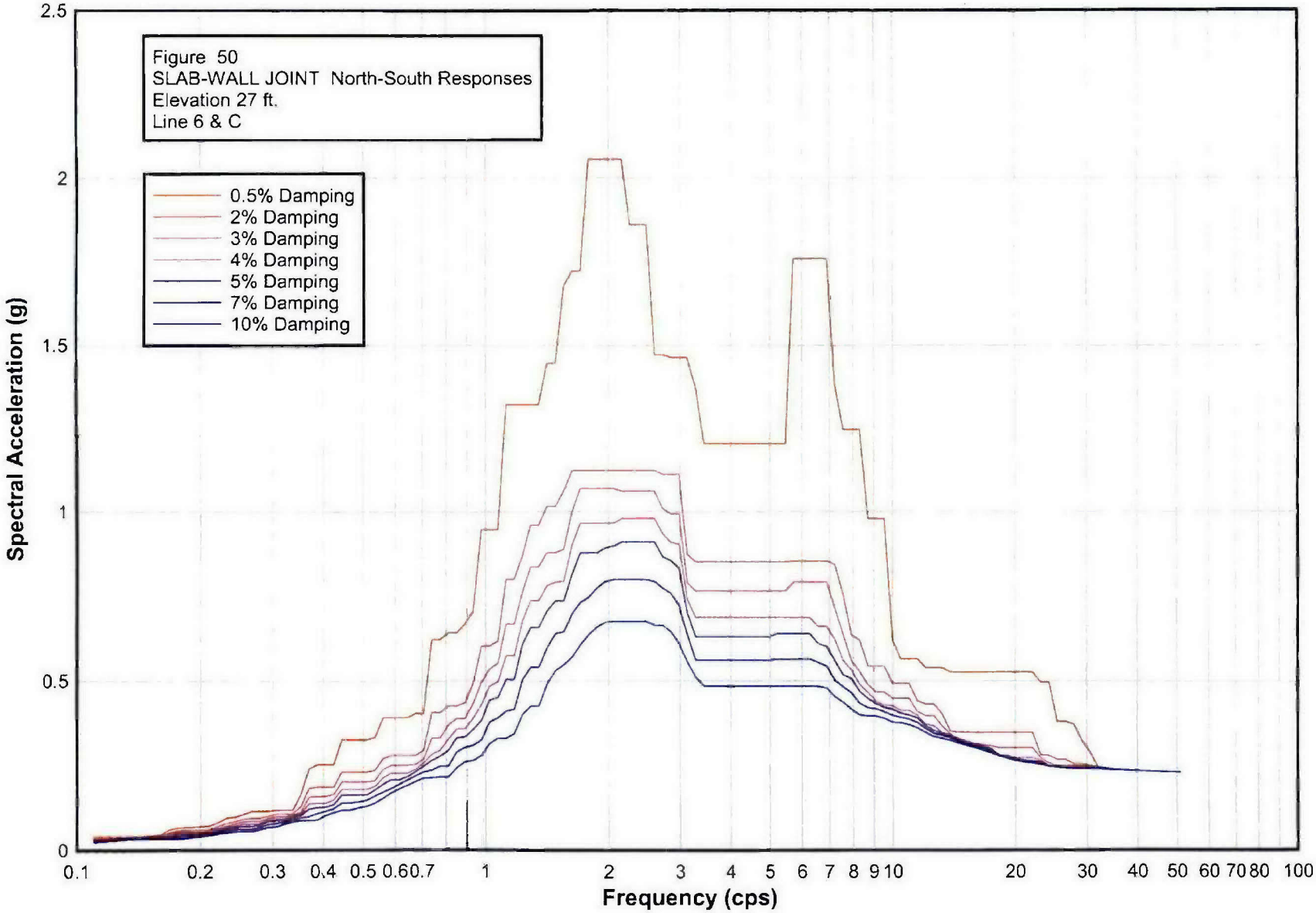



6

# RPP-WTP Pretreatment Facility ISRS

6

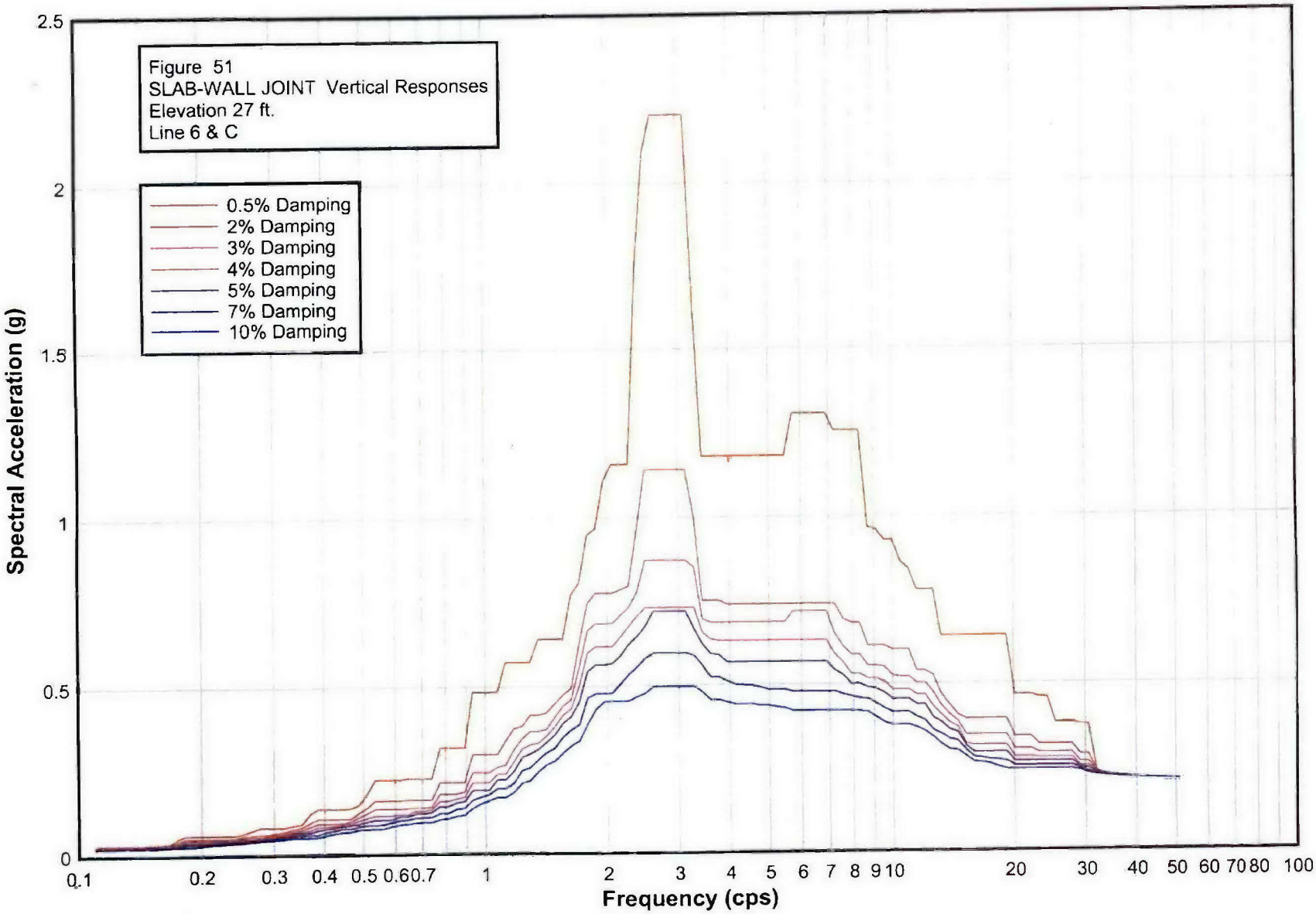
**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



# RPP-WTP Pretreatment Facility ISRS

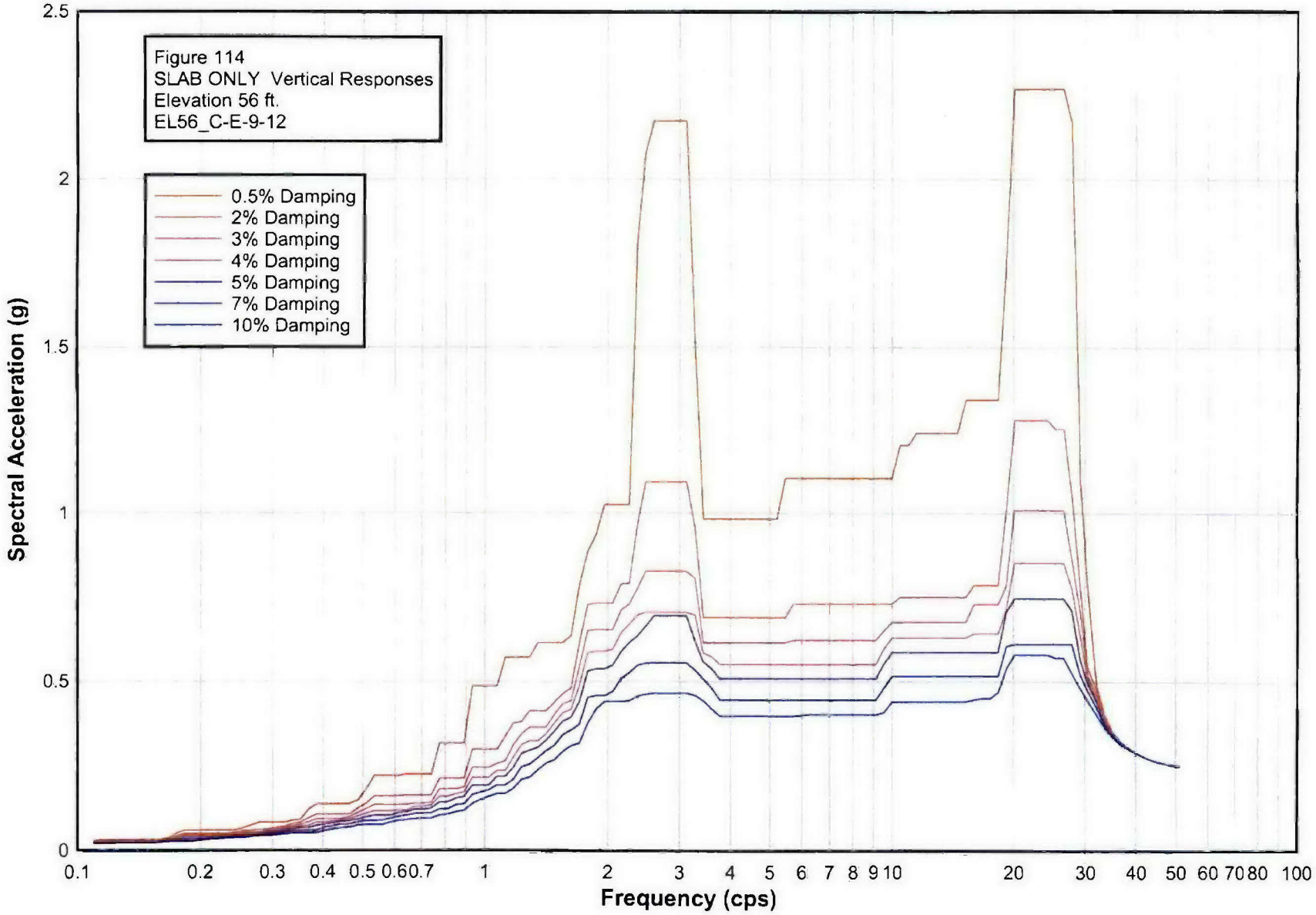
6

Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A



# RPP-WTP Pretreatment Facility ISRS

**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



PTWW037.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 37 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.1098 | 0.0375 | 0.1098 | 0.0344 | 0.1098 | 0.0327 | 0.1098 | 0.0312 | 0.1098 | 0.0298 | 0.1098 | 0.0274 | 0.1098 | 0.0252 |
| 0.115 | 0.0375 | 0.115 | 0.0344 | 0.115 | 0.0327 | 0.115 | 0.0312 | 0.115 | 0.0299 | 0.115 | 0.0277 | 0.115 | 0.0258 |
| 0.1204 | 0.0375 | 0.1204 | 0.0344 | 0.1204 | 0.0331 | 0.1204 | 0.0322 | 0.1204 | 0.0312 | 0.1204 | 0.0294 | 0.1204 | 0.0269 |
| 0.1262 | 0.0431 | 0.1262 | 0.0397 | 0.1262 | 0.0378 | 0.1262 | 0.036 | 0.1262 | 0.0343 | 0.1262 | 0.0314 | 0.1262 | 0.0278 |
| 0.1322 | 0.0504 | 0.1322 | 0.045 | 0.1322 | 0.042 | 0.1322 | 0.0393 | 0.1322 | 0.0369 | 0.1322 | 0.0328 | 0.1322 | 0.0281 |
| 0.1385 | 0.056 | 0.1385 | 0.0489 | 0.1385 | 0.0449 | 0.1385 | 0.0414 | 0.1385 | 0.0384 | 0.1385 | 0.0344 | 0.1385 | 0.0303 |
| 0.1451 | 0.058 | 0.1451 | 0.0509 | 0.1451 | 0.0475 | 0.1451 | 0.0445 | 0.1451 | 0.0419 | 0.1451 | 0.0375 | 0.1451 | 0.0325 |
| 0.152 | 0.0616 | 0.152 | 0.0546 | 0.152 | 0.0506 | 0.152 | 0.0472 | 0.152 | 0.0442 | 0.152 | 0.0391 | 0.152 | 0.0338 |
| 0.1592 | 0.062 | 0.1592 | 0.0546 | 0.1592 | 0.0506 | 0.1592 | 0.0472 | 0.1592 | 0.0442 | 0.1592 | 0.0396 | 0.1592 | 0.0351 |
| 0.1668 | 0.064 | 0.1668 | 0.056 | 0.1668 | 0.0517 | 0.1668 | 0.0481 | 0.1668 | 0.0451 | 0.1668 | 0.0403 | 0.1668 | 0.0356 |
| 0.1748 | 0.064 | 0.1748 | 0.056 | 0.1748 | 0.0517 | 0.1748 | 0.0481 | 0.1748 | 0.0451 | 0.1748 | 0.0403 | 0.1748 | 0.0356 |
| 0.1831 | 0.064 | 0.1831 | 0.056 | 0.1831 | 0.0517 | 0.1831 | 0.0481 | 0.1831 | 0.0451 | 0.1831 | 0.0403 | 0.1831 | 0.0368 |
| 0.1918 | 0.0641 | 0.1918 | 0.0561 | 0.1918 | 0.0517 | 0.1918 | 0.0495 | 0.1918 | 0.0477 | 0.1918 | 0.0445 | 0.1918 | 0.0404 |
| 0.2009 | 0.0642 | 0.2009 | 0.0583 | 0.2009 | 0.0558 | 0.2009 | 0.0535 | 0.2009 | 0.0513 | 0.2009 | 0.0474 | 0.2009 | 0.0424 |
| 0.2105 | 0.0665 | 0.2105 | 0.0603 | 0.2105 | 0.0575 | 0.2105 | 0.0549 | 0.2105 | 0.0525 | 0.2105 | 0.049 | 0.2105 | 0.0448 |
| 0.2205 | 0.078 | 0.2205 | 0.0647 | 0.2205 | 0.062 | 0.2205 | 0.0595 | 0.2205 | 0.0573 | 0.2205 | 0.0533 | 0.2205 | 0.0484 |
| 0.231 | 0.0933 | 0.231 | 0.0774 | 0.231 | 0.0694 | 0.231 | 0.063 | 0.231 | 0.0598 | 0.231 | 0.0556 | 0.231 | 0.0503 |
| 0.242 | 0.0933 | 0.242 | 0.0774 | 0.242 | 0.0723 | 0.242 | 0.0678 | 0.242 | 0.0638 | 0.242 | 0.0567 | 0.242 | 0.0513 |
| 0.2535 | 0.0933 | 0.2535 | 0.0817 | 0.2535 | 0.0771 | 0.2535 | 0.0729 | 0.2535 | 0.0692 | 0.2535 | 0.0628 | 0.2535 | 0.0553 |
| 0.2656 | 0.0933 | 0.2656 | 0.0839 | 0.2656 | 0.0794 | 0.2656 | 0.0754 | 0.2656 | 0.0718 | 0.2656 | 0.0653 | 0.2656 | 0.0575 |
| 0.2783 | 0.0954 | 0.2783 | 0.0847 | 0.2783 | 0.0794 | 0.2783 | 0.0754 | 0.2783 | 0.0718 | 0.2783 | 0.0653 | 0.2783 | 0.058 |
| 0.2915 | 0.1187 | 0.2915 | 0.0987 | 0.2915 | 0.089 | 0.2915 | 0.0813 | 0.2915 | 0.0753 | 0.2915 | 0.0668 | 0.2915 | 0.0592 |
| 0.3054 | 0.1504 | 0.3054 | 0.1235 | 0.3054 | 0.1097 | 0.3054 | 0.0985 | 0.3054 | 0.0894 | 0.3054 | 0.0758 | 0.3054 | 0.0633 |
| 0.3199 | 0.1504 | 0.3199 | 0.1235 | 0.3199 | 0.1097 | 0.3199 | 0.0985 | 0.3199 | 0.0894 | 0.3199 | 0.0801 | 0.3199 | 0.0706 |
| 0.3352 | 0.1504 | 0.3352 | 0.1235 | 0.3352 | 0.1097 | 0.3352 | 0.0985 | 0.3352 | 0.0931 | 0.3352 | 0.0857 | 0.3352 | 0.0762 |
| 0.3511 | 0.1504 | 0.3511 | 0.1289 | 0.3511 | 0.1172 | 0.3511 | 0.107 | 0.3511 | 0.0997 | 0.3511 | 0.0894 | 0.3511 | 0.0786 |
| 0.3678 | 0.168 | 0.3678 | 0.1438 | 0.3678 | 0.1303 | 0.3678 | 0.1186 | 0.3678 | 0.1121 | 0.3678 | 0.1017 | 0.3678 | 0.0898 |
| 0.3853 | 0.168 | 0.3853 | 0.1438 | 0.3853 | 0.1346 | 0.3853 | 0.1279 | 0.3853 | 0.1219 | 0.3853 | 0.1115 | 0.3853 | 0.0992 |
| 0.4037 | 0.194 | 0.4037 | 0.1598 | 0.4037 | 0.1426 | 0.4037 | 0.1306 | 0.4037 | 0.1259 | 0.4037 | 0.117 | 0.4037 | 0.1054 |
| 0.4229 | 0.2368 | 0.4229 | 0.1906 | 0.4229 | 0.1721 | 0.4229 | 0.1558 | 0.4229 | 0.1416 | 0.4229 | 0.1217 | 0.4229 | 0.1092 |
| 0.4431 | 0.3088 | 0.4431 | 0.2193 | 0.4431 | 0.1881 | 0.4431 | 0.1671 | 0.4431 | 0.1496 | 0.4431 | 0.1273 | 0.4431 | 0.1097 |
| 0.4642 | 0.3417 | 0.4642 | 0.2524 | 0.4642 | 0.2138 | 0.4642 | 0.1852 | 0.4642 | 0.1637 | 0.4642 | 0.1345 | 0.4642 | 0.1211 |
| 0.4863 | 0.3417 | 0.4863 | 0.256 | 0.4863 | 0.2208 | 0.4863 | 0.1928 | 0.4863 | 0.1701 | 0.4863 | 0.1409 | 0.4863 | 0.1323 |
| 0.5094 | 0.3522 | 0.5094 | 0.2656 | 0.5094 | 0.2325 | 0.5094 | 0.2054 | 0.5094 | 0.1831 | 0.5094 | 0.1497 | 0.5094 | 0.1391 |

PTWW037.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 37 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.5337 | 0.4096 | 0.5337 | 0.2771 | 0.5337 | 0.2325 | 0.5337 | 0.2054 | 0.5337 | 0.1831 | 0.5337 | 0.1539 | 0.5337 | 0.1396 |
| 0.5591 | 0.4096 | 0.5591 | 0.2771 | 0.5591 | 0.2398 | 0.5591 | 0.2148 | 0.5591 | 0.1949 | 0.5591 | 0.1654 | 0.5591 | 0.1396 |
| 0.5857 | 0.4096 | 0.5857 | 0.2771 | 0.5857 | 0.2404 | 0.5857 | 0.2159 | 0.5857 | 0.1975 | 0.5857 | 0.1686 | 0.5857 | 0.1441 |
| 0.6136 | 0.4475 | 0.6136 | 0.2969 | 0.6136 | 0.2444 | 0.6136 | 0.2234 | 0.6136 | 0.2051 | 0.6136 | 0.1751 | 0.6136 | 0.1441 |
| 0.6428 | 0.478 | 0.6428 | 0.3547 | 0.6428 | 0.3006 | 0.6428 | 0.2612 | 0.6428 | 0.2347 | 0.6428 | 0.1988 | 0.6428 | 0.168 |
| 0.6734 | 0.478 | 0.6734 | 0.3547 | 0.6734 | 0.3006 | 0.6734 | 0.2612 | 0.6734 | 0.2413 | 0.6734 | 0.2165 | 0.6734 | 0.1872 |
| 0.7055 | 0.478 | 0.7055 | 0.3547 | 0.7055 | 0.3006 | 0.7055 | 0.2612 | 0.7055 | 0.2413 | 0.7055 | 0.2186 | 0.7055 | 0.1922 |
| 0.7391 | 0.478 | 0.7391 | 0.3547 | 0.7391 | 0.3006 | 0.7391 | 0.2692 | 0.7391 | 0.2463 | 0.7391 | 0.2186 | 0.7391 | 0.1922 |
| 0.7743 | 0.5518 | 0.7743 | 0.3958 | 0.7743 | 0.3332 | 0.7743 | 0.2918 | 0.7743 | 0.268 | 0.7743 | 0.2351 | 0.7743 | 0.2018 |
| 0.8111 | 0.5518 | 0.8111 | 0.3958 | 0.8111 | 0.3332 | 0.8111 | 0.3035 | 0.8111 | 0.2874 | 0.8111 | 0.2587 | 0.8111 | 0.2236 |
| 0.8497 | 0.5518 | 0.8497 | 0.3958 | 0.8497 | 0.3332 | 0.8497 | 0.3117 | 0.8497 | 0.2984 | 0.8497 | 0.2723 | 0.8497 | 0.2373 |
| 0.8902 | 0.5518 | 0.8902 | 0.3958 | 0.8902 | 0.3656 | 0.8902 | 0.3431 | 0.8902 | 0.3226 | 0.8902 | 0.2873 | 0.8902 | 0.2462 |
| 0.9326 | 0.8605 | 0.9326 | 0.5585 | 0.9326 | 0.4629 | 0.9326 | 0.4023 | 0.9326 | 0.3602 | 0.9326 | 0.3049 | 0.9326 | 0.2549 |
| 0.977 | 0.8605 | 0.977 | 0.5585 | 0.977 | 0.4629 | 0.977 | 0.4045 | 0.977 | 0.3644 | 0.977 | 0.3083 | 0.977 | 0.2637 |
| 1.0235 | 0.9315 | 1.0235 | 0.5965 | 1.0235 | 0.5261 | 1.0235 | 0.4814 | 1.0235 | 0.4436 | 1.0235 | 0.3837 | 1.0235 | 0.3277 |
| 1.0723 | 0.9315 | 1.0723 | 0.6685 | 1.0723 | 0.603 | 1.0723 | 0.5467 | 1.0723 | 0.4995 | 1.0723 | 0.4355 | 1.0723 | 0.3729 |
| 1.1233 | 1.3398 | 1.1233 | 0.8315 | 1.1233 | 0.6788 | 1.1233 | 0.5837 | 1.1233 | 0.5408 | 1.1233 | 0.4681 | 1.1233 | 0.3987 |
| 1.1768 | 1.3398 | 1.1768 | 0.8315 | 1.1768 | 0.6788 | 1.1768 | 0.5855 | 1.1768 | 0.5505 | 1.1768 | 0.4858 | 1.1768 | 0.4238 |
| 1.2328 | 1.3398 | 1.2328 | 0.8315 | 1.2328 | 0.7369 | 1.2328 | 0.6596 | 1.2328 | 0.5925 | 1.2328 | 0.5105 | 1.2328 | 0.452 |
| 1.2916 | 1.3398 | 1.2916 | 0.9002 | 1.2916 | 0.7926 | 1.2916 | 0.7024 | 1.2916 | 0.6263 | 1.2916 | 0.5455 | 1.2916 | 0.4806 |
| 1.353 | 1.3398 | 1.353 | 0.9485 | 1.353 | 0.7926 | 1.353 | 0.7024 | 1.353 | 0.6282 | 1.353 | 0.574 | 1.353 | 0.5058 |
| 1.4175 | 1.4626 | 1.4175 | 0.9485 | 1.4175 | 0.7926 | 1.4175 | 0.7024 | 1.4175 | 0.6579 | 1.4175 | 0.6026 | 1.4175 | 0.5321 |
| 1.485 | 1.4626 | 1.485 | 0.9485 | 1.485 | 0.7926 | 1.485 | 0.7282 | 1.485 | 0.6958 | 1.485 | 0.636 | 1.485 | 0.5624 |
| 1.5557 | 1.5113 | 1.5557 | 1.0297 | 1.5557 | 0.8797 | 1.5557 | 0.7754 | 1.5557 | 0.726 | 1.5557 | 0.6634 | 1.5557 | 0.5886 |
| 1.6298 | 1.8158 | 1.6298 | 1.1086 | 1.6298 | 0.9552 | 1.6298 | 0.8627 | 1.6298 | 0.7931 | 1.6298 | 0.6875 | 1.6298 | 0.6064 |
| 1.7074 | 1.8158 | 1.7074 | 1.1086 | 1.7074 | 0.9552 | 1.7074 | 0.8627 | 1.7074 | 0.7931 | 1.7074 | 0.7024 | 1.7074 | 0.6246 |
| 1.7887 | 1.8158 | 1.7887 | 1.1086 | 1.7887 | 0.9552 | 1.7887 | 0.8627 | 1.7887 | 0.7931 | 1.7887 | 0.7213 | 1.7887 | 0.6476 |
| 1.8738 | 1.8158 | 1.8738 | 1.1086 | 1.8738 | 0.9552 | 1.8738 | 0.8651 | 1.8738 | 0.8263 | 1.8738 | 0.7567 | 1.8738 | 0.6698 |
| 1.963 | 1.8158 | 1.963 | 1.1086 | 1.963 | 0.9552 | 1.963 | 0.8972 | 1.963 | 0.8525 | 1.963 | 0.7755 | 1.963 | 0.683 |
| 2.0565 | 1.7414 | 2.0565 | 1.0948 | 2.0565 | 0.9593 | 2.0565 | 0.9017 | 2.0565 | 0.8525 | 2.0565 | 0.7755 | 2.0565 | 0.683 |
| 2.1544 | 1.7414 | 2.1544 | 1.0948 | 2.1544 | 0.9593 | 2.1544 | 0.9017 | 2.1544 | 0.8525 | 2.1544 | 0.7755 | 2.1544 | 0.683 |
| 2.257 | 1.5091 | 2.257 | 1.0367 | 2.257 | 0.9593 | 2.257 | 0.9017 | 2.257 | 0.8525 | 2.257 | 0.7755 | 2.257 | 0.683 |
| 2.3645 | 1.5091 | 2.3645 | 1.0367 | 2.3645 | 0.9593 | 2.3645 | 0.9017 | 2.3645 | 0.8525 | 2.3645 | 0.7755 | 2.3645 | 0.683 |
| 2.4771 | 1.5091 | 2.4771 | 1.0367 | 2.4771 | 1.009 | 2.4771 | 0.9017 | 2.4771 | 0.852 | 2.4771 | 0.7697 | 2.4771 | 0.6811 |
| 2.595 | 1.5091 | 2.595 | 1.0367 | 2.595 | 1.009 | 2.595 | 0.9017 | 2.595 | 0.8387 | 2.595 | 0.7357 | 2.595 | 0.6811 |

PTWW037.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 37 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 2.7186 | 1.5091 | 2.7186 | 1.0367 | 2.7186 | 1.009 | 2.7186 | 0.9017 | 2.7186 | 0.8387 | 2.7186 | 0.7357 | 2.7186 | 0.6811 |
| 2.848 | 1.5091 | 2.848 | 1.0367 | 2.848 | 1.009 | 2.848 | 0.9017 | 2.848 | 0.8387 | 2.848 | 0.7357 | 2.848 | 0.6811 |
| 2.9836 | 1.5091 | 2.9836 | 1.0367 | 2.9836 | 1.009 | 2.9836 | 0.9017 | 2.9836 | 0.8387 | 2.9836 | 0.7357 | 2.9836 | 0.6811 |
| 3.1257 | 1.5091 | 3.1257 | 1.0367 | 3.1257 | 0.9237 | 3.1257 | 0.9017 | 3.1257 | 0.8387 | 3.1257 | 0.7357 | 3.1257 | 0.6811 |
| 3.2745 | 1.5091 | 3.2745 | 1.0367 | 3.2745 | 0.9237 | 3.2745 | 0.9017 | 3.2745 | 0.8387 | 3.2745 | 0.7357 | 3.2745 | 0.6811 |
| 3.4305 | 1.5091 | 3.4305 | 1.0367 | 3.4305 | 0.9237 | 3.4305 | 0.9017 | 3.4305 | 0.8387 | 3.4305 | 0.7357 | 3.4305 | 0.6801 |
| 3.5938 | 1.6472 | 3.5938 | 1.0367 | 3.5938 | 0.9237 | 3.5938 | 0.9017 | 3.5938 | 0.8387 | 3.5938 | 0.7357 | 3.5938 | 0.6801 |
| 3.7649 | 1.6472 | 3.7649 | 1.1356 | 3.7649 | 0.9237 | 3.7649 | 0.9017 | 3.7649 | 0.8387 | 3.7649 | 0.7357 | 3.7649 | 0.6766 |
| 3.9442 | 1.6472 | 3.9442 | 1.1356 | 3.9442 | 0.9237 | 3.9442 | 0.906 | 3.9442 | 0.8387 | 3.9442 | 0.7357 | 3.9442 | 0.6759 |
| 4.132 | 1.6472 | 4.132 | 1.1356 | 4.132 | 0.9237 | 4.132 | 0.906 | 4.132 | 0.8387 | 4.132 | 0.7357 | 4.132 | 0.6712 |
| 4.3288 | 1.6472 | 4.3288 | 1.1356 | 4.3288 | 0.9237 | 4.3288 | 0.906 | 4.3288 | 0.8387 | 4.3288 | 0.7357 | 4.3288 | 0.6626 |
| 4.5349 | 1.6472 | 4.5349 | 1.1356 | 4.5349 | 0.9237 | 4.5349 | 0.906 | 4.5349 | 0.8387 | 4.5349 | 0.7357 | 4.5349 | 0.6525 |
| 4.7508 | 1.6472 | 4.7508 | 1.1048 | 4.7508 | 0.9237 | 4.7508 | 0.906 | 4.7508 | 0.8387 | 4.7508 | 0.7357 | 4.7508 | 0.6316 |
| 4.977 | 1.6472 | 4.977 | 0.9746 | 4.977 | 0.8757 | 4.977 | 0.829 | 4.977 | 0.7851 | 4.977 | 0.7083 | 4.977 | 0.6206 |
| 5.214 | 1.6472 | 5.214 | 0.9746 | 5.214 | 0.8463 | 5.214 | 0.785 | 5.214 | 0.7434 | 5.214 | 0.6732 | 5.214 | 0.5898 |
| 5.4623 | 1.7798 | 5.4623 | 0.9746 | 5.4623 | 0.8463 | 5.4623 | 0.785 | 5.4623 | 0.7434 | 5.4623 | 0.6732 | 5.4623 | 0.5898 |
| 5.7224 | 1.7798 | 5.7224 | 0.9746 | 5.7224 | 0.8463 | 5.7224 | 0.785 | 5.7224 | 0.7434 | 5.7224 | 0.6732 | 5.7224 | 0.5898 |
| 5.9948 | 1.7798 | 5.9948 | 0.9746 | 5.9948 | 0.8438 | 5.9948 | 0.785 | 5.9948 | 0.7434 | 5.9948 | 0.6732 | 5.9948 | 0.5898 |
| 6.2803 | 1.7798 | 6.2803 | 0.9746 | 6.2803 | 0.8438 | 6.2803 | 0.785 | 6.2803 | 0.7434 | 6.2803 | 0.6732 | 6.2803 | 0.5898 |
| 6.5793 | 1.7798 | 6.5793 | 0.9746 | 6.5793 | 0.8438 | 6.5793 | 0.7804 | 6.5793 | 0.7393 | 6.5793 | 0.6657 | 6.5793 | 0.5795 |
| 6.8926 | 1.7798 | 6.8926 | 0.963 | 6.8926 | 0.8429 | 6.8926 | 0.7674 | 6.8926 | 0.7128 | 6.8926 | 0.6345 | 6.8926 | 0.5677 |
| 7.2208 | 1.4914 | 7.2208 | 0.935 | 7.2208 | 0.7922 | 7.2208 | 0.7331 | 7.2208 | 0.6844 | 7.2208 | 0.6283 | 7.2208 | 0.5677 |
| 7.5646 | 1.168 | 7.5646 | 0.822 | 7.5646 | 0.7632 | 7.5646 | 0.7188 | 7.5646 | 0.6833 | 7.5646 | 0.6283 | 7.5646 | 0.5677 |
| 7.9248 | 1.0987 | 7.9248 | 0.8201 | 7.9248 | 0.7623 | 7.9248 | 0.7176 | 7.9248 | 0.6811 | 7.9248 | 0.6237 | 7.9248 | 0.5627 |
| 8.3022 | 1.0987 | 8.3022 | 0.7845 | 8.3022 | 0.7283 | 8.3022 | 0.6777 | 8.3022 | 0.6364 | 8.3022 | 0.5884 | 8.3022 | 0.5417 |
| 8.6975 | 0.8935 | 8.6975 | 0.7092 | 8.6975 | 0.6368 | 8.6975 | 0.6061 | 8.6975 | 0.5819 | 8.6975 | 0.5373 | 8.6975 | 0.5059 |
| 9.1116 | 0.8935 | 9.1116 | 0.7092 | 9.1116 | 0.6368 | 9.1116 | 0.5827 | 9.1116 | 0.5505 | 9.1116 | 0.5085 | 9.1116 | 0.4846 |
| 9.5455 | 0.8763 | 9.5455 | 0.7092 | 9.5455 | 0.6368 | 9.5455 | 0.5827 | 9.5455 | 0.5459 | 9.5455 | 0.4951 | 9.5455 | 0.4643 |
| 10 | 0.8763 | 10 | 0.7092 | 10 | 0.6368 | 10 | 0.5827 | 10 | 0.5459 | 10 | 0.4934 | 10 | 0.4429 |
| 10.4762 | 0.8603 | 10.4762 | 0.7092 | 10.4762 | 0.6368 | 10.4762 | 0.5774 | 10.4762 | 0.5297 | 10.4762 | 0.4688 | 10.4762 | 0.4271 |
| 10.975 | 0.791 | 10.975 | 0.6543 | 10.975 | 0.6067 | 10.975 | 0.5582 | 10.975 | 0.5137 | 10.975 | 0.4674 | 10.975 | 0.4271 |
| 11.4976 | 0.791 | 11.4976 | 0.6543 | 11.4976 | 0.6014 | 11.4976 | 0.5519 | 11.4976 | 0.5094 | 11.4976 | 0.4435 | 11.4976 | 0.4142 |
| 12.045 | 0.6677 | 12.045 | 0.5543 | 12.045 | 0.5086 | 12.045 | 0.4716 | 12.045 | 0.4394 | 12.045 | 0.4081 | 12.045 | 0.3915 |
| 12.6186 | 0.6325 | 12.6186 | 0.5145 | 12.6186 | 0.4727 | 12.6186 | 0.4409 | 12.6186 | 0.4251 | 12.6186 | 0.4004 | 12.6186 | 0.3774 |
| 13.2194 | 0.6325 | 13.2194 | 0.5025 | 13.2194 | 0.4639 | 13.2194 | 0.4269 | 13.2194 | 0.4021 | 13.2194 | 0.379 | 13.2194 | 0.3634 |

PTWW037.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 37 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13.8489 | 0.6152 | 13.8489 | 0.4815 | 13.8489 | 0.433 | 13.8489 | 0.3995 | 13.8489 | 0.3896 | 13.8489 | 0.3705 | 13.8489 | 0.3527 |
| 14.5083 | 0.5318 | 14.5083 | 0.4455 | 14.5083 | 0.4096 | 14.5083 | 0.381 | 14.5083 | 0.3726 | 14.5083 | 0.3575 | 14.5083 | 0.3484 |
| 15.1991 | 0.4787 | 15.1991 | 0.4141 | 15.1991 | 0.3936 | 15.1991 | 0.3795 | 15.1991 | 0.3697 | 15.1991 | 0.3575 | 15.1991 | 0.3484 |
| 15.9228 | 0.4787 | 15.9228 | 0.3815 | 15.9228 | 0.3644 | 15.9228 | 0.3609 | 15.9228 | 0.358 | 15.9228 | 0.3528 | 15.9228 | 0.3467 |
| 16.681 | 0.4787 | 16.681 | 0.3815 | 16.681 | 0.3644 | 16.681 | 0.3544 | 16.681 | 0.3483 | 16.681 | 0.3439 | 16.681 | 0.3416 |
| 17.4753 | 0.4307 | 17.4753 | 0.3815 | 17.4753 | 0.3644 | 17.4753 | 0.3544 | 17.4753 | 0.3483 | 17.4753 | 0.3418 | 17.4753 | 0.337 |
| 18.3074 | 0.4095 | 18.3074 | 0.3431 | 18.3074 | 0.3367 | 18.3074 | 0.3354 | 18.3074 | 0.3336 | 18.3074 | 0.3315 | 18.3074 | 0.3305 |
| 19.1791 | 0.4095 | 19.1791 | 0.3431 | 19.1791 | 0.3349 | 19.1791 | 0.3293 | 19.1791 | 0.3262 | 19.1791 | 0.3251 | 19.1791 | 0.325 |
| 20.0923 | 0.3708 | 20.0923 | 0.3431 | 20.0923 | 0.3349 | 20.0923 | 0.3293 | 20.0923 | 0.3262 | 20.0923 | 0.3243 | 20.0923 | 0.323 |
| 21.049 | 0.3708 | 21.049 | 0.3431 | 21.049 | 0.3349 | 21.049 | 0.3293 | 21.049 | 0.3262 | 21.049 | 0.3236 | 21.049 | 0.3215 |
| 22.0513 | 0.3708 | 22.0513 | 0.3431 | 22.0513 | 0.3349 | 22.0513 | 0.3293 | 22.0513 | 0.3262 | 22.0513 | 0.323 | 22.0513 | 0.3199 |
| 23.1013 | 0.3708 | 23.1013 | 0.3431 | 23.1013 | 0.3349 | 23.1013 | 0.3293 | 23.1013 | 0.3262 | 23.1013 | 0.323 | 23.1013 | 0.3199 |
| 24.2013 | 0.3708 | 24.2013 | 0.3431 | 24.2013 | 0.3349 | 24.2013 | 0.3293 | 24.2013 | 0.3255 | 24.2013 | 0.3206 | 24.2013 | 0.3186 |
| 25.3536 | 0.3358 | 25.3536 | 0.3197 | 25.3536 | 0.3192 | 25.3536 | 0.3187 | 25.3536 | 0.3181 | 25.3536 | 0.317 | 25.3536 | 0.3164 |
| 26.5609 | 0.3358 | 26.5609 | 0.3169 | 26.5609 | 0.3159 | 26.5609 | 0.3158 | 26.5609 | 0.3158 | 26.5609 | 0.3155 | 26.5609 | 0.3148 |
| 27.8256 | 0.3358 | 27.8256 | 0.3169 | 27.8256 | 0.3159 | 27.8256 | 0.3153 | 27.8256 | 0.3149 | 27.8256 | 0.3143 | 27.8256 | 0.3137 |
| 29.1505 | 0.3358 | 29.1505 | 0.3165 | 29.1505 | 0.3153 | 29.1505 | 0.3142 | 29.1505 | 0.3137 | 29.1505 | 0.3132 | 29.1505 | 0.313 |
| 30.5386 | 0.3312 | 30.5386 | 0.3165 | 30.5386 | 0.3153 | 30.5386 | 0.3142 | 30.5386 | 0.3133 | 30.5386 | 0.3131 | 30.5386 | 0.313 |
| 31.9927 | 0.3297 | 31.9927 | 0.3163 | 31.9927 | 0.3146 | 31.9927 | 0.3138 | 31.9927 | 0.3132 | 31.9927 | 0.3131 | 31.9927 | 0.313 |
| 33.516 | 0.3144 | 33.516 | 0.3134 | 33.516 | 0.3133 | 33.516 | 0.3132 | 33.516 | 0.3132 | 33.516 | 0.3131 | 33.516 | 0.313 |
| 35.1119 | 0.3135 | 35.1119 | 0.3134 | 35.1119 | 0.3133 | 35.1119 | 0.3132 | 35.1119 | 0.3132 | 35.1119 | 0.3131 | 35.1119 | 0.313 |
| 36.7838 | 0.3134 | 36.7838 | 0.3133 | 36.7838 | 0.3132 | 36.7838 | 0.3132 | 36.7838 | 0.3132 | 36.7838 | 0.3131 | 36.7838 | 0.313 |
| 38.5353 | 0.3132 | 38.5353 | 0.3132 | 38.5353 | 0.3131 | 38.5353 | 0.3131 | 38.5353 | 0.3131 | 38.5353 | 0.3131 | 38.5353 | 0.313 |
| 40.3702 | 0.3131 | 40.3702 | 0.3131 | 40.3702 | 0.3131 | 40.3702 | 0.313 | 40.3702 | 0.313 | 40.3702 | 0.313 | 40.3702 | 0.3129 |
| 42.2924 | 0.313 | 42.2924 | 0.3129 | 42.2924 | 0.3129 | 42.2924 | 0.3129 | 42.2924 | 0.3129 | 42.2924 | 0.3129 | 42.2924 | 0.3129 |
| 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 |
| 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 |
| 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 |
| 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 |

PTWW038.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 38 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.1098 | 0.0405 | 0.1098 | 0.0365 | 0.1098 | 0.0342 | 0.1098 | 0.0322 | 0.1098 | 0.0303 | 0.1098 | 0.0272 | 0.1098 | 0.0235 |
| 0.115 | 0.0405 | 0.115 | 0.0365 | 0.115 | 0.0342 | 0.115 | 0.0322 | 0.115 | 0.0303 | 0.115 | 0.0272 | 0.115 | 0.0259 |
| 0.1204 | 0.0405 | 0.1204 | 0.0365 | 0.1204 | 0.0342 | 0.1204 | 0.0322 | 0.1204 | 0.031 | 0.1204 | 0.0297 | 0.1204 | 0.028 |
| 0.1262 | 0.0405 | 0.1262 | 0.0365 | 0.1262 | 0.0352 | 0.1262 | 0.0342 | 0.1262 | 0.0334 | 0.1262 | 0.0318 | 0.1262 | 0.0297 |
| 0.1322 | 0.0405 | 0.1322 | 0.0382 | 0.1322 | 0.037 | 0.1322 | 0.0359 | 0.1322 | 0.0349 | 0.1322 | 0.0333 | 0.1322 | 0.0316 |
| 0.1385 | 0.0411 | 0.1385 | 0.0392 | 0.1385 | 0.0382 | 0.1385 | 0.0372 | 0.1385 | 0.0363 | 0.1385 | 0.0348 | 0.1385 | 0.0328 |
| 0.1451 | 0.0417 | 0.1451 | 0.0398 | 0.1451 | 0.0387 | 0.1451 | 0.0377 | 0.1451 | 0.0368 | 0.1451 | 0.0352 | 0.1451 | 0.0332 |
| 0.152 | 0.0439 | 0.152 | 0.0401 | 0.152 | 0.0387 | 0.152 | 0.0377 | 0.152 | 0.0368 | 0.152 | 0.0352 | 0.152 | 0.0332 |
| 0.1592 | 0.0462 | 0.1592 | 0.0416 | 0.1592 | 0.0396 | 0.1592 | 0.0377 | 0.1592 | 0.0368 | 0.1592 | 0.0352 | 0.1592 | 0.0332 |
| 0.1668 | 0.0584 | 0.1668 | 0.0506 | 0.1668 | 0.0463 | 0.1668 | 0.0426 | 0.1668 | 0.0395 | 0.1668 | 0.0352 | 0.1668 | 0.0332 |
| 0.1748 | 0.0645 | 0.1748 | 0.0566 | 0.1748 | 0.0522 | 0.1748 | 0.0484 | 0.1748 | 0.045 | 0.1748 | 0.0394 | 0.1748 | 0.0332 |
| 0.1831 | 0.0668 | 0.1831 | 0.0583 | 0.1831 | 0.0541 | 0.1831 | 0.0504 | 0.1831 | 0.0471 | 0.1831 | 0.0415 | 0.1831 | 0.0354 |
| 0.1918 | 0.0678 | 0.1918 | 0.0586 | 0.1918 | 0.0543 | 0.1918 | 0.0507 | 0.1918 | 0.0474 | 0.1918 | 0.0418 | 0.1918 | 0.038 |
| 0.2009 | 0.0697 | 0.2009 | 0.0596 | 0.2009 | 0.0543 | 0.2009 | 0.0514 | 0.2009 | 0.0487 | 0.2009 | 0.0438 | 0.2009 | 0.0411 |
| 0.2105 | 0.0722 | 0.2105 | 0.062 | 0.2105 | 0.0582 | 0.2105 | 0.0547 | 0.2105 | 0.0516 | 0.2105 | 0.0482 | 0.2105 | 0.0446 |
| 0.2205 | 0.0819 | 0.2205 | 0.0709 | 0.2205 | 0.0651 | 0.2205 | 0.06 | 0.2205 | 0.0574 | 0.2205 | 0.0531 | 0.2205 | 0.0475 |
| 0.231 | 0.0959 | 0.231 | 0.0792 | 0.231 | 0.0703 | 0.231 | 0.0665 | 0.231 | 0.063 | 0.231 | 0.0578 | 0.231 | 0.0525 |
| 0.242 | 0.0984 | 0.242 | 0.0845 | 0.242 | 0.0774 | 0.242 | 0.0721 | 0.242 | 0.0681 | 0.242 | 0.0618 | 0.242 | 0.0551 |
| 0.2535 | 0.1059 | 0.2535 | 0.0913 | 0.2535 | 0.0833 | 0.2535 | 0.0763 | 0.2535 | 0.0702 | 0.2535 | 0.0618 | 0.2535 | 0.0551 |
| 0.2656 | 0.1138 | 0.2656 | 0.0944 | 0.2656 | 0.084 | 0.2656 | 0.0763 | 0.2656 | 0.0702 | 0.2656 | 0.0618 | 0.2656 | 0.0551 |
| 0.2783 | 0.1138 | 0.2783 | 0.0944 | 0.2783 | 0.084 | 0.2783 | 0.0779 | 0.2783 | 0.074 | 0.2783 | 0.0677 | 0.2783 | 0.0611 |
| 0.2915 | 0.1138 | 0.2915 | 0.1008 | 0.2915 | 0.0946 | 0.2915 | 0.0892 | 0.2915 | 0.0843 | 0.2915 | 0.0764 | 0.2915 | 0.0677 |
| 0.3054 | 0.1179 | 0.3054 | 0.1056 | 0.3054 | 0.0987 | 0.3054 | 0.0926 | 0.3054 | 0.0872 | 0.3054 | 0.0785 | 0.3054 | 0.0706 |
| 0.3199 | 0.1179 | 0.3199 | 0.1056 | 0.3199 | 0.0987 | 0.3199 | 0.0926 | 0.3199 | 0.0894 | 0.3199 | 0.0844 | 0.3199 | 0.0786 |
| 0.3352 | 0.1179 | 0.3352 | 0.1098 | 0.3352 | 0.1056 | 0.3352 | 0.1017 | 0.3352 | 0.0982 | 0.3352 | 0.0921 | 0.3352 | 0.0848 |
| 0.3511 | 0.1654 | 0.3511 | 0.129 | 0.3511 | 0.1133 | 0.3511 | 0.1075 | 0.3511 | 0.1035 | 0.3511 | 0.0964 | 0.3511 | 0.088 |
| 0.3678 | 0.2415 | 0.3678 | 0.1832 | 0.3678 | 0.1565 | 0.3678 | 0.1364 | 0.3678 | 0.1213 | 0.3678 | 0.1006 | 0.3678 | 0.088 |
| 0.3853 | 0.2549 | 0.3853 | 0.187 | 0.3853 | 0.1595 | 0.3853 | 0.1387 | 0.3853 | 0.1269 | 0.3853 | 0.1092 | 0.3853 | 0.091 |
| 0.4037 | 0.2549 | 0.4037 | 0.187 | 0.4037 | 0.1595 | 0.4037 | 0.1387 | 0.4037 | 0.1279 | 0.4037 | 0.1163 | 0.4037 | 0.1034 |
| 0.4229 | 0.2549 | 0.4229 | 0.187 | 0.4229 | 0.1651 | 0.4229 | 0.1485 | 0.4229 | 0.1344 | 0.4229 | 0.1233 | 0.4229 | 0.1111 |
| 0.4431 | 0.3288 | 0.4431 | 0.2339 | 0.4431 | 0.2038 | 0.4431 | 0.1813 | 0.4431 | 0.1641 | 0.4431 | 0.1399 | 0.4431 | 0.1181 |
| 0.4642 | 0.3288 | 0.4642 | 0.2339 | 0.4642 | 0.2038 | 0.4642 | 0.1813 | 0.4642 | 0.1641 | 0.4642 | 0.1399 | 0.4642 | 0.1181 |
| 0.4863 | 0.3288 | 0.4863 | 0.2339 | 0.4863 | 0.2038 | 0.4863 | 0.1813 | 0.4863 | 0.1641 | 0.4863 | 0.1421 | 0.4863 | 0.1246 |
| 0.5094 | 0.3288 | 0.5094 | 0.2339 | 0.5094 | 0.2038 | 0.5094 | 0.1813 | 0.5094 | 0.1641 | 0.5094 | 0.1472 | 0.5094 | 0.1295 |

PTWW038.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 38 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.5337 | 0.3356 | 0.5337 | 0.2387 | 0.5337 | 0.2081 | 0.5337 | 0.19 | 0.5337 | 0.1796 | 0.5337 | 0.1614 | 0.5337 | 0.1401 |
| 0.5591 | 0.3997 | 0.5591 | 0.2762 | 0.5591 | 0.244 | 0.5591 | 0.2179 | 0.5591 | 0.1971 | 0.5591 | 0.1724 | 0.5591 | 0.1556 |
| 0.5857 | 0.3997 | 0.5857 | 0.2863 | 0.5857 | 0.2573 | 0.5857 | 0.2332 | 0.5857 | 0.2128 | 0.5857 | 0.1853 | 0.5857 | 0.1724 |
| 0.6136 | 0.3997 | 0.6136 | 0.2863 | 0.6136 | 0.2573 | 0.6136 | 0.2332 | 0.6136 | 0.2128 | 0.6136 | 0.1998 | 0.6136 | 0.1858 |
| 0.6428 | 0.3997 | 0.6428 | 0.2863 | 0.6428 | 0.2573 | 0.6428 | 0.2332 | 0.6428 | 0.2219 | 0.6428 | 0.2115 | 0.6428 | 0.1969 |
| 0.6734 | 0.411 | 0.6734 | 0.2863 | 0.6734 | 0.2574 | 0.6734 | 0.2449 | 0.6734 | 0.2378 | 0.6734 | 0.2244 | 0.6734 | 0.2072 |
| 0.7055 | 0.411 | 0.7055 | 0.301 | 0.7055 | 0.2757 | 0.7055 | 0.2638 | 0.7055 | 0.2534 | 0.7055 | 0.2357 | 0.7055 | 0.2156 |
| 0.7391 | 0.6367 | 0.7391 | 0.4169 | 0.7391 | 0.3404 | 0.7391 | 0.2927 | 0.7391 | 0.2746 | 0.7391 | 0.2445 | 0.7391 | 0.217 |
| 0.7743 | 0.6367 | 0.7743 | 0.4169 | 0.7743 | 0.3404 | 0.7743 | 0.3038 | 0.7743 | 0.2858 | 0.7743 | 0.2555 | 0.7743 | 0.2218 |
| 0.8111 | 0.6596 | 0.8111 | 0.4428 | 0.8111 | 0.386 | 0.8111 | 0.3422 | 0.8111 | 0.3081 | 0.8111 | 0.2598 | 0.8111 | 0.2218 |
| 0.8497 | 0.6596 | 0.8497 | 0.4428 | 0.8497 | 0.4051 | 0.8497 | 0.3738 | 0.8497 | 0.347 | 0.8497 | 0.3034 | 0.8497 | 0.256 |
| 0.8902 | 0.6828 | 0.8902 | 0.4451 | 0.8902 | 0.4051 | 0.8902 | 0.3738 | 0.8902 | 0.3511 | 0.8902 | 0.3194 | 0.8902 | 0.2761 |
| 0.9326 | 0.737 | 0.9326 | 0.5191 | 0.9326 | 0.4567 | 0.9326 | 0.411 | 0.9326 | 0.3766 | 0.9326 | 0.328 | 0.9326 | 0.2821 |
| 0.977 | 0.9914 | 0.977 | 0.6358 | 0.977 | 0.525 | 0.977 | 0.4553 | 0.977 | 0.408 | 0.977 | 0.3484 | 0.977 | 0.2994 |
| 1.0235 | 0.9914 | 1.0235 | 0.6358 | 1.0235 | 0.5662 | 1.0235 | 0.5139 | 1.0235 | 0.4702 | 1.0235 | 0.4041 | 1.0235 | 0.3384 |
| 1.0723 | 0.9914 | 1.0723 | 0.6668 | 1.0723 | 0.5976 | 1.0723 | 0.5399 | 1.0723 | 0.4914 | 1.0723 | 0.4166 | 1.0723 | 0.3541 |
| 1.1233 | 1.2606 | 1.1233 | 0.8561 | 1.1233 | 0.7168 | 1.1233 | 0.6174 | 1.1233 | 0.5433 | 1.1233 | 0.4431 | 1.1233 | 0.3633 |
| 1.1768 | 1.2606 | 1.1768 | 0.8561 | 1.1768 | 0.7168 | 1.1768 | 0.6174 | 1.1768 | 0.5433 | 1.1768 | 0.4467 | 1.1768 | 0.3729 |
| 1.2328 | 1.2606 | 1.2328 | 0.935 | 1.2328 | 0.8202 | 1.2328 | 0.7293 | 1.2328 | 0.6556 | 1.2328 | 0.5433 | 1.2328 | 0.4321 |
| 1.2916 | 1.2606 | 1.2916 | 1.0351 | 1.2916 | 0.8991 | 1.2916 | 0.793 | 1.2916 | 0.708 | 1.2916 | 0.5814 | 1.2916 | 0.4586 |
| 1.353 | 1.3319 | 1.353 | 1.0351 | 1.353 | 0.8991 | 1.353 | 0.793 | 1.353 | 0.708 | 1.353 | 0.5814 | 1.353 | 0.4631 |
| 1.4175 | 1.6092 | 1.4175 | 1.1325 | 1.4175 | 0.9683 | 1.4175 | 0.8621 | 1.4175 | 0.7817 | 1.4175 | 0.6627 | 1.4175 | 0.5486 |
| 1.485 | 1.6092 | 1.485 | 1.1325 | 1.485 | 0.9683 | 1.485 | 0.885 | 1.485 | 0.8264 | 1.485 | 0.7199 | 1.485 | 0.6006 |
| 1.5557 | 1.8872 | 1.5557 | 1.1818 | 1.5557 | 1.0008 | 1.5557 | 0.892 | 1.5557 | 0.8264 | 1.5557 | 0.7265 | 1.5557 | 0.6185 |
| 1.6298 | 1.9322 | 1.6298 | 1.3084 | 1.6298 | 1.1683 | 1.6298 | 1.0534 | 1.6298 | 0.9565 | 1.6298 | 0.8016 | 1.6298 | 0.6401 |
| 1.7074 | 1.9702 | 1.7074 | 1.3601 | 1.7074 | 1.2627 | 1.7074 | 1.1415 | 1.7074 | 1.0371 | 1.7074 | 0.8692 | 1.7074 | 0.7006 |
| 1.7887 | 2.4552 | 1.7887 | 1.4456 | 1.7887 | 1.2629 | 1.7887 | 1.1415 | 1.7887 | 1.0371 | 1.7887 | 0.8773 | 1.7887 | 0.7486 |
| 1.8738 | 2.4552 | 1.8738 | 1.4456 | 1.8738 | 1.2629 | 1.8738 | 1.1415 | 1.8738 | 1.0371 | 1.8738 | 0.9259 | 1.8738 | 0.788 |
| 1.963 | 2.4552 | 1.963 | 1.4456 | 1.963 | 1.2629 | 1.963 | 1.1498 | 1.963 | 1.0818 | 1.963 | 0.9626 | 1.963 | 0.8157 |
| 2.0565 | 2.4552 | 2.0565 | 1.4456 | 2.0565 | 1.2629 | 2.0565 | 1.1701 | 2.0565 | 1.1049 | 2.0565 | 0.9829 | 2.0565 | 0.8288 |
| 2.1544 | 2.4552 | 2.1544 | 1.4456 | 2.1544 | 1.3316 | 2.1544 | 1.2297 | 2.1544 | 1.1411 | 2.1544 | 0.9932 | 2.1544 | 0.8645 |
| 2.257 | 2.2367 | 2.257 | 1.4456 | 2.257 | 1.3316 | 2.257 | 1.2297 | 2.257 | 1.1534 | 2.257 | 1.0344 | 2.257 | 0.8939 |
| 2.3645 | 2.2367 | 2.3645 | 1.4456 | 2.3645 | 1.3316 | 2.3645 | 1.2422 | 2.3645 | 1.1724 | 2.3645 | 1.0471 | 2.3645 | 0.898 |
| 2.4771 | 2.2367 | 2.4771 | 1.6143 | 2.4771 | 1.3804 | 2.4771 | 1.2551 | 2.4771 | 1.1724 | 2.4771 | 1.0471 | 2.4771 | 0.898 |
| 2.595 | 2.138 | 2.595 | 1.6143 | 2.595 | 1.3804 | 2.595 | 1.2551 | 2.595 | 1.1724 | 2.595 | 1.0471 | 2.595 | 0.898 |

PTWW038.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 38 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 2.7186 | 2.138 | 2.7186 | 1.6143 | 2.7186 | 1.3804 | 2.7186 | 1.2551 | 2.7186 | 1.1724 | 2.7186 | 1.0471 | 2.7186 | 0.898 |
| 2.848 | 2.138 | 2.848 | 1.6143 | 2.848 | 1.3804 | 2.848 | 1.2551 | 2.848 | 1.1724 | 2.848 | 1.0471 | 2.848 | 0.898 |
| 2.9836 | 2.138 | 2.9836 | 1.6143 | 2.9836 | 1.3804 | 2.9836 | 1.2551 | 2.9836 | 1.1568 | 2.9836 | 1.0114 | 2.9836 | 0.8645 |
| 3.1257 | 2.138 | 3.1257 | 1.3773 | 3.1257 | 1.0982 | 3.1257 | 1.0035 | 3.1257 | 0.9573 | 3.1257 | 0.8829 | 3.1257 | 0.7931 |
| 3.2745 | 2.138 | 3.2745 | 1.2119 | 3.2745 | 1.0686 | 3.2745 | 0.9673 | 3.2745 | 0.886 | 3.2745 | 0.778 | 3.2745 | 0.7168 |
| 3.4305 | 1.5368 | 3.4305 | 1.0471 | 3.4305 | 0.9495 | 3.4305 | 0.8824 | 3.4305 | 0.8379 | 3.4305 | 0.7547 | 3.4305 | 0.6598 |
| 3.5938 | 1.5368 | 3.5938 | 1.0165 | 3.5938 | 0.898 | 3.5938 | 0.8299 | 3.5938 | 0.7946 | 3.5938 | 0.7273 | 3.5938 | 0.6376 |
| 3.7649 | 1.5368 | 3.7649 | 1.0165 | 3.7649 | 0.898 | 3.7649 | 0.8299 | 3.7649 | 0.7769 | 3.7649 | 0.6958 | 3.7649 | 0.6089 |
| 3.9442 | 1.5368 | 3.9442 | 1.0165 | 3.9442 | 0.8472 | 3.9442 | 0.7941 | 3.9442 | 0.7477 | 3.9442 | 0.6723 | 3.9442 | 0.5955 |
| 4.132 | 1.5368 | 4.132 | 1.0165 | 4.132 | 0.845 | 4.132 | 0.7941 | 4.132 | 0.7477 | 4.132 | 0.6723 | 4.132 | 0.5955 |
| 4.3288 | 1.5368 | 4.3288 | 0.9973 | 4.3288 | 0.8194 | 4.3288 | 0.7522 | 4.3288 | 0.7017 | 4.3288 | 0.6303 | 4.3288 | 0.5622 |
| 4.5349 | 1.5368 | 4.5349 | 0.8745 | 4.5349 | 0.7347 | 4.5349 | 0.6652 | 4.5349 | 0.6197 | 4.5349 | 0.5656 | 4.5349 | 0.5097 |
| 4.7508 | 1.518 | 4.7508 | 0.8745 | 4.7508 | 0.7183 | 4.7508 | 0.6169 | 4.7508 | 0.5587 | 4.7508 | 0.4909 | 4.7508 | 0.4618 |
| 4.977 | 1.518 | 4.977 | 0.8614 | 4.977 | 0.7025 | 4.977 | 0.6052 | 4.977 | 0.5367 | 4.977 | 0.4572 | 4.977 | 0.4284 |
| 5.214 | 1.3404 | 5.214 | 0.7497 | 5.214 | 0.6443 | 5.214 | 0.5421 | 5.214 | 0.5109 | 5.214 | 0.4398 | 5.214 | 0.4021 |
| 5.4623 | 1.3404 | 5.4623 | 0.7497 | 5.4623 | 0.6443 | 5.4623 | 0.5254 | 5.4623 | 0.5109 | 5.4623 | 0.438 | 5.4623 | 0.3783 |
| 5.7224 | 1.3404 | 5.7224 | 0.7497 | 5.7224 | 0.6443 | 5.7224 | 0.5254 | 5.7224 | 0.5109 | 5.7224 | 0.438 | 5.7224 | 0.3681 |
| 5.9948 | 1.3404 | 5.9948 | 0.7497 | 5.9948 | 0.6443 | 5.9948 | 0.5254 | 5.9948 | 0.5109 | 5.9948 | 0.438 | 5.9948 | 0.3681 |
| 6.2803 | 1.3404 | 6.2803 | 0.7497 | 6.2803 | 0.6443 | 6.2803 | 0.5254 | 6.2803 | 0.5109 | 6.2803 | 0.438 | 6.2803 | 0.3681 |
| 6.5793 | 1.3404 | 6.5793 | 0.7497 | 6.5793 | 0.6443 | 6.5793 | 0.5254 | 6.5793 | 0.5109 | 6.5793 | 0.438 | 6.5793 | 0.3681 |
| 6.8926 | 1.3404 | 6.8926 | 0.7497 | 6.8926 | 0.6443 | 6.8926 | 0.5254 | 6.8926 | 0.5109 | 6.8926 | 0.438 | 6.8926 | 0.3681 |
| 7.2208 | 1.274 | 7.2208 | 0.7497 | 7.2208 | 0.6443 | 7.2208 | 0.5254 | 7.2208 | 0.5109 | 7.2208 | 0.438 | 7.2208 | 0.3681 |
| 7.5646 | 1.274 | 7.5646 | 0.7455 | 7.5646 | 0.6309 | 7.5646 | 0.5254 | 7.5646 | 0.5092 | 7.5646 | 0.438 | 7.5646 | 0.3681 |
| 7.9248 | 1.274 | 7.9248 | 0.6003 | 7.9248 | 0.5494 | 7.9248 | 0.5064 | 7.9248 | 0.471 | 7.9248 | 0.4168 | 7.9248 | 0.3609 |
| 8.3022 | 1.274 | 8.3022 | 0.5659 | 8.3022 | 0.4849 | 8.3022 | 0.454 | 8.3022 | 0.4288 | 8.3022 | 0.394 | 8.3022 | 0.3594 |
| 8.6975 | 1.0027 | 8.6975 | 0.521 | 8.6975 | 0.4849 | 8.6975 | 0.454 | 8.6975 | 0.4288 | 8.6975 | 0.3913 | 8.6975 | 0.3536 |
| 9.1116 | 1.0027 | 9.1116 | 0.4701 | 9.1116 | 0.4386 | 9.1116 | 0.4105 | 9.1116 | 0.3865 | 9.1116 | 0.3654 | 9.1116 | 0.3376 |
| 9.5455 | 1.0027 | 9.5455 | 0.4494 | 9.5455 | 0.4069 | 9.5455 | 0.3794 | 9.5455 | 0.3652 | 9.5455 | 0.3418 | 9.5455 | 0.3167 |
| 10 | 0.6463 | 10 | 0.4494 | 10 | 0.4069 | 10 | 0.3794 | 10 | 0.3585 | 10 | 0.3293 | 10 | 0.3015 |
| 10.4762 | 0.6411 | 10.4762 | 0.4371 | 10.4762 | 0.3959 | 10.4762 | 0.3648 | 10.4762 | 0.347 | 10.4762 | 0.3169 | 10.4762 | 0.2936 |
| 10.975 | 0.6411 | 10.975 | 0.4085 | 10.975 | 0.3668 | 10.975 | 0.3387 | 10.975 | 0.3179 | 10.975 | 0.2923 | 10.975 | 0.2891 |
| 11.4976 | 0.6411 | 11.4976 | 0.3647 | 11.4976 | 0.3304 | 11.4976 | 0.3133 | 11.4976 | 0.3024 | 11.4976 | 0.2893 | 11.4976 | 0.2857 |
| 12.045 | 0.6411 | 12.045 | 0.3647 | 12.045 | 0.3304 | 12.045 | 0.3133 | 12.045 | 0.3024 | 12.045 | 0.2893 | 12.045 | 0.2839 |
| 12.6186 | 0.6411 | 12.6186 | 0.3647 | 12.6186 | 0.3304 | 12.6186 | 0.3133 | 12.6186 | 0.3024 | 12.6186 | 0.2893 | 12.6186 | 0.2831 |
| 13.2194 | 0.6411 | 13.2194 | 0.3647 | 13.2194 | 0.3304 | 13.2194 | 0.3133 | 13.2194 | 0.3024 | 13.2194 | 0.2893 | 13.2194 | 0.2831 |

PTWW038.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 38 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 0.6411 | 13.8489 | 0.3647 | 13.8489 | 0.3304 | 13.8489 | 0.3133 | 13.8489 | 0.3024 | 13.8489 | 0.2893 | 13.8489 | 0.2831 |
| 14.5083 | 0.6411 | 14.5083 | 0.3647 | 14.5083 | 0.3304 | 14.5083 | 0.3133 | 14.5083 | 0.3024 | 14.5083 | 0.2893 | 14.5083 | 0.2831 |
| 15.1991 | 0.6411 | 15.1991 | 0.3647 | 15.1991 | 0.3304 | 15.1991 | 0.3133 | 15.1991 | 0.3024 | 15.1991 | 0.2893 | 15.1991 | 0.2831 |
| 15.9228 | 0.6411 | 15.9228 | 0.3647 | 15.9228 | 0.3304 | 15.9228 | 0.3133 | 15.9228 | 0.3024 | 15.9228 | 0.2893 | 15.9228 | 0.2831 |
| 16.681 | 0.6411 | 16.681 | 0.3647 | 16.681 | 0.3304 | 16.681 | 0.3133 | 16.681 | 0.3024 | 16.681 | 0.2893 | 16.681 | 0.2831 |
| 17.4753 | 0.6411 | 17.4753 | 0.3647 | 17.4753 | 0.3304 | 17.4753 | 0.3133 | 17.4753 | 0.3024 | 17.4753 | 0.2893 | 17.4753 | 0.2831 |
| 18.3074 | 0.4714 | 18.3074 | 0.3284 | 18.3074 | 0.3152 | 18.3074 | 0.3052 | 18.3074 | 0.298 | 18.3074 | 0.2893 | 18.3074 | 0.2831 |
| 19.1791 | 0.4714 | 19.1791 | 0.3088 | 19.1791 | 0.2936 | 19.1791 | 0.2872 | 19.1791 | 0.2851 | 19.1791 | 0.2842 | 19.1791 | 0.2825 |
| 20.0923 | 0.4714 | 20.0923 | 0.3088 | 20.0923 | 0.2886 | 20.0923 | 0.2865 | 20.0923 | 0.2851 | 20.0923 | 0.2833 | 20.0923 | 0.2814 |
| 21.049 | 0.3824 | 21.049 | 0.2877 | 21.049 | 0.2842 | 21.049 | 0.2843 | 21.049 | 0.2836 | 21.049 | 0.2819 | 21.049 | 0.2801 |
| 22.0513 | 0.3824 | 22.0513 | 0.2873 | 22.0513 | 0.2834 | 22.0513 | 0.2816 | 22.0513 | 0.2806 | 22.0513 | 0.2795 | 22.0513 | 0.2783 |
| 23.1013 | 0.2973 | 23.1013 | 0.2832 | 23.1013 | 0.2814 | 23.1013 | 0.2802 | 23.1013 | 0.2793 | 23.1013 | 0.2779 | 23.1013 | 0.2765 |
| 24.2013 | 0.2947 | 24.2013 | 0.2805 | 24.2013 | 0.2788 | 24.2013 | 0.2776 | 24.2013 | 0.2768 | 24.2013 | 0.2763 | 24.2013 | 0.2756 |
| 25.3536 | 0.288 | 25.3536 | 0.2805 | 25.3536 | 0.2788 | 25.3536 | 0.2776 | 25.3536 | 0.2768 | 25.3536 | 0.2757 | 25.3536 | 0.2749 |
| 26.5609 | 0.288 | 26.5609 | 0.2805 | 26.5609 | 0.2788 | 26.5609 | 0.2776 | 26.5609 | 0.2768 | 26.5609 | 0.2757 | 26.5609 | 0.2747 |
| 27.8256 | 0.2867 | 27.8256 | 0.28 | 27.8256 | 0.2782 | 27.8256 | 0.2771 | 27.8256 | 0.2762 | 27.8256 | 0.2751 | 27.8256 | 0.2741 |
| 29.1505 | 0.2773 | 29.1505 | 0.2753 | 29.1505 | 0.2749 | 29.1505 | 0.2745 | 29.1505 | 0.2742 | 29.1505 | 0.2738 | 29.1505 | 0.2732 |
| 30.5386 | 0.2773 | 30.5386 | 0.2727 | 30.5386 | 0.2726 | 30.5386 | 0.2725 | 30.5386 | 0.2724 | 30.5386 | 0.2723 | 30.5386 | 0.2721 |
| 31.9927 | 0.2707 | 31.9927 | 0.271 | 31.9927 | 0.271 | 31.9927 | 0.2711 | 31.9927 | 0.2711 | 31.9927 | 0.2712 | 31.9927 | 0.2712 |
| 33.516 | 0.2707 | 33.516 | 0.2707 | 33.516 | 0.2706 | 33.516 | 0.2706 | 33.516 | 0.2706 | 33.516 | 0.2706 | 33.516 | 0.2706 |
| 35.1119 | 0.27 | 35.1119 | 0.27 | 35.1119 | 0.27 | 35.1119 | 0.2701 | 35.1119 | 0.2701 | 35.1119 | 0.2701 | 35.1119 | 0.2701 |
| 36.7838 | 0.2695 | 36.7838 | 0.2696 | 36.7838 | 0.2696 | 36.7838 | 0.2696 | 36.7838 | 0.2697 | 36.7838 | 0.2697 | 36.7838 | 0.2697 |
| 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 |
| 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 |
| 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2688 |
| 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 |
| 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 |
| 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 |
| 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 |

PTWW049.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 49 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 27 ft. ~ Line 6 C

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.1098 | 0.0375 | 0.1098 | 0.0344 | 0.1098 | 0.0327 | 0.1098 | 0.0312 | 0.1098 | 0.0298 | 0.1098 | 0.0274 | 0.1098 | 0.0252 |
| 0.115 | 0.0375 | 0.115 | 0.0344 | 0.115 | 0.0327 | 0.115 | 0.0312 | 0.115 | 0.0299 | 0.115 | 0.0277 | 0.115 | 0.0258 |
| 0.1204 | 0.0375 | 0.1204 | 0.0344 | 0.1204 | 0.0331 | 0.1204 | 0.0322 | 0.1204 | 0.0312 | 0.1204 | 0.0293 | 0.1204 | 0.0268 |
| 0.1262 | 0.0431 | 0.1262 | 0.0397 | 0.1262 | 0.0378 | 0.1262 | 0.036 | 0.1262 | 0.0343 | 0.1262 | 0.0314 | 0.1262 | 0.0277 |
| 0.1322 | 0.0504 | 0.1322 | 0.045 | 0.1322 | 0.042 | 0.1322 | 0.0393 | 0.1322 | 0.0369 | 0.1322 | 0.0328 | 0.1322 | 0.0281 |
| 0.1385 | 0.056 | 0.1385 | 0.0489 | 0.1385 | 0.0449 | 0.1385 | 0.0414 | 0.1385 | 0.0383 | 0.1385 | 0.0344 | 0.1385 | 0.0303 |
| 0.1451 | 0.058 | 0.1451 | 0.0509 | 0.1451 | 0.0475 | 0.1451 | 0.0445 | 0.1451 | 0.0419 | 0.1451 | 0.0374 | 0.1451 | 0.0325 |
| 0.152 | 0.0616 | 0.152 | 0.0545 | 0.152 | 0.0506 | 0.152 | 0.0472 | 0.152 | 0.0441 | 0.152 | 0.0391 | 0.152 | 0.0336 |
| 0.1592 | 0.062 | 0.1592 | 0.0545 | 0.1592 | 0.0506 | 0.1592 | 0.0472 | 0.1592 | 0.0441 | 0.1592 | 0.0395 | 0.1592 | 0.0349 |
| 0.1668 | 0.0639 | 0.1668 | 0.056 | 0.1668 | 0.0517 | 0.1668 | 0.048 | 0.1668 | 0.045 | 0.1668 | 0.0402 | 0.1668 | 0.0354 |
| 0.1748 | 0.0639 | 0.1748 | 0.056 | 0.1748 | 0.0517 | 0.1748 | 0.048 | 0.1748 | 0.045 | 0.1748 | 0.0402 | 0.1748 | 0.0354 |
| 0.1831 | 0.0639 | 0.1831 | 0.056 | 0.1831 | 0.0517 | 0.1831 | 0.048 | 0.1831 | 0.045 | 0.1831 | 0.0402 | 0.1831 | 0.0366 |
| 0.1918 | 0.0641 | 0.1918 | 0.0561 | 0.1918 | 0.0517 | 0.1918 | 0.0493 | 0.1918 | 0.0475 | 0.1918 | 0.0443 | 0.1918 | 0.0402 |
| 0.2009 | 0.0641 | 0.2009 | 0.0582 | 0.2009 | 0.0556 | 0.2009 | 0.0533 | 0.2009 | 0.0512 | 0.2009 | 0.0473 | 0.2009 | 0.0423 |
| 0.2105 | 0.0664 | 0.2105 | 0.0602 | 0.2105 | 0.0574 | 0.2105 | 0.0548 | 0.2105 | 0.0525 | 0.2105 | 0.049 | 0.2105 | 0.0448 |
| 0.2205 | 0.0779 | 0.2205 | 0.0646 | 0.2205 | 0.0619 | 0.2205 | 0.0595 | 0.2205 | 0.0572 | 0.2205 | 0.0532 | 0.2205 | 0.0483 |
| 0.231 | 0.0932 | 0.231 | 0.0773 | 0.231 | 0.0693 | 0.231 | 0.0628 | 0.231 | 0.0598 | 0.231 | 0.0555 | 0.231 | 0.0503 |
| 0.242 | 0.0932 | 0.242 | 0.0773 | 0.242 | 0.0722 | 0.242 | 0.0678 | 0.242 | 0.0637 | 0.242 | 0.0566 | 0.242 | 0.0512 |
| 0.2535 | 0.0932 | 0.2535 | 0.0816 | 0.2535 | 0.0769 | 0.2535 | 0.0727 | 0.2535 | 0.0689 | 0.2535 | 0.0626 | 0.2535 | 0.0549 |
| 0.2656 | 0.0932 | 0.2656 | 0.0837 | 0.2656 | 0.0793 | 0.2656 | 0.0752 | 0.2656 | 0.0715 | 0.2656 | 0.0651 | 0.2656 | 0.0572 |
| 0.2783 | 0.0953 | 0.2783 | 0.0845 | 0.2783 | 0.0793 | 0.2783 | 0.0752 | 0.2783 | 0.0715 | 0.2783 | 0.0651 | 0.2783 | 0.0576 |
| 0.2915 | 0.1185 | 0.2915 | 0.0984 | 0.2915 | 0.0887 | 0.2915 | 0.0811 | 0.2915 | 0.0751 | 0.2915 | 0.0667 | 0.2915 | 0.0588 |
| 0.3054 | 0.1502 | 0.3054 | 0.1232 | 0.3054 | 0.1095 | 0.3054 | 0.0984 | 0.3054 | 0.0893 | 0.3054 | 0.0757 | 0.3054 | 0.0631 |
| 0.3199 | 0.1502 | 0.3199 | 0.1232 | 0.3199 | 0.1095 | 0.3199 | 0.0984 | 0.3199 | 0.0893 | 0.3199 | 0.0799 | 0.3199 | 0.0702 |
| 0.3352 | 0.1502 | 0.3352 | 0.1232 | 0.3352 | 0.1095 | 0.3352 | 0.0984 | 0.3352 | 0.0928 | 0.3352 | 0.0853 | 0.3352 | 0.0758 |
| 0.3511 | 0.1502 | 0.3511 | 0.1285 | 0.3511 | 0.1169 | 0.3511 | 0.1067 | 0.3511 | 0.0994 | 0.3511 | 0.0893 | 0.3511 | 0.0784 |
| 0.3678 | 0.1677 | 0.3678 | 0.1436 | 0.3678 | 0.1301 | 0.3678 | 0.1184 | 0.3678 | 0.112 | 0.3678 | 0.1015 | 0.3678 | 0.0896 |
| 0.3853 | 0.1677 | 0.3853 | 0.1436 | 0.3853 | 0.1343 | 0.3853 | 0.1276 | 0.3853 | 0.1216 | 0.3853 | 0.1112 | 0.3853 | 0.0989 |
| 0.4037 | 0.1934 | 0.4037 | 0.1593 | 0.4037 | 0.1421 | 0.4037 | 0.1303 | 0.4037 | 0.1255 | 0.4037 | 0.1166 | 0.4037 | 0.1048 |
| 0.4229 | 0.2364 | 0.4229 | 0.1902 | 0.4229 | 0.1717 | 0.4229 | 0.1555 | 0.4229 | 0.1413 | 0.4229 | 0.1211 | 0.4229 | 0.1085 |
| 0.4431 | 0.3083 | 0.4431 | 0.2191 | 0.4431 | 0.188 | 0.4431 | 0.1669 | 0.4431 | 0.1495 | 0.4431 | 0.1268 | 0.4431 | 0.1093 |
| 0.4642 | 0.341 | 0.4642 | 0.2513 | 0.4642 | 0.2128 | 0.4642 | 0.1843 | 0.4642 | 0.1628 | 0.4642 | 0.1335 | 0.4642 | 0.12 |
| 0.4863 | 0.341 | 0.4863 | 0.2553 | 0.4863 | 0.2202 | 0.4863 | 0.1922 | 0.4863 | 0.1696 | 0.4863 | 0.1398 | 0.4863 | 0.1311 |
| 0.5094 | 0.3509 | 0.5094 | 0.2648 | 0.5094 | 0.2318 | 0.5094 | 0.2047 | 0.5094 | 0.1825 | 0.5094 | 0.1489 | 0.5094 | 0.1378 |

PTWW049.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 49 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 27 ft. ~ Line 6 C

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.5337 | 0.4079 | 0.5337 | 0.2756 | 0.5337 | 0.2318 | 0.5337 | 0.2047 | 0.5337 | 0.1825 | 0.5337 | 0.1533 | 0.5337 | 0.1382 |
| 0.5591 | 0.4079 | 0.5591 | 0.2756 | 0.5591 | 0.2389 | 0.5591 | 0.2137 | 0.5591 | 0.1942 | 0.5591 | 0.1648 | 0.5591 | 0.1382 |
| 0.5857 | 0.4079 | 0.5857 | 0.2756 | 0.5857 | 0.2393 | 0.5857 | 0.2149 | 0.5857 | 0.1971 | 0.5857 | 0.1684 | 0.5857 | 0.1432 |
| 0.6136 | 0.4456 | 0.6136 | 0.2956 | 0.6136 | 0.2431 | 0.6136 | 0.2222 | 0.6136 | 0.204 | 0.6136 | 0.174 | 0.6136 | 0.1432 |
| 0.6428 | 0.4757 | 0.6428 | 0.3528 | 0.6428 | 0.2989 | 0.6428 | 0.2599 | 0.6428 | 0.2334 | 0.6428 | 0.1976 | 0.6428 | 0.1667 |
| 0.6734 | 0.4757 | 0.6734 | 0.3528 | 0.6734 | 0.2989 | 0.6734 | 0.2599 | 0.6734 | 0.2397 | 0.6734 | 0.2151 | 0.6734 | 0.1858 |
| 0.7055 | 0.4757 | 0.7055 | 0.3528 | 0.7055 | 0.2989 | 0.7055 | 0.2599 | 0.7055 | 0.2397 | 0.7055 | 0.217 | 0.7055 | 0.1906 |
| 0.7391 | 0.4757 | 0.7391 | 0.3528 | 0.7391 | 0.2989 | 0.7391 | 0.2679 | 0.7391 | 0.245 | 0.7391 | 0.217 | 0.7391 | 0.1906 |
| 0.7743 | 0.5482 | 0.7743 | 0.393 | 0.7743 | 0.3305 | 0.7743 | 0.2894 | 0.7743 | 0.2662 | 0.7743 | 0.2336 | 0.7743 | 0.2004 |
| 0.8111 | 0.5482 | 0.8111 | 0.393 | 0.8111 | 0.3305 | 0.8111 | 0.3012 | 0.8111 | 0.2852 | 0.8111 | 0.2566 | 0.8111 | 0.2219 |
| 0.8497 | 0.5482 | 0.8497 | 0.393 | 0.8497 | 0.3305 | 0.8497 | 0.3092 | 0.8497 | 0.296 | 0.8497 | 0.2701 | 0.8497 | 0.2354 |
| 0.8902 | 0.5482 | 0.8902 | 0.393 | 0.8902 | 0.3625 | 0.8902 | 0.3402 | 0.8902 | 0.3199 | 0.8902 | 0.2849 | 0.8902 | 0.2441 |
| 0.9326 | 0.8527 | 0.9326 | 0.5531 | 0.9326 | 0.4584 | 0.9326 | 0.3984 | 0.9326 | 0.3569 | 0.9326 | 0.3022 | 0.9326 | 0.2531 |
| 0.977 | 0.8527 | 0.977 | 0.5531 | 0.977 | 0.4584 | 0.977 | 0.3999 | 0.977 | 0.3604 | 0.977 | 0.305 | 0.977 | 0.261 |
| 1.0235 | 0.9203 | 1.0235 | 0.589 | 1.0235 | 0.5208 | 1.0235 | 0.4766 | 1.0235 | 0.4392 | 1.0235 | 0.3801 | 1.0235 | 0.3209 |
| 1.0723 | 0.9203 | 1.0723 | 0.6595 | 1.0723 | 0.5948 | 1.0723 | 0.5392 | 1.0723 | 0.4938 | 1.0723 | 0.4314 | 1.0723 | 0.3652 |
| 1.1233 | 1.3206 | 1.1233 | 0.8207 | 1.1233 | 0.6699 | 1.1233 | 0.575 | 1.1233 | 0.5329 | 1.1233 | 0.4612 | 1.1233 | 0.3927 |
| 1.1768 | 1.3206 | 1.1768 | 0.8207 | 1.1768 | 0.6699 | 1.1768 | 0.5777 | 1.1768 | 0.5432 | 1.1768 | 0.4797 | 1.1768 | 0.4179 |
| 1.2328 | 1.3206 | 1.2328 | 0.8207 | 1.2328 | 0.7254 | 1.2328 | 0.65 | 1.2328 | 0.5838 | 1.2328 | 0.5018 | 1.2328 | 0.4439 |
| 1.2916 | 1.3206 | 1.2916 | 0.8882 | 1.2916 | 0.7824 | 1.2916 | 0.6937 | 1.2916 | 0.619 | 1.2916 | 0.535 | 1.2916 | 0.4715 |
| 1.353 | 1.3206 | 1.353 | 0.9277 | 1.353 | 0.7824 | 1.353 | 0.6937 | 1.353 | 0.619 | 1.353 | 0.5627 | 1.353 | 0.4956 |
| 1.4175 | 1.4262 | 1.4175 | 0.9277 | 1.4175 | 0.7824 | 1.4175 | 0.6937 | 1.4175 | 0.6433 | 1.4175 | 0.5891 | 1.4175 | 0.5204 |
| 1.485 | 1.4262 | 1.485 | 0.9277 | 1.485 | 0.7824 | 1.485 | 0.7106 | 1.485 | 0.679 | 1.485 | 0.6208 | 1.485 | 0.549 |
| 1.5557 | 1.4708 | 1.5557 | 1.0004 | 1.5557 | 0.8543 | 1.5557 | 0.7528 | 1.5557 | 0.7061 | 1.5557 | 0.6453 | 1.5557 | 0.5721 |
| 1.6298 | 1.7647 | 1.6298 | 1.075 | 1.6298 | 0.9241 | 1.6298 | 0.8341 | 1.6298 | 0.7665 | 1.6298 | 0.6647 | 1.6298 | 0.5878 |
| 1.7074 | 1.7647 | 1.7074 | 1.075 | 1.7074 | 0.9241 | 1.7074 | 0.8341 | 1.7074 | 0.7665 | 1.7074 | 0.6786 | 1.7074 | 0.6046 |
| 1.7887 | 1.7647 | 1.7887 | 1.075 | 1.7887 | 0.9241 | 1.7887 | 0.8341 | 1.7887 | 0.7694 | 1.7887 | 0.6957 | 1.7887 | 0.6252 |
| 1.8738 | 1.7647 | 1.8738 | 1.075 | 1.8738 | 0.9241 | 1.8738 | 0.8341 | 1.8738 | 0.7942 | 1.8738 | 0.7274 | 1.8738 | 0.6431 |
| 1.963 | 1.7647 | 1.963 | 1.075 | 1.963 | 0.9241 | 1.963 | 0.8586 | 1.963 | 0.8157 | 1.963 | 0.7405 | 1.963 | 0.6517 |
| 2.0565 | 1.6738 | 2.0565 | 1.0621 | 2.0565 | 0.9186 | 2.0565 | 0.8586 | 2.0565 | 0.8157 | 2.0565 | 0.7405 | 2.0565 | 0.6517 |
| 2.1544 | 1.6738 | 2.1544 | 1.0621 | 2.1544 | 0.9186 | 2.1544 | 0.8586 | 2.1544 | 0.8157 | 2.1544 | 0.7405 | 2.1544 | 0.6517 |
| 2.257 | 1.4485 | 2.257 | 1.0621 | 2.257 | 0.914 | 2.257 | 0.8586 | 2.257 | 0.8157 | 2.257 | 0.7405 | 2.257 | 0.6517 |
| 2.3645 | 1.4485 | 2.3645 | 1.0621 | 2.3645 | 0.914 | 2.3645 | 0.8586 | 2.3645 | 0.8157 | 2.3645 | 0.7405 | 2.3645 | 0.6517 |
| 2.4771 | 1.4485 | 2.4771 | 1.0621 | 2.4771 | 0.914 | 2.4771 | 0.8585 | 2.4771 | 0.8107 | 2.4771 | 0.7315 | 2.4771 | 0.6501 |
| 2.595 | 1.4485 | 2.595 | 1.0621 | 2.595 | 0.9126 | 2.595 | 0.8311 | 2.595 | 0.7696 | 2.595 | 0.6987 | 2.595 | 0.6501 |

PTWW049.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 49 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 27 ft. ~ Line 6 C

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 2.7186 | 1.4485 | 2.7186 | 1.0621 | 2.7186 | 0.9126 | 2.7186 | 0.8311 | 2.7186 | 0.7696 | 2.7186 | 0.6987 | 2.7186 | 0.6501 |
| 2.848 | 1.4485 | 2.848 | 1.0621 | 2.848 | 0.9126 | 2.848 | 0.8311 | 2.848 | 0.7696 | 2.848 | 0.6987 | 2.848 | 0.6501 |
| 2.9836 | 1.4485 | 2.9836 | 1.0621 | 2.9836 | 0.9126 | 2.9836 | 0.8311 | 2.9836 | 0.7696 | 2.9836 | 0.6977 | 2.9836 | 0.6501 |
| 3.1257 | 1.4485 | 3.1257 | 1.0535 | 3.1257 | 0.9085 | 3.1257 | 0.8311 | 3.1257 | 0.7696 | 3.1257 | 0.6937 | 3.1257 | 0.6501 |
| 3.2745 | 1.4485 | 3.2745 | 1.0535 | 3.2745 | 0.9085 | 3.2745 | 0.8311 | 3.2745 | 0.7696 | 3.2745 | 0.6911 | 3.2745 | 0.6497 |
| 3.4305 | 1.4485 | 3.4305 | 1.0535 | 3.4305 | 0.9085 | 3.4305 | 0.8311 | 3.4305 | 0.7696 | 3.4305 | 0.6888 | 3.4305 | 0.6461 |
| 3.5938 | 1.5312 | 3.5938 | 1.0535 | 3.5938 | 0.9085 | 3.5938 | 0.8311 | 3.5938 | 0.7696 | 3.5938 | 0.6843 | 3.5938 | 0.6443 |
| 3.7649 | 1.5312 | 3.7649 | 1.0535 | 3.7649 | 0.9085 | 3.7649 | 0.8311 | 3.7649 | 0.7696 | 3.7649 | 0.6807 | 3.7649 | 0.6412 |
| 3.9442 | 1.5312 | 3.9442 | 1.0535 | 3.9442 | 0.9085 | 3.9442 | 0.8311 | 3.9442 | 0.7696 | 3.9442 | 0.6807 | 3.9442 | 0.6367 |
| 4.132 | 1.5312 | 4.132 | 1.0535 | 4.132 | 0.9085 | 4.132 | 0.8311 | 4.132 | 0.7696 | 4.132 | 0.6764 | 4.132 | 0.6342 |
| 4.3288 | 1.5312 | 4.3288 | 1.0535 | 4.3288 | 0.9085 | 4.3288 | 0.8311 | 4.3288 | 0.7696 | 4.3288 | 0.6752 | 4.3288 | 0.627 |
| 4.5349 | 1.5312 | 4.5349 | 1.0535 | 4.5349 | 0.9085 | 4.5349 | 0.8311 | 4.5349 | 0.7696 | 4.5349 | 0.6752 | 4.5349 | 0.616 |
| 4.7508 | 1.5009 | 4.7508 | 1.0126 | 4.7508 | 0.9085 | 4.7508 | 0.8311 | 4.7508 | 0.7696 | 4.7508 | 0.6752 | 4.7508 | 0.5994 |
| 4.977 | 1.3687 | 4.977 | 0.8562 | 4.977 | 0.8117 | 4.977 | 0.7658 | 4.977 | 0.7229 | 4.977 | 0.6501 | 4.977 | 0.5702 |
| 5.214 | 1.3687 | 5.214 | 0.8281 | 5.214 | 0.7539 | 5.214 | 0.6871 | 5.214 | 0.6434 | 5.214 | 0.6053 | 5.214 | 0.5554 |
| 5.4623 | 1.3687 | 5.4623 | 0.8281 | 5.4623 | 0.7539 | 5.4623 | 0.6871 | 5.4623 | 0.6427 | 5.4623 | 0.5979 | 5.4623 | 0.5453 |
| 5.7224 | 1.3687 | 5.7224 | 0.8281 | 5.7224 | 0.7539 | 5.7224 | 0.6871 | 5.7224 | 0.6421 | 5.7224 | 0.5862 | 5.7224 | 0.5291 |
| 5.9948 | 1.3687 | 5.9948 | 0.7893 | 5.9948 | 0.7539 | 5.9948 | 0.6858 | 5.9948 | 0.6413 | 5.9948 | 0.5862 | 5.9948 | 0.5187 |
| 6.2803 | 1.3687 | 6.2803 | 0.7893 | 6.2803 | 0.7539 | 6.2803 | 0.6858 | 6.2803 | 0.6404 | 6.2803 | 0.5812 | 6.2803 | 0.513 |
| 6.5793 | 1.3687 | 6.5793 | 0.7893 | 6.5793 | 0.7539 | 6.5793 | 0.6858 | 6.5793 | 0.6345 | 6.5793 | 0.5633 | 6.5793 | 0.4957 |
| 6.8926 | 1.3687 | 6.8926 | 0.7778 | 6.8926 | 0.6878 | 6.8926 | 0.63 | 6.8926 | 0.6051 | 6.8926 | 0.5553 | 6.8926 | 0.4938 |
| 7.2208 | 1.0724 | 7.2208 | 0.766 | 7.2208 | 0.6643 | 7.2208 | 0.6125 | 7.2208 | 0.5826 | 7.2208 | 0.534 | 7.2208 | 0.481 |
| 7.5646 | 1.017 | 7.5646 | 0.6788 | 7.5646 | 0.633 | 7.5646 | 0.5977 | 7.5646 | 0.5688 | 7.5646 | 0.524 | 7.5646 | 0.481 |
| 7.9248 | 0.9521 | 7.9248 | 0.6788 | 7.9248 | 0.633 | 7.9248 | 0.5977 | 7.9248 | 0.5688 | 7.9248 | 0.5236 | 7.9248 | 0.4759 |
| 8.3022 | 0.8831 | 8.3022 | 0.6254 | 8.3022 | 0.5778 | 8.3022 | 0.549 | 8.3022 | 0.5275 | 8.3022 | 0.4937 | 8.3022 | 0.4557 |
| 8.6975 | 0.7086 | 8.6975 | 0.5731 | 8.6975 | 0.5136 | 8.6975 | 0.4771 | 8.6975 | 0.4698 | 8.6975 | 0.4556 | 8.6975 | 0.4337 |
| 9.1116 | 0.7086 | 9.1116 | 0.5731 | 9.1116 | 0.5136 | 9.1116 | 0.4746 | 9.1116 | 0.4473 | 9.1116 | 0.4269 | 9.1116 | 0.4107 |
| 9.5455 | 0.7086 | 9.5455 | 0.5731 | 9.5455 | 0.5136 | 9.5455 | 0.4746 | 9.5455 | 0.4473 | 9.5455 | 0.4178 | 9.5455 | 0.3965 |
| 10 | 0.7086 | 10 | 0.5731 | 10 | 0.5136 | 10 | 0.4746 | 10 | 0.4473 | 10 | 0.4118 | 10 | 0.3815 |
| 10.4762 | 0.6638 | 10.4762 | 0.5214 | 10.4762 | 0.4753 | 10.4762 | 0.4478 | 10.4762 | 0.426 | 10.4762 | 0.3952 | 10.4762 | 0.3703 |
| 10.975 | 0.6612 | 10.975 | 0.4839 | 10.975 | 0.4498 | 10.975 | 0.4283 | 10.975 | 0.4131 | 10.975 | 0.39 | 10.975 | 0.3681 |
| 11.4976 | 0.6612 | 11.4976 | 0.4257 | 11.4976 | 0.3915 | 11.4976 | 0.3816 | 11.4976 | 0.3751 | 11.4976 | 0.3632 | 11.4976 | 0.3493 |
| 12.045 | 0.6612 | 12.045 | 0.4165 | 12.045 | 0.3814 | 12.045 | 0.3612 | 12.045 | 0.3491 | 12.045 | 0.3414 | 12.045 | 0.3354 |
| 12.6186 | 0.6612 | 12.6186 | 0.4165 | 12.6186 | 0.379 | 12.6186 | 0.3603 | 12.6186 | 0.3491 | 12.6186 | 0.3329 | 12.6186 | 0.3236 |
| 13.2194 | 0.6612 | 13.2194 | 0.4165 | 13.2194 | 0.379 | 13.2194 | 0.3588 | 13.2194 | 0.3465 | 13.2194 | 0.3321 | 13.2194 | 0.3236 |

PTWW049.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 49 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 27 ft. ~ Line 6 C

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 0.6612 | 13.8489 | 0.4165 | 13.8489 | 0.379 | 13.8489 | 0.3588 | 13.8489 | 0.3465 | 13.8489 | 0.3321 | 13.8489 | 0.3236 |
| 14.5083 | 0.6612 | 14.5083 | 0.4165 | 14.5083 | 0.379 | 14.5083 | 0.3588 | 14.5083 | 0.3465 | 14.5083 | 0.3321 | 14.5083 | 0.3236 |
| 15.1991 | 0.6612 | 15.1991 | 0.4165 | 15.1991 | 0.379 | 15.1991 | 0.3588 | 15.1991 | 0.3465 | 15.1991 | 0.3321 | 15.1991 | 0.3236 |
| 15.9228 | 0.6612 | 15.9228 | 0.4165 | 15.9228 | 0.379 | 15.9228 | 0.3588 | 15.9228 | 0.3465 | 15.9228 | 0.3321 | 15.9228 | 0.3236 |
| 16.681 | 0.6612 | 16.681 | 0.4165 | 16.681 | 0.379 | 16.681 | 0.3588 | 16.681 | 0.3465 | 16.681 | 0.3321 | 16.681 | 0.3236 |
| 17.4753 | 0.6362 | 17.4753 | 0.3956 | 17.4753 | 0.3619 | 17.4753 | 0.3448 | 17.4753 | 0.3378 | 17.4753 | 0.3311 | 17.4753 | 0.3236 |
| 18.3074 | 0.5834 | 18.3074 | 0.3956 | 18.3074 | 0.3619 | 18.3074 | 0.3448 | 18.3074 | 0.3378 | 18.3074 | 0.3311 | 18.3074 | 0.3236 |
| 19.1791 | 0.5834 | 19.1791 | 0.3956 | 19.1791 | 0.3619 | 19.1791 | 0.3448 | 19.1791 | 0.3378 | 19.1791 | 0.3311 | 19.1791 | 0.3236 |
| 20.0923 | 0.5834 | 20.0923 | 0.3956 | 20.0923 | 0.3619 | 20.0923 | 0.3448 | 20.0923 | 0.3378 | 20.0923 | 0.3311 | 20.0923 | 0.3236 |
| 21.049 | 0.5834 | 21.049 | 0.3956 | 21.049 | 0.3619 | 21.049 | 0.3448 | 21.049 | 0.3378 | 21.049 | 0.3311 | 21.049 | 0.3236 |
| 22.0513 | 0.5834 | 22.0513 | 0.3956 | 22.0513 | 0.3619 | 22.0513 | 0.3427 | 22.0513 | 0.3378 | 22.0513 | 0.3311 | 22.0513 | 0.3236 |
| 23.1013 | 0.5834 | 23.1013 | 0.3956 | 23.1013 | 0.3619 | 23.1013 | 0.3427 | 23.1013 | 0.3363 | 23.1013 | 0.3279 | 23.1013 | 0.3207 |
| 24.2013 | 0.5267 | 24.2013 | 0.3956 | 24.2013 | 0.3619 | 24.2013 | 0.3406 | 24.2013 | 0.3276 | 24.2013 | 0.3192 | 24.2013 | 0.3136 |
| 25.3536 | 0.5267 | 25.3536 | 0.3382 | 25.3536 | 0.321 | 25.3536 | 0.3185 | 25.3536 | 0.3166 | 25.3536 | 0.3134 | 25.3536 | 0.31 |
| 26.5609 | 0.5267 | 26.5609 | 0.3382 | 26.5609 | 0.3171 | 26.5609 | 0.3115 | 26.5609 | 0.3103 | 26.5609 | 0.3087 | 26.5609 | 0.3065 |
| 27.8256 | 0.429 | 27.8256 | 0.3328 | 27.8256 | 0.3171 | 27.8256 | 0.3115 | 27.8256 | 0.3102 | 27.8256 | 0.3083 | 27.8256 | 0.3065 |
| 29.1505 | 0.3989 | 29.1505 | 0.3251 | 29.1505 | 0.3136 | 29.1505 | 0.3115 | 29.1505 | 0.3102 | 29.1505 | 0.3083 | 29.1505 | 0.3065 |
| 30.5386 | 0.3989 | 30.5386 | 0.3194 | 30.5386 | 0.3136 | 30.5386 | 0.3115 | 30.5386 | 0.3102 | 30.5386 | 0.3083 | 30.5386 | 0.3065 |
| 31.9927 | 0.324 | 31.9927 | 0.3154 | 31.9927 | 0.3129 | 31.9927 | 0.3115 | 31.9927 | 0.3102 | 31.9927 | 0.3083 | 31.9927 | 0.3065 |
| 33.516 | 0.3077 | 33.516 | 0.3085 | 33.516 | 0.3086 | 33.516 | 0.3084 | 33.516 | 0.3081 | 33.516 | 0.3073 | 33.516 | 0.3062 |
| 35.1119 | 0.307 | 35.1119 | 0.3067 | 35.1119 | 0.3066 | 35.1119 | 0.3065 | 35.1119 | 0.3063 | 35.1119 | 0.306 | 35.1119 | 0.3054 |
| 36.7838 | 0.3055 | 36.7838 | 0.3055 | 36.7838 | 0.3054 | 36.7838 | 0.3052 | 36.7838 | 0.3051 | 36.7838 | 0.3049 | 36.7838 | 0.3046 |
| 38.5353 | 0.3045 | 38.5353 | 0.3044 | 38.5353 | 0.3043 | 38.5353 | 0.3042 | 38.5353 | 0.3041 | 38.5353 | 0.304 | 38.5353 | 0.3038 |
| 40.3702 | 0.3035 | 40.3702 | 0.3034 | 40.3702 | 0.3034 | 40.3702 | 0.3033 | 40.3702 | 0.3033 | 40.3702 | 0.3032 | 40.3702 | 0.303 |
| 42.2924 | 0.3026 | 42.2924 | 0.3026 | 42.2924 | 0.3026 | 42.2924 | 0.3025 | 42.2924 | 0.3025 | 42.2924 | 0.3025 | 42.2924 | 0.3024 |
| 44.3062 | 0.3019 | 44.3062 | 0.3019 | 44.3062 | 0.3019 | 44.3062 | 0.3019 | 44.3062 | 0.3018 | 44.3062 | 0.3018 | 44.3062 | 0.3018 |
| 46.4159 | 0.3013 | 46.4159 | 0.3013 | 46.4159 | 0.3012 | 46.4159 | 0.3012 | 46.4159 | 0.3012 | 46.4159 | 0.3012 | 46.4159 | 0.3012 |
| 48.626 | 0.3007 | 48.626 | 0.3007 | 48.626 | 0.3007 | 48.626 | 0.3007 | 48.626 | 0.3007 | 48.626 | 0.3007 | 48.626 | 0.3007 |
| 50.9414 | 0.3001 | 50.9414 | 0.3001 | 50.9414 | 0.3001 | 50.9414 | 0.3001 | 50.9414 | 0.3002 | 50.9414 | 0.3002 | 50.9414 | 0.3002 |

PTWW050.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 50 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 27 ft. ~ Line 6 C

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.1098 | 0.0404 | 0.1098 | 0.0365 | 0.1098 | 0.0342 | 0.1098 | 0.0321 | 0.1098 | 0.0303 | 0.1098 | 0.0271 | 0.1098 | 0.0235 |
| 0.115 | 0.0404 | 0.115 | 0.0365 | 0.115 | 0.0342 | 0.115 | 0.0321 | 0.115 | 0.0303 | 0.115 | 0.0271 | 0.115 | 0.0254 |
| 0.1204 | 0.0404 | 0.1204 | 0.0365 | 0.1204 | 0.0342 | 0.1204 | 0.0321 | 0.1204 | 0.0308 | 0.1204 | 0.0294 | 0.1204 | 0.0276 |
| 0.1262 | 0.0404 | 0.1262 | 0.0365 | 0.1262 | 0.035 | 0.1262 | 0.034 | 0.1262 | 0.0331 | 0.1262 | 0.0314 | 0.1262 | 0.0295 |
| 0.1322 | 0.0404 | 0.1322 | 0.038 | 0.1322 | 0.0368 | 0.1322 | 0.0357 | 0.1322 | 0.0347 | 0.1322 | 0.033 | 0.1322 | 0.0314 |
| 0.1385 | 0.0409 | 0.1385 | 0.039 | 0.1385 | 0.0379 | 0.1385 | 0.0369 | 0.1385 | 0.0361 | 0.1385 | 0.0346 | 0.1385 | 0.0327 |
| 0.1451 | 0.0415 | 0.1451 | 0.0396 | 0.1451 | 0.0386 | 0.1451 | 0.0376 | 0.1451 | 0.0367 | 0.1451 | 0.0351 | 0.1451 | 0.0332 |
| 0.152 | 0.0438 | 0.152 | 0.0401 | 0.152 | 0.0386 | 0.152 | 0.0376 | 0.152 | 0.0367 | 0.152 | 0.0351 | 0.152 | 0.0332 |
| 0.1592 | 0.0461 | 0.1592 | 0.0415 | 0.1592 | 0.0395 | 0.1592 | 0.0376 | 0.1592 | 0.0367 | 0.1592 | 0.0351 | 0.1592 | 0.0332 |
| 0.1668 | 0.0583 | 0.1668 | 0.0505 | 0.1668 | 0.0462 | 0.1668 | 0.0425 | 0.1668 | 0.0394 | 0.1668 | 0.0351 | 0.1668 | 0.0332 |
| 0.1748 | 0.0644 | 0.1748 | 0.0565 | 0.1748 | 0.0521 | 0.1748 | 0.0483 | 0.1748 | 0.0449 | 0.1748 | 0.0393 | 0.1748 | 0.0332 |
| 0.1831 | 0.0667 | 0.1831 | 0.0583 | 0.1831 | 0.0541 | 0.1831 | 0.0504 | 0.1831 | 0.047 | 0.1831 | 0.0413 | 0.1831 | 0.0353 |
| 0.1918 | 0.0677 | 0.1918 | 0.0585 | 0.1918 | 0.0542 | 0.1918 | 0.0506 | 0.1918 | 0.0473 | 0.1918 | 0.0416 | 0.1918 | 0.0378 |
| 0.2009 | 0.0696 | 0.2009 | 0.0595 | 0.2009 | 0.0542 | 0.2009 | 0.051 | 0.2009 | 0.0483 | 0.2009 | 0.0433 | 0.2009 | 0.0407 |
| 0.2105 | 0.072 | 0.2105 | 0.0617 | 0.2105 | 0.0579 | 0.2105 | 0.0543 | 0.2105 | 0.0512 | 0.2105 | 0.0478 | 0.2105 | 0.0439 |
| 0.2205 | 0.0816 | 0.2205 | 0.0707 | 0.2205 | 0.0649 | 0.2205 | 0.0598 | 0.2205 | 0.057 | 0.2205 | 0.0527 | 0.2205 | 0.0476 |
| 0.231 | 0.0956 | 0.231 | 0.079 | 0.231 | 0.0704 | 0.231 | 0.0666 | 0.231 | 0.0632 | 0.231 | 0.0573 | 0.231 | 0.0514 |
| 0.242 | 0.0979 | 0.242 | 0.0843 | 0.242 | 0.0773 | 0.242 | 0.0711 | 0.242 | 0.0671 | 0.242 | 0.0608 | 0.242 | 0.0541 |
| 0.2535 | 0.1054 | 0.2535 | 0.0909 | 0.2535 | 0.0828 | 0.2535 | 0.0758 | 0.2535 | 0.0697 | 0.2535 | 0.0608 | 0.2535 | 0.0541 |
| 0.2656 | 0.1137 | 0.2656 | 0.0944 | 0.2656 | 0.0841 | 0.2656 | 0.0758 | 0.2656 | 0.0697 | 0.2656 | 0.0608 | 0.2656 | 0.0541 |
| 0.2783 | 0.1137 | 0.2783 | 0.0944 | 0.2783 | 0.0841 | 0.2783 | 0.0777 | 0.2783 | 0.0737 | 0.2783 | 0.0666 | 0.2783 | 0.0597 |
| 0.2915 | 0.1137 | 0.2915 | 0.0997 | 0.2915 | 0.0935 | 0.2915 | 0.0881 | 0.2915 | 0.0832 | 0.2915 | 0.0751 | 0.2915 | 0.0662 |
| 0.3054 | 0.117 | 0.3054 | 0.1048 | 0.3054 | 0.0978 | 0.3054 | 0.0917 | 0.3054 | 0.0863 | 0.3054 | 0.0775 | 0.3054 | 0.068 |
| 0.3199 | 0.117 | 0.3199 | 0.1048 | 0.3199 | 0.0978 | 0.3199 | 0.0917 | 0.3199 | 0.0874 | 0.3199 | 0.0822 | 0.3199 | 0.076 |
| 0.3352 | 0.117 | 0.3352 | 0.1079 | 0.3352 | 0.1037 | 0.3352 | 0.0997 | 0.3352 | 0.0962 | 0.3352 | 0.0899 | 0.3352 | 0.0826 |
| 0.3511 | 0.1643 | 0.3511 | 0.1278 | 0.3511 | 0.1113 | 0.3511 | 0.1058 | 0.3511 | 0.1017 | 0.3511 | 0.0948 | 0.3511 | 0.0867 |
| 0.3678 | 0.2407 | 0.3678 | 0.1827 | 0.3678 | 0.1561 | 0.3678 | 0.136 | 0.3678 | 0.1205 | 0.3678 | 0.0991 | 0.3678 | 0.087 |
| 0.3853 | 0.2534 | 0.3853 | 0.1859 | 0.3853 | 0.1584 | 0.3853 | 0.1377 | 0.3853 | 0.1247 | 0.3853 | 0.107 | 0.3853 | 0.0888 |
| 0.4037 | 0.2534 | 0.4037 | 0.1859 | 0.4037 | 0.1584 | 0.4037 | 0.1377 | 0.4037 | 0.126 | 0.4037 | 0.1137 | 0.4037 | 0.1009 |
| 0.4229 | 0.2534 | 0.4229 | 0.1859 | 0.4229 | 0.164 | 0.4229 | 0.1477 | 0.4229 | 0.1337 | 0.4229 | 0.1215 | 0.4229 | 0.1098 |
| 0.4431 | 0.3269 | 0.4431 | 0.2314 | 0.4431 | 0.2015 | 0.4431 | 0.1793 | 0.4431 | 0.1623 | 0.4431 | 0.1385 | 0.4431 | 0.1172 |
| 0.4642 | 0.3269 | 0.4642 | 0.2314 | 0.4642 | 0.2015 | 0.4642 | 0.1793 | 0.4642 | 0.1623 | 0.4642 | 0.1385 | 0.4642 | 0.1172 |
| 0.4863 | 0.3269 | 0.4863 | 0.2314 | 0.4863 | 0.2015 | 0.4863 | 0.1793 | 0.4863 | 0.1623 | 0.4863 | 0.1413 | 0.4863 | 0.1241 |
| 0.5094 | 0.3269 | 0.5094 | 0.2314 | 0.5094 | 0.2015 | 0.5094 | 0.1793 | 0.5094 | 0.1623 | 0.5094 | 0.147 | 0.5094 | 0.1288 |

PTWW050.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 50 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 27 ft. ~ Line 6 C

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5337 | 0.3336 | 0.5337 | 0.2362 | 0.5337 | 0.205 | 0.5337 | 0.1877 | 0.5337 | 0.1771 | 0.5337 | 0.1591 | 0.5337 | 0.1383 |
| 0.5591 | 0.3923 | 0.5591 | 0.2713 | 0.5591 | 0.2392 | 0.5591 | 0.2134 | 0.5591 | 0.1951 | 0.5591 | 0.1708 | 0.5591 | 0.1529 |
| 0.5857 | 0.3923 | 0.5857 | 0.2803 | 0.5857 | 0.2516 | 0.5857 | 0.2276 | 0.5857 | 0.2076 | 0.5857 | 0.1819 | 0.5857 | 0.169 |
| 0.6136 | 0.3923 | 0.6136 | 0.2803 | 0.6136 | 0.2516 | 0.6136 | 0.2276 | 0.6136 | 0.2076 | 0.6136 | 0.1957 | 0.6136 | 0.1815 |
| 0.6428 | 0.3923 | 0.6428 | 0.2803 | 0.6428 | 0.2516 | 0.6428 | 0.2276 | 0.6428 | 0.2169 | 0.6428 | 0.2065 | 0.6428 | 0.1917 |
| 0.6734 | 0.4039 | 0.6734 | 0.2803 | 0.6734 | 0.254 | 0.6734 | 0.239 | 0.6734 | 0.2319 | 0.6734 | 0.2188 | 0.6734 | 0.2026 |
| 0.7055 | 0.4039 | 0.7055 | 0.2948 | 0.7055 | 0.2694 | 0.7055 | 0.258 | 0.7055 | 0.248 | 0.7055 | 0.2311 | 0.7055 | 0.212 |
| 0.7391 | 0.6215 | 0.7391 | 0.4064 | 0.7391 | 0.3316 | 0.7391 | 0.2831 | 0.7391 | 0.2657 | 0.7391 | 0.2366 | 0.7391 | 0.2134 |
| 0.7743 | 0.6215 | 0.7743 | 0.4064 | 0.7743 | 0.3316 | 0.7743 | 0.2952 | 0.7743 | 0.2775 | 0.7743 | 0.2483 | 0.7743 | 0.2157 |
| 0.8111 | 0.6413 | 0.8111 | 0.4256 | 0.8111 | 0.3705 | 0.8111 | 0.3281 | 0.8111 | 0.2952 | 0.8111 | 0.2488 | 0.8111 | 0.2157 |
| 0.8497 | 0.6413 | 0.8497 | 0.4256 | 0.8497 | 0.3887 | 0.8497 | 0.3585 | 0.8497 | 0.3324 | 0.8497 | 0.2903 | 0.8497 | 0.244 |
| 0.8902 | 0.6667 | 0.8902 | 0.4349 | 0.8902 | 0.3887 | 0.8902 | 0.3585 | 0.8902 | 0.3344 | 0.8902 | 0.3036 | 0.8902 | 0.2617 |
| 0.9326 | 0.7056 | 0.9326 | 0.4941 | 0.9326 | 0.434 | 0.9326 | 0.39 | 0.9326 | 0.3569 | 0.9326 | 0.3099 | 0.9326 | 0.2652 |
| 0.977 | 0.9445 | 0.977 | 0.6024 | 0.977 | 0.4957 | 0.977 | 0.4288 | 0.977 | 0.3834 | 0.977 | 0.3262 | 0.977 | 0.2796 |
| 1.0235 | 0.9445 | 1.0235 | 0.6024 | 1.0235 | 0.5348 | 1.0235 | 0.4847 | 1.0235 | 0.4431 | 1.0235 | 0.3795 | 1.0235 | 0.3158 |
| 1.0723 | 0.9445 | 1.0723 | 0.6174 | 1.0723 | 0.5518 | 1.0723 | 0.497 | 1.0723 | 0.451 | 1.0723 | 0.3905 | 1.0723 | 0.3311 |
| 1.1233 | 1.3209 | 1.1233 | 0.7979 | 1.1233 | 0.6669 | 1.1233 | 0.5738 | 1.1233 | 0.5044 | 1.1233 | 0.4107 | 1.1233 | 0.3311 |
| 1.1768 | 1.3209 | 1.1768 | 0.7979 | 1.1768 | 0.6669 | 1.1768 | 0.5738 | 1.1768 | 0.5044 | 1.1768 | 0.4161 | 1.1768 | 0.345 |
| 1.2328 | 1.3209 | 1.2328 | 0.8663 | 1.2328 | 0.7604 | 1.2328 | 0.6766 | 1.2328 | 0.6082 | 1.2328 | 0.5045 | 1.2328 | 0.4018 |
| 1.2916 | 1.3209 | 1.2916 | 0.9581 | 1.2916 | 0.833 | 1.2916 | 0.7352 | 1.2916 | 0.6568 | 1.2916 | 0.5399 | 1.2916 | 0.426 |
| 1.353 | 1.3209 | 1.353 | 0.9581 | 1.353 | 0.833 | 1.353 | 0.7352 | 1.353 | 0.6568 | 1.353 | 0.5399 | 1.353 | 0.426 |
| 1.4175 | 1.4477 | 1.4175 | 1.0154 | 1.4175 | 0.8749 | 1.4175 | 0.7785 | 1.4175 | 0.7053 | 1.4175 | 0.5973 | 1.4175 | 0.492 |
| 1.485 | 1.4477 | 1.485 | 1.0154 | 1.485 | 0.8749 | 1.485 | 0.7889 | 1.485 | 0.735 | 1.485 | 0.639 | 1.485 | 0.53 |
| 1.5557 | 1.6759 | 1.5557 | 1.0608 | 1.5557 | 0.8852 | 1.5557 | 0.791 | 1.5557 | 0.735 | 1.5557 | 0.6443 | 1.5557 | 0.5468 |
| 1.6298 | 1.7214 | 1.6298 | 1.1222 | 1.6298 | 0.9981 | 1.6298 | 0.8983 | 1.6298 | 0.8124 | 1.6298 | 0.6973 | 1.6298 | 0.5693 |
| 1.7074 | 1.7214 | 1.7074 | 1.1222 | 1.7074 | 1.0689 | 1.7074 | 0.9643 | 1.7074 | 0.8752 | 1.7074 | 0.7304 | 1.7074 | 0.6055 |
| 1.7887 | 2.0554 | 1.7887 | 1.1222 | 1.7887 | 1.0689 | 1.7887 | 0.9643 | 1.7887 | 0.8752 | 1.7887 | 0.7453 | 1.7887 | 0.6362 |
| 1.8738 | 2.0554 | 1.8738 | 1.1222 | 1.8738 | 1.0689 | 1.8738 | 0.9643 | 1.8738 | 0.8752 | 1.8738 | 0.7725 | 1.8738 | 0.658 |
| 1.963 | 2.0554 | 1.963 | 1.1222 | 1.963 | 1.0689 | 1.963 | 0.9643 | 1.963 | 0.889 | 1.963 | 0.7906 | 1.963 | 0.6717 |
| 2.0565 | 2.0554 | 2.0565 | 1.1222 | 2.0565 | 1.0689 | 2.0565 | 0.9643 | 2.0565 | 0.8958 | 2.0565 | 0.7967 | 2.0565 | 0.6746 |
| 2.1544 | 2.0554 | 2.1544 | 1.1222 | 2.1544 | 1.0603 | 2.1544 | 0.9781 | 2.1544 | 0.9074 | 2.1544 | 0.7967 | 2.1544 | 0.6746 |
| 2.257 | 1.8595 | 2.257 | 1.1222 | 2.257 | 1.0603 | 2.257 | 0.9781 | 2.257 | 0.9074 | 2.257 | 0.7967 | 2.257 | 0.6746 |
| 2.3645 | 1.8595 | 2.3645 | 1.1222 | 2.3645 | 1.0603 | 2.3645 | 0.9781 | 2.3645 | 0.9074 | 2.3645 | 0.7967 | 2.3645 | 0.6746 |
| 2.4771 | 1.8595 | 2.4771 | 1.1222 | 2.4771 | 1.0603 | 2.4771 | 0.9781 | 2.4771 | 0.9074 | 2.4771 | 0.7967 | 2.4771 | 0.6746 |
| 2.595 | 1.4719 | 2.595 | 1.1222 | 2.595 | 1.0603 | 2.595 | 0.9781 | 2.595 | 0.9074 | 2.595 | 0.7911 | 2.595 | 0.6632 |

PTWW050.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 50 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 27 ft. ~ Line 6 C

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 2.7186 | 1.4719 | 2.7186 | 1.1109 | 2.7186 | 1.0085 | 2.7186 | 0.9315 | 2.7186 | 0.863 | 2.7186 | 0.7718 | 2.7186 | 0.6632 |
| 2.848 | 1.4642 | 2.848 | 1.1109 | 2.848 | 0.9919 | 2.848 | 0.9052 | 2.848 | 0.8518 | 2.848 | 0.7567 | 2.848 | 0.6441 |
| 2.9836 | 1.4642 | 2.9836 | 1.1109 | 2.9836 | 0.9919 | 2.9836 | 0.9008 | 2.9836 | 0.8286 | 2.9836 | 0.7202 | 2.9836 | 0.608 |
| 3.1257 | 1.4642 | 3.1257 | 0.8698 | 3.1257 | 0.7873 | 3.1257 | 0.7398 | 3.1257 | 0.6998 | 3.1257 | 0.6358 | 3.1257 | 0.5549 |
| 3.2745 | 1.3717 | 3.2745 | 0.8476 | 3.2745 | 0.7634 | 3.2745 | 0.6856 | 3.2745 | 0.6289 | 3.2745 | 0.5595 | 3.2745 | 0.5096 |
| 3.4305 | 1.2028 | 3.4305 | 0.8476 | 3.4305 | 0.7634 | 3.4305 | 0.6856 | 3.4305 | 0.6289 | 3.4305 | 0.5595 | 3.4305 | 0.4839 |
| 3.5938 | 1.2028 | 3.5938 | 0.8476 | 3.5938 | 0.7634 | 3.5938 | 0.6856 | 3.5938 | 0.6289 | 3.5938 | 0.5595 | 3.5938 | 0.4839 |
| 3.7649 | 1.2028 | 3.7649 | 0.8476 | 3.7649 | 0.7634 | 3.7649 | 0.6856 | 3.7649 | 0.6289 | 3.7649 | 0.5595 | 3.7649 | 0.4839 |
| 3.9442 | 1.2028 | 3.9442 | 0.8476 | 3.9442 | 0.7634 | 3.9442 | 0.6856 | 3.9442 | 0.6289 | 3.9442 | 0.5595 | 3.9442 | 0.4839 |
| 4.132 | 1.2028 | 4.132 | 0.8476 | 4.132 | 0.7634 | 4.132 | 0.6856 | 4.132 | 0.6289 | 4.132 | 0.5595 | 4.132 | 0.4839 |
| 4.3288 | 1.2028 | 4.3288 | 0.8476 | 4.3288 | 0.7634 | 4.3288 | 0.6856 | 4.3288 | 0.6289 | 4.3288 | 0.5595 | 4.3288 | 0.4839 |
| 4.5349 | 1.2028 | 4.5349 | 0.8476 | 4.5349 | 0.7634 | 4.5349 | 0.6856 | 4.5349 | 0.6289 | 4.5349 | 0.5595 | 4.5349 | 0.4839 |
| 4.7508 | 1.2028 | 4.7508 | 0.8476 | 4.7508 | 0.7634 | 4.7508 | 0.6856 | 4.7508 | 0.6289 | 4.7508 | 0.5595 | 4.7508 | 0.4839 |
| 4.977 | 1.2028 | 4.977 | 0.8476 | 4.977 | 0.7634 | 4.977 | 0.6856 | 4.977 | 0.6289 | 4.977 | 0.5595 | 4.977 | 0.4839 |
| 5.214 | 1.2028 | 5.214 | 0.8476 | 5.214 | 0.7634 | 5.214 | 0.6856 | 5.214 | 0.6381 | 5.214 | 0.5632 | 5.214 | 0.4839 |
| 5.4623 | 1.2028 | 5.4623 | 0.8476 | 5.4623 | 0.7634 | 5.4623 | 0.6856 | 5.4623 | 0.6381 | 5.4623 | 0.5632 | 5.4623 | 0.4839 |
| 5.7224 | 1.7577 | 5.7224 | 0.8505 | 5.7224 | 0.7886 | 5.7224 | 0.6856 | 5.7224 | 0.6381 | 5.7224 | 0.5632 | 5.7224 | 0.4839 |
| 5.9948 | 1.7577 | 5.9948 | 0.8505 | 5.9948 | 0.7886 | 5.9948 | 0.6856 | 5.9948 | 0.6381 | 5.9948 | 0.5632 | 5.9948 | 0.4839 |
| 6.2803 | 1.7577 | 6.2803 | 0.8505 | 6.2803 | 0.7886 | 6.2803 | 0.6848 | 6.2803 | 0.6381 | 6.2803 | 0.5632 | 6.2803 | 0.4839 |
| 6.5793 | 1.7577 | 6.5793 | 0.8505 | 6.5793 | 0.7886 | 6.5793 | 0.6587 | 6.5793 | 0.6082 | 6.5793 | 0.5531 | 6.5793 | 0.4829 |
| 6.8926 | 1.7577 | 6.8926 | 0.8505 | 6.8926 | 0.7886 | 6.8926 | 0.6587 | 6.8926 | 0.6 | 6.8926 | 0.5416 | 6.8926 | 0.4773 |
| 7.2208 | 1.3818 | 7.2208 | 0.8392 | 7.2208 | 0.7127 | 7.2208 | 0.6213 | 7.2208 | 0.5578 | 7.2208 | 0.5008 | 7.2208 | 0.4529 |
| 7.5646 | 1.2449 | 7.5646 | 0.752 | 7.5646 | 0.6346 | 7.5646 | 0.5584 | 7.5646 | 0.5166 | 7.5646 | 0.482 | 7.5646 | 0.4368 |
| 7.9248 | 1.2449 | 7.9248 | 0.634 | 7.9248 | 0.5586 | 7.9248 | 0.5307 | 7.9248 | 0.5059 | 7.9248 | 0.4642 | 7.9248 | 0.4156 |
| 8.3022 | 1.2449 | 8.3022 | 0.6194 | 8.3022 | 0.5259 | 8.3022 | 0.4884 | 8.3022 | 0.4684 | 8.3022 | 0.4335 | 8.3022 | 0.3993 |
| 8.6975 | 0.9774 | 8.6975 | 0.5426 | 8.6975 | 0.4871 | 8.6975 | 0.4649 | 8.6975 | 0.4471 | 8.6975 | 0.4206 | 8.6975 | 0.3961 |
| 9.1116 | 0.9774 | 9.1116 | 0.5426 | 9.1116 | 0.4662 | 9.1116 | 0.439 | 9.1116 | 0.4321 | 9.1116 | 0.417 | 9.1116 | 0.3957 |
| 9.5455 | 0.9774 | 9.5455 | 0.5426 | 9.5455 | 0.4662 | 9.5455 | 0.4268 | 9.5455 | 0.4206 | 9.5455 | 0.4075 | 9.5455 | 0.3884 |
| 10 | 0.6205 | 10 | 0.4918 | 10 | 0.4474 | 10 | 0.425 | 10 | 0.4147 | 10 | 0.3973 | 10 | 0.377 |
| 10.4762 | 0.5638 | 10.4762 | 0.4918 | 10.4762 | 0.4474 | 10.4762 | 0.4116 | 10.4762 | 0.4035 | 10.4762 | 0.3913 | 10.4762 | 0.3749 |
| 10.975 | 0.5638 | 10.975 | 0.4918 | 10.975 | 0.4474 | 10.975 | 0.4116 | 10.975 | 0.3977 | 10.975 | 0.3857 | 10.975 | 0.3697 |
| 11.4976 | 0.5638 | 11.4976 | 0.4401 | 11.4976 | 0.4083 | 11.4976 | 0.3976 | 11.4976 | 0.3892 | 11.4976 | 0.3758 | 11.4976 | 0.3602 |
| 12.045 | 0.5378 | 12.045 | 0.4308 | 12.045 | 0.396 | 12.045 | 0.3711 | 12.045 | 0.3666 | 12.045 | 0.3584 | 12.045 | 0.3467 |
| 12.6186 | 0.5378 | 12.6186 | 0.4308 | 12.6186 | 0.396 | 12.6186 | 0.3658 | 12.6186 | 0.3523 | 12.6186 | 0.3444 | 12.6186 | 0.3344 |
| 13.2194 | 0.5378 | 13.2194 | 0.4012 | 13.2194 | 0.3661 | 13.2194 | 0.3471 | 13.2194 | 0.3439 | 13.2194 | 0.3379 | 13.2194 | 0.3294 |

PTWW050.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 50 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 27 ft. ~ Line 6 C

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 0.5248 | 13.8489 | 0.3512 | 13.8489 | 0.3413 | 13.8489 | 0.339 | 13.8489 | 0.3362 | 13.8489 | 0.3307 | 13.8489 | 0.3231 |
| 14.5083 | 0.5248 | 14.5083 | 0.3474 | 14.5083 | 0.3294 | 14.5083 | 0.3276 | 14.5083 | 0.3256 | 14.5083 | 0.3216 | 14.5083 | 0.3157 |
| 15.1991 | 0.5248 | 15.1991 | 0.3474 | 15.1991 | 0.3221 | 15.1991 | 0.3185 | 15.1991 | 0.3164 | 15.1991 | 0.3132 | 15.1991 | 0.3085 |
| 15.9228 | 0.5248 | 15.9228 | 0.3474 | 15.9228 | 0.3131 | 15.9228 | 0.3137 | 15.9228 | 0.3122 | 15.9228 | 0.3079 | 15.9228 | 0.3022 |
| 16.681 | 0.5248 | 16.681 | 0.3474 | 16.681 | 0.3128 | 16.681 | 0.3086 | 16.681 | 0.3053 | 16.681 | 0.3002 | 16.681 | 0.2947 |
| 17.4753 | 0.5248 | 17.4753 | 0.3474 | 17.4753 | 0.3068 | 17.4753 | 0.2988 | 17.4753 | 0.2946 | 17.4753 | 0.2901 | 17.4753 | 0.2862 |
| 18.3074 | 0.5248 | 18.3074 | 0.3474 | 18.3074 | 0.3021 | 18.3074 | 0.2792 | 18.3074 | 0.2797 | 18.3074 | 0.2795 | 18.3074 | 0.2777 |
| 19.1791 | 0.5248 | 19.1791 | 0.3474 | 19.1791 | 0.3021 | 19.1791 | 0.279 | 19.1791 | 0.2761 | 19.1791 | 0.2729 | 19.1791 | 0.2708 |
| 20.0923 | 0.5248 | 20.0923 | 0.3474 | 20.0923 | 0.3021 | 20.0923 | 0.2725 | 20.0923 | 0.2685 | 20.0923 | 0.2669 | 20.0923 | 0.265 |
| 21.049 | 0.5248 | 21.049 | 0.3474 | 21.049 | 0.3021 | 21.049 | 0.2725 | 21.049 | 0.265 | 21.049 | 0.2626 | 21.049 | 0.26 |
| 22.0513 | 0.5248 | 22.0513 | 0.3474 | 22.0513 | 0.3021 | 22.0513 | 0.2725 | 22.0513 | 0.2634 | 22.0513 | 0.2605 | 22.0513 | 0.2572 |
| 23.1013 | 0.4959 | 23.1013 | 0.2808 | 23.1013 | 0.2712 | 23.1013 | 0.265 | 23.1013 | 0.261 | 23.1013 | 0.2564 | 23.1013 | 0.2535 |
| 24.2013 | 0.4959 | 24.2013 | 0.2792 | 24.2013 | 0.2569 | 24.2013 | 0.2474 | 24.2013 | 0.248 | 24.2013 | 0.2489 | 24.2013 | 0.2488 |
| 25.3536 | 0.3801 | 25.3536 | 0.2679 | 25.3536 | 0.2501 | 25.3536 | 0.2474 | 25.3536 | 0.2457 | 25.3536 | 0.2452 | 25.3536 | 0.2455 |
| 26.5609 | 0.3801 | 26.5609 | 0.2679 | 26.5609 | 0.2501 | 26.5609 | 0.2474 | 26.5609 | 0.2457 | 26.5609 | 0.2441 | 26.5609 | 0.2435 |
| 27.8256 | 0.3721 | 27.8256 | 0.2553 | 27.8256 | 0.2499 | 27.8256 | 0.2466 | 27.8256 | 0.2444 | 27.8256 | 0.2419 | 27.8256 | 0.2415 |
| 29.1505 | 0.3237 | 29.1505 | 0.2553 | 29.1505 | 0.2499 | 29.1505 | 0.2466 | 29.1505 | 0.2444 | 29.1505 | 0.2419 | 29.1505 | 0.2407 |
| 30.5386 | 0.2902 | 30.5386 | 0.2504 | 30.5386 | 0.2471 | 30.5386 | 0.245 | 30.5386 | 0.2436 | 30.5386 | 0.2419 | 30.5386 | 0.2407 |
| 31.9927 | 0.2427 | 31.9927 | 0.2458 | 31.9927 | 0.2449 | 31.9927 | 0.2438 | 31.9927 | 0.2429 | 31.9927 | 0.2416 | 31.9927 | 0.2403 |
| 33.516 | 0.2417 | 33.516 | 0.2409 | 33.516 | 0.2407 | 33.516 | 0.2405 | 33.516 | 0.2403 | 33.516 | 0.2399 | 33.516 | 0.2392 |
| 35.1119 | 0.2392 | 35.1119 | 0.2389 | 35.1119 | 0.2388 | 35.1119 | 0.2386 | 35.1119 | 0.2385 | 35.1119 | 0.2382 | 35.1119 | 0.2378 |
| 36.7838 | 0.2371 | 36.7838 | 0.2371 | 36.7838 | 0.237 | 36.7838 | 0.2369 | 36.7838 | 0.2369 | 36.7838 | 0.2367 | 36.7838 | 0.2365 |
| 38.5353 | 0.2356 | 38.5353 | 0.2356 | 38.5353 | 0.2355 | 38.5353 | 0.2355 | 38.5353 | 0.2355 | 38.5353 | 0.2354 | 38.5353 | 0.2353 |
| 40.3702 | 0.2344 | 40.3702 | 0.2343 | 40.3702 | 0.2343 | 40.3702 | 0.2343 | 40.3702 | 0.2343 | 40.3702 | 0.2343 | 40.3702 | 0.2342 |
| 42.2924 | 0.2334 | 42.2924 | 0.2334 | 42.2924 | 0.2333 | 42.2924 | 0.2333 | 42.2924 | 0.2333 | 42.2924 | 0.2333 | 42.2924 | 0.2333 |
| 44.3062 | 0.2325 | 44.3062 | 0.2325 | 44.3062 | 0.2325 | 44.3062 | 0.2325 | 44.3062 | 0.2325 | 44.3062 | 0.2325 | 44.3062 | 0.2325 |
| 46.4159 | 0.2317 | 46.4159 | 0.2317 | 46.4159 | 0.2317 | 46.4159 | 0.2317 | 46.4159 | 0.2317 | 46.4159 | 0.2317 | 46.4159 | 0.2318 |
| 48.626 | 0.231 | 48.626 | 0.231 | 48.626 | 0.231 | 48.626 | 0.231 | 48.626 | 0.231 | 48.626 | 0.2311 | 48.626 | 0.2311 |
| 50.9414 | 0.2304 | 50.9414 | 0.2304 | 50.9414 | 0.2304 | 50.9414 | 0.2304 | 50.9414 | 0.2304 | 50.9414 | 0.2304 | 50.9414 | 0.2305 |

PTWW051.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 51 ~ SLAB-WALL JOINT Vertical Responses ~ Elevation 27 ft. ~ Line 6 C

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.1098 | 0.0291 | 0.1098 | 0.026 | 0.1098 | 0.0244 | 0.1098 | 0.0229 | 0.1098 | 0.022 | 0.1098 | 0.0212 | 0.1098 | 0.0203 |
| 0.115 | 0.0308 | 0.115 | 0.026 | 0.115 | 0.0244 | 0.115 | 0.0233 | 0.115 | 0.0228 | 0.115 | 0.0221 | 0.115 | 0.0212 |
| 0.1204 | 0.0313 | 0.1204 | 0.0262 | 0.1204 | 0.0245 | 0.1204 | 0.024 | 0.1204 | 0.0236 | 0.1204 | 0.0228 | 0.1204 | 0.0217 |
| 0.1262 | 0.0313 | 0.1262 | 0.027 | 0.1262 | 0.0257 | 0.1262 | 0.0246 | 0.1262 | 0.0241 | 0.1262 | 0.0232 | 0.1262 | 0.022 |
| 0.1322 | 0.0313 | 0.1322 | 0.027 | 0.1322 | 0.0257 | 0.1322 | 0.0247 | 0.1322 | 0.0242 | 0.1322 | 0.0234 | 0.1322 | 0.0224 |
| 0.1385 | 0.0313 | 0.1385 | 0.0277 | 0.1385 | 0.0265 | 0.1385 | 0.0255 | 0.1385 | 0.0245 | 0.1385 | 0.0235 | 0.1385 | 0.0225 |
| 0.1451 | 0.0316 | 0.1451 | 0.0294 | 0.1451 | 0.0282 | 0.1451 | 0.027 | 0.1451 | 0.0259 | 0.1451 | 0.0238 | 0.1451 | 0.0225 |
| 0.152 | 0.032 | 0.152 | 0.0298 | 0.152 | 0.0285 | 0.152 | 0.0273 | 0.152 | 0.0261 | 0.152 | 0.024 | 0.152 | 0.0225 |
| 0.1592 | 0.033 | 0.1592 | 0.031 | 0.1592 | 0.0299 | 0.1592 | 0.0288 | 0.1592 | 0.0277 | 0.1592 | 0.0261 | 0.1592 | 0.0242 |
| 0.1668 | 0.0367 | 0.1668 | 0.0323 | 0.1668 | 0.0312 | 0.1668 | 0.0302 | 0.1668 | 0.0293 | 0.1668 | 0.0277 | 0.1668 | 0.0256 |
| 0.1748 | 0.0507 | 0.1748 | 0.0427 | 0.1748 | 0.0385 | 0.1748 | 0.035 | 0.1748 | 0.0321 | 0.1748 | 0.0284 | 0.1748 | 0.0264 |
| 0.1831 | 0.0586 | 0.1831 | 0.0492 | 0.1831 | 0.0442 | 0.1831 | 0.0399 | 0.1831 | 0.0362 | 0.1831 | 0.0305 | 0.1831 | 0.0265 |
| 0.1918 | 0.0586 | 0.1918 | 0.0492 | 0.1918 | 0.0442 | 0.1918 | 0.0399 | 0.1918 | 0.0362 | 0.1918 | 0.0305 | 0.1918 | 0.0266 |
| 0.2009 | 0.0586 | 0.2009 | 0.0492 | 0.2009 | 0.0442 | 0.2009 | 0.0399 | 0.2009 | 0.0362 | 0.2009 | 0.0324 | 0.2009 | 0.0294 |
| 0.2105 | 0.0586 | 0.2105 | 0.0492 | 0.2105 | 0.0442 | 0.2105 | 0.0399 | 0.2105 | 0.0384 | 0.2105 | 0.0357 | 0.2105 | 0.0322 |
| 0.2205 | 0.0586 | 0.2205 | 0.0492 | 0.2205 | 0.0452 | 0.2205 | 0.0426 | 0.2205 | 0.0406 | 0.2205 | 0.0376 | 0.2205 | 0.0336 |
| 0.231 | 0.0586 | 0.231 | 0.0492 | 0.231 | 0.0457 | 0.231 | 0.0438 | 0.231 | 0.042 | 0.231 | 0.0386 | 0.231 | 0.0353 |
| 0.242 | 0.0586 | 0.242 | 0.0509 | 0.242 | 0.0485 | 0.242 | 0.0464 | 0.242 | 0.0444 | 0.242 | 0.0409 | 0.242 | 0.0367 |
| 0.2535 | 0.0648 | 0.2535 | 0.0572 | 0.2535 | 0.0528 | 0.2535 | 0.0488 | 0.2535 | 0.0453 | 0.2535 | 0.041 | 0.2535 | 0.0373 |
| 0.2656 | 0.0731 | 0.2656 | 0.0585 | 0.2656 | 0.0534 | 0.2656 | 0.049 | 0.2656 | 0.0453 | 0.2656 | 0.0425 | 0.2656 | 0.0403 |
| 0.2783 | 0.0816 | 0.2783 | 0.0598 | 0.2783 | 0.0534 | 0.2783 | 0.05 | 0.2783 | 0.0486 | 0.2783 | 0.046 | 0.2783 | 0.0427 |
| 0.2915 | 0.0816 | 0.2915 | 0.0618 | 0.2915 | 0.0579 | 0.2915 | 0.0545 | 0.2915 | 0.0514 | 0.2915 | 0.0479 | 0.2915 | 0.0437 |
| 0.3054 | 0.0816 | 0.3054 | 0.0663 | 0.3054 | 0.0621 | 0.3054 | 0.0584 | 0.3054 | 0.0549 | 0.3054 | 0.0488 | 0.3054 | 0.0449 |
| 0.3199 | 0.0816 | 0.3199 | 0.07 | 0.3199 | 0.0658 | 0.3199 | 0.062 | 0.3199 | 0.0587 | 0.3199 | 0.0532 | 0.3199 | 0.0469 |
| 0.3352 | 0.0871 | 0.3352 | 0.0766 | 0.3352 | 0.0706 | 0.3352 | 0.066 | 0.3352 | 0.0626 | 0.3352 | 0.0567 | 0.3352 | 0.0496 |
| 0.3511 | 0.0907 | 0.3511 | 0.0807 | 0.3511 | 0.075 | 0.3511 | 0.0699 | 0.3511 | 0.0654 | 0.3511 | 0.0578 | 0.3511 | 0.0501 |
| 0.3678 | 0.1217 | 0.3678 | 0.0951 | 0.3678 | 0.0823 | 0.3678 | 0.0721 | 0.3678 | 0.0654 | 0.3678 | 0.0578 | 0.3678 | 0.0501 |
| 0.3853 | 0.1361 | 0.3853 | 0.1057 | 0.3853 | 0.0918 | 0.3853 | 0.0807 | 0.3853 | 0.0718 | 0.3853 | 0.0587 | 0.3853 | 0.0503 |
| 0.4037 | 0.1361 | 0.4037 | 0.1057 | 0.4037 | 0.0918 | 0.4037 | 0.0821 | 0.4037 | 0.0761 | 0.4037 | 0.0662 | 0.4037 | 0.0568 |
| 0.4229 | 0.1361 | 0.4229 | 0.1057 | 0.4229 | 0.0918 | 0.4229 | 0.0849 | 0.4229 | 0.0797 | 0.4229 | 0.0709 | 0.4229 | 0.0611 |
| 0.4431 | 0.1361 | 0.4431 | 0.1057 | 0.4431 | 0.0935 | 0.4431 | 0.0886 | 0.4431 | 0.0841 | 0.4431 | 0.0758 | 0.4431 | 0.0654 |
| 0.4642 | 0.1375 | 0.4642 | 0.1057 | 0.4642 | 0.0975 | 0.4642 | 0.0916 | 0.4642 | 0.0861 | 0.4642 | 0.0764 | 0.4642 | 0.0668 |
| 0.4863 | 0.1477 | 0.4863 | 0.1237 | 0.4863 | 0.1107 | 0.4863 | 0.0995 | 0.4863 | 0.0901 | 0.4863 | 0.0821 | 0.4863 | 0.0728 |
| 0.5094 | 0.1813 | 0.5094 | 0.1382 | 0.5094 | 0.1216 | 0.5094 | 0.1081 | 0.5094 | 0.0973 | 0.5094 | 0.0863 | 0.5094 | 0.0746 |

PTWW051.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 51 ~ SLAB-WALL JOINT Vertical Responses ~ Elevation 27 ft. ~ Line 6 C

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5337 | 0.2218 | 0.5337 | 0.1606 | 0.5337 | 0.1344 | 0.5337 | 0.1147 | 0.5337 | 0.1021 | 0.5337 | 0.0863 | 0.5337 | 0.0746 |
| 0.5591 | 0.2218 | 0.5591 | 0.1606 | 0.5591 | 0.1344 | 0.5591 | 0.1147 | 0.5591 | 0.1021 | 0.5591 | 0.0884 | 0.5591 | 0.0752 |
| 0.5857 | 0.2218 | 0.5857 | 0.1606 | 0.5857 | 0.1344 | 0.5857 | 0.1147 | 0.5857 | 0.1021 | 0.5857 | 0.094 | 0.5857 | 0.0823 |
| 0.6136 | 0.2218 | 0.6136 | 0.1606 | 0.6136 | 0.1344 | 0.6136 | 0.1177 | 0.6136 | 0.111 | 0.6136 | 0.1002 | 0.6136 | 0.0872 |
| 0.6428 | 0.2264 | 0.6428 | 0.1627 | 0.6428 | 0.1362 | 0.6428 | 0.1177 | 0.6428 | 0.1126 | 0.6428 | 0.1026 | 0.6428 | 0.0894 |
| 0.6734 | 0.2264 | 0.6734 | 0.1627 | 0.6734 | 0.1381 | 0.6734 | 0.1282 | 0.6734 | 0.1203 | 0.6734 | 0.1076 | 0.6734 | 0.0929 |
| 0.7055 | 0.2264 | 0.7055 | 0.1627 | 0.7055 | 0.1381 | 0.7055 | 0.1282 | 0.7055 | 0.1203 | 0.7055 | 0.1091 | 0.7055 | 0.0948 |
| 0.7391 | 0.2264 | 0.7391 | 0.1627 | 0.7391 | 0.1411 | 0.7391 | 0.1329 | 0.7391 | 0.1248 | 0.7391 | 0.11 | 0.7391 | 0.0948 |
| 0.7743 | 0.3171 | 0.7743 | 0.2133 | 0.7743 | 0.1805 | 0.7743 | 0.1581 | 0.7743 | 0.1421 | 0.7743 | 0.1212 | 0.7743 | 0.1032 |
| 0.8111 | 0.3171 | 0.8111 | 0.2133 | 0.8111 | 0.1805 | 0.8111 | 0.1581 | 0.8111 | 0.1421 | 0.8111 | 0.1212 | 0.8111 | 0.106 |
| 0.8497 | 0.3171 | 0.8497 | 0.2133 | 0.8497 | 0.1805 | 0.8497 | 0.1653 | 0.8497 | 0.1529 | 0.8497 | 0.1331 | 0.8497 | 0.1127 |
| 0.8902 | 0.3171 | 0.8902 | 0.2133 | 0.8902 | 0.1866 | 0.8902 | 0.171 | 0.8902 | 0.1578 | 0.8902 | 0.1374 | 0.8902 | 0.1164 |
| 0.9326 | 0.4837 | 0.9326 | 0.2979 | 0.9326 | 0.244 | 0.9326 | 0.2131 | 0.9326 | 0.191 | 0.9326 | 0.1619 | 0.9326 | 0.1362 |
| 0.977 | 0.4837 | 0.977 | 0.2979 | 0.977 | 0.244 | 0.977 | 0.2131 | 0.977 | 0.191 | 0.977 | 0.171 | 0.977 | 0.1499 |
| 1.0235 | 0.4837 | 1.0235 | 0.2979 | 1.0235 | 0.244 | 1.0235 | 0.2131 | 1.0235 | 0.1915 | 1.0235 | 0.1793 | 1.0235 | 0.1604 |
| 1.0723 | 0.4837 | 1.0723 | 0.2979 | 1.0723 | 0.2594 | 1.0723 | 0.2384 | 1.0723 | 0.2217 | 1.0723 | 0.196 | 1.0723 | 0.1696 |
| 1.1233 | 0.571 | 1.1233 | 0.3372 | 1.1233 | 0.2655 | 1.1233 | 0.2384 | 1.1233 | 0.2217 | 1.1233 | 0.196 | 1.1233 | 0.1696 |
| 1.1768 | 0.571 | 1.1768 | 0.3738 | 1.1768 | 0.3111 | 1.1768 | 0.2751 | 1.1768 | 0.2463 | 1.1768 | 0.2105 | 1.1768 | 0.1847 |
| 1.2328 | 0.571 | 1.2328 | 0.3812 | 1.2328 | 0.3441 | 1.2328 | 0.3134 | 1.2328 | 0.2883 | 1.2328 | 0.2494 | 1.2328 | 0.2109 |
| 1.2916 | 0.571 | 1.2916 | 0.4133 | 1.2916 | 0.3648 | 1.2916 | 0.3255 | 1.2916 | 0.2985 | 1.2916 | 0.2578 | 1.2916 | 0.218 |
| 1.353 | 0.6403 | 1.353 | 0.4133 | 1.353 | 0.3648 | 1.353 | 0.3303 | 1.353 | 0.3119 | 1.353 | 0.281 | 1.353 | 0.2449 |
| 1.4175 | 0.6403 | 1.4175 | 0.4195 | 1.4175 | 0.3714 | 1.4175 | 0.3512 | 1.4175 | 0.3329 | 1.4175 | 0.3016 | 1.4175 | 0.2657 |
| 1.485 | 0.6403 | 1.485 | 0.4476 | 1.485 | 0.4069 | 1.485 | 0.3794 | 1.485 | 0.3553 | 1.485 | 0.3153 | 1.485 | 0.2772 |
| 1.5557 | 0.6403 | 1.5557 | 0.4729 | 1.5557 | 0.4396 | 1.5557 | 0.4123 | 1.5557 | 0.3891 | 1.5557 | 0.3482 | 1.5557 | 0.3005 |
| 1.6298 | 0.7704 | 1.6298 | 0.4915 | 1.6298 | 0.4591 | 1.6298 | 0.4317 | 1.6298 | 0.4086 | 1.6298 | 0.3691 | 1.6298 | 0.3215 |
| 1.7074 | 0.8065 | 1.7074 | 0.6267 | 1.7074 | 0.5554 | 1.7074 | 0.4984 | 1.7074 | 0.4524 | 1.7074 | 0.3851 | 1.7074 | 0.337 |
| 1.7887 | 0.9465 | 1.7887 | 0.7453 | 1.7887 | 0.6636 | 1.7887 | 0.5969 | 1.7887 | 0.5416 | 1.7887 | 0.4635 | 1.7887 | 0.3866 |
| 1.8738 | 0.9657 | 1.8738 | 0.7751 | 1.8738 | 0.6845 | 1.8738 | 0.616 | 1.8738 | 0.5613 | 1.8738 | 0.4757 | 1.8738 | 0.4291 |
| 1.963 | 1.108 | 1.963 | 0.7751 | 1.963 | 0.6845 | 1.963 | 0.616 | 1.963 | 0.5613 | 1.963 | 0.4757 | 1.963 | 0.452 |
| 2.0565 | 1.1568 | 2.0565 | 0.7751 | 2.0565 | 0.6845 | 2.0565 | 0.616 | 2.0565 | 0.5655 | 2.0565 | 0.477 | 2.0565 | 0.4532 |
| 2.1544 | 1.1568 | 2.1544 | 0.7852 | 2.1544 | 0.7095 | 2.1544 | 0.6449 | 2.1544 | 0.5882 | 2.1544 | 0.504 | 2.1544 | 0.4532 |
| 2.257 | 1.1568 | 2.257 | 0.7954 | 2.257 | 0.7323 | 2.257 | 0.675 | 2.257 | 0.6224 | 2.257 | 0.5316 | 2.257 | 0.4532 |
| 2.3645 | 1.758 | 2.3645 | 0.9603 | 2.3645 | 0.7766 | 2.3645 | 0.7062 | 2.3645 | 0.6458 | 2.3645 | 0.5545 | 2.3645 | 0.4653 |
| 2.4771 | 2.0947 | 2.4771 | 1.1401 | 2.4771 | 0.8709 | 2.4771 | 0.7316 | 2.4771 | 0.6758 | 2.4771 | 0.5798 | 2.4771 | 0.4755 |
| 2.595 | 2.2037 | 2.595 | 1.1401 | 2.595 | 0.8709 | 2.595 | 0.7316 | 2.595 | 0.7206 | 2.595 | 0.5958 | 2.595 | 0.4942 |

PTWW051.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 51 ~ SLAB-WALL JOINT Vertical Responses ~ Elevation 27 ft. ~ Line 6 C

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.7186 | 2.2037 | 2.7186 | 1.1401 | 2.7186 | 0.8709 | 2.7186 | 0.7316 | 2.7186 | 0.7206 | 2.7186 | 0.5958 | 2.7186 | 0.4954 |
| 2.848 | 2.2037 | 2.848 | 1.1401 | 2.848 | 0.8709 | 2.848 | 0.7316 | 2.848 | 0.7206 | 2.848 | 0.5958 | 2.848 | 0.4954 |
| 2.9836 | 2.2037 | 2.9836 | 1.1401 | 2.9836 | 0.8709 | 2.9836 | 0.7316 | 2.9836 | 0.7206 | 2.9836 | 0.5958 | 2.9836 | 0.4954 |
| 3.1257 | 2.2037 | 3.1257 | 1.1401 | 3.1257 | 0.8709 | 3.1257 | 0.7316 | 3.1257 | 0.7206 | 3.1257 | 0.5958 | 3.1257 | 0.4954 |
| 3.2745 | 1.6309 | 3.2745 | 1.0007 | 3.2745 | 0.8507 | 3.2745 | 0.7316 | 3.2745 | 0.6672 | 3.2745 | 0.5873 | 3.2745 | 0.4954 |
| 3.4305 | 1.1791 | 3.4305 | 0.7517 | 3.4305 | 0.6974 | 3.4305 | 0.6576 | 3.4305 | 0.6218 | 3.4305 | 0.5572 | 3.4305 | 0.4779 |
| 3.5938 | 1.1791 | 3.5938 | 0.7517 | 3.5938 | 0.6858 | 3.5938 | 0.6361 | 3.5938 | 0.592 | 3.5938 | 0.5229 | 3.5938 | 0.4549 |
| 3.7649 | 1.1791 | 3.7649 | 0.7517 | 3.7649 | 0.6858 | 3.7649 | 0.6315 | 3.7649 | 0.5889 | 3.7649 | 0.5229 | 3.7649 | 0.4549 |
| 3.9442 | 1.1791 | 3.9442 | 0.7396 | 3.9442 | 0.6858 | 3.9442 | 0.6315 | 3.9442 | 0.5667 | 3.9442 | 0.5102 | 3.9442 | 0.4477 |
| 4.132 | 1.1791 | 4.132 | 0.7396 | 4.132 | 0.6858 | 4.132 | 0.6315 | 4.132 | 0.5667 | 4.132 | 0.4996 | 4.132 | 0.4412 |
| 4.3288 | 1.1791 | 4.3288 | 0.7396 | 4.3288 | 0.6858 | 4.3288 | 0.6315 | 4.3288 | 0.5667 | 4.3288 | 0.497 | 4.3288 | 0.4412 |
| 4.5349 | 1.1791 | 4.5349 | 0.7396 | 4.5349 | 0.6858 | 4.5349 | 0.6315 | 4.5349 | 0.5667 | 4.5349 | 0.4955 | 4.5349 | 0.4412 |
| 4.7508 | 1.1791 | 4.7508 | 0.7396 | 4.7508 | 0.6858 | 4.7508 | 0.6315 | 4.7508 | 0.5667 | 4.7508 | 0.4902 | 4.7508 | 0.4365 |
| 4.977 | 1.1791 | 4.977 | 0.7396 | 4.977 | 0.6858 | 4.977 | 0.6315 | 4.977 | 0.5667 | 4.977 | 0.4838 | 4.977 | 0.4365 |
| 5.214 | 1.1791 | 5.214 | 0.7396 | 5.214 | 0.6858 | 5.214 | 0.6315 | 5.214 | 0.5667 | 5.214 | 0.4838 | 5.214 | 0.4318 |
| 5.4623 | 1.1791 | 5.4623 | 0.7396 | 5.4623 | 0.6858 | 5.4623 | 0.6315 | 5.4623 | 0.5667 | 5.4623 | 0.4835 | 5.4623 | 0.4286 |
| 5.7224 | 1.304 | 5.7224 | 0.7396 | 5.7224 | 0.7182 | 5.7224 | 0.6315 | 5.7224 | 0.5667 | 5.7224 | 0.4771 | 5.7224 | 0.4196 |
| 5.9948 | 1.304 | 5.9948 | 0.7396 | 5.9948 | 0.7182 | 5.9948 | 0.6315 | 5.9948 | 0.5667 | 5.9948 | 0.4771 | 5.9948 | 0.4196 |
| 6.2803 | 1.304 | 6.2803 | 0.7396 | 6.2803 | 0.7182 | 6.2803 | 0.6315 | 6.2803 | 0.5667 | 6.2803 | 0.4771 | 6.2803 | 0.4196 |
| 6.5793 | 1.304 | 6.5793 | 0.7396 | 6.5793 | 0.7182 | 6.5793 | 0.6315 | 6.5793 | 0.5667 | 6.5793 | 0.4771 | 6.5793 | 0.4196 |
| 6.8926 | 1.304 | 6.8926 | 0.7396 | 6.8926 | 0.7182 | 6.8926 | 0.6315 | 6.8926 | 0.5667 | 6.8926 | 0.4771 | 6.8926 | 0.4196 |
| 7.2208 | 1.2532 | 7.2208 | 0.7396 | 7.2208 | 0.6499 | 7.2208 | 0.5888 | 7.2208 | 0.5406 | 7.2208 | 0.4771 | 7.2208 | 0.4196 |
| 7.5646 | 1.2532 | 7.5646 | 0.693 | 7.5646 | 0.6107 | 7.5646 | 0.5625 | 7.5646 | 0.5258 | 7.5646 | 0.4681 | 7.5646 | 0.4196 |
| 7.9248 | 1.2532 | 7.9248 | 0.6817 | 7.9248 | 0.5858 | 7.9248 | 0.5283 | 7.9248 | 0.4987 | 7.9248 | 0.462 | 7.9248 | 0.4196 |
| 8.3022 | 1.2532 | 8.3022 | 0.6817 | 8.3022 | 0.5858 | 8.3022 | 0.5283 | 8.3022 | 0.4987 | 8.3022 | 0.456 | 8.3022 | 0.4184 |
| 8.6975 | 0.9647 | 8.6975 | 0.6128 | 8.6975 | 0.5524 | 8.6975 | 0.5138 | 8.6975 | 0.488 | 8.6975 | 0.4543 | 8.6975 | 0.4143 |
| 9.1116 | 0.9578 | 9.1116 | 0.6128 | 9.1116 | 0.5524 | 9.1116 | 0.5138 | 9.1116 | 0.4835 | 9.1116 | 0.4405 | 9.1116 | 0.3992 |
| 9.5455 | 0.9264 | 9.5455 | 0.6128 | 9.5455 | 0.5483 | 9.5455 | 0.504 | 9.5455 | 0.4713 | 9.5455 | 0.425 | 9.5455 | 0.3836 |
| 10 | 0.9264 | 10 | 0.6012 | 10 | 0.5229 | 10 | 0.4804 | 10 | 0.4525 | 10 | 0.4135 | 10 | 0.3761 |
| 10.4762 | 0.8622 | 10.4762 | 0.6007 | 10.4762 | 0.5189 | 10.4762 | 0.4804 | 10.4762 | 0.4525 | 10.4762 | 0.4135 | 10.4762 | 0.3761 |
| 10.975 | 0.8419 | 10.975 | 0.6007 | 10.975 | 0.5189 | 10.975 | 0.4804 | 10.975 | 0.4525 | 10.975 | 0.4135 | 10.975 | 0.3761 |
| 11.4976 | 0.7795 | 11.4976 | 0.536 | 11.4976 | 0.4996 | 11.4976 | 0.4651 | 11.4976 | 0.436 | 11.4976 | 0.3988 | 11.4976 | 0.3678 |
| 12.045 | 0.7795 | 12.045 | 0.536 | 12.045 | 0.4996 | 12.045 | 0.4651 | 12.045 | 0.436 | 12.045 | 0.3889 | 12.045 | 0.3562 |
| 12.6186 | 0.7795 | 12.6186 | 0.5228 | 12.6186 | 0.4717 | 12.6186 | 0.4294 | 12.6186 | 0.3964 | 12.6186 | 0.359 | 12.6186 | 0.3391 |
| 13.2194 | 0.6405 | 13.2194 | 0.4653 | 13.2194 | 0.4316 | 13.2194 | 0.4047 | 13.2194 | 0.3825 | 13.2194 | 0.3477 | 13.2194 | 0.3171 |

PTWW051.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 51 ~ SLAB-WALL JOINT Vertical Responses ~ Elevation 27 ft. ~ Line 6 C

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 0.6405 | 13.8489 | 0.4348 | 13.8489 | 0.4049 | 13.8489 | 0.3807 | 13.8489 | 0.3603 | 13.8489 | 0.3318 | 13.8489 | 0.3008 |
| 14.5083 | 0.6405 | 14.5083 | 0.4039 | 14.5083 | 0.3853 | 14.5083 | 0.3679 | 14.5083 | 0.3525 | 14.5083 | 0.327 | 14.5083 | 0.2985 |
| 15.1991 | 0.6405 | 15.1991 | 0.3916 | 15.1991 | 0.3444 | 15.1991 | 0.3173 | 15.1991 | 0.3103 | 15.1991 | 0.2977 | 15.1991 | 0.2803 |
| 15.9228 | 0.6405 | 15.9228 | 0.3916 | 15.9228 | 0.3444 | 15.9228 | 0.3127 | 15.9228 | 0.2917 | 15.9228 | 0.2775 | 15.9228 | 0.2636 |
| 16.681 | 0.6405 | 16.681 | 0.3916 | 16.681 | 0.3444 | 16.681 | 0.3127 | 16.681 | 0.2917 | 16.681 | 0.2747 | 16.681 | 0.2614 |
| 17.4753 | 0.6405 | 17.4753 | 0.3916 | 17.4753 | 0.3444 | 17.4753 | 0.3127 | 17.4753 | 0.2917 | 17.4753 | 0.2704 | 17.4753 | 0.2568 |
| 18.3074 | 0.6405 | 18.3074 | 0.3916 | 18.3074 | 0.3444 | 18.3074 | 0.3127 | 18.3074 | 0.2917 | 18.3074 | 0.269 | 18.3074 | 0.2482 |
| 19.1791 | 0.6405 | 19.1791 | 0.3916 | 19.1791 | 0.3444 | 19.1791 | 0.3127 | 19.1791 | 0.2917 | 19.1791 | 0.2648 | 19.1791 | 0.2415 |
| 20.0923 | 0.4629 | 20.0923 | 0.3383 | 20.0923 | 0.3009 | 20.0923 | 0.2769 | 20.0923 | 0.2641 | 20.0923 | 0.2513 | 20.0923 | 0.2408 |
| 21.049 | 0.4629 | 21.049 | 0.3383 | 21.049 | 0.3009 | 21.049 | 0.2769 | 21.049 | 0.2641 | 21.049 | 0.2513 | 21.049 | 0.2408 |
| 22.0513 | 0.4629 | 22.0513 | 0.3383 | 22.0513 | 0.3009 | 22.0513 | 0.2769 | 22.0513 | 0.2641 | 22.0513 | 0.2513 | 22.0513 | 0.2408 |
| 23.1013 | 0.4551 | 23.1013 | 0.3138 | 23.1013 | 0.2896 | 23.1013 | 0.2744 | 23.1013 | 0.2641 | 23.1013 | 0.2513 | 23.1013 | 0.2408 |
| 24.2013 | 0.4551 | 24.2013 | 0.3138 | 24.2013 | 0.2896 | 24.2013 | 0.2744 | 24.2013 | 0.2641 | 24.2013 | 0.2513 | 24.2013 | 0.2408 |
| 25.3536 | 0.3793 | 25.3536 | 0.3138 | 25.3536 | 0.2896 | 25.3536 | 0.2744 | 25.3536 | 0.2641 | 25.3536 | 0.2513 | 25.3536 | 0.2408 |
| 26.5609 | 0.3793 | 26.5609 | 0.3138 | 26.5609 | 0.2896 | 26.5609 | 0.2744 | 26.5609 | 0.2641 | 26.5609 | 0.2513 | 26.5609 | 0.2408 |
| 27.8256 | 0.3793 | 27.8256 | 0.3138 | 27.8256 | 0.2896 | 27.8256 | 0.2744 | 27.8256 | 0.2641 | 27.8256 | 0.2513 | 27.8256 | 0.2408 |
| 29.1505 | 0.3738 | 29.1505 | 0.2833 | 29.1505 | 0.2616 | 29.1505 | 0.2493 | 29.1505 | 0.2471 | 29.1505 | 0.2421 | 29.1505 | 0.2357 |
| 30.5386 | 0.3738 | 30.5386 | 0.2833 | 30.5386 | 0.2616 | 30.5386 | 0.2489 | 30.5386 | 0.2408 | 30.5386 | 0.231 | 30.5386 | 0.2269 |
| 31.9927 | 0.2298 | 31.9927 | 0.2311 | 31.9927 | 0.2325 | 31.9927 | 0.2317 | 31.9927 | 0.2301 | 31.9927 | 0.2262 | 31.9927 | 0.2215 |
| 33.516 | 0.2241 | 33.516 | 0.2236 | 33.516 | 0.2232 | 33.516 | 0.2228 | 33.516 | 0.2223 | 33.516 | 0.2212 | 33.516 | 0.2195 |
| 35.1119 | 0.2202 | 35.1119 | 0.22 | 35.1119 | 0.2197 | 35.1119 | 0.2195 | 35.1119 | 0.2192 | 35.1119 | 0.2186 | 35.1119 | 0.2175 |
| 36.7838 | 0.2174 | 36.7838 | 0.2173 | 36.7838 | 0.2171 | 36.7838 | 0.217 | 36.7838 | 0.2168 | 36.7838 | 0.2164 | 36.7838 | 0.2157 |
| 38.5353 | 0.2153 | 38.5353 | 0.2152 | 38.5353 | 0.2151 | 38.5353 | 0.215 | 38.5353 | 0.2149 | 38.5353 | 0.2146 | 38.5353 | 0.2142 |
| 40.3702 | 0.2137 | 40.3702 | 0.2135 | 40.3702 | 0.2135 | 40.3702 | 0.2134 | 40.3702 | 0.2133 | 40.3702 | 0.2131 | 40.3702 | 0.2128 |
| 42.2924 | 0.2122 | 42.2924 | 0.2121 | 42.2924 | 0.2121 | 42.2924 | 0.212 | 42.2924 | 0.212 | 42.2924 | 0.2119 | 42.2924 | 0.2116 |
| 44.3062 | 0.211 | 44.3062 | 0.211 | 44.3062 | 0.2109 | 44.3062 | 0.2109 | 44.3062 | 0.2109 | 44.3062 | 0.2108 | 44.3062 | 0.2106 |
| 46.4159 | 0.21 | 46.4159 | 0.21 | 46.4159 | 0.2099 | 46.4159 | 0.2099 | 46.4159 | 0.2099 | 46.4159 | 0.2098 | 46.4159 | 0.2097 |
| 48.626 | 0.2091 | 48.626 | 0.2091 | 48.626 | 0.2091 | 48.626 | 0.209 | 48.626 | 0.209 | 48.626 | 0.209 | 48.626 | 0.2089 |
| 50.9414 | 0.2083 | 50.9414 | 0.2083 | 50.9414 | 0.2083 | 50.9414 | 0.2083 | 50.9414 | 0.2082 | 50.9414 | 0.2082 | 50.9414 | 0.2082 |

PTWW114.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 114 ~ SLAB ONLY Vertical Responses ~ Elevation 56 ft. ~ EL56_C-E-9-12

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.1098 | 0.0291 | 0.1098 | 0.026 | 0.1098 | 0.0244 | 0.1098 | 0.0229 | 0.1098 | 0.022 | 0.1098 | 0.0213 | 0.1098 | 0.0204 |
| 0.115 | 0.0309 | 0.115 | 0.026 | 0.115 | 0.0244 | 0.115 | 0.0233 | 0.115 | 0.0229 | 0.115 | 0.0221 | 0.115 | 0.0211 |
| 0.1204 | 0.0313 | 0.1204 | 0.0263 | 0.1204 | 0.0245 | 0.1204 | 0.024 | 0.1204 | 0.0236 | 0.1204 | 0.0227 | 0.1204 | 0.0217 |
| 0.1262 | 0.0313 | 0.1262 | 0.027 | 0.1262 | 0.0257 | 0.1262 | 0.0245 | 0.1262 | 0.024 | 0.1262 | 0.0232 | 0.1262 | 0.0221 |
| 0.1322 | 0.0313 | 0.1322 | 0.0271 | 0.1322 | 0.0258 | 0.1322 | 0.0247 | 0.1322 | 0.0243 | 0.1322 | 0.0234 | 0.1322 | 0.0224 |
| 0.1385 | 0.0313 | 0.1385 | 0.0277 | 0.1385 | 0.0265 | 0.1385 | 0.0255 | 0.1385 | 0.0245 | 0.1385 | 0.0234 | 0.1385 | 0.0224 |
| 0.1451 | 0.0316 | 0.1451 | 0.0295 | 0.1451 | 0.0282 | 0.1451 | 0.027 | 0.1451 | 0.0259 | 0.1451 | 0.0239 | 0.1451 | 0.0224 |
| 0.152 | 0.032 | 0.152 | 0.0298 | 0.152 | 0.0285 | 0.152 | 0.0273 | 0.152 | 0.0261 | 0.152 | 0.024 | 0.152 | 0.0224 |
| 0.1592 | 0.033 | 0.1592 | 0.0311 | 0.1592 | 0.0299 | 0.1592 | 0.0288 | 0.1592 | 0.0278 | 0.1592 | 0.0261 | 0.1592 | 0.0242 |
| 0.1668 | 0.0367 | 0.1668 | 0.0323 | 0.1668 | 0.0312 | 0.1668 | 0.0302 | 0.1668 | 0.0292 | 0.1668 | 0.0277 | 0.1668 | 0.0257 |
| 0.1748 | 0.0507 | 0.1748 | 0.0427 | 0.1748 | 0.0385 | 0.1748 | 0.035 | 0.1748 | 0.0321 | 0.1748 | 0.0284 | 0.1748 | 0.0264 |
| 0.1831 | 0.0586 | 0.1831 | 0.0492 | 0.1831 | 0.0442 | 0.1831 | 0.0399 | 0.1831 | 0.0362 | 0.1831 | 0.0306 | 0.1831 | 0.0266 |
| 0.1918 | 0.0586 | 0.1918 | 0.0492 | 0.1918 | 0.0442 | 0.1918 | 0.0399 | 0.1918 | 0.0362 | 0.1918 | 0.0306 | 0.1918 | 0.0268 |
| 0.2009 | 0.0586 | 0.2009 | 0.0492 | 0.2009 | 0.0442 | 0.2009 | 0.0399 | 0.2009 | 0.0362 | 0.2009 | 0.0324 | 0.2009 | 0.0296 |
| 0.2105 | 0.0586 | 0.2105 | 0.0492 | 0.2105 | 0.0442 | 0.2105 | 0.0399 | 0.2105 | 0.0384 | 0.2105 | 0.0358 | 0.2105 | 0.0324 |
| 0.2205 | 0.0586 | 0.2205 | 0.0492 | 0.2205 | 0.0453 | 0.2205 | 0.0426 | 0.2205 | 0.0407 | 0.2205 | 0.0377 | 0.2205 | 0.0338 |
| 0.231 | 0.0586 | 0.231 | 0.0492 | 0.231 | 0.0457 | 0.231 | 0.0438 | 0.231 | 0.0419 | 0.231 | 0.0388 | 0.231 | 0.0354 |
| 0.242 | 0.0586 | 0.242 | 0.0509 | 0.242 | 0.0486 | 0.242 | 0.0465 | 0.242 | 0.0445 | 0.242 | 0.0411 | 0.242 | 0.0369 |
| 0.2535 | 0.0648 | 0.2535 | 0.0573 | 0.2535 | 0.0529 | 0.2535 | 0.0489 | 0.2535 | 0.0454 | 0.2535 | 0.0411 | 0.2535 | 0.0371 |
| 0.2656 | 0.0731 | 0.2656 | 0.0586 | 0.2656 | 0.0535 | 0.2656 | 0.049 | 0.2656 | 0.0454 | 0.2656 | 0.0424 | 0.2656 | 0.0402 |
| 0.2783 | 0.0817 | 0.2783 | 0.0599 | 0.2783 | 0.0535 | 0.2783 | 0.05 | 0.2783 | 0.0485 | 0.2783 | 0.0458 | 0.2783 | 0.0426 |
| 0.2915 | 0.0817 | 0.2915 | 0.0618 | 0.2915 | 0.058 | 0.2915 | 0.0547 | 0.2915 | 0.0516 | 0.2915 | 0.0479 | 0.2915 | 0.0437 |
| 0.3054 | 0.0817 | 0.3054 | 0.0663 | 0.3054 | 0.0622 | 0.3054 | 0.0584 | 0.3054 | 0.0549 | 0.3054 | 0.0489 | 0.3054 | 0.0448 |
| 0.3199 | 0.0817 | 0.3199 | 0.0702 | 0.3199 | 0.0659 | 0.3199 | 0.0622 | 0.3199 | 0.0589 | 0.3199 | 0.0532 | 0.3199 | 0.047 |
| 0.3352 | 0.0872 | 0.3352 | 0.0767 | 0.3352 | 0.0707 | 0.3352 | 0.066 | 0.3352 | 0.0626 | 0.3352 | 0.0568 | 0.3352 | 0.0498 |
| 0.3511 | 0.0906 | 0.3511 | 0.0807 | 0.3511 | 0.0749 | 0.3511 | 0.0699 | 0.3511 | 0.0653 | 0.3511 | 0.0578 | 0.3511 | 0.0501 |
| 0.3678 | 0.1215 | 0.3678 | 0.095 | 0.3678 | 0.0822 | 0.3678 | 0.072 | 0.3678 | 0.0653 | 0.3678 | 0.0578 | 0.3678 | 0.0501 |
| 0.3853 | 0.136 | 0.3853 | 0.1057 | 0.3853 | 0.0918 | 0.3853 | 0.0807 | 0.3853 | 0.0718 | 0.3853 | 0.0586 | 0.3853 | 0.0506 |
| 0.4037 | 0.136 | 0.4037 | 0.1057 | 0.4037 | 0.0918 | 0.4037 | 0.0821 | 0.4037 | 0.0762 | 0.4037 | 0.0664 | 0.4037 | 0.0571 |
| 0.4229 | 0.136 | 0.4229 | 0.1057 | 0.4229 | 0.0918 | 0.4229 | 0.085 | 0.4229 | 0.0799 | 0.4229 | 0.0709 | 0.4229 | 0.0612 |
| 0.4431 | 0.136 | 0.4431 | 0.1057 | 0.4431 | 0.0934 | 0.4431 | 0.0886 | 0.4431 | 0.084 | 0.4431 | 0.0758 | 0.4431 | 0.0653 |
| 0.4642 | 0.1373 | 0.4642 | 0.1057 | 0.4642 | 0.0974 | 0.4642 | 0.0914 | 0.4642 | 0.0859 | 0.4642 | 0.0763 | 0.4642 | 0.067 |
| 0.4863 | 0.1478 | 0.4863 | 0.1237 | 0.4863 | 0.1107 | 0.4863 | 0.0996 | 0.4863 | 0.0902 | 0.4863 | 0.0823 | 0.4863 | 0.073 |
| 0.5094 | 0.1813 | 0.5094 | 0.1382 | 0.5094 | 0.1216 | 0.5094 | 0.1082 | 0.5094 | 0.0975 | 0.5094 | 0.0865 | 0.5094 | 0.075 |

PTWW114.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 114 ~ SLAB ONLY Vertical Responses ~ Elevation 56 ft. ~ EL56_C-E-9-12

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.5337 | 0.2215 | 0.5337 | 0.1604 | 0.5337 | 0.1342 | 0.5337 | 0.1149 | 0.5337 | 0.1022 | 0.5337 | 0.0865 | 0.5337 | 0.075 |
| 0.5591 | 0.2215 | 0.5591 | 0.1604 | 0.5591 | 0.1342 | 0.5591 | 0.1149 | 0.5591 | 0.1022 | 0.5591 | 0.0882 | 0.5591 | 0.075 |
| 0.5857 | 0.2215 | 0.5857 | 0.1604 | 0.5857 | 0.1342 | 0.5857 | 0.1149 | 0.5857 | 0.1022 | 0.5857 | 0.0937 | 0.5857 | 0.082 |
| 0.6136 | 0.2215 | 0.6136 | 0.1604 | 0.6136 | 0.1342 | 0.6136 | 0.1176 | 0.6136 | 0.1109 | 0.6136 | 0.1 | 0.6136 | 0.0872 |
| 0.6428 | 0.2258 | 0.6428 | 0.1621 | 0.6428 | 0.1356 | 0.6428 | 0.1177 | 0.6428 | 0.1129 | 0.6428 | 0.1028 | 0.6428 | 0.0895 |
| 0.6734 | 0.2258 | 0.6734 | 0.1621 | 0.6734 | 0.1383 | 0.6734 | 0.1286 | 0.6734 | 0.1207 | 0.6734 | 0.108 | 0.6734 | 0.0932 |
| 0.7055 | 0.2258 | 0.7055 | 0.1621 | 0.7055 | 0.1383 | 0.7055 | 0.1286 | 0.7055 | 0.1207 | 0.7055 | 0.109 | 0.7055 | 0.0946 |
| 0.7391 | 0.2258 | 0.7391 | 0.1621 | 0.7391 | 0.1409 | 0.7391 | 0.1325 | 0.7391 | 0.1242 | 0.7391 | 0.1095 | 0.7391 | 0.0946 |
| 0.7743 | 0.3171 | 0.7743 | 0.2132 | 0.7743 | 0.1805 | 0.7743 | 0.1582 | 0.7743 | 0.1421 | 0.7743 | 0.1212 | 0.7743 | 0.1034 |
| 0.8111 | 0.3171 | 0.8111 | 0.2132 | 0.8111 | 0.1805 | 0.8111 | 0.1582 | 0.8111 | 0.1421 | 0.8111 | 0.1212 | 0.8111 | 0.1063 |
| 0.8497 | 0.3171 | 0.8497 | 0.2132 | 0.8497 | 0.1805 | 0.8497 | 0.1653 | 0.8497 | 0.1529 | 0.8497 | 0.1331 | 0.8497 | 0.1125 |
| 0.8902 | 0.3171 | 0.8902 | 0.2132 | 0.8902 | 0.1863 | 0.8902 | 0.1706 | 0.8902 | 0.1575 | 0.8902 | 0.137 | 0.8902 | 0.117 |
| 0.9326 | 0.4856 | 0.9326 | 0.2988 | 0.9326 | 0.2458 | 0.9326 | 0.2147 | 0.9326 | 0.1923 | 0.9326 | 0.1629 | 0.9326 | 0.1372 |
| 0.977 | 0.4856 | 0.977 | 0.2988 | 0.977 | 0.2458 | 0.977 | 0.2147 | 0.977 | 0.1923 | 0.977 | 0.1712 | 0.977 | 0.1498 |
| 1.0235 | 0.4856 | 1.0235 | 0.2988 | 1.0235 | 0.2458 | 1.0235 | 0.2147 | 1.0235 | 0.1923 | 1.0235 | 0.1778 | 1.0235 | 0.1585 |
| 1.0723 | 0.4856 | 1.0723 | 0.2988 | 1.0723 | 0.2567 | 1.0723 | 0.2357 | 1.0723 | 0.2186 | 1.0723 | 0.1927 | 1.0723 | 0.1661 |
| 1.1233 | 0.571 | 1.1233 | 0.3365 | 1.1233 | 0.2645 | 1.1233 | 0.2357 | 1.1233 | 0.2186 | 1.1233 | 0.1927 | 1.1233 | 0.1661 |
| 1.1768 | 0.571 | 1.1768 | 0.3761 | 1.1768 | 0.3118 | 1.1768 | 0.2752 | 1.1768 | 0.2461 | 1.1768 | 0.2094 | 1.1768 | 0.1827 |
| 1.2328 | 0.571 | 1.2328 | 0.3802 | 1.2328 | 0.3434 | 1.2328 | 0.3123 | 1.2328 | 0.287 | 1.2328 | 0.2477 | 1.2328 | 0.2092 |
| 1.2916 | 0.571 | 1.2916 | 0.4124 | 1.2916 | 0.3638 | 1.2916 | 0.324 | 1.2916 | 0.2966 | 1.2916 | 0.2555 | 1.2916 | 0.2155 |
| 1.353 | 0.6146 | 1.353 | 0.4124 | 1.353 | 0.3638 | 1.353 | 0.324 | 1.353 | 0.3054 | 1.353 | 0.2746 | 1.353 | 0.2387 |
| 1.4175 | 0.6146 | 1.4175 | 0.4124 | 1.4175 | 0.3638 | 1.4175 | 0.3436 | 1.4175 | 0.3262 | 1.4175 | 0.2952 | 1.4175 | 0.259 |
| 1.485 | 0.6146 | 1.485 | 0.4377 | 1.485 | 0.4023 | 1.485 | 0.3763 | 1.485 | 0.3523 | 1.485 | 0.3122 | 1.485 | 0.2688 |
| 1.5557 | 0.6146 | 1.5557 | 0.4628 | 1.5557 | 0.4325 | 1.5557 | 0.406 | 1.5557 | 0.3819 | 1.5557 | 0.3421 | 1.5557 | 0.2937 |
| 1.6298 | 0.6344 | 1.6298 | 0.4805 | 1.6298 | 0.4418 | 1.6298 | 0.4164 | 1.6298 | 0.3937 | 1.6298 | 0.3554 | 1.6298 | 0.3103 |
| 1.7074 | 0.7807 | 1.7074 | 0.6115 | 1.7074 | 0.5414 | 1.7074 | 0.4855 | 1.7074 | 0.4393 | 1.7074 | 0.3723 | 1.7074 | 0.3174 |
| 1.7887 | 0.8828 | 1.7887 | 0.7257 | 1.7887 | 0.6496 | 1.7887 | 0.585 | 1.7887 | 0.5302 | 1.7887 | 0.452 | 1.7887 | 0.3759 |
| 1.8738 | 0.9335 | 1.8738 | 0.7297 | 1.8738 | 0.6518 | 1.8738 | 0.5887 | 1.8738 | 0.5371 | 1.8738 | 0.4575 | 1.8738 | 0.418 |
| 1.963 | 1.0248 | 1.963 | 0.7297 | 1.963 | 0.6518 | 1.963 | 0.5887 | 1.963 | 0.5371 | 1.963 | 0.4575 | 1.963 | 0.4401 |
| 2.0565 | 1.0248 | 2.0565 | 0.7297 | 2.0565 | 0.6518 | 2.0565 | 0.5945 | 2.0565 | 0.5478 | 2.0565 | 0.4696 | 2.0565 | 0.4401 |
| 2.1544 | 1.0248 | 2.1544 | 0.7864 | 2.1544 | 0.7093 | 2.1544 | 0.6425 | 2.1544 | 0.5884 | 2.1544 | 0.5086 | 2.1544 | 0.4401 |
| 2.257 | 1.0248 | 2.257 | 0.788 | 2.257 | 0.7266 | 2.257 | 0.6685 | 2.257 | 0.6147 | 2.257 | 0.5258 | 2.257 | 0.4416 |
| 2.3645 | 1.8203 | 2.3645 | 0.9657 | 2.3645 | 0.7731 | 2.3645 | 0.6955 | 2.3645 | 0.6344 | 2.3645 | 0.5474 | 2.3645 | 0.4561 |
| 2.4771 | 2.0792 | 2.4771 | 1.093 | 2.4771 | 0.8239 | 2.4771 | 0.7035 | 2.4771 | 0.6626 | 2.4771 | 0.5541 | 2.4771 | 0.4612 |
| 2.595 | 2.1716 | 2.595 | 1.093 | 2.595 | 0.8239 | 2.595 | 0.7035 | 2.595 | 0.6934 | 2.595 | 0.5552 | 2.595 | 0.4649 |

PTWW114.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 114 ~ SLAB ONLY Vertical Responses ~ Elevation 56 ft. ~ EL56_C-E-9-12

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.7186 | 2.1716 | 2.7186 | 1.093 | 2.7186 | 0.8239 | 2.7186 | 0.7035 | 2.7186 | 0.6934 | 2.7186 | 0.5552 | 2.7186 | 0.4649 |
| 2.848 | 2.1716 | 2.848 | 1.093 | 2.848 | 0.8239 | 2.848 | 0.7035 | 2.848 | 0.6934 | 2.848 | 0.5552 | 2.848 | 0.4649 |
| 2.9836 | 2.1716 | 2.9836 | 1.093 | 2.9836 | 0.8239 | 2.9836 | 0.7035 | 2.9836 | 0.6934 | 2.9836 | 0.5552 | 2.9836 | 0.4649 |
| 3.1257 | 2.1716 | 3.1257 | 1.093 | 3.1257 | 0.8239 | 3.1257 | 0.7035 | 3.1257 | 0.6934 | 3.1257 | 0.5552 | 3.1257 | 0.4649 |
| 3.2745 | 1.4998 | 3.2745 | 0.9545 | 3.2745 | 0.8037 | 3.2745 | 0.6961 | 3.2745 | 0.6196 | 3.2745 | 0.5335 | 3.2745 | 0.458 |
| 3.4305 | 0.9809 | 3.4305 | 0.6884 | 3.4305 | 0.6145 | 3.4305 | 0.5843 | 3.4305 | 0.558 | 3.4305 | 0.5075 | 3.4305 | 0.4416 |
| 3.5938 | 0.9809 | 3.5938 | 0.6884 | 3.5938 | 0.6145 | 3.5938 | 0.5735 | 3.5938 | 0.5378 | 3.5938 | 0.48 | 3.5938 | 0.4174 |
| 3.7649 | 0.9809 | 3.7649 | 0.6884 | 3.7649 | 0.6145 | 3.7649 | 0.5503 | 3.7649 | 0.5077 | 3.7649 | 0.4448 | 3.7649 | 0.3971 |
| 3.9442 | 0.9809 | 3.9442 | 0.6884 | 3.9442 | 0.6145 | 3.9442 | 0.5503 | 3.9442 | 0.5077 | 3.9442 | 0.4448 | 3.9442 | 0.3971 |
| 4.132 | 0.9809 | 4.132 | 0.6884 | 4.132 | 0.6145 | 4.132 | 0.5503 | 4.132 | 0.5077 | 4.132 | 0.4448 | 4.132 | 0.3971 |
| 4.3288 | 0.9809 | 4.3288 | 0.6884 | 4.3288 | 0.6145 | 4.3288 | 0.5503 | 4.3288 | 0.5077 | 4.3288 | 0.4448 | 4.3288 | 0.3971 |
| 4.5349 | 0.9809 | 4.5349 | 0.6884 | 4.5349 | 0.6145 | 4.5349 | 0.5503 | 4.5349 | 0.5077 | 4.5349 | 0.4448 | 4.5349 | 0.3971 |
| 4.7508 | 0.9809 | 4.7508 | 0.6884 | 4.7508 | 0.6145 | 4.7508 | 0.5503 | 4.7508 | 0.5077 | 4.7508 | 0.4448 | 4.7508 | 0.3971 |
| 4.977 | 0.9809 | 4.977 | 0.6884 | 4.977 | 0.6145 | 4.977 | 0.5503 | 4.977 | 0.5077 | 4.977 | 0.4448 | 4.977 | 0.3971 |
| 5.214 | 0.9809 | 5.214 | 0.6884 | 5.214 | 0.6145 | 5.214 | 0.5503 | 5.214 | 0.5077 | 5.214 | 0.4448 | 5.214 | 0.3971 |
| 5.4623 | 1.1044 | 5.4623 | 0.6884 | 5.4623 | 0.6145 | 5.4623 | 0.5503 | 5.4623 | 0.5077 | 5.4623 | 0.4448 | 5.4623 | 0.3971 |
| 5.7224 | 1.1044 | 5.7224 | 0.7283 | 5.7224 | 0.622 | 5.7224 | 0.5503 | 5.7224 | 0.5077 | 5.7224 | 0.4448 | 5.7224 | 0.3971 |
| 5.9948 | 1.1044 | 5.9948 | 0.7283 | 5.9948 | 0.622 | 5.9948 | 0.5503 | 5.9948 | 0.5077 | 5.9948 | 0.4448 | 5.9948 | 0.3998 |
| 6.2803 | 1.1044 | 6.2803 | 0.7283 | 6.2803 | 0.622 | 6.2803 | 0.5503 | 6.2803 | 0.5077 | 6.2803 | 0.4448 | 6.2803 | 0.4016 |
| 6.5793 | 1.1044 | 6.5793 | 0.7283 | 6.5793 | 0.622 | 6.5793 | 0.5503 | 6.5793 | 0.5077 | 6.5793 | 0.4448 | 6.5793 | 0.4016 |
| 6.8926 | 1.1044 | 6.8926 | 0.7283 | 6.8926 | 0.622 | 6.8926 | 0.5503 | 6.8926 | 0.5077 | 6.8926 | 0.4448 | 6.8926 | 0.4016 |
| 7.2208 | 1.1044 | 7.2208 | 0.7283 | 7.2208 | 0.622 | 7.2208 | 0.5503 | 7.2208 | 0.5077 | 7.2208 | 0.4448 | 7.2208 | 0.4016 |
| 7.5646 | 1.1044 | 7.5646 | 0.7283 | 7.5646 | 0.622 | 7.5646 | 0.5503 | 7.5646 | 0.5077 | 7.5646 | 0.4448 | 7.5646 | 0.4016 |
| 7.9248 | 1.1044 | 7.9248 | 0.7283 | 7.9248 | 0.622 | 7.9248 | 0.5503 | 7.9248 | 0.5077 | 7.9248 | 0.4448 | 7.9248 | 0.4016 |
| 8.3022 | 1.1044 | 8.3022 | 0.7283 | 8.3022 | 0.622 | 8.3022 | 0.5503 | 8.3022 | 0.5077 | 8.3022 | 0.4448 | 8.3022 | 0.4016 |
| 8.6975 | 1.1044 | 8.6975 | 0.7283 | 8.6975 | 0.622 | 8.6975 | 0.5503 | 8.6975 | 0.5077 | 8.6975 | 0.4448 | 8.6975 | 0.4016 |
| 9.1116 | 1.1044 | 9.1116 | 0.7283 | 9.1116 | 0.622 | 9.1116 | 0.5503 | 9.1116 | 0.5077 | 9.1116 | 0.4455 | 9.1116 | 0.4016 |
| 9.5455 | 1.1044 | 9.5455 | 0.7283 | 9.5455 | 0.6496 | 9.5455 | 0.5959 | 9.5455 | 0.5516 | 9.5455 | 0.4806 | 9.5455 | 0.4077 |
| 10 | 1.1044 | 10 | 0.7283 | 10 | 0.6753 | 10 | 0.6293 | 10 | 0.5867 | 10 | 0.5157 | 10 | 0.4392 |
| 10.4762 | 1.204 | 10.4762 | 0.7487 | 10.4762 | 0.6753 | 10.4762 | 0.6293 | 10.4762 | 0.5867 | 10.4762 | 0.5157 | 10.4762 | 0.4392 |
| 10.975 | 1.204 | 10.975 | 0.7487 | 10.975 | 0.6753 | 10.975 | 0.6293 | 10.975 | 0.5867 | 10.975 | 0.5157 | 10.975 | 0.4392 |
| 11.4976 | 1.2393 | 11.4976 | 0.7487 | 11.4976 | 0.6753 | 11.4976 | 0.6293 | 11.4976 | 0.5867 | 11.4976 | 0.5157 | 11.4976 | 0.4392 |
| 12.045 | 1.2393 | 12.045 | 0.7487 | 12.045 | 0.6753 | 12.045 | 0.6293 | 12.045 | 0.5867 | 12.045 | 0.5157 | 12.045 | 0.4392 |
| 12.6186 | 1.2393 | 12.6186 | 0.7487 | 12.6186 | 0.6753 | 12.6186 | 0.6293 | 12.6186 | 0.5867 | 12.6186 | 0.5157 | 12.6186 | 0.4392 |
| 13.2194 | 1.2393 | 13.2194 | 0.7487 | 13.2194 | 0.6753 | 13.2194 | 0.6293 | 13.2194 | 0.5867 | 13.2194 | 0.5157 | 13.2194 | 0.4392 |

PTWW114.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 114 ~ SLAB ONLY Vertical Responses ~ Elevation 56 ft. ~ EL56_C-E-9-12

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 1.2393 | 13.8489 | 0.7487 | 13.8489 | 0.6753 | 13.8489 | 0.6293 | 13.8489 | 0.5867 | 13.8489 | 0.5157 | 13.8489 | 0.4392 |
| 14.5083 | 1.2393 | 14.5083 | 0.7487 | 14.5083 | 0.6753 | 14.5083 | 0.6293 | 14.5083 | 0.5867 | 14.5083 | 0.5157 | 14.5083 | 0.4392 |
| 15.1991 | 1.3415 | 15.1991 | 0.7487 | 15.1991 | 0.6753 | 15.1991 | 0.6293 | 15.1991 | 0.5867 | 15.1991 | 0.5157 | 15.1991 | 0.4392 |
| 15.9228 | 1.3415 | 15.9228 | 0.7838 | 15.9228 | 0.7272 | 15.9228 | 0.6416 | 15.9228 | 0.5867 | 15.9228 | 0.5157 | 15.9228 | 0.4453 |
| 16.681 | 1.3415 | 16.681 | 0.7838 | 16.681 | 0.7272 | 16.681 | 0.6416 | 16.681 | 0.5867 | 16.681 | 0.5157 | 16.681 | 0.4493 |
| 17.4753 | 1.3415 | 17.4753 | 0.7838 | 17.4753 | 0.7272 | 17.4753 | 0.6416 | 17.4753 | 0.5867 | 17.4753 | 0.5157 | 17.4753 | 0.4493 |
| 18.3074 | 1.3415 | 18.3074 | 0.7838 | 18.3074 | 0.7272 | 18.3074 | 0.6416 | 18.3074 | 0.5867 | 18.3074 | 0.5157 | 18.3074 | 0.4681 |
| 19.1791 | 1.7415 | 19.1791 | 1.0077 | 19.1791 | 0.7827 | 19.1791 | 0.7138 | 19.1791 | 0.7037 | 19.1791 | 0.6041 | 19.1791 | 0.5379 |
| 20.0923 | 2.2676 | 20.0923 | 1.2791 | 20.0923 | 1.0078 | 20.0923 | 0.8492 | 20.0923 | 0.7444 | 20.0923 | 0.6108 | 20.0923 | 0.5802 |
| 21.049 | 2.2676 | 21.049 | 1.2791 | 21.049 | 1.0078 | 21.049 | 0.8492 | 21.049 | 0.7444 | 21.049 | 0.6108 | 21.049 | 0.5802 |
| 22.0513 | 2.2676 | 22.0513 | 1.2791 | 22.0513 | 1.0078 | 22.0513 | 0.8492 | 22.0513 | 0.7444 | 22.0513 | 0.6108 | 22.0513 | 0.5802 |
| 23.1013 | 2.2676 | 23.1013 | 1.2791 | 23.1013 | 1.0078 | 23.1013 | 0.8492 | 23.1013 | 0.7444 | 23.1013 | 0.6108 | 23.1013 | 0.5802 |
| 24.2013 | 2.2676 | 24.2013 | 1.2791 | 24.2013 | 1.0078 | 24.2013 | 0.8492 | 24.2013 | 0.7444 | 24.2013 | 0.6108 | 24.2013 | 0.5802 |
| 25.3536 | 2.2676 | 25.3536 | 1.2517 | 25.3536 | 1.0078 | 25.3536 | 0.8492 | 25.3536 | 0.7444 | 25.3536 | 0.6108 | 25.3536 | 0.5708 |
| 26.5609 | 2.2676 | 26.5609 | 1.2517 | 26.5609 | 1.0078 | 26.5609 | 0.8492 | 26.5609 | 0.7444 | 26.5609 | 0.6108 | 26.5609 | 0.5708 |
| 27.8256 | 2.169 | 27.8256 | 1.0486 | 27.8256 | 0.8581 | 27.8256 | 0.7745 | 27.8256 | 0.7093 | 27.8256 | 0.6108 | 27.8256 | 0.5248 |
| 29.1505 | 1.0972 | 29.1505 | 0.7793 | 29.1505 | 0.7092 | 29.1505 | 0.6373 | 29.1505 | 0.5666 | 29.1505 | 0.5216 | 29.1505 | 0.4804 |
| 30.5386 | 0.7655 | 30.5386 | 0.5382 | 30.5386 | 0.5146 | 30.5386 | 0.5014 | 30.5386 | 0.4905 | 30.5386 | 0.4703 | 30.5386 | 0.4417 |
| 31.9927 | 0.49 | 31.9927 | 0.4758 | 31.9927 | 0.4619 | 31.9927 | 0.4498 | 31.9927 | 0.4394 | 31.9927 | 0.4224 | 31.9927 | 0.4018 |
| 33.516 | 0.4005 | 33.516 | 0.3959 | 33.516 | 0.3892 | 33.516 | 0.3827 | 33.516 | 0.3768 | 33.516 | 0.3684 | 33.516 | 0.3616 |
| 35.1119 | 0.3498 | 35.1119 | 0.3494 | 35.1119 | 0.3485 | 35.1119 | 0.3471 | 35.1119 | 0.3453 | 35.1119 | 0.3411 | 35.1119 | 0.3342 |
| 36.7838 | 0.3221 | 36.7838 | 0.3222 | 36.7838 | 0.322 | 36.7838 | 0.3215 | 36.7838 | 0.3209 | 36.7838 | 0.3191 | 36.7838 | 0.3155 |
| 38.5353 | 0.3028 | 38.5353 | 0.303 | 38.5353 | 0.303 | 38.5353 | 0.3028 | 38.5353 | 0.3026 | 38.5353 | 0.3017 | 38.5353 | 0.2998 |
| 40.3702 | 0.2881 | 40.3702 | 0.2882 | 40.3702 | 0.2883 | 40.3702 | 0.2883 | 40.3702 | 0.2882 | 40.3702 | 0.2878 | 40.3702 | 0.2867 |
| 42.2924 | 0.2762 | 42.2924 | 0.2764 | 42.2924 | 0.2765 | 42.2924 | 0.2765 | 42.2924 | 0.2765 | 42.2924 | 0.2763 | 42.2924 | 0.2758 |
| 44.3062 | 0.2664 | 44.3062 | 0.2665 | 44.3062 | 0.2666 | 44.3062 | 0.2666 | 44.3062 | 0.2666 | 44.3062 | 0.2666 | 44.3062 | 0.2664 |
| 46.4159 | 0.2593 | 46.4159 | 0.2596 | 46.4159 | 0.2598 | 46.4159 | 0.26 | 46.4159 | 0.2602 | 46.4159 | 0.2605 | 46.4159 | 0.2608 |
| 48.626 | 0.2549 | 48.626 | 0.2552 | 48.626 | 0.2553 | 48.626 | 0.2555 | 48.626 | 0.2556 | 48.626 | 0.2558 | 48.626 | 0.2561 |
| 50.9414 | 0.2512 | 50.9414 | 0.2513 | 50.9414 | 0.2514 | 50.9414 | 0.2515 | 50.9414 | 0.2516 | 50.9414 | 0.2518 | 50.9414 | 0.252 |

| | | |
|---|---|---|
| BECHTEL | **MECHANICAL SYSTEMS DATA SHEET: VESSEL** | PLANT ITEM No. 5<br>*24590-PTF-MW-FEP-SEP-00001A*<br>Data Sheet No.<br>*24590-PTF-MVD-FEP-00006* |

| | | | |
|---|---|---|---|
| Project: | *RPP-WTP* | P&ID: | *24590-PTF-M6-FEP-00002001* |
| Project No: | *24590* | Process Data: | *24590-QL-POA-MEVV-00001-04-04* |
| Project Site: | *Hanford* | Vessel Drawing | *24590-QL-POA-MEVV-00001-01-194* |
| Description: | *Waste Feed Evaporator Separator Vessel FEP-SEP-00001A* | | |

R11042827

## Reference Data

| | |
|---|---|
| Charge Vessels (Tag Numbers) | *None* |
| Pulsejet Mixers / Agitators (Tag Numbers) | *None* |
| RFDs/Pumps (Tag Numbers) | *None* |

ISSUED BY
RPP-WTP PDC

| | | | | |
|---|---|---|---|---|
| Quality Level | | *Q (See Note 12)* | Fabrication Specs | *24590-WTP-3PS-MV00-T0001* |
| Seismic Category | | *SC-1* | Design Code | *ASME VIII Div 1* |
| Service/Contents | | *Radioactive Slurry* | Code Stamp | *U1 Stamp* |
| Design Specific Gravity | | *1.50* | NB Registration | *Yes* |
| Maximum Operating Volume | gal | *3,817* | Wind Design | *None* |
| Total Volume | gal | *14,512* | Snow/Ash Design | *None* |
| Postweld Heat Treat | | *Not Required* | Seismic Design | *24590-WTP-3PS-MV00-T0002*<br>*24590-WTP-3PS-SS90-T0001*<br>*See attachment 1* 5 |
| Seismic Base Moment | ft*lb | *N/A* | | |

## Design Data

| | | | | | |
|---|---|---|---|---|---|
| Inside Diameter | inch | *7'-6" (Upper), 11'-5" (Lower)* | | Corrosion Allowance Inch | *0.04* |
| Length/Height (TL-TL) | inch | *417-3/4"* | | | |
| | | Vessel Operating | Vessel Design | Coil / Jacket Design | Notes |
| Internal Pressure | psig | *-13.4* | *50* | *N/A* | *Vessel Operating at 1.3 psia* |
| External Pressure | psig | *0* | *14.7* | *N/A* | |
| Temperature | °F | *129* | *175* | *N/A* | |
| Min. Design Metal Temp. | °F | *49* | | Hydrostatic Test Pressure PSIG | *65 - Horizontal* |

## Materials of Construction

| Component | Material | Containment | Notes |
|---|---|---|---|
| Top Head | *SA 240 304 SS* | *Auxiliary (See Note 6)* | *1/2" Nom. thickness; maximum carbon content of 0.030% for welded components* |
| Shell | *SA 240 304 SS* | *Primary (See Note 6)* | *1/2" thickness; maximum carbon content of 0.030% for welded components* |
| Lower Cone | *SA 240 304 SS* | *Primary (See Note 6)* | *1/2" thickness; maximum carbon content of 0.030% for welded components* |
| Vessel Support | *SA 240 304 SS* | *N/A* | *Maximum carbon content of 0.030% for welded components* |
| Jacket/Coils/Half-Pipe Jacket | *N/A* | *N/A* | |
| Internals | *SA 403 304 SS and SA 240 304 SS* | *Thermowell Primary (See Note 6)* | *Maximum carbon content of 0.030% for welded components* |
| Pipe | *SA 312 304 SS* | *Note 6* | *Maximum carbon content of 0.030% for welded components* |
| Forgings/ Bar stock | *SA 182 304 SS / SA 479 304 SS* | *Note 1* | *Maximum carbon content of 0.030% for welded components* |
| Gaskets | *SA 240 304 SS* | | *Flexitallic spiral wound with Thermiculite Filler, note 15* |
| Bolting (Captive Bolts) | *Nitronic 60, SA 193 B8S* | | *24590-QL-POA-MEVV-00001-01-00317* |
| Other (Fittings) | *SA 182 304 SS* | *Auxiliary* | *Maximum carbon content of 0.030% for welded components* |

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

| | | |
|---|---|---|
| BECHTEL | **MECHANICAL SYSTEMS DATA SHEET: VESSEL** | PLANT ITEM No. 5<br>*24590-PTF-MW-FEP-SEP-00001A*<br>Data Sheet No.<br>*24590-PTF-MVD-FEP-00006* |

## Miscellaneous Data

| | |
|---|---|
| Orientation | ***Vertical*** |
| Support Type | ***Stainless Steel Legs, A 554-304 SS*** |
| Insulation Function | ***None*** |
| Insulation Thickness (inch) | ***None*** |
| Insulation Material | ***None*** |
| External Finish | ***Welds Descaled as Laid*** |
| Internal Finish | ***Welds Ground Smooth; lower 15'-4 15/16" shell and cone to be #4 polished finish.*** |

## Notes

***(1) Nozzles located below the top of the overflow nozzle are primary containment. See 24590-WTP-3PS-MV00-T0001 for NDE requirements.***

***(2) Nozzle tolerance +/- 1/4"***

***(3) Material for demister pad is Inconel 625 fine mesh. See drawings 24590-QL-POA-MEVV-00001-01-00794 and 24590-QL-POA-MEVV-00001-01-00795. Upper Mesh is Style 1899 and Lower Mesh is Style 346.***

***(4) Non-replaceable 40 years design life (except demister pads section).***

***(5 )NDE for this vessel must meet requirements per para 6.1, 6.2 and 7.2 of specification 24590-WTP-3PS-MV00-T0001.***

***(6) All welds forming part of the primary and auxiliary containment including nozzle attachment welds shall be subject to 100% volumetric examination.***

***(7) This vessel is in a Black Cell.***

***(8) Vendor to specify all metal thickness. See Vendor Drawing 24590-QL-POA-MEVV-00001-01-00733.***

***(9) Contents of this document are Dangerous Waste Permit affecting.***

***(10) All vessel nozzle loads due to thermal expansion are estimated based on the maximum operating temperature of 150 degree F.***

***(11) Deleted.*** 5

***(12) Vendor will provide Item at BNI quality level Q specification, which correlates to vendors quality level of QL-2.***

***(13) Final Vendor Design Process information is from document 24590-QL-POA-MEVV-00001-02-00056.***

***(14) Equipment cyclic data is from document 24590-QL-POA-MEVV-00001-04-03.***

***(15) Vendor to provide manufacturer, chemical make-up, waste chemical composition, acceptable temperature range, and maximum radiation dose allowed.***

***(16) When combining vessel loading with seismic, seller shall use design pressure. Seller has the option to use 2 psi or 15% over maximum operating pressure, whichever is greatest, not to exceed vessel design pressure and full vacuum in lieu of vessel design pressure.***

5 ***(17) Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.***

***Safety screening/evaluation required? ☐Yes ☒No If yes per 24590-WTP-GPP-SREG-002, E&NS signature required below.***

## Revision History

| Rev | Description | By | Checked | EN&S | Approved | Date |
|---|---|---|---|---|---|---|
| 5 | Updated to reflect WSGM analysis, 24590-PTF-U0N-W16T-00003 and incorporate DOE AEA note (17). | D. Tate | R. Rickenbach | Butt Hall | J. Julyk | 2/19/09 |
| 4 | Incorporated vendor design information, SDDR 24590-WTP-SDDR-M-06-00158 and Equipment Qualification data. | R. Rickenbach | C. Knauss | S. Sontag | J. Julyk | 08/07/2008 |
| 3 | Clarified vessel nozzle load design | E. Le | R. Nowak | N/A | J. Julyk | 03/28/2005 |
| 2 | Incorporated vendor final design information | E. Le | S. Crow | N/A | J. Julyk | 02/10/2005 |
| 1 | Incorporated SDDR-PROC-04-00104 and vendor design information | E. Le | G. Butt | N/A | J. Julyk | 04/02/2004 |
| 0 | Issued for Procurement | E. Le | A. Donnelly | N/A | M. Hoffmann | 05/01/2003 |

# EQUIPMENT QUALIFICATION DATASHEET (EQD)

## Equipment Identification

| | | | |
|---|---|---|---|
| Component Tag Number | 24590-PTF-MW-FEP-SEP-00001A | Safety Classification | ☒ SC ☐ SS ☐ APC ☐ SDC ☐ SDS ☐ RRC Note 13 5 |
| Manufacturer / Supplier | TBD | | |
| Requisition Number | 24590-QL-POA-MEVV-00001 | | |
| Model | TBD | Seismic Category | ☒ SC-I ☐ SC-II ☐ SC-III ☐ SC-IV Note 13 5 |
| Description (Include descriptive text [e.g., location, elevation]) | Waste Feed Separator Vessel FEP-SEP-00001A, room P-0106, elevation 0'-0" | | |
| Safety Function(s) | Confinement (ref. 1) 5<br>Hydrogen Purging (ref. 1) 5<br>Initiate purge upon low steam flow to the reboiler (ref. 1) 5 | | |

| | | | |
|---|---|---|---|
| Seismic Safety Function | ☒ Yes ☐ No | Room Number(s): | P-0106, Note 3 |
| Maintenance Accessible | ☐ Yes ☒ No | Method of Maintenance Access: | ☐ Remote ☐ Hands On ☒ None |
| Seismic Operability Requirements: | 5 ☐ During Seismic Event | 5 ☐ After Seismic Event | |
| ITS Equipment Type: | ☒ Passive Mechanical | ☐ Active Mechanical | ☐ Electrical |

## Equipment Environmental Qualification (EEQ)

| | | |
|---|---|---|
| Environment ☐ Mild ☒ Harsh<br>Contamination Class: C5<br>Radiation Class: R5 | Hi Rad Service ☒ Yes ☐ No | Design Life (yrs) ☒ 40 ☐ Other 5<br>Not applicable to Demister Pad (Note 3). |

| Parameter Type/Units | Parameter Value | Time Duration (number) | Time Units | WTP Document Number (BUYER) | Submittal Number (SELLER) |
|---|---|---|---|---|---|
| **Normal** | | | | | |
| Normal High Temperature (°F) | 113 | 40 | yrs | 24590-PTF-U0D-W16T-00001, Note 8 | Note 1 |
| Normal Low Temperature (°F) | 59 | 40 | yrs | 24590-PTF-U0D-W16T-00001, Note 8 | Note 1 |
| Normal High Relative Humidity (%RH) | 100 | 40 | yrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Normal Low Relative Humidity (%RH) | 5 | 40 | yrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Normal High Pressure (in.-w.g.) | 0 | 40 | yrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Normal Low Pressure (in.-w.g.) | -1.4 | 40 | yrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Normal Radiation Dose Rate (mR/hr) | 5 Note 5 | 40 | yrs | Note 5 | Note 1 |
| Vibration Magnitude (g) | N/A | N/A | N/A | N/A | Note 1 |
| Vibration Frequency (Hz) | N/A | N/A | N/A | N/A | Note 1 |
| Additional Normal Information: | See Note 2 for pressure units. | | | | |

**Equipment Environmental Qualification (EEQ)** *(continued)*

| Parameter Type/Units | Parameter Value | Time Duration (number) | Time units | WTP Document Number (BUYER) | Submittal Number (SELLER) |
|---|---|---|---|---|---|
| **Abnormal** | | | | | |
| Abnormal High Temperature (°F) | 5 128 | 8 | hr/yr | 24590-PTF-U0D-W16T-00001, Note 8 5 | Note 1 |
| Abnormal Low Temperature (°F) | 59 | 8 | hr/yr | 24590-WTP-DB-01-001, Notes 8 and 11 | Note 1 |
| Abnormal High Relative Humidity (%RH) | 100 | 24 | hr/yr | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Abnormal Low Relative Humidity (%RH) | 2 | 22 | hr/yr | 24590-PTF-U0D-W16T-00001, Note 12 5 | Note 1 |
| Abnormal High Pressure (in.-w.g.) | 4 | 8 | hr/yr | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Abnormal Low Pressure (in.-w.g.) | -7.3 | 8 | hr/yr | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Abnormal Radiation Dose Rate (mR/hr) | 5 Notes 4&5 | 5 0 | 5 hr/yr | Note 5 | Note 1 |
| Wet Sprinkler System Present | No | N/A | N/A | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Additional Abnormal Information | See Note 2 for pressure units. | | | | |
| **Design Basis Events (DBE)** | | | | | |
| DBE High Temperature (°F) | 5 138 | 1000 | hrs | 24590-PTF-U0D-W16T-00001, Note 8 5 | Note 1 |
| DBE Low Temperature (°F) | 40 | 1000 | hrs | 24590-PTF-U0D-W16T-00001, Note 8 | Note 1 |
| DBE High Relative Humidity (%RH) | 100 | 482 | hrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| DBE Low Relative Humidity (%RH) | 4 | 1000 | hrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| DBE High Pressure (in.-w.g.) | 4 | 1000 | hrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| DBE Low Pressure (in.-w.g.) | -7.3 | 1000 | hrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| DBE Radiation Dose Rate (mR/hr) | 5 Notes 4&5 | 5 0 | 5 hrs | Note 5 | Note 1 |
| Flood Height (ft) | 2.08 | 1000 | hrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Submergence (ft) | 0, Note 6 | 1000 5 | hrs | 24590-PTF-U0D-W16T-00001<br>24590-QL-POA-MEVV-00001-01-0000288 | Note 1 |
| Chemical/Spray Exposure | Yes, Note 10 | 5 1000 | hrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Additional DBE Information | See Note 2 for pressure units. | | | | |

| DBE Chemical Exposure Details | |
|---|---|
| DBE Chemical Types/Concentrations | 19M Sodium Hydroxide<br>Anti-foaming agent 5<br>1M Sodium Permanganate 5<br>1M Strontium Nitrate 5 |

| Interfaces (Electrical) | |
|---|---|
| Power Supply Voltage (VAC, VDC) | N/A |
| Power Supply Frequency (Hz) | N/A |
| Power Connection Method | N/A |
| I/O Signals to/from Equipment | N/A |
| I/O Connection Method | N/A |

| Interfaces (Mechanical) | |
|---|---|
| Mounting Configuration (orientation) | Vertical |
| Mounting Method (bolts, welds, etc.) | Welded, Bolted Studs, FEP-SKID-00007A, FEP-SKID-00008A, 24590-PTF-DD-S13T-00027, 24590-PTF-DD-S13T-00028 |
| Auxiliary Devices | N/A |

**Equipment Seismic Qualification (ESQ)**

| Parameter | Title | Reference/Document Number | Version / Revision | Remarks |
|---|---|---|---|---|
| WTP Seismic Design Specification (BUYER) | Engineering Specification for seismic qualification criteria for pressrue vessels. | 24590-WTP-3PS-MV00-T0002 | 002 | None |
| Specified Seismic Load (BUYER) | Seismic Analysis of Pretreatment Building - WSGM In-Structure Response Spectre (ISRS) 5 | 24590-PTF-S0C-S15T-00057 5 | 00A 5 | Calculation is not included in MR, see attached figures 37, 38, 67, 68 and 24E per CCN 185267. 5 |
| Design Seismic Load (SELLER | Note 1 | Note 1 | Note 1 | Note 1 |
| Qualification Method (SELLER) | Note 1 | Note 1 | Note 1 | Note 1 |
| Qualification Report Number (SELLER) | Note 1 | Note 1 | Note 1 | Note 1 |
| Submittal Number (BUYER) | TBD | TBD | TBD | TBD |

## Notes and Additional Information

Notes

1. Data to be provided by SELLER through the submittal process as required on the G-321E.
2. Where pressure is given in inches of water column (in-w.c.) in the source document, it is generally assumed that this is in reference to atmospheric pressure and is therefore equivalent to inches of water gage (in-w.g.).
3. A shield plug is provided above the vessel for access to the demister pad section of the separator vessel.
4. Abnormal and DBE Radiation dose rates are set equal to normal and do not contribute to the total integrated dose.
5. Gamma radiation dose rate will not exceed 2.0 E+06 mRad/hr per CCN 175006. Beta radiation dose is 1.39 E+07 mRad/hr based on the ratio of Strontium-90 from reference 9 as compared to the Strontium-90 / Beta dose rate from reference 10, which is the bounding beta dose rate for the WTP project.
6. Submergence depth is determined from the lowest point of the vessel in relation to the flood height above the floor.
7. Environmental data given in reference 3 is for room environment only.
8. For application of AISC N690, the normal temperatures are not used. Abnormal temperatures shall be applied as Normal Operation Temperature, $T_O$, with seismic effects, $E_S$. The Design basis event temperature shall be applied as a Thermal Load generated by a postulated accident, $T_A$, without seismic effects, $E_s$ or $E_o$.
9. Deleted 5
10. Deleted 5
11. Abnormal low temperature, as calculated in reference 3, is based on a Loss of Heating Accident (LOHA) which occurs when steam supply to the building is lost. Since the evaporators are run on steam, this would cause the evaporators to go off-line. Abnormal low temperature will be based on reference 6 at 59°F.
12. Parameter value used on data sheet has been previously established and determined more conservative than values 5 derived from the reference document noted.
13. For commercial reasons, safety and seismic classification may be higher than elsewhere documented, and therefore 5 conservative.

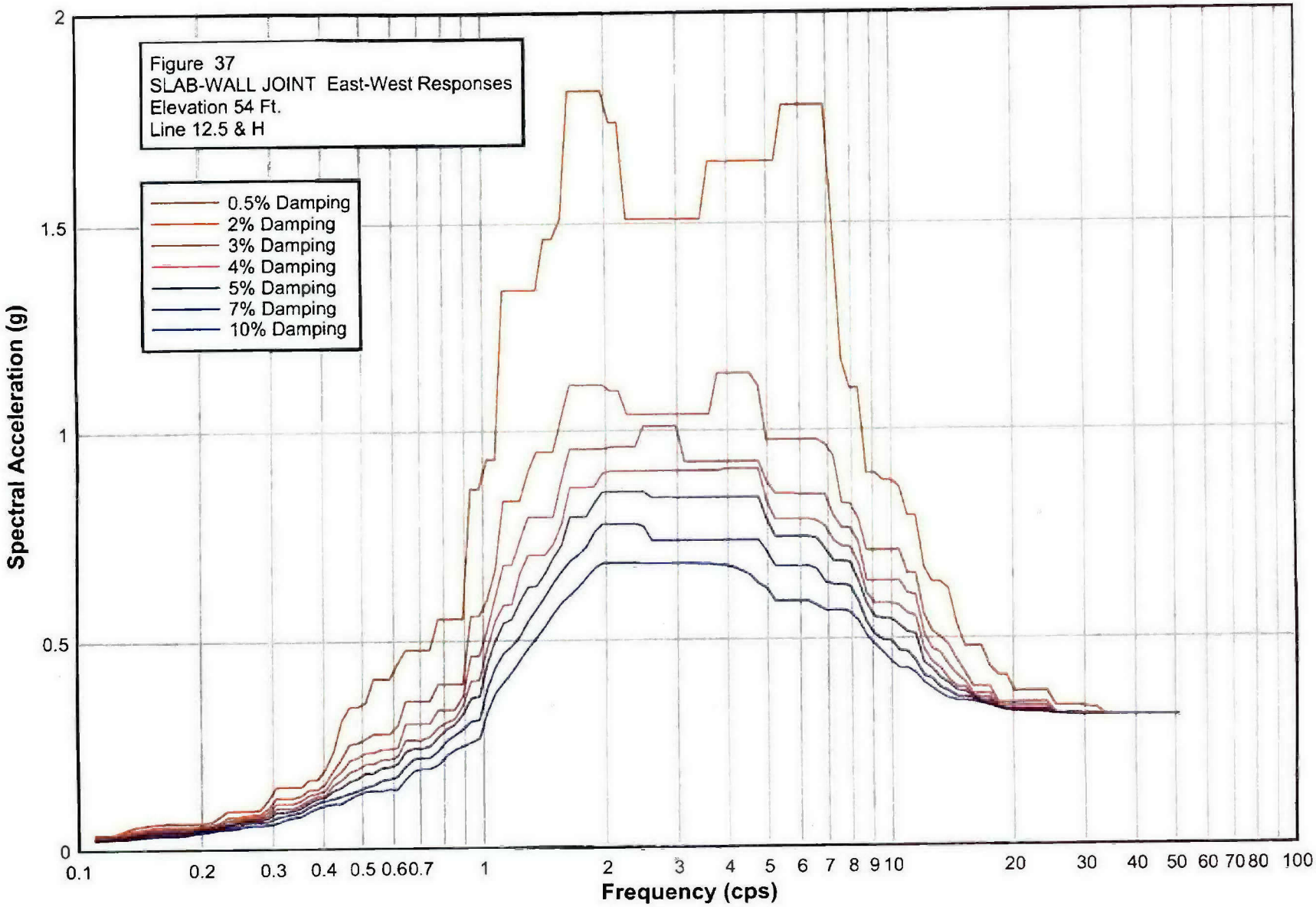
References

1. 24590-WTP-PSAR-ESH-01-002-02, Rev. 04A, Preliminary documented safety analysis to support construction 5 authorization; PT facility specific information.
2. CCN #096661, FEP and CNP Evaporator Vent Problems with New PVP Isolation Valve.
3. 24590-PTF-U0D-W16T-00001, Rev. 0, PTF Room Environment Datasheet.
4. 24590-PTF-DD-S13T-00027, Rev. 9, Pretreatment Facility Structural Concrete Embedments Plan El. 0'-0", Sh 5.
5. 24590-PTF-DD-S13T-00028, Rev. 15, Pretreatment Facility Structural Concrete Embedments Plan El. 0'-0", Sh 6.
6. 24590-WTP-DB-ENG-01-001, Rev. 1M, Basis Of Design. 5
7. 24590-PTF-U0N-W16T-00001, Add data for room P-0427. Incorporate additional steam break analysis. 5
8. 24590-PTF-U0N-W16T-00003, Revised temperature & relative humidity data for PTF rooms. 5
9. 24590-WTP-Z0C-50-00008, Rev. B, Comparison of Source Terms for use in Shielding Calculations.
10. 24590-LAB-Z0C-80-00001, Rev. D, Beta and Gamma Dose Rate Determinations from Laboratory Sample Bottles.

# RPP-WTP Pretreatment Facility ISRS

5

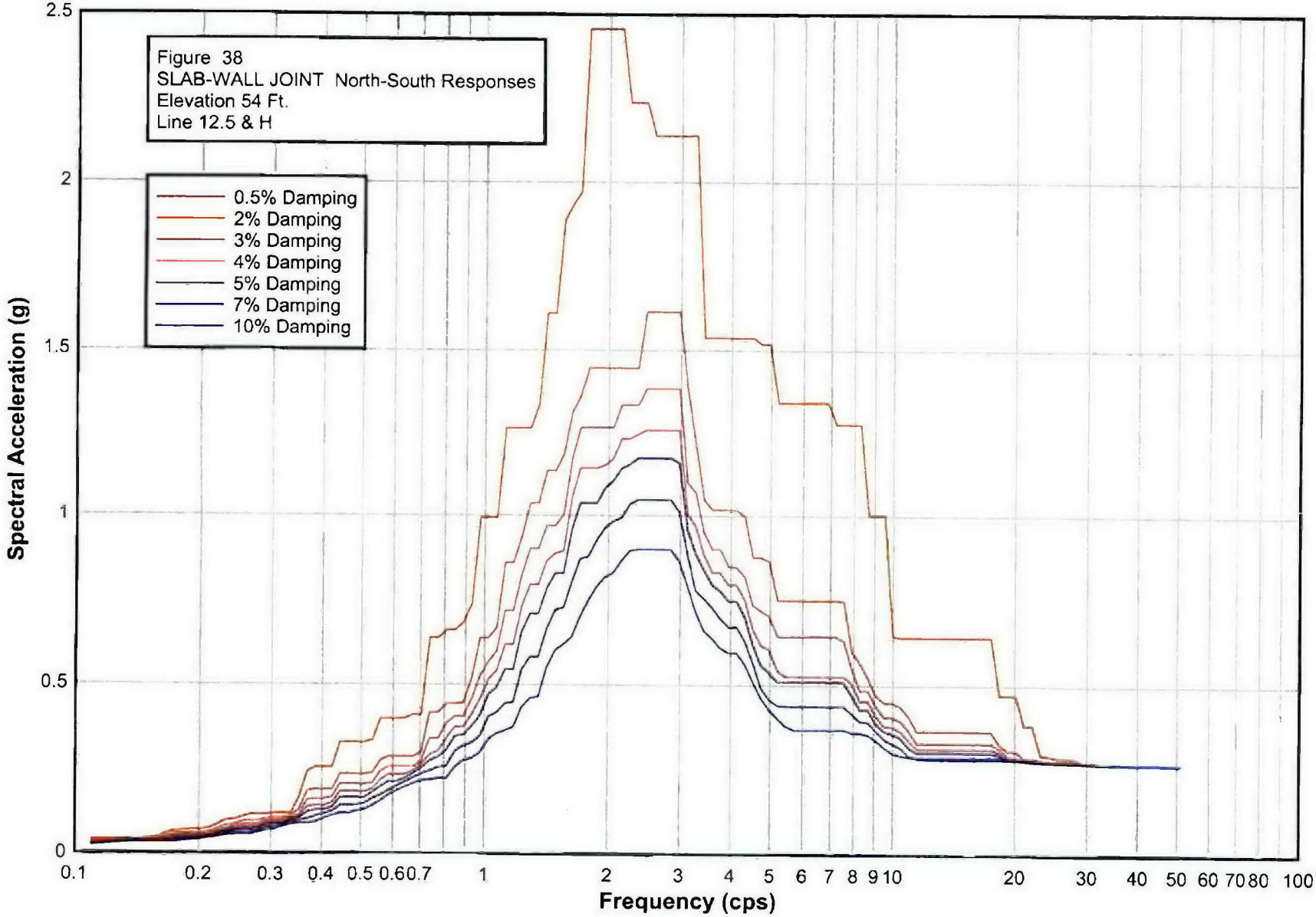
**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



# RPP-WTP Pretreatment Facility ISRS

5

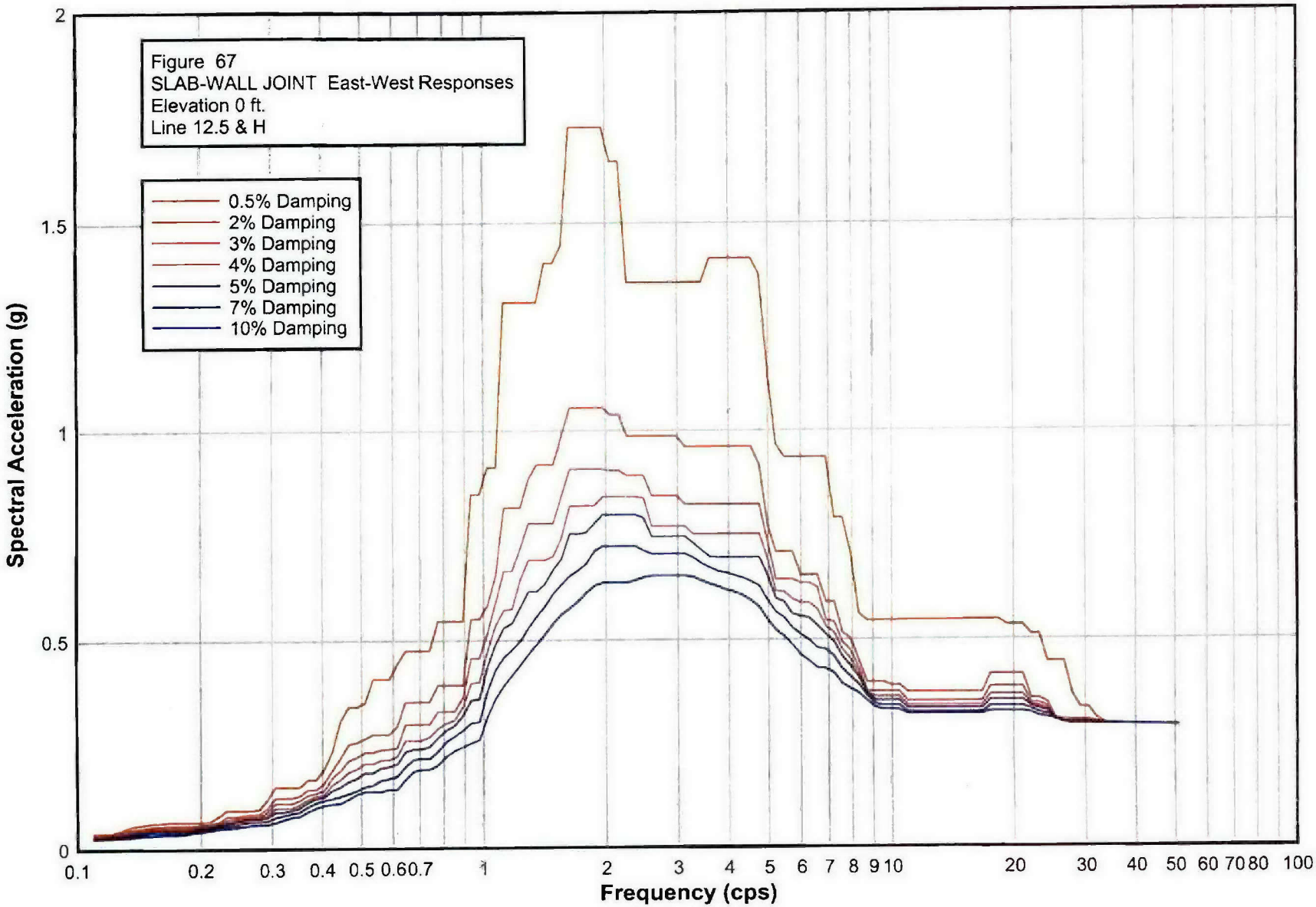
**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



# RPP-WTP Pretreatment Facility ISRS

5

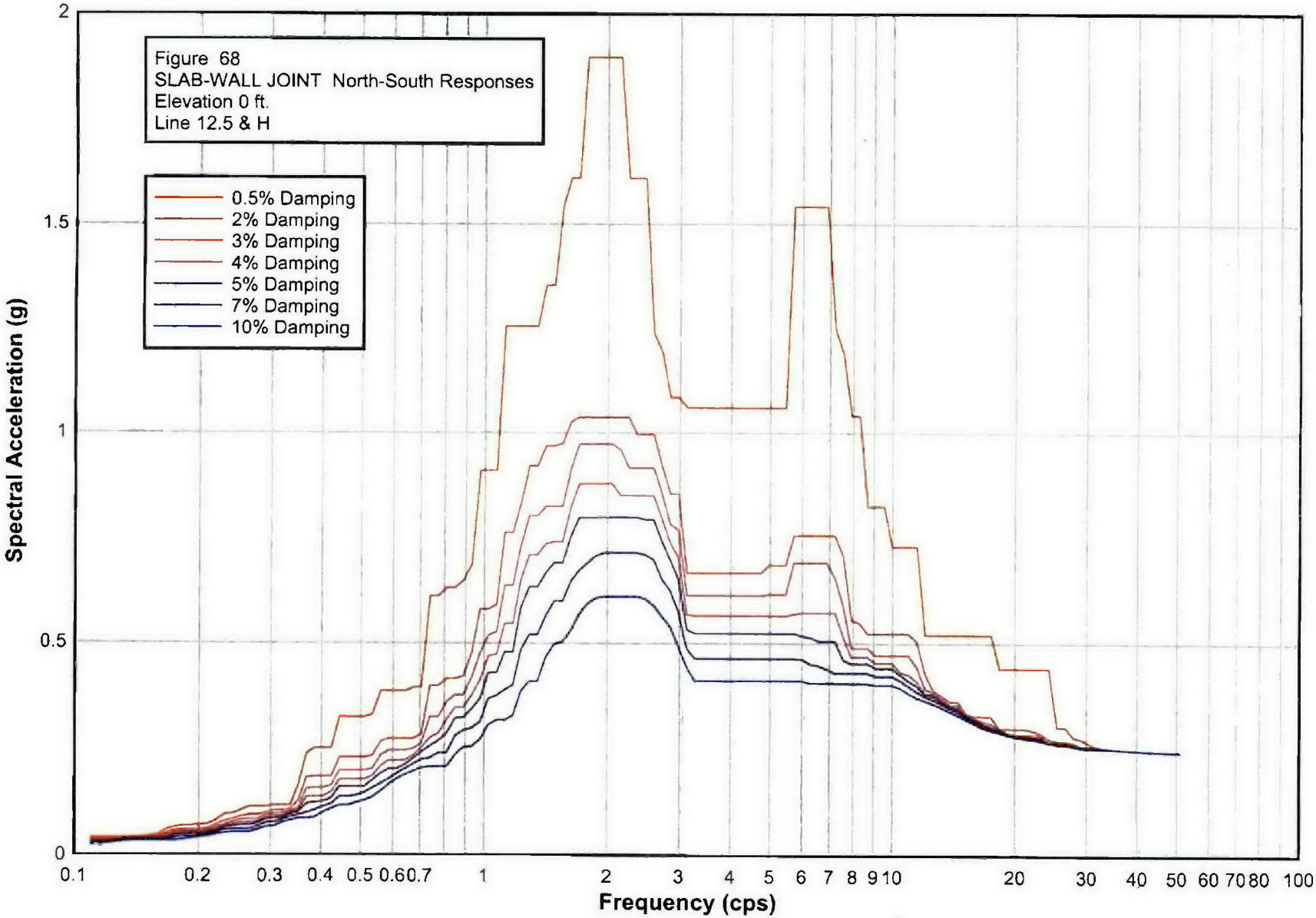
**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



# RPP-WTP Pretreatment Facility ISRS

5

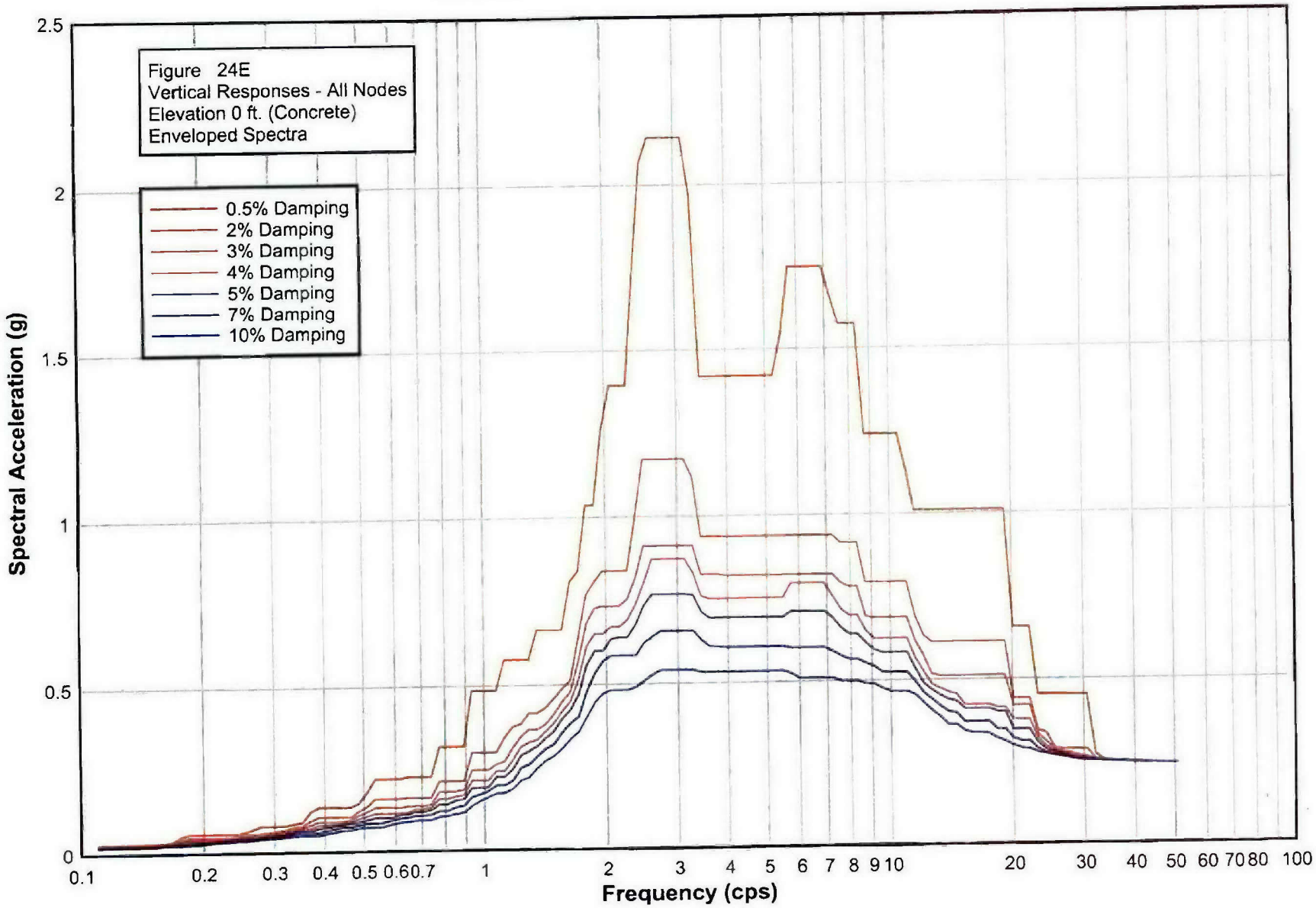
**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



# RPP-WTP Pretreatment Facility ISRS

5

**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



PTWW037.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 37 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.1098 | 0.0375 | 0.1098 | 0.0344 | 0.1098 | 0.0327 | 0.1098 | 0.0312 | 0.1098 | 0.0298 | 0.1098 | 0.0274 | 0.1098 | 0.0252 |
| 0.115 | 0.0375 | 0.115 | 0.0344 | 0.115 | 0.0327 | 0.115 | 0.0312 | 0.115 | 0.0299 | 0.115 | 0.0277 | 0.115 | 0.0258 |
| 0.1204 | 0.0375 | 0.1204 | 0.0344 | 0.1204 | 0.0331 | 0.1204 | 0.0322 | 0.1204 | 0.0312 | 0.1204 | 0.0294 | 0.1204 | 0.0269 |
| 0.1262 | 0.0431 | 0.1262 | 0.0397 | 0.1262 | 0.0378 | 0.1262 | 0.036 | 0.1262 | 0.0343 | 0.1262 | 0.0314 | 0.1262 | 0.0278 |
| 0.1322 | 0.0504 | 0.1322 | 0.045 | 0.1322 | 0.042 | 0.1322 | 0.0393 | 0.1322 | 0.0369 | 0.1322 | 0.0328 | 0.1322 | 0.0281 |
| 0.1385 | 0.056 | 0.1385 | 0.0489 | 0.1385 | 0.0449 | 0.1385 | 0.0414 | 0.1385 | 0.0384 | 0.1385 | 0.0344 | 0.1385 | 0.0303 |
| 0.1451 | 0.058 | 0.1451 | 0.0509 | 0.1451 | 0.0475 | 0.1451 | 0.0445 | 0.1451 | 0.0419 | 0.1451 | 0.0375 | 0.1451 | 0.0325 |
| 0.152 | 0.0616 | 0.152 | 0.0546 | 0.152 | 0.0506 | 0.152 | 0.0472 | 0.152 | 0.0442 | 0.152 | 0.0391 | 0.152 | 0.0338 |
| 0.1592 | 0.062 | 0.1592 | 0.0546 | 0.1592 | 0.0506 | 0.1592 | 0.0472 | 0.1592 | 0.0442 | 0.1592 | 0.0396 | 0.1592 | 0.0351 |
| 0.1668 | 0.064 | 0.1668 | 0.056 | 0.1668 | 0.0517 | 0.1668 | 0.0481 | 0.1668 | 0.0451 | 0.1668 | 0.0403 | 0.1668 | 0.0356 |
| 0.1748 | 0.064 | 0.1748 | 0.056 | 0.1748 | 0.0517 | 0.1748 | 0.0481 | 0.1748 | 0.0451 | 0.1748 | 0.0403 | 0.1748 | 0.0356 |
| 0.1831 | 0.064 | 0.1831 | 0.056 | 0.1831 | 0.0517 | 0.1831 | 0.0481 | 0.1831 | 0.0451 | 0.1831 | 0.0403 | 0.1831 | 0.0368 |
| 0.1918 | 0.0641 | 0.1918 | 0.0561 | 0.1918 | 0.0517 | 0.1918 | 0.0495 | 0.1918 | 0.0477 | 0.1918 | 0.0445 | 0.1918 | 0.0404 |
| 0.2009 | 0.0642 | 0.2009 | 0.0583 | 0.2009 | 0.0558 | 0.2009 | 0.0535 | 0.2009 | 0.0513 | 0.2009 | 0.0474 | 0.2009 | 0.0424 |
| 0.2105 | 0.0665 | 0.2105 | 0.0603 | 0.2105 | 0.0575 | 0.2105 | 0.0549 | 0.2105 | 0.0525 | 0.2105 | 0.049 | 0.2105 | 0.0448 |
| 0.2205 | 0.078 | 0.2205 | 0.0647 | 0.2205 | 0.062 | 0.2205 | 0.0595 | 0.2205 | 0.0573 | 0.2205 | 0.0533 | 0.2205 | 0.0484 |
| 0.231 | 0.0933 | 0.231 | 0.0774 | 0.231 | 0.0694 | 0.231 | 0.063 | 0.231 | 0.0598 | 0.231 | 0.0556 | 0.231 | 0.0503 |
| 0.242 | 0.0933 | 0.242 | 0.0774 | 0.242 | 0.0723 | 0.242 | 0.0678 | 0.242 | 0.0638 | 0.242 | 0.0567 | 0.242 | 0.0513 |
| 0.2535 | 0.0933 | 0.2535 | 0.0817 | 0.2535 | 0.0771 | 0.2535 | 0.0729 | 0.2535 | 0.0692 | 0.2535 | 0.0628 | 0.2535 | 0.0553 |
| 0.2656 | 0.0933 | 0.2656 | 0.0839 | 0.2656 | 0.0794 | 0.2656 | 0.0754 | 0.2656 | 0.0718 | 0.2656 | 0.0653 | 0.2656 | 0.0575 |
| 0.2783 | 0.0954 | 0.2783 | 0.0847 | 0.2783 | 0.0794 | 0.2783 | 0.0754 | 0.2783 | 0.0718 | 0.2783 | 0.0653 | 0.2783 | 0.058 |
| 0.2915 | 0.1187 | 0.2915 | 0.0987 | 0.2915 | 0.089 | 0.2915 | 0.0813 | 0.2915 | 0.0753 | 0.2915 | 0.0668 | 0.2915 | 0.0592 |
| 0.3054 | 0.1504 | 0.3054 | 0.1235 | 0.3054 | 0.1097 | 0.3054 | 0.0985 | 0.3054 | 0.0894 | 0.3054 | 0.0758 | 0.3054 | 0.0633 |
| 0.3199 | 0.1504 | 0.3199 | 0.1235 | 0.3199 | 0.1097 | 0.3199 | 0.0985 | 0.3199 | 0.0894 | 0.3199 | 0.0801 | 0.3199 | 0.0706 |
| 0.3352 | 0.1504 | 0.3352 | 0.1235 | 0.3352 | 0.1097 | 0.3352 | 0.0985 | 0.3352 | 0.0931 | 0.3352 | 0.0857 | 0.3352 | 0.0762 |
| 0.3511 | 0.1504 | 0.3511 | 0.1289 | 0.3511 | 0.1172 | 0.3511 | 0.107 | 0.3511 | 0.0997 | 0.3511 | 0.0894 | 0.3511 | 0.0786 |
| 0.3678 | 0.168 | 0.3678 | 0.1438 | 0.3678 | 0.1303 | 0.3678 | 0.1186 | 0.3678 | 0.1121 | 0.3678 | 0.1017 | 0.3678 | 0.0898 |
| 0.3853 | 0.168 | 0.3853 | 0.1438 | 0.3853 | 0.1346 | 0.3853 | 0.1279 | 0.3853 | 0.1219 | 0.3853 | 0.1115 | 0.3853 | 0.0992 |
| 0.4037 | 0.194 | 0.4037 | 0.1598 | 0.4037 | 0.1426 | 0.4037 | 0.1306 | 0.4037 | 0.1259 | 0.4037 | 0.117 | 0.4037 | 0.1054 |
| 0.4229 | 0.2368 | 0.4229 | 0.1906 | 0.4229 | 0.1721 | 0.4229 | 0.1558 | 0.4229 | 0.1416 | 0.4229 | 0.1217 | 0.4229 | 0.1092 |
| 0.4431 | 0.3088 | 0.4431 | 0.2193 | 0.4431 | 0.1881 | 0.4431 | 0.1671 | 0.4431 | 0.1496 | 0.4431 | 0.1273 | 0.4431 | 0.1097 |
| 0.4642 | 0.3417 | 0.4642 | 0.2524 | 0.4642 | 0.2138 | 0.4642 | 0.1852 | 0.4642 | 0.1637 | 0.4642 | 0.1345 | 0.4642 | 0.1211 |
| 0.4863 | 0.3417 | 0.4863 | 0.256 | 0.4863 | 0.2208 | 0.4863 | 0.1928 | 0.4863 | 0.1701 | 0.4863 | 0.1409 | 0.4863 | 0.1323 |
| 0.5094 | 0.3522 | 0.5094 | 0.2656 | 0.5094 | 0.2325 | 0.5094 | 0.2054 | 0.5094 | 0.1831 | 0.5094 | 0.1497 | 0.5094 | 0.1391 |

PTWW037.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 37 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5337 | 0.4096 | 0.5337 | 0.2771 | 0.5337 | 0.2325 | 0.5337 | 0.2054 | 0.5337 | 0.1831 | 0.5337 | 0.1539 | 0.5337 | 0.1396 |
| 0.5591 | 0.4096 | 0.5591 | 0.2771 | 0.5591 | 0.2398 | 0.5591 | 0.2148 | 0.5591 | 0.1949 | 0.5591 | 0.1654 | 0.5591 | 0.1396 |
| 0.5857 | 0.4096 | 0.5857 | 0.2771 | 0.5857 | 0.2404 | 0.5857 | 0.2159 | 0.5857 | 0.1975 | 0.5857 | 0.1686 | 0.5857 | 0.1441 |
| 0.6136 | 0.4475 | 0.6136 | 0.2969 | 0.6136 | 0.2444 | 0.6136 | 0.2234 | 0.6136 | 0.2051 | 0.6136 | 0.1751 | 0.6136 | 0.1441 |
| 0.6428 | 0.478 | 0.6428 | 0.3547 | 0.6428 | 0.3006 | 0.6428 | 0.2612 | 0.6428 | 0.2347 | 0.6428 | 0.1988 | 0.6428 | 0.168 |
| 0.6734 | 0.478 | 0.6734 | 0.3547 | 0.6734 | 0.3006 | 0.6734 | 0.2612 | 0.6734 | 0.2413 | 0.6734 | 0.2165 | 0.6734 | 0.1872 |
| 0.7055 | 0.478 | 0.7055 | 0.3547 | 0.7055 | 0.3006 | 0.7055 | 0.2612 | 0.7055 | 0.2413 | 0.7055 | 0.2186 | 0.7055 | 0.1922 |
| 0.7391 | 0.478 | 0.7391 | 0.3547 | 0.7391 | 0.3006 | 0.7391 | 0.2692 | 0.7391 | 0.2463 | 0.7391 | 0.2186 | 0.7391 | 0.1922 |
| 0.7743 | 0.5518 | 0.7743 | 0.3958 | 0.7743 | 0.3332 | 0.7743 | 0.2918 | 0.7743 | 0.268 | 0.7743 | 0.2351 | 0.7743 | 0.2018 |
| 0.8111 | 0.5518 | 0.8111 | 0.3958 | 0.8111 | 0.3332 | 0.8111 | 0.3035 | 0.8111 | 0.2874 | 0.8111 | 0.2587 | 0.8111 | 0.2236 |
| 0.8497 | 0.5518 | 0.8497 | 0.3958 | 0.8497 | 0.3332 | 0.8497 | 0.3117 | 0.8497 | 0.2984 | 0.8497 | 0.2723 | 0.8497 | 0.2373 |
| 0.8902 | 0.5518 | 0.8902 | 0.3958 | 0.8902 | 0.3656 | 0.8902 | 0.3431 | 0.8902 | 0.3226 | 0.8902 | 0.2873 | 0.8902 | 0.2462 |
| 0.9326 | 0.8605 | 0.9326 | 0.5585 | 0.9326 | 0.4629 | 0.9326 | 0.4023 | 0.9326 | 0.3602 | 0.9326 | 0.3049 | 0.9326 | 0.2549 |
| 0.977 | 0.8605 | 0.977 | 0.5585 | 0.977 | 0.4629 | 0.977 | 0.4045 | 0.977 | 0.3644 | 0.977 | 0.3083 | 0.977 | 0.2637 |
| 1.0235 | 0.9315 | 1.0235 | 0.5965 | 1.0235 | 0.5261 | 1.0235 | 0.4814 | 1.0235 | 0.4436 | 1.0235 | 0.3837 | 1.0235 | 0.3277 |
| 1.0723 | 0.9315 | 1.0723 | 0.6685 | 1.0723 | 0.603 | 1.0723 | 0.5467 | 1.0723 | 0.4995 | 1.0723 | 0.4355 | 1.0723 | 0.3729 |
| 1.1233 | 1.3398 | 1.1233 | 0.8315 | 1.1233 | 0.6788 | 1.1233 | 0.5837 | 1.1233 | 0.5408 | 1.1233 | 0.4681 | 1.1233 | 0.3987 |
| 1.1768 | 1.3398 | 1.1768 | 0.8315 | 1.1768 | 0.6788 | 1.1768 | 0.5855 | 1.1768 | 0.5505 | 1.1768 | 0.4858 | 1.1768 | 0.4238 |
| 1.2328 | 1.3398 | 1.2328 | 0.8315 | 1.2328 | 0.7369 | 1.2328 | 0.6596 | 1.2328 | 0.5925 | 1.2328 | 0.5105 | 1.2328 | 0.452 |
| 1.2916 | 1.3398 | 1.2916 | 0.9002 | 1.2916 | 0.7926 | 1.2916 | 0.7024 | 1.2916 | 0.6263 | 1.2916 | 0.5455 | 1.2916 | 0.4806 |
| 1.353 | 1.3398 | 1.353 | 0.9485 | 1.353 | 0.7926 | 1.353 | 0.7024 | 1.353 | 0.6282 | 1.353 | 0.574 | 1.353 | 0.5058 |
| 1.4175 | 1.4626 | 1.4175 | 0.9485 | 1.4175 | 0.7926 | 1.4175 | 0.7024 | 1.4175 | 0.6579 | 1.4175 | 0.6026 | 1.4175 | 0.5321 |
| 1.485 | 1.4626 | 1.485 | 0.9485 | 1.485 | 0.7926 | 1.485 | 0.7282 | 1.485 | 0.6958 | 1.485 | 0.636 | 1.485 | 0.5624 |
| 1.5557 | 1.5113 | 1.5557 | 1.0297 | 1.5557 | 0.8797 | 1.5557 | 0.7754 | 1.5557 | 0.726 | 1.5557 | 0.6634 | 1.5557 | 0.5886 |
| 1.6298 | 1.8158 | 1.6298 | 1.1086 | 1.6298 | 0.9552 | 1.6298 | 0.8627 | 1.6298 | 0.7931 | 1.6298 | 0.6875 | 1.6298 | 0.6064 |
| 1.7074 | 1.8158 | 1.7074 | 1.1086 | 1.7074 | 0.9552 | 1.7074 | 0.8627 | 1.7074 | 0.7931 | 1.7074 | 0.7024 | 1.7074 | 0.6246 |
| 1.7887 | 1.8158 | 1.7887 | 1.1086 | 1.7887 | 0.9552 | 1.7887 | 0.8627 | 1.7887 | 0.7931 | 1.7887 | 0.7213 | 1.7887 | 0.6476 |
| 1.8738 | 1.8158 | 1.8738 | 1.1086 | 1.8738 | 0.9552 | 1.8738 | 0.8651 | 1.8738 | 0.8263 | 1.8738 | 0.7567 | 1.8738 | 0.6698 |
| 1.963 | 1.8158 | 1.963 | 1.1086 | 1.963 | 0.9552 | 1.963 | 0.8972 | 1.963 | 0.8525 | 1.963 | 0.7755 | 1.963 | 0.683 |
| 2.0565 | 1.7414 | 2.0565 | 1.0948 | 2.0565 | 0.9593 | 2.0565 | 0.9017 | 2.0565 | 0.8525 | 2.0565 | 0.7755 | 2.0565 | 0.683 |
| 2.1544 | 1.7414 | 2.1544 | 1.0948 | 2.1544 | 0.9593 | 2.1544 | 0.9017 | 2.1544 | 0.8525 | 2.1544 | 0.7755 | 2.1544 | 0.683 |
| 2.257 | 1.5091 | 2.257 | 1.0367 | 2.257 | 0.9593 | 2.257 | 0.9017 | 2.257 | 0.8525 | 2.257 | 0.7755 | 2.257 | 0.683 |
| 2.3645 | 1.5091 | 2.3645 | 1.0367 | 2.3645 | 0.9593 | 2.3645 | 0.9017 | 2.3645 | 0.8525 | 2.3645 | 0.7755 | 2.3645 | 0.683 |
| 2.4771 | 1.5091 | 2.4771 | 1.0367 | 2.4771 | 1.009 | 2.4771 | 0.9017 | 2.4771 | 0.852 | 2.4771 | 0.7697 | 2.4771 | 0.6811 |
| 2.595 | 1.5091 | 2.595 | 1.0367 | 2.595 | 1.009 | 2.595 | 0.9017 | 2.595 | 0.8387 | 2.595 | 0.7357 | 2.595 | 0.6811 |

PTWW037.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 37 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.7186 | 1.5091 | 2.7186 | 1.0367 | 2.7186 | 1.009 | 2.7186 | 0.9017 | 2.7186 | 0.8387 | 2.7186 | 0.7357 | 2.7186 | 0.6811 |
| 2.848 | 1.5091 | 2.848 | 1.0367 | 2.848 | 1.009 | 2.848 | 0.9017 | 2.848 | 0.8387 | 2.848 | 0.7357 | 2.848 | 0.6811 |
| 2.9836 | 1.5091 | 2.9836 | 1.0367 | 2.9836 | 1.009 | 2.9836 | 0.9017 | 2.9836 | 0.8387 | 2.9836 | 0.7357 | 2.9836 | 0.6811 |
| 3.1257 | 1.5091 | 3.1257 | 1.0367 | 3.1257 | 0.9237 | 3.1257 | 0.9017 | 3.1257 | 0.8387 | 3.1257 | 0.7357 | 3.1257 | 0.6811 |
| 3.2745 | 1.5091 | 3.2745 | 1.0367 | 3.2745 | 0.9237 | 3.2745 | 0.9017 | 3.2745 | 0.8387 | 3.2745 | 0.7357 | 3.2745 | 0.6811 |
| 3.4305 | 1.5091 | 3.4305 | 1.0367 | 3.4305 | 0.9237 | 3.4305 | 0.9017 | 3.4305 | 0.8387 | 3.4305 | 0.7357 | 3.4305 | 0.6801 |
| 3.5938 | 1.6472 | 3.5938 | 1.0367 | 3.5938 | 0.9237 | 3.5938 | 0.9017 | 3.5938 | 0.8387 | 3.5938 | 0.7357 | 3.5938 | 0.6801 |
| 3.7649 | 1.6472 | 3.7649 | 1.1356 | 3.7649 | 0.9237 | 3.7649 | 0.9017 | 3.7649 | 0.8387 | 3.7649 | 0.7357 | 3.7649 | 0.6766 |
| 3.9442 | 1.6472 | 3.9442 | 1.1356 | 3.9442 | 0.9237 | 3.9442 | 0.906 | 3.9442 | 0.8387 | 3.9442 | 0.7357 | 3.9442 | 0.6759 |
| 4.132 | 1.6472 | 4.132 | 1.1356 | 4.132 | 0.9237 | 4.132 | 0.906 | 4.132 | 0.8387 | 4.132 | 0.7357 | 4.132 | 0.6712 |
| 4.3288 | 1.6472 | 4.3288 | 1.1356 | 4.3288 | 0.9237 | 4.3288 | 0.906 | 4.3288 | 0.8387 | 4.3288 | 0.7357 | 4.3288 | 0.6626 |
| 4.5349 | 1.6472 | 4.5349 | 1.1356 | 4.5349 | 0.9237 | 4.5349 | 0.906 | 4.5349 | 0.8387 | 4.5349 | 0.7357 | 4.5349 | 0.6525 |
| 4.7508 | 1.6472 | 4.7508 | 1.1048 | 4.7508 | 0.9237 | 4.7508 | 0.906 | 4.7508 | 0.8387 | 4.7508 | 0.7357 | 4.7508 | 0.6316 |
| 4.977 | 1.6472 | 4.977 | 0.9746 | 4.977 | 0.8757 | 4.977 | 0.829 | 4.977 | 0.7851 | 4.977 | 0.7083 | 4.977 | 0.6206 |
| 5.214 | 1.6472 | 5.214 | 0.9746 | 5.214 | 0.8463 | 5.214 | 0.785 | 5.214 | 0.7434 | 5.214 | 0.6732 | 5.214 | 0.5898 |
| 5.4623 | 1.7798 | 5.4623 | 0.9746 | 5.4623 | 0.8463 | 5.4623 | 0.785 | 5.4623 | 0.7434 | 5.4623 | 0.6732 | 5.4623 | 0.5898 |
| 5.7224 | 1.7798 | 5.7224 | 0.9746 | 5.7224 | 0.8463 | 5.7224 | 0.785 | 5.7224 | 0.7434 | 5.7224 | 0.6732 | 5.7224 | 0.5898 |
| 5.9948 | 1.7798 | 5.9948 | 0.9746 | 5.9948 | 0.8438 | 5.9948 | 0.785 | 5.9948 | 0.7434 | 5.9948 | 0.6732 | 5.9948 | 0.5898 |
| 6.2803 | 1.7798 | 6.2803 | 0.9746 | 6.2803 | 0.8438 | 6.2803 | 0.785 | 6.2803 | 0.7434 | 6.2803 | 0.6732 | 6.2803 | 0.5898 |
| 6.5793 | 1.7798 | 6.5793 | 0.9746 | 6.5793 | 0.8438 | 6.5793 | 0.7804 | 6.5793 | 0.7393 | 6.5793 | 0.6657 | 6.5793 | 0.5795 |
| 6.8926 | 1.7798 | 6.8926 | 0.963 | 6.8926 | 0.8429 | 6.8926 | 0.7674 | 6.8926 | 0.7128 | 6.8926 | 0.6345 | 6.8926 | 0.5677 |
| 7.2208 | 1.4914 | 7.2208 | 0.935 | 7.2208 | 0.7922 | 7.2208 | 0.7331 | 7.2208 | 0.6844 | 7.2208 | 0.6283 | 7.2208 | 0.5677 |
| 7.5646 | 1.168 | 7.5646 | 0.822 | 7.5646 | 0.7632 | 7.5646 | 0.7188 | 7.5646 | 0.6833 | 7.5646 | 0.6283 | 7.5646 | 0.5677 |
| 7.9248 | 1.0987 | 7.9248 | 0.8201 | 7.9248 | 0.7623 | 7.9248 | 0.7176 | 7.9248 | 0.6811 | 7.9248 | 0.6237 | 7.9248 | 0.5627 |
| 8.3022 | 1.0987 | 8.3022 | 0.7845 | 8.3022 | 0.7283 | 8.3022 | 0.6777 | 8.3022 | 0.6364 | 8.3022 | 0.5884 | 8.3022 | 0.5417 |
| 8.6975 | 0.8935 | 8.6975 | 0.7092 | 8.6975 | 0.6368 | 8.6975 | 0.6061 | 8.6975 | 0.5819 | 8.6975 | 0.5373 | 8.6975 | 0.5059 |
| 9.1116 | 0.8935 | 9.1116 | 0.7092 | 9.1116 | 0.6368 | 9.1116 | 0.5827 | 9.1116 | 0.5505 | 9.1116 | 0.5085 | 9.1116 | 0.4846 |
| 9.5455 | 0.8763 | 9.5455 | 0.7092 | 9.5455 | 0.6368 | 9.5455 | 0.5827 | 9.5455 | 0.5459 | 9.5455 | 0.4951 | 9.5455 | 0.4643 |
| 10 | 0.8763 | 10 | 0.7092 | 10 | 0.6368 | 10 | 0.5827 | 10 | 0.5459 | 10 | 0.4934 | 10 | 0.4429 |
| 10.4762 | 0.8603 | 10.4762 | 0.7092 | 10.4762 | 0.6368 | 10.4762 | 0.5774 | 10.4762 | 0.5297 | 10.4762 | 0.4688 | 10.4762 | 0.4271 |
| 10.975 | 0.791 | 10.975 | 0.6543 | 10.975 | 0.6067 | 10.975 | 0.5582 | 10.975 | 0.5137 | 10.975 | 0.4674 | 10.975 | 0.4271 |
| 11.4976 | 0.791 | 11.4976 | 0.6543 | 11.4976 | 0.6014 | 11.4976 | 0.5519 | 11.4976 | 0.5094 | 11.4976 | 0.4435 | 11.4976 | 0.4142 |
| 12.045 | 0.6677 | 12.045 | 0.5543 | 12.045 | 0.5086 | 12.045 | 0.4716 | 12.045 | 0.4394 | 12.045 | 0.4081 | 12.045 | 0.3915 |
| 12.6186 | 0.6325 | 12.6186 | 0.5145 | 12.6186 | 0.4727 | 12.6186 | 0.4409 | 12.6186 | 0.4251 | 12.6186 | 0.4004 | 12.6186 | 0.3774 |
| 13.2194 | 0.6325 | 13.2194 | 0.5025 | 13.2194 | 0.4639 | 13.2194 | 0.4269 | 13.2194 | 0.4021 | 13.2194 | 0.379 | 13.2194 | 0.3634 |

PTWW037.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 37 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 0.6152 | 13.8489 | 0.4815 | 13.8489 | 0.433 | 13.8489 | 0.3995 | 13.8489 | 0.3896 | 13.8489 | 0.3705 | 13.8489 | 0.3527 |
| 14.5083 | 0.5318 | 14.5083 | 0.4455 | 14.5083 | 0.4096 | 14.5083 | 0.381 | 14.5083 | 0.3726 | 14.5083 | 0.3575 | 14.5083 | 0.3484 |
| 15.1991 | 0.4787 | 15.1991 | 0.4141 | 15.1991 | 0.3936 | 15.1991 | 0.3795 | 15.1991 | 0.3697 | 15.1991 | 0.3575 | 15.1991 | 0.3484 |
| 15.9228 | 0.4787 | 15.9228 | 0.3815 | 15.9228 | 0.3644 | 15.9228 | 0.3609 | 15.9228 | 0.358 | 15.9228 | 0.3528 | 15.9228 | 0.3467 |
| 16.681 | 0.4787 | 16.681 | 0.3815 | 16.681 | 0.3644 | 16.681 | 0.3544 | 16.681 | 0.3483 | 16.681 | 0.3439 | 16.681 | 0.3416 |
| 17.4753 | 0.4307 | 17.4753 | 0.3815 | 17.4753 | 0.3644 | 17.4753 | 0.3544 | 17.4753 | 0.3483 | 17.4753 | 0.3418 | 17.4753 | 0.337 |
| 18.3074 | 0.4095 | 18.3074 | 0.3431 | 18.3074 | 0.3367 | 18.3074 | 0.3354 | 18.3074 | 0.3336 | 18.3074 | 0.3315 | 18.3074 | 0.3305 |
| 19.1791 | 0.4095 | 19.1791 | 0.3431 | 19.1791 | 0.3349 | 19.1791 | 0.3293 | 19.1791 | 0.3262 | 19.1791 | 0.3251 | 19.1791 | 0.325 |
| 20.0923 | 0.3708 | 20.0923 | 0.3431 | 20.0923 | 0.3349 | 20.0923 | 0.3293 | 20.0923 | 0.3262 | 20.0923 | 0.3243 | 20.0923 | 0.323 |
| 21.049 | 0.3708 | 21.049 | 0.3431 | 21.049 | 0.3349 | 21.049 | 0.3293 | 21.049 | 0.3262 | 21.049 | 0.3236 | 21.049 | 0.3215 |
| 22.0513 | 0.3708 | 22.0513 | 0.3431 | 22.0513 | 0.3349 | 22.0513 | 0.3293 | 22.0513 | 0.3262 | 22.0513 | 0.323 | 22.0513 | 0.3199 |
| 23.1013 | 0.3708 | 23.1013 | 0.3431 | 23.1013 | 0.3349 | 23.1013 | 0.3293 | 23.1013 | 0.3262 | 23.1013 | 0.323 | 23.1013 | 0.3199 |
| 24.2013 | 0.3708 | 24.2013 | 0.3431 | 24.2013 | 0.3349 | 24.2013 | 0.3293 | 24.2013 | 0.3255 | 24.2013 | 0.3206 | 24.2013 | 0.3186 |
| 25.3536 | 0.3358 | 25.3536 | 0.3197 | 25.3536 | 0.3192 | 25.3536 | 0.3187 | 25.3536 | 0.3181 | 25.3536 | 0.317 | 25.3536 | 0.3164 |
| 26.5609 | 0.3358 | 26.5609 | 0.3169 | 26.5609 | 0.3159 | 26.5609 | 0.3158 | 26.5609 | 0.3158 | 26.5609 | 0.3155 | 26.5609 | 0.3148 |
| 27.8256 | 0.3358 | 27.8256 | 0.3169 | 27.8256 | 0.3159 | 27.8256 | 0.3153 | 27.8256 | 0.3149 | 27.8256 | 0.3143 | 27.8256 | 0.3137 |
| 29.1505 | 0.3358 | 29.1505 | 0.3165 | 29.1505 | 0.3153 | 29.1505 | 0.3142 | 29.1505 | 0.3137 | 29.1505 | 0.3132 | 29.1505 | 0.313 |
| 30.5386 | 0.3312 | 30.5386 | 0.3165 | 30.5386 | 0.3153 | 30.5386 | 0.3142 | 30.5386 | 0.3133 | 30.5386 | 0.3131 | 30.5386 | 0.313 |
| 31.9927 | 0.3297 | 31.9927 | 0.3163 | 31.9927 | 0.3146 | 31.9927 | 0.3138 | 31.9927 | 0.3132 | 31.9927 | 0.3131 | 31.9927 | 0.313 |
| 33.516 | 0.3144 | 33.516 | 0.3134 | 33.516 | 0.3133 | 33.516 | 0.3132 | 33.516 | 0.3132 | 33.516 | 0.3131 | 33.516 | 0.313 |
| 35.1119 | 0.3135 | 35.1119 | 0.3134 | 35.1119 | 0.3133 | 35.1119 | 0.3132 | 35.1119 | 0.3132 | 35.1119 | 0.3131 | 35.1119 | 0.313 |
| 36.7838 | 0.3134 | 36.7838 | 0.3133 | 36.7838 | 0.3132 | 36.7838 | 0.3132 | 36.7838 | 0.3132 | 36.7838 | 0.3131 | 36.7838 | 0.313 |
| 38.5353 | 0.3132 | 38.5353 | 0.3132 | 38.5353 | 0.3131 | 38.5353 | 0.3131 | 38.5353 | 0.3131 | 38.5353 | 0.3131 | 38.5353 | 0.313 |
| 40.3702 | 0.3131 | 40.3702 | 0.3131 | 40.3702 | 0.3131 | 40.3702 | 0.313 | 40.3702 | 0.313 | 40.3702 | 0.313 | 40.3702 | 0.3129 |
| 42.2924 | 0.313 | 42.2924 | 0.3129 | 42.2924 | 0.3129 | 42.2924 | 0.3129 | 42.2924 | 0.3129 | 42.2924 | 0.3129 | 42.2924 | 0.3129 |
| 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 |
| 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 |
| 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 |
| 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 |

PTWW038.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 38 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.1098 | 0.0405 | 0.1098 | 0.0365 | 0.1098 | 0.0342 | 0.1098 | 0.0322 | 0.1098 | 0.0303 | 0.1098 | 0.0272 | 0.1098 | 0.0235 |
| 0.115 | 0.0405 | 0.115 | 0.0365 | 0.115 | 0.0342 | 0.115 | 0.0322 | 0.115 | 0.0303 | 0.115 | 0.0272 | 0.115 | 0.0259 |
| 0.1204 | 0.0405 | 0.1204 | 0.0365 | 0.1204 | 0.0342 | 0.1204 | 0.0322 | 0.1204 | 0.031 | 0.1204 | 0.0297 | 0.1204 | 0.028 |
| 0.1262 | 0.0405 | 0.1262 | 0.0365 | 0.1262 | 0.0352 | 0.1262 | 0.0342 | 0.1262 | 0.0334 | 0.1262 | 0.0318 | 0.1262 | 0.0297 |
| 0.1322 | 0.0405 | 0.1322 | 0.0382 | 0.1322 | 0.037 | 0.1322 | 0.0359 | 0.1322 | 0.0349 | 0.1322 | 0.0333 | 0.1322 | 0.0316 |
| 0.1385 | 0.0411 | 0.1385 | 0.0392 | 0.1385 | 0.0382 | 0.1385 | 0.0372 | 0.1385 | 0.0363 | 0.1385 | 0.0348 | 0.1385 | 0.0328 |
| 0.1451 | 0.0417 | 0.1451 | 0.0398 | 0.1451 | 0.0387 | 0.1451 | 0.0377 | 0.1451 | 0.0368 | 0.1451 | 0.0352 | 0.1451 | 0.0332 |
| 0.152 | 0.0439 | 0.152 | 0.0401 | 0.152 | 0.0387 | 0.152 | 0.0377 | 0.152 | 0.0368 | 0.152 | 0.0352 | 0.152 | 0.0332 |
| 0.1592 | 0.0462 | 0.1592 | 0.0416 | 0.1592 | 0.0396 | 0.1592 | 0.0377 | 0.1592 | 0.0368 | 0.1592 | 0.0352 | 0.1592 | 0.0332 |
| 0.1668 | 0.0584 | 0.1668 | 0.0506 | 0.1668 | 0.0463 | 0.1668 | 0.0426 | 0.1668 | 0.0395 | 0.1668 | 0.0352 | 0.1668 | 0.0332 |
| 0.1748 | 0.0645 | 0.1748 | 0.0566 | 0.1748 | 0.0522 | 0.1748 | 0.0484 | 0.1748 | 0.045 | 0.1748 | 0.0394 | 0.1748 | 0.0332 |
| 0.1831 | 0.0668 | 0.1831 | 0.0583 | 0.1831 | 0.0541 | 0.1831 | 0.0504 | 0.1831 | 0.0471 | 0.1831 | 0.0415 | 0.1831 | 0.0354 |
| 0.1918 | 0.0678 | 0.1918 | 0.0586 | 0.1918 | 0.0543 | 0.1918 | 0.0507 | 0.1918 | 0.0474 | 0.1918 | 0.0418 | 0.1918 | 0.038 |
| 0.2009 | 0.0697 | 0.2009 | 0.0596 | 0.2009 | 0.0543 | 0.2009 | 0.0514 | 0.2009 | 0.0487 | 0.2009 | 0.0438 | 0.2009 | 0.0411 |
| 0.2105 | 0.0722 | 0.2105 | 0.062 | 0.2105 | 0.0582 | 0.2105 | 0.0547 | 0.2105 | 0.0516 | 0.2105 | 0.0482 | 0.2105 | 0.0446 |
| 0.2205 | 0.0819 | 0.2205 | 0.0709 | 0.2205 | 0.0651 | 0.2205 | 0.06 | 0.2205 | 0.0574 | 0.2205 | 0.0531 | 0.2205 | 0.0475 |
| 0.231 | 0.0959 | 0.231 | 0.0792 | 0.231 | 0.0703 | 0.231 | 0.0665 | 0.231 | 0.063 | 0.231 | 0.0578 | 0.231 | 0.0525 |
| 0.242 | 0.0984 | 0.242 | 0.0845 | 0.242 | 0.0774 | 0.242 | 0.0721 | 0.242 | 0.0681 | 0.242 | 0.0618 | 0.242 | 0.0551 |
| 0.2535 | 0.1059 | 0.2535 | 0.0913 | 0.2535 | 0.0833 | 0.2535 | 0.0763 | 0.2535 | 0.0702 | 0.2535 | 0.0618 | 0.2535 | 0.0551 |
| 0.2656 | 0.1138 | 0.2656 | 0.0944 | 0.2656 | 0.084 | 0.2656 | 0.0763 | 0.2656 | 0.0702 | 0.2656 | 0.0618 | 0.2656 | 0.0551 |
| 0.2783 | 0.1138 | 0.2783 | 0.0944 | 0.2783 | 0.084 | 0.2783 | 0.0779 | 0.2783 | 0.074 | 0.2783 | 0.0677 | 0.2783 | 0.0611 |
| 0.2915 | 0.1138 | 0.2915 | 0.1008 | 0.2915 | 0.0946 | 0.2915 | 0.0892 | 0.2915 | 0.0843 | 0.2915 | 0.0764 | 0.2915 | 0.0677 |
| 0.3054 | 0.1179 | 0.3054 | 0.1056 | 0.3054 | 0.0987 | 0.3054 | 0.0926 | 0.3054 | 0.0872 | 0.3054 | 0.0785 | 0.3054 | 0.0706 |
| 0.3199 | 0.1179 | 0.3199 | 0.1056 | 0.3199 | 0.0987 | 0.3199 | 0.0926 | 0.3199 | 0.0894 | 0.3199 | 0.0844 | 0.3199 | 0.0786 |
| 0.3352 | 0.1179 | 0.3352 | 0.1098 | 0.3352 | 0.1056 | 0.3352 | 0.1017 | 0.3352 | 0.0982 | 0.3352 | 0.0921 | 0.3352 | 0.0848 |
| 0.3511 | 0.1654 | 0.3511 | 0.129 | 0.3511 | 0.1133 | 0.3511 | 0.1075 | 0.3511 | 0.1035 | 0.3511 | 0.0964 | 0.3511 | 0.088 |
| 0.3678 | 0.2415 | 0.3678 | 0.1832 | 0.3678 | 0.1565 | 0.3678 | 0.1364 | 0.3678 | 0.1213 | 0.3678 | 0.1006 | 0.3678 | 0.088 |
| 0.3853 | 0.2549 | 0.3853 | 0.187 | 0.3853 | 0.1595 | 0.3853 | 0.1387 | 0.3853 | 0.1269 | 0.3853 | 0.1092 | 0.3853 | 0.091 |
| 0.4037 | 0.2549 | 0.4037 | 0.187 | 0.4037 | 0.1595 | 0.4037 | 0.1387 | 0.4037 | 0.1279 | 0.4037 | 0.1163 | 0.4037 | 0.1034 |
| 0.4229 | 0.2549 | 0.4229 | 0.187 | 0.4229 | 0.1651 | 0.4229 | 0.1485 | 0.4229 | 0.1344 | 0.4229 | 0.1233 | 0.4229 | 0.1111 |
| 0.4431 | 0.3288 | 0.4431 | 0.2339 | 0.4431 | 0.2038 | 0.4431 | 0.1813 | 0.4431 | 0.1641 | 0.4431 | 0.1399 | 0.4431 | 0.1181 |
| 0.4642 | 0.3288 | 0.4642 | 0.2339 | 0.4642 | 0.2038 | 0.4642 | 0.1813 | 0.4642 | 0.1641 | 0.4642 | 0.1399 | 0.4642 | 0.1181 |
| 0.4863 | 0.3288 | 0.4863 | 0.2339 | 0.4863 | 0.2038 | 0.4863 | 0.1813 | 0.4863 | 0.1641 | 0.4863 | 0.1421 | 0.4863 | 0.1246 |
| 0.5094 | 0.3288 | 0.5094 | 0.2339 | 0.5094 | 0.2038 | 0.5094 | 0.1813 | 0.5094 | 0.1641 | 0.5094 | 0.1472 | 0.5094 | 0.1295 |

PTWW038.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 38 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.5337 | 0.3356 | 0.5337 | 0.2387 | 0.5337 | 0.2081 | 0.5337 | 0.19 | 0.5337 | 0.1796 | 0.5337 | 0.1614 | 0.5337 | 0.1401 |
| 0.5591 | 0.3997 | 0.5591 | 0.2762 | 0.5591 | 0.244 | 0.5591 | 0.2179 | 0.5591 | 0.1971 | 0.5591 | 0.1724 | 0.5591 | 0.1556 |
| 0.5857 | 0.3997 | 0.5857 | 0.2863 | 0.5857 | 0.2573 | 0.5857 | 0.2332 | 0.5857 | 0.2128 | 0.5857 | 0.1853 | 0.5857 | 0.1724 |
| 0.6136 | 0.3997 | 0.6136 | 0.2863 | 0.6136 | 0.2573 | 0.6136 | 0.2332 | 0.6136 | 0.2128 | 0.6136 | 0.1998 | 0.6136 | 0.1858 |
| 0.6428 | 0.3997 | 0.6428 | 0.2863 | 0.6428 | 0.2573 | 0.6428 | 0.2332 | 0.6428 | 0.2219 | 0.6428 | 0.2115 | 0.6428 | 0.1969 |
| 0.6734 | 0.411 | 0.6734 | 0.2863 | 0.6734 | 0.2574 | 0.6734 | 0.2449 | 0.6734 | 0.2378 | 0.6734 | 0.2244 | 0.6734 | 0.2072 |
| 0.7055 | 0.411 | 0.7055 | 0.301 | 0.7055 | 0.2757 | 0.7055 | 0.2638 | 0.7055 | 0.2534 | 0.7055 | 0.2357 | 0.7055 | 0.2156 |
| 0.7391 | 0.6367 | 0.7391 | 0.4169 | 0.7391 | 0.3404 | 0.7391 | 0.2927 | 0.7391 | 0.2746 | 0.7391 | 0.2445 | 0.7391 | 0.217 |
| 0.7743 | 0.6367 | 0.7743 | 0.4169 | 0.7743 | 0.3404 | 0.7743 | 0.3038 | 0.7743 | 0.2858 | 0.7743 | 0.2555 | 0.7743 | 0.2218 |
| 0.8111 | 0.6596 | 0.8111 | 0.4428 | 0.8111 | 0.386 | 0.8111 | 0.3422 | 0.8111 | 0.3081 | 0.8111 | 0.2598 | 0.8111 | 0.2218 |
| 0.8497 | 0.6596 | 0.8497 | 0.4428 | 0.8497 | 0.4051 | 0.8497 | 0.3738 | 0.8497 | 0.347 | 0.8497 | 0.3034 | 0.8497 | 0.256 |
| 0.8902 | 0.6828 | 0.8902 | 0.4451 | 0.8902 | 0.4051 | 0.8902 | 0.3738 | 0.8902 | 0.3511 | 0.8902 | 0.3194 | 0.8902 | 0.2761 |
| 0.9326 | 0.737 | 0.9326 | 0.5191 | 0.9326 | 0.4567 | 0.9326 | 0.411 | 0.9326 | 0.3766 | 0.9326 | 0.328 | 0.9326 | 0.2821 |
| 0.977 | 0.9914 | 0.977 | 0.6358 | 0.977 | 0.525 | 0.977 | 0.4553 | 0.977 | 0.408 | 0.977 | 0.3484 | 0.977 | 0.2994 |
| 1.0235 | 0.9914 | 1.0235 | 0.6358 | 1.0235 | 0.5662 | 1.0235 | 0.5139 | 1.0235 | 0.4702 | 1.0235 | 0.4041 | 1.0235 | 0.3384 |
| 1.0723 | 0.9914 | 1.0723 | 0.6668 | 1.0723 | 0.5976 | 1.0723 | 0.5399 | 1.0723 | 0.4914 | 1.0723 | 0.4166 | 1.0723 | 0.3541 |
| 1.1233 | 1.2606 | 1.1233 | 0.8561 | 1.1233 | 0.7168 | 1.1233 | 0.6174 | 1.1233 | 0.5433 | 1.1233 | 0.4431 | 1.1233 | 0.3633 |
| 1.1768 | 1.2606 | 1.1768 | 0.8561 | 1.1768 | 0.7168 | 1.1768 | 0.6174 | 1.1768 | 0.5433 | 1.1768 | 0.4467 | 1.1768 | 0.3729 |
| 1.2328 | 1.2606 | 1.2328 | 0.935 | 1.2328 | 0.8202 | 1.2328 | 0.7293 | 1.2328 | 0.6556 | 1.2328 | 0.5433 | 1.2328 | 0.4321 |
| 1.2916 | 1.2606 | 1.2916 | 1.0351 | 1.2916 | 0.8991 | 1.2916 | 0.793 | 1.2916 | 0.708 | 1.2916 | 0.5814 | 1.2916 | 0.4586 |
| 1.353 | 1.3319 | 1.353 | 1.0351 | 1.353 | 0.8991 | 1.353 | 0.793 | 1.353 | 0.708 | 1.353 | 0.5814 | 1.353 | 0.4631 |
| 1.4175 | 1.6092 | 1.4175 | 1.1325 | 1.4175 | 0.9683 | 1.4175 | 0.8621 | 1.4175 | 0.7817 | 1.4175 | 0.6627 | 1.4175 | 0.5486 |
| 1.485 | 1.6092 | 1.485 | 1.1325 | 1.485 | 0.9683 | 1.485 | 0.885 | 1.485 | 0.8264 | 1.485 | 0.7199 | 1.485 | 0.6006 |
| 1.5557 | 1.8872 | 1.5557 | 1.1818 | 1.5557 | 1.0008 | 1.5557 | 0.892 | 1.5557 | 0.8264 | 1.5557 | 0.7265 | 1.5557 | 0.6185 |
| 1.6298 | 1.9322 | 1.6298 | 1.3084 | 1.6298 | 1.1683 | 1.6298 | 1.0534 | 1.6298 | 0.9565 | 1.6298 | 0.8016 | 1.6298 | 0.6401 |
| 1.7074 | 1.9702 | 1.7074 | 1.3601 | 1.7074 | 1.2627 | 1.7074 | 1.1415 | 1.7074 | 1.0371 | 1.7074 | 0.8692 | 1.7074 | 0.7006 |
| 1.7887 | 2.4552 | 1.7887 | 1.4456 | 1.7887 | 1.2629 | 1.7887 | 1.1415 | 1.7887 | 1.0371 | 1.7887 | 0.8773 | 1.7887 | 0.7486 |
| 1.8738 | 2.4552 | 1.8738 | 1.4456 | 1.8738 | 1.2629 | 1.8738 | 1.1415 | 1.8738 | 1.0371 | 1.8738 | 0.9259 | 1.8738 | 0.788 |
| 1.963 | 2.4552 | 1.963 | 1.4456 | 1.963 | 1.2629 | 1.963 | 1.1498 | 1.963 | 1.0818 | 1.963 | 0.9626 | 1.963 | 0.8157 |
| 2.0565 | 2.4552 | 2.0565 | 1.4456 | 2.0565 | 1.2629 | 2.0565 | 1.1701 | 2.0565 | 1.1049 | 2.0565 | 0.9829 | 2.0565 | 0.8288 |
| 2.1544 | 2.4552 | 2.1544 | 1.4456 | 2.1544 | 1.3316 | 2.1544 | 1.2297 | 2.1544 | 1.1411 | 2.1544 | 0.9932 | 2.1544 | 0.8645 |
| 2.257 | 2.2367 | 2.257 | 1.4456 | 2.257 | 1.3316 | 2.257 | 1.2297 | 2.257 | 1.1534 | 2.257 | 1.0344 | 2.257 | 0.8939 |
| 2.3645 | 2.2367 | 2.3645 | 1.4456 | 2.3645 | 1.3316 | 2.3645 | 1.2422 | 2.3645 | 1.1724 | 2.3645 | 1.0471 | 2.3645 | 0.898 |
| 2.4771 | 2.2367 | 2.4771 | 1.6143 | 2.4771 | 1.3804 | 2.4771 | 1.2551 | 2.4771 | 1.1724 | 2.4771 | 1.0471 | 2.4771 | 0.898 |
| 2.595 | 2.138 | 2.595 | 1.6143 | 2.595 | 1.3804 | 2.595 | 1.2551 | 2.595 | 1.1724 | 2.595 | 1.0471 | 2.595 | 0.898 |

PTWW038.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 38 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.7186 | 2.138 | 2.7186 | 1.6143 | 2.7186 | 1.3804 | 2.7186 | 1.2551 | 2.7186 | 1.1724 | 2.7186 | 1.0471 | 2.7186 | 0.898 |
| 2.848 | 2.138 | 2.848 | 1.6143 | 2.848 | 1.3804 | 2.848 | 1.2551 | 2.848 | 1.1724 | 2.848 | 1.0471 | 2.848 | 0.898 |
| 2.9836 | 2.138 | 2.9836 | 1.6143 | 2.9836 | 1.3804 | 2.9836 | 1.2551 | 2.9836 | 1.1568 | 2.9836 | 1.0114 | 2.9836 | 0.8645 |
| 3.1257 | 2.138 | 3.1257 | 1.3773 | 3.1257 | 1.0982 | 3.1257 | 1.0035 | 3.1257 | 0.9573 | 3.1257 | 0.8829 | 3.1257 | 0.7931 |
| 3.2745 | 2.138 | 3.2745 | 1.2119 | 3.2745 | 1.0686 | 3.2745 | 0.9673 | 3.2745 | 0.886 | 3.2745 | 0.778 | 3.2745 | 0.7168 |
| 3.4305 | 1.5368 | 3.4305 | 1.0471 | 3.4305 | 0.9495 | 3.4305 | 0.8824 | 3.4305 | 0.8379 | 3.4305 | 0.7547 | 3.4305 | 0.6598 |
| 3.5938 | 1.5368 | 3.5938 | 1.0165 | 3.5938 | 0.898 | 3.5938 | 0.8299 | 3.5938 | 0.7946 | 3.5938 | 0.7273 | 3.5938 | 0.6376 |
| 3.7649 | 1.5368 | 3.7649 | 1.0165 | 3.7649 | 0.898 | 3.7649 | 0.8299 | 3.7649 | 0.7769 | 3.7649 | 0.6958 | 3.7649 | 0.6089 |
| 3.9442 | 1.5368 | 3.9442 | 1.0165 | 3.9442 | 0.8472 | 3.9442 | 0.7941 | 3.9442 | 0.7477 | 3.9442 | 0.6723 | 3.9442 | 0.5955 |
| 4.132 | 1.5368 | 4.132 | 1.0165 | 4.132 | 0.845 | 4.132 | 0.7941 | 4.132 | 0.7477 | 4.132 | 0.6723 | 4.132 | 0.5955 |
| 4.3288 | 1.5368 | 4.3288 | 0.9973 | 4.3288 | 0.8194 | 4.3288 | 0.7522 | 4.3288 | 0.7017 | 4.3288 | 0.6303 | 4.3288 | 0.5622 |
| 4.5349 | 1.5368 | 4.5349 | 0.8745 | 4.5349 | 0.7347 | 4.5349 | 0.6652 | 4.5349 | 0.6197 | 4.5349 | 0.5656 | 4.5349 | 0.5097 |
| 4.7508 | 1.518 | 4.7508 | 0.8745 | 4.7508 | 0.7183 | 4.7508 | 0.6169 | 4.7508 | 0.5587 | 4.7508 | 0.4909 | 4.7508 | 0.4618 |
| 4.977 | 1.518 | 4.977 | 0.8614 | 4.977 | 0.7025 | 4.977 | 0.6052 | 4.977 | 0.5367 | 4.977 | 0.4572 | 4.977 | 0.4284 |
| 5.214 | 1.3404 | 5.214 | 0.7497 | 5.214 | 0.6443 | 5.214 | 0.5421 | 5.214 | 0.5109 | 5.214 | 0.4398 | 5.214 | 0.4021 |
| 5.4623 | 1.3404 | 5.4623 | 0.7497 | 5.4623 | 0.6443 | 5.4623 | 0.5254 | 5.4623 | 0.5109 | 5.4623 | 0.438 | 5.4623 | 0.3783 |
| 5.7224 | 1.3404 | 5.7224 | 0.7497 | 5.7224 | 0.6443 | 5.7224 | 0.5254 | 5.7224 | 0.5109 | 5.7224 | 0.438 | 5.7224 | 0.3681 |
| 5.9948 | 1.3404 | 5.9948 | 0.7497 | 5.9948 | 0.6443 | 5.9948 | 0.5254 | 5.9948 | 0.5109 | 5.9948 | 0.438 | 5.9948 | 0.3681 |
| 6.2803 | 1.3404 | 6.2803 | 0.7497 | 6.2803 | 0.6443 | 6.2803 | 0.5254 | 6.2803 | 0.5109 | 6.2803 | 0.438 | 6.2803 | 0.3681 |
| 6.5793 | 1.3404 | 6.5793 | 0.7497 | 6.5793 | 0.6443 | 6.5793 | 0.5254 | 6.5793 | 0.5109 | 6.5793 | 0.438 | 6.5793 | 0.3681 |
| 6.8926 | 1.3404 | 6.8926 | 0.7497 | 6.8926 | 0.6443 | 6.8926 | 0.5254 | 6.8926 | 0.5109 | 6.8926 | 0.438 | 6.8926 | 0.3681 |
| 7.2208 | 1.274 | 7.2208 | 0.7497 | 7.2208 | 0.6443 | 7.2208 | 0.5254 | 7.2208 | 0.5109 | 7.2208 | 0.438 | 7.2208 | 0.3681 |
| 7.5646 | 1.274 | 7.5646 | 0.7455 | 7.5646 | 0.6309 | 7.5646 | 0.5254 | 7.5646 | 0.5092 | 7.5646 | 0.438 | 7.5646 | 0.3681 |
| 7.9248 | 1.274 | 7.9248 | 0.6003 | 7.9248 | 0.5494 | 7.9248 | 0.5064 | 7.9248 | 0.471 | 7.9248 | 0.4168 | 7.9248 | 0.3609 |
| 8.3022 | 1.274 | 8.3022 | 0.5659 | 8.3022 | 0.4849 | 8.3022 | 0.454 | 8.3022 | 0.4288 | 8.3022 | 0.394 | 8.3022 | 0.3594 |
| 8.6975 | 1.0027 | 8.6975 | 0.521 | 8.6975 | 0.4849 | 8.6975 | 0.454 | 8.6975 | 0.4288 | 8.6975 | 0.3913 | 8.6975 | 0.3536 |
| 9.1116 | 1.0027 | 9.1116 | 0.4701 | 9.1116 | 0.4386 | 9.1116 | 0.4105 | 9.1116 | 0.3865 | 9.1116 | 0.3654 | 9.1116 | 0.3376 |
| 9.5455 | 1.0027 | 9.5455 | 0.4494 | 9.5455 | 0.4069 | 9.5455 | 0.3794 | 9.5455 | 0.3652 | 9.5455 | 0.3418 | 9.5455 | 0.3167 |
| 10 | 0.6463 | 10 | 0.4494 | 10 | 0.4069 | 10 | 0.3794 | 10 | 0.3585 | 10 | 0.3293 | 10 | 0.3015 |
| 10.4762 | 0.6411 | 10.4762 | 0.4371 | 10.4762 | 0.3959 | 10.4762 | 0.3648 | 10.4762 | 0.347 | 10.4762 | 0.3169 | 10.4762 | 0.2936 |
| 10.975 | 0.6411 | 10.975 | 0.4085 | 10.975 | 0.3668 | 10.975 | 0.3387 | 10.975 | 0.3179 | 10.975 | 0.2923 | 10.975 | 0.2891 |
| 11.4976 | 0.6411 | 11.4976 | 0.3647 | 11.4976 | 0.3304 | 11.4976 | 0.3133 | 11.4976 | 0.3024 | 11.4976 | 0.2893 | 11.4976 | 0.2857 |
| 12.045 | 0.6411 | 12.045 | 0.3647 | 12.045 | 0.3304 | 12.045 | 0.3133 | 12.045 | 0.3024 | 12.045 | 0.2893 | 12.045 | 0.2839 |
| 12.6186 | 0.6411 | 12.6186 | 0.3647 | 12.6186 | 0.3304 | 12.6186 | 0.3133 | 12.6186 | 0.3024 | 12.6186 | 0.2893 | 12.6186 | 0.2831 |
| 13.2194 | 0.6411 | 13.2194 | 0.3647 | 13.2194 | 0.3304 | 13.2194 | 0.3133 | 13.2194 | 0.3024 | 13.2194 | 0.2893 | 13.2194 | 0.2831 |

PTWW038.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 38 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 0.6411 | 13.8489 | 0.3647 | 13.8489 | 0.3304 | 13.8489 | 0.3133 | 13.8489 | 0.3024 | 13.8489 | 0.2893 | 13.8489 | 0.2831 |
| 14.5083 | 0.6411 | 14.5083 | 0.3647 | 14.5083 | 0.3304 | 14.5083 | 0.3133 | 14.5083 | 0.3024 | 14.5083 | 0.2893 | 14.5083 | 0.2831 |
| 15.1991 | 0.6411 | 15.1991 | 0.3647 | 15.1991 | 0.3304 | 15.1991 | 0.3133 | 15.1991 | 0.3024 | 15.1991 | 0.2893 | 15.1991 | 0.2831 |
| 15.9228 | 0.6411 | 15.9228 | 0.3647 | 15.9228 | 0.3304 | 15.9228 | 0.3133 | 15.9228 | 0.3024 | 15.9228 | 0.2893 | 15.9228 | 0.2831 |
| 16.681 | 0.6411 | 16.681 | 0.3647 | 16.681 | 0.3304 | 16.681 | 0.3133 | 16.681 | 0.3024 | 16.681 | 0.2893 | 16.681 | 0.2831 |
| 17.4753 | 0.6411 | 17.4753 | 0.3647 | 17.4753 | 0.3304 | 17.4753 | 0.3133 | 17.4753 | 0.3024 | 17.4753 | 0.2893 | 17.4753 | 0.2831 |
| 18.3074 | 0.4714 | 18.3074 | 0.3284 | 18.3074 | 0.3152 | 18.3074 | 0.3052 | 18.3074 | 0.298 | 18.3074 | 0.2893 | 18.3074 | 0.2831 |
| 19.1791 | 0.4714 | 19.1791 | 0.3088 | 19.1791 | 0.2936 | 19.1791 | 0.2872 | 19.1791 | 0.2851 | 19.1791 | 0.2842 | 19.1791 | 0.2825 |
| 20.0923 | 0.4714 | 20.0923 | 0.3088 | 20.0923 | 0.2886 | 20.0923 | 0.2865 | 20.0923 | 0.2851 | 20.0923 | 0.2833 | 20.0923 | 0.2814 |
| 21.049 | 0.3824 | 21.049 | 0.2877 | 21.049 | 0.2842 | 21.049 | 0.2843 | 21.049 | 0.2836 | 21.049 | 0.2819 | 21.049 | 0.2801 |
| 22.0513 | 0.3824 | 22.0513 | 0.2873 | 22.0513 | 0.2834 | 22.0513 | 0.2816 | 22.0513 | 0.2806 | 22.0513 | 0.2795 | 22.0513 | 0.2783 |
| 23.1013 | 0.2973 | 23.1013 | 0.2832 | 23.1013 | 0.2814 | 23.1013 | 0.2802 | 23.1013 | 0.2793 | 23.1013 | 0.2779 | 23.1013 | 0.2765 |
| 24.2013 | 0.2947 | 24.2013 | 0.2805 | 24.2013 | 0.2788 | 24.2013 | 0.2776 | 24.2013 | 0.2768 | 24.2013 | 0.2763 | 24.2013 | 0.2756 |
| 25.3536 | 0.288 | 25.3536 | 0.2805 | 25.3536 | 0.2788 | 25.3536 | 0.2776 | 25.3536 | 0.2768 | 25.3536 | 0.2757 | 25.3536 | 0.2749 |
| 26.5609 | 0.288 | 26.5609 | 0.2805 | 26.5609 | 0.2788 | 26.5609 | 0.2776 | 26.5609 | 0.2768 | 26.5609 | 0.2757 | 26.5609 | 0.2747 |
| 27.8256 | 0.2867 | 27.8256 | 0.28 | 27.8256 | 0.2782 | 27.8256 | 0.2771 | 27.8256 | 0.2762 | 27.8256 | 0.2751 | 27.8256 | 0.2741 |
| 29.1505 | 0.2773 | 29.1505 | 0.2753 | 29.1505 | 0.2749 | 29.1505 | 0.2745 | 29.1505 | 0.2742 | 29.1505 | 0.2738 | 29.1505 | 0.2732 |
| 30.5386 | 0.2773 | 30.5386 | 0.2727 | 30.5386 | 0.2726 | 30.5386 | 0.2725 | 30.5386 | 0.2724 | 30.5386 | 0.2723 | 30.5386 | 0.2721 |
| 31.9927 | 0.2707 | 31.9927 | 0.271 | 31.9927 | 0.271 | 31.9927 | 0.2711 | 31.9927 | 0.2711 | 31.9927 | 0.2712 | 31.9927 | 0.2712 |
| 33.516 | 0.2707 | 33.516 | 0.2707 | 33.516 | 0.2706 | 33.516 | 0.2706 | 33.516 | 0.2706 | 33.516 | 0.2706 | 33.516 | 0.2706 |
| 35.1119 | 0.27 | 35.1119 | 0.27 | 35.1119 | 0.27 | 35.1119 | 0.2701 | 35.1119 | 0.2701 | 35.1119 | 0.2701 | 35.1119 | 0.2701 |
| 36.7838 | 0.2695 | 36.7838 | 0.2696 | 36.7838 | 0.2696 | 36.7838 | 0.2696 | 36.7838 | 0.2697 | 36.7838 | 0.2697 | 36.7838 | 0.2697 |
| 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 |
| 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 |
| 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2688 |
| 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 |
| 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 |
| 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 |
| 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 |

PTWW067.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 67 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.1098 | 0.0375 | 0.1098 | 0.0345 | 0.1098 | 0.0327 | 0.1098 | 0.0312 | 0.1098 | 0.0298 | 0.1098 | 0.0274 | 0.1098 | 0.0252 |
| 0.115 | 0.0375 | 0.115 | 0.0345 | 0.115 | 0.0327 | 0.115 | 0.0312 | 0.115 | 0.0299 | 0.115 | 0.0277 | 0.115 | 0.0259 |
| 0.1204 | 0.0375 | 0.1204 | 0.0345 | 0.1204 | 0.0331 | 0.1204 | 0.0322 | 0.1204 | 0.0312 | 0.1204 | 0.0294 | 0.1204 | 0.0268 |
| 0.1262 | 0.0431 | 0.1262 | 0.0397 | 0.1262 | 0.0378 | 0.1262 | 0.036 | 0.1262 | 0.0343 | 0.1262 | 0.0314 | 0.1262 | 0.0277 |
| 0.1322 | 0.0505 | 0.1322 | 0.0451 | 0.1322 | 0.042 | 0.1322 | 0.0393 | 0.1322 | 0.0369 | 0.1322 | 0.0327 | 0.1322 | 0.0281 |
| 0.1385 | 0.0561 | 0.1385 | 0.049 | 0.1385 | 0.045 | 0.1385 | 0.0415 | 0.1385 | 0.0384 | 0.1385 | 0.0344 | 0.1385 | 0.0303 |
| 0.1451 | 0.0582 | 0.1451 | 0.0509 | 0.1451 | 0.0474 | 0.1451 | 0.0444 | 0.1451 | 0.0417 | 0.1451 | 0.0373 | 0.1451 | 0.0324 |
| 0.152 | 0.0617 | 0.152 | 0.0546 | 0.152 | 0.0507 | 0.152 | 0.0472 | 0.152 | 0.0442 | 0.152 | 0.0392 | 0.152 | 0.0336 |
| 0.1592 | 0.0619 | 0.1592 | 0.0546 | 0.1592 | 0.0507 | 0.1592 | 0.0472 | 0.1592 | 0.0442 | 0.1592 | 0.0394 | 0.1592 | 0.0347 |
| 0.1668 | 0.0639 | 0.1668 | 0.056 | 0.1668 | 0.0516 | 0.1668 | 0.0479 | 0.1668 | 0.0448 | 0.1668 | 0.04 | 0.1668 | 0.0352 |
| 0.1748 | 0.0639 | 0.1748 | 0.056 | 0.1748 | 0.0516 | 0.1748 | 0.0479 | 0.1748 | 0.0448 | 0.1748 | 0.04 | 0.1748 | 0.0352 |
| 0.1831 | 0.0639 | 0.1831 | 0.056 | 0.1831 | 0.0516 | 0.1831 | 0.0479 | 0.1831 | 0.0448 | 0.1831 | 0.04 | 0.1831 | 0.0364 |
| 0.1918 | 0.064 | 0.1918 | 0.056 | 0.1918 | 0.0516 | 0.1918 | 0.0491 | 0.1918 | 0.0473 | 0.1918 | 0.0442 | 0.1918 | 0.0401 |
| 0.2009 | 0.0641 | 0.2009 | 0.0581 | 0.2009 | 0.0556 | 0.2009 | 0.0533 | 0.2009 | 0.0511 | 0.2009 | 0.0472 | 0.2009 | 0.0422 |
| 0.2105 | 0.0664 | 0.2105 | 0.0603 | 0.2105 | 0.0575 | 0.2105 | 0.0549 | 0.2105 | 0.0525 | 0.2105 | 0.049 | 0.2105 | 0.0448 |
| 0.2205 | 0.078 | 0.2205 | 0.0645 | 0.2205 | 0.0618 | 0.2205 | 0.0594 | 0.2205 | 0.0571 | 0.2205 | 0.0531 | 0.2205 | 0.0482 |
| 0.231 | 0.0931 | 0.231 | 0.0772 | 0.231 | 0.0692 | 0.231 | 0.0628 | 0.231 | 0.0596 | 0.231 | 0.0553 | 0.231 | 0.0502 |
| 0.242 | 0.0931 | 0.242 | 0.0772 | 0.242 | 0.072 | 0.242 | 0.0676 | 0.242 | 0.0636 | 0.242 | 0.0564 | 0.242 | 0.051 |
| 0.2535 | 0.0931 | 0.2535 | 0.0817 | 0.2535 | 0.077 | 0.2535 | 0.0728 | 0.2535 | 0.069 | 0.2535 | 0.0625 | 0.2535 | 0.0547 |
| 0.2656 | 0.0931 | 0.2656 | 0.0839 | 0.2656 | 0.0794 | 0.2656 | 0.0753 | 0.2656 | 0.0716 | 0.2656 | 0.065 | 0.2656 | 0.0571 |
| 0.2783 | 0.0955 | 0.2783 | 0.0842 | 0.2783 | 0.0794 | 0.2783 | 0.0753 | 0.2783 | 0.0716 | 0.2783 | 0.065 | 0.2783 | 0.0574 |
| 0.2915 | 0.1183 | 0.2915 | 0.0982 | 0.2915 | 0.0885 | 0.2915 | 0.081 | 0.2915 | 0.075 | 0.2915 | 0.0664 | 0.2915 | 0.0586 |
| 0.3054 | 0.1496 | 0.3054 | 0.1228 | 0.3054 | 0.1092 | 0.3054 | 0.0981 | 0.3054 | 0.089 | 0.3054 | 0.0756 | 0.3054 | 0.063 |
| 0.3199 | 0.1496 | 0.3199 | 0.1228 | 0.3199 | 0.1092 | 0.3199 | 0.0981 | 0.3199 | 0.089 | 0.3199 | 0.0797 | 0.3199 | 0.07 |
| 0.3352 | 0.1496 | 0.3352 | 0.1228 | 0.3352 | 0.1092 | 0.3352 | 0.0981 | 0.3352 | 0.0927 | 0.3352 | 0.0852 | 0.3352 | 0.0755 |
| 0.3511 | 0.1496 | 0.3511 | 0.1285 | 0.3511 | 0.1168 | 0.3511 | 0.1065 | 0.3511 | 0.0994 | 0.3511 | 0.0891 | 0.3511 | 0.0782 |
| 0.3678 | 0.1677 | 0.3678 | 0.1435 | 0.3678 | 0.13 | 0.3678 | 0.1183 | 0.3678 | 0.112 | 0.3678 | 0.1014 | 0.3678 | 0.0894 |
| 0.3853 | 0.1677 | 0.3853 | 0.1435 | 0.3853 | 0.134 | 0.3853 | 0.1273 | 0.3853 | 0.1213 | 0.3853 | 0.1109 | 0.3853 | 0.0986 |
| 0.4037 | 0.1925 | 0.4037 | 0.1587 | 0.4037 | 0.1415 | 0.4037 | 0.1298 | 0.4037 | 0.1251 | 0.4037 | 0.1163 | 0.4037 | 0.1044 |
| 0.4229 | 0.2358 | 0.4229 | 0.1897 | 0.4229 | 0.1713 | 0.4229 | 0.1551 | 0.4229 | 0.1411 | 0.4229 | 0.1206 | 0.4229 | 0.1079 |
| 0.4431 | 0.3083 | 0.4431 | 0.219 | 0.4431 | 0.1881 | 0.4431 | 0.167 | 0.4431 | 0.1495 | 0.4431 | 0.1263 | 0.4431 | 0.1088 |
| 0.4642 | 0.3407 | 0.4642 | 0.2508 | 0.4642 | 0.2123 | 0.4642 | 0.1837 | 0.4642 | 0.1622 | 0.4642 | 0.1328 | 0.4642 | 0.1192 |
| 0.4863 | 0.3407 | 0.4863 | 0.2548 | 0.4863 | 0.2198 | 0.4863 | 0.1918 | 0.4863 | 0.1692 | 0.4863 | 0.1398 | 0.4863 | 0.1303 |
| 0.5094 | 0.3496 | 0.5094 | 0.2641 | 0.5094 | 0.2311 | 0.5094 | 0.2042 | 0.5094 | 0.182 | 0.5094 | 0.1485 | 0.5094 | 0.1369 |

PTWW067.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 67 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5337 | 0.4063 | 0.5337 | 0.2745 | 0.5337 | 0.2311 | 0.5337 | 0.2042 | 0.5337 | 0.182 | 0.5337 | 0.1529 | 0.5337 | 0.1371 |
| 0.5591 | 0.4063 | 0.5591 | 0.2745 | 0.5591 | 0.2378 | 0.5591 | 0.213 | 0.5591 | 0.194 | 0.5591 | 0.1646 | 0.5591 | 0.1371 |
| 0.5857 | 0.4063 | 0.5857 | 0.2745 | 0.5857 | 0.2385 | 0.5857 | 0.2142 | 0.5857 | 0.1966 | 0.5857 | 0.1681 | 0.5857 | 0.1425 |
| 0.6136 | 0.4438 | 0.6136 | 0.2944 | 0.6136 | 0.2421 | 0.6136 | 0.2213 | 0.6136 | 0.2032 | 0.6136 | 0.1733 | 0.6136 | 0.1425 |
| 0.6428 | 0.4742 | 0.6428 | 0.3514 | 0.6428 | 0.2975 | 0.6428 | 0.2588 | 0.6428 | 0.2323 | 0.6428 | 0.1964 | 0.6428 | 0.1655 |
| 0.6734 | 0.4742 | 0.6734 | 0.3514 | 0.6734 | 0.2975 | 0.6734 | 0.2588 | 0.6734 | 0.2383 | 0.6734 | 0.2137 | 0.6734 | 0.1844 |
| 0.7055 | 0.4742 | 0.7055 | 0.3514 | 0.7055 | 0.2975 | 0.7055 | 0.2588 | 0.7055 | 0.2383 | 0.7055 | 0.2155 | 0.7055 | 0.1892 |
| 0.7391 | 0.4742 | 0.7391 | 0.3514 | 0.7391 | 0.2975 | 0.7391 | 0.2667 | 0.7391 | 0.2438 | 0.7391 | 0.2155 | 0.7391 | 0.1892 |
| 0.7743 | 0.5449 | 0.7743 | 0.3911 | 0.7743 | 0.3284 | 0.7743 | 0.2875 | 0.7743 | 0.2646 | 0.7743 | 0.2323 | 0.7743 | 0.1993 |
| 0.8111 | 0.5449 | 0.8111 | 0.3911 | 0.8111 | 0.3284 | 0.8111 | 0.2996 | 0.8111 | 0.2837 | 0.8111 | 0.2551 | 0.8111 | 0.2205 |
| 0.8497 | 0.5449 | 0.8497 | 0.3911 | 0.8497 | 0.3284 | 0.8497 | 0.3072 | 0.8497 | 0.2942 | 0.8497 | 0.2684 | 0.8497 | 0.2339 |
| 0.8902 | 0.5449 | 0.8902 | 0.3911 | 0.8902 | 0.3604 | 0.8902 | 0.3382 | 0.8902 | 0.318 | 0.8902 | 0.2831 | 0.8902 | 0.2427 |
| 0.9326 | 0.8469 | 0.9326 | 0.5495 | 0.9326 | 0.4554 | 0.9326 | 0.3957 | 0.9326 | 0.3545 | 0.9326 | 0.3003 | 0.9326 | 0.2517 |
| 0.977 | 0.8469 | 0.977 | 0.5495 | 0.977 | 0.4554 | 0.977 | 0.3975 | 0.977 | 0.3585 | 0.977 | 0.3036 | 0.977 | 0.2596 |
| 1.0235 | 0.9107 | 1.0235 | 0.5826 | 1.0235 | 0.5168 | 1.0235 | 0.4731 | 1.0235 | 0.4362 | 1.0235 | 0.3776 | 1.0235 | 0.3164 |
| 1.0723 | 0.9107 | 1.0723 | 0.6542 | 1.0723 | 0.5901 | 1.0723 | 0.535 | 1.0723 | 0.4906 | 1.0723 | 0.4288 | 1.0723 | 0.36 |
| 1.1233 | 1.3081 | 1.1233 | 0.8142 | 1.1233 | 0.6641 | 1.1233 | 0.5708 | 1.1233 | 0.5287 | 1.1233 | 0.4575 | 1.1233 | 0.3904 |
| 1.1768 | 1.3081 | 1.1768 | 0.8142 | 1.1768 | 0.6641 | 1.1768 | 0.5735 | 1.1768 | 0.5393 | 1.1768 | 0.4764 | 1.1768 | 0.4143 |
| 1.2328 | 1.3081 | 1.2328 | 0.8142 | 1.2328 | 0.7174 | 1.2328 | 0.6427 | 1.2328 | 0.577 | 1.2328 | 0.4965 | 1.2328 | 0.439 |
| 1.2916 | 1.3081 | 1.2916 | 0.8822 | 1.2916 | 0.7774 | 1.2916 | 0.6895 | 1.2916 | 0.6157 | 1.2916 | 0.5283 | 1.2916 | 0.4653 |
| 1.353 | 1.3081 | 1.353 | 0.9165 | 1.353 | 0.7774 | 1.353 | 0.6895 | 1.353 | 0.6157 | 1.353 | 0.5556 | 1.353 | 0.4889 |
| 1.4175 | 1.4021 | 1.4175 | 0.9165 | 1.4175 | 0.7774 | 1.4175 | 0.6895 | 1.4175 | 0.6326 | 1.4175 | 0.5795 | 1.4175 | 0.5119 |
| 1.485 | 1.4021 | 1.485 | 0.9165 | 1.485 | 0.7774 | 1.485 | 0.6984 | 1.485 | 0.6672 | 1.485 | 0.6099 | 1.485 | 0.539 |
| 1.5557 | 1.4438 | 1.5557 | 0.9843 | 1.5557 | 0.8409 | 1.5557 | 0.7415 | 1.5557 | 0.6919 | 1.5557 | 0.6323 | 1.5557 | 0.5603 |
| 1.6298 | 1.729 | 1.6298 | 1.0527 | 1.6298 | 0.9055 | 1.6298 | 0.8177 | 1.6298 | 0.7518 | 1.6298 | 0.6519 | 1.6298 | 0.5748 |
| 1.7074 | 1.729 | 1.7074 | 1.0527 | 1.7074 | 0.9055 | 1.7074 | 0.8177 | 1.7074 | 0.7518 | 1.7074 | 0.6652 | 1.7074 | 0.5915 |
| 1.7887 | 1.729 | 1.7887 | 1.0527 | 1.7887 | 0.9055 | 1.7887 | 0.8185 | 1.7887 | 0.7553 | 1.7887 | 0.6808 | 1.7887 | 0.6117 |
| 1.8738 | 1.729 | 1.8738 | 1.0527 | 1.8738 | 0.9055 | 1.8738 | 0.8185 | 1.8738 | 0.7765 | 1.8738 | 0.7113 | 1.8738 | 0.6287 |
| 1.963 | 1.729 | 1.963 | 1.0527 | 1.963 | 0.9055 | 1.963 | 0.8397 | 1.963 | 0.7973 | 1.963 | 0.7229 | 1.963 | 0.6359 |
| 2.0565 | 1.6472 | 2.0565 | 1.0359 | 2.0565 | 0.902 | 2.0565 | 0.8397 | 2.0565 | 0.7973 | 2.0565 | 0.7229 | 2.0565 | 0.6359 |
| 2.1544 | 1.6472 | 2.1544 | 1.0359 | 2.1544 | 0.902 | 2.1544 | 0.8397 | 2.1544 | 0.7973 | 2.1544 | 0.7229 | 2.1544 | 0.6359 |
| 2.257 | 1.3558 | 2.257 | 0.9839 | 2.257 | 0.8903 | 2.257 | 0.8397 | 2.257 | 0.7973 | 2.257 | 0.7229 | 2.257 | 0.6361 |
| 2.3645 | 1.3558 | 2.3645 | 0.9839 | 2.3645 | 0.8903 | 2.3645 | 0.8397 | 2.3645 | 0.7973 | 2.3645 | 0.7229 | 2.3645 | 0.6418 |
| 2.4771 | 1.3558 | 2.4771 | 0.9839 | 2.4771 | 0.8903 | 2.4771 | 0.8363 | 2.4771 | 0.7896 | 2.4771 | 0.7121 | 2.4771 | 0.6484 |
| 2.595 | 1.3558 | 2.595 | 0.9839 | 2.595 | 0.8416 | 2.595 | 0.7692 | 2.595 | 0.745 | 2.595 | 0.7036 | 2.595 | 0.6522 |

PTWW067.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 67 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 2.7186 | 1.3558 | 2.7186 | 0.9839 | 2.7186 | 0.8416 | 2.7186 | 0.7692 | 2.7186 | 0.745 | 2.7186 | 0.7036 | 2.7186 | 0.6522 |
| 2.848 | 1.3558 | 2.848 | 0.9839 | 2.848 | 0.8416 | 2.848 | 0.7692 | 2.848 | 0.745 | 2.848 | 0.7036 | 2.848 | 0.6522 |
| 2.9836 | 1.3558 | 2.9836 | 0.9839 | 2.9836 | 0.8416 | 2.9836 | 0.7692 | 2.9836 | 0.745 | 2.9836 | 0.7036 | 2.9836 | 0.6522 |
| 3.1257 | 1.3558 | 3.1257 | 0.9586 | 3.1257 | 0.8211 | 3.1257 | 0.7692 | 3.1257 | 0.745 | 3.1257 | 0.7036 | 3.1257 | 0.6522 |
| 3.2745 | 1.3558 | 3.2745 | 0.9586 | 3.2745 | 0.8211 | 3.2745 | 0.751 | 3.2745 | 0.7299 | 3.2745 | 0.6954 | 3.2745 | 0.6492 |
| 3.4305 | 1.3558 | 3.4305 | 0.9586 | 3.4305 | 0.8211 | 3.4305 | 0.751 | 3.4305 | 0.7126 | 3.4305 | 0.681 | 3.4305 | 0.6403 |
| 3.5938 | 1.4127 | 3.5938 | 0.9586 | 3.5938 | 0.8211 | 3.5938 | 0.751 | 3.5938 | 0.6971 | 3.5938 | 0.671 | 3.5938 | 0.6329 |
| 3.7649 | 1.4127 | 3.7649 | 0.9586 | 3.7649 | 0.8211 | 3.7649 | 0.751 | 3.7649 | 0.6954 | 3.7649 | 0.6626 | 3.7649 | 0.6263 |
| 3.9442 | 1.4127 | 3.9442 | 0.9586 | 3.9442 | 0.8211 | 3.9442 | 0.751 | 3.9442 | 0.6954 | 3.9442 | 0.659 | 3.9442 | 0.6182 |
| 4.132 | 1.4127 | 4.132 | 0.9586 | 4.132 | 0.8211 | 4.132 | 0.751 | 4.132 | 0.6954 | 4.132 | 0.6519 | 4.132 | 0.6132 |
| 4.3288 | 1.4127 | 4.3288 | 0.9586 | 4.3288 | 0.8211 | 4.3288 | 0.751 | 4.3288 | 0.6954 | 4.3288 | 0.6467 | 4.3288 | 0.6045 |
| 4.5349 | 1.4127 | 4.5349 | 0.9586 | 4.5349 | 0.8211 | 4.5349 | 0.751 | 4.5349 | 0.6954 | 4.5349 | 0.6383 | 4.5349 | 0.5926 |
| 4.7508 | 1.376 | 4.7508 | 0.9153 | 4.7508 | 0.8211 | 4.7508 | 0.751 | 4.7508 | 0.6954 | 4.7508 | 0.6271 | 4.7508 | 0.5766 |
| 4.977 | 1.1452 | 4.977 | 0.7722 | 4.977 | 0.7324 | 4.977 | 0.6911 | 4.977 | 0.6525 | 4.977 | 0.5927 | 4.977 | 0.5466 |
| 5.214 | 0.9648 | 5.214 | 0.7082 | 5.214 | 0.6425 | 5.214 | 0.6138 | 5.214 | 0.5972 | 5.214 | 0.5647 | 5.214 | 0.5221 |
| 5.4623 | 0.9342 | 5.4623 | 0.7082 | 5.4623 | 0.6425 | 5.4623 | 0.6129 | 5.4623 | 0.5893 | 5.4623 | 0.5516 | 5.4623 | 0.5074 |
| 5.7224 | 0.9342 | 5.7224 | 0.7082 | 5.7224 | 0.6425 | 5.7224 | 0.5954 | 5.7224 | 0.5597 | 5.7224 | 0.5268 | 5.7224 | 0.486 |
| 5.9948 | 0.9342 | 5.9948 | 0.6534 | 5.9948 | 0.6337 | 5.9948 | 0.5864 | 5.9948 | 0.5544 | 5.9948 | 0.5117 | 5.9948 | 0.4626 |
| 6.2803 | 0.9342 | 6.2803 | 0.6534 | 6.2803 | 0.6337 | 6.2803 | 0.5864 | 6.2803 | 0.5504 | 6.2803 | 0.4978 | 6.2803 | 0.448 |
| 6.5793 | 0.9342 | 6.5793 | 0.6534 | 6.5793 | 0.6231 | 6.5793 | 0.5714 | 6.5793 | 0.5325 | 6.5793 | 0.4789 | 6.5793 | 0.4308 |
| 6.8926 | 0.9342 | 6.8926 | 0.5885 | 6.8926 | 0.5443 | 6.8926 | 0.5297 | 6.8926 | 0.5115 | 6.8926 | 0.4747 | 6.8926 | 0.4289 |
| 7.2208 | 0.7892 | 7.2208 | 0.5885 | 7.2208 | 0.5404 | 7.2208 | 0.5146 | 7.2208 | 0.4932 | 7.2208 | 0.4582 | 7.2208 | 0.4179 |
| 7.5646 | 0.7892 | 7.5646 | 0.515 | 7.5646 | 0.4923 | 7.5646 | 0.4748 | 7.5646 | 0.4577 | 7.5646 | 0.4273 | 7.5646 | 0.3917 |
| 7.9248 | 0.7038 | 7.9248 | 0.5002 | 7.9248 | 0.4721 | 7.9248 | 0.4509 | 7.9248 | 0.4342 | 7.9248 | 0.4082 | 7.9248 | 0.3799 |
| 8.3022 | 0.5601 | 8.3022 | 0.4481 | 8.3022 | 0.4293 | 8.3022 | 0.4172 | 8.3022 | 0.4072 | 8.3022 | 0.3901 | 8.3022 | 0.3692 |
| 8.6975 | 0.5437 | 8.6975 | 0.3949 | 8.6975 | 0.3739 | 8.6975 | 0.371 | 8.6975 | 0.3686 | 8.6975 | 0.3626 | 8.6975 | 0.3516 |
| 9.1116 | 0.5437 | 9.1116 | 0.3949 | 9.1116 | 0.3729 | 9.1116 | 0.3608 | 9.1116 | 0.3515 | 9.1116 | 0.3431 | 9.1116 | 0.3349 |
| 9.5455 | 0.5437 | 9.5455 | 0.3949 | 9.5455 | 0.3729 | 9.5455 | 0.3608 | 9.5455 | 0.3515 | 9.5455 | 0.3389 | 9.5455 | 0.3303 |
| 10 | 0.5437 | 10 | 0.3883 | 10 | 0.3729 | 10 | 0.3608 | 10 | 0.3515 | 10 | 0.3389 | 10 | 0.3303 |
| 10.4762 | 0.5437 | 10.4762 | 0.3883 | 10.4762 | 0.3729 | 10.4762 | 0.3608 | 10.4762 | 0.3515 | 10.4762 | 0.3389 | 10.4762 | 0.3284 |
| 10.975 | 0.5437 | 10.975 | 0.3711 | 10.975 | 0.3496 | 10.975 | 0.3401 | 10.975 | 0.3328 | 10.975 | 0.3231 | 10.975 | 0.3197 |
| 11.4976 | 0.5437 | 11.4976 | 0.3711 | 11.4976 | 0.3496 | 11.4976 | 0.3401 | 11.4976 | 0.3328 | 11.4976 | 0.3231 | 11.4976 | 0.3197 |
| 12.045 | 0.5437 | 12.045 | 0.3711 | 12.045 | 0.3496 | 12.045 | 0.3401 | 12.045 | 0.3328 | 12.045 | 0.3231 | 12.045 | 0.3197 |
| 12.6186 | 0.5437 | 12.6186 | 0.3711 | 12.6186 | 0.3496 | 12.6186 | 0.3401 | 12.6186 | 0.3328 | 12.6186 | 0.3231 | 12.6186 | 0.3197 |
| 13.2194 | 0.5437 | 13.2194 | 0.3711 | 13.2194 | 0.3496 | 13.2194 | 0.3401 | 13.2194 | 0.3328 | 13.2194 | 0.3231 | 13.2194 | 0.3197 |

PTWW067.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 67 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 0.5437 | 13.8489 | 0.3711 | 13.8489 | 0.3496 | 13.8489 | 0.3401 | 13.8489 | 0.3328 | 13.8489 | 0.3231 | 13.8489 | 0.3197 |
| 14.5083 | 0.5437 | 14.5083 | 0.3711 | 14.5083 | 0.3496 | 14.5083 | 0.3401 | 14.5083 | 0.3328 | 14.5083 | 0.3231 | 14.5083 | 0.3197 |
| 15.1991 | 0.5451 | 15.1991 | 0.3711 | 15.1991 | 0.3496 | 15.1991 | 0.3401 | 15.1991 | 0.3328 | 15.1991 | 0.3231 | 15.1991 | 0.3197 |
| 15.9228 | 0.5451 | 15.9228 | 0.3711 | 15.9228 | 0.3496 | 15.9228 | 0.3401 | 15.9228 | 0.3328 | 15.9228 | 0.3231 | 15.9228 | 0.3197 |
| 16.681 | 0.5451 | 16.681 | 0.3711 | 16.681 | 0.3496 | 16.681 | 0.3401 | 16.681 | 0.3328 | 16.681 | 0.3231 | 16.681 | 0.3197 |
| 17.4753 | 0.5451 | 17.4753 | 0.4145 | 17.4753 | 0.384 | 17.4753 | 0.3654 | 17.4753 | 0.3531 | 17.4753 | 0.338 | 17.4753 | 0.3258 |
| 18.3074 | 0.5451 | 18.3074 | 0.4145 | 18.3074 | 0.384 | 18.3074 | 0.3654 | 18.3074 | 0.3531 | 18.3074 | 0.338 | 18.3074 | 0.3258 |
| 19.1791 | 0.5325 | 19.1791 | 0.4145 | 19.1791 | 0.384 | 19.1791 | 0.3654 | 19.1791 | 0.3531 | 19.1791 | 0.338 | 19.1791 | 0.3258 |
| 20.0923 | 0.5325 | 20.0923 | 0.4145 | 20.0923 | 0.384 | 20.0923 | 0.3654 | 20.0923 | 0.3531 | 20.0923 | 0.338 | 20.0923 | 0.3258 |
| 21.049 | 0.5325 | 21.049 | 0.4145 | 21.049 | 0.384 | 21.049 | 0.3654 | 21.049 | 0.3531 | 21.049 | 0.338 | 21.049 | 0.3258 |
| 22.0513 | 0.5093 | 22.0513 | 0.357 | 22.0513 | 0.345 | 22.0513 | 0.3404 | 22.0513 | 0.3377 | 22.0513 | 0.3309 | 22.0513 | 0.3223 |
| 23.1013 | 0.5093 | 23.1013 | 0.357 | 23.1013 | 0.345 | 23.1013 | 0.3371 | 23.1013 | 0.3312 | 23.1013 | 0.3223 | 23.1013 | 0.3135 |
| 24.2013 | 0.4442 | 24.2013 | 0.3461 | 24.2013 | 0.3355 | 24.2013 | 0.3293 | 24.2013 | 0.3248 | 24.2013 | 0.3182 | 24.2013 | 0.3115 |
| 25.3536 | 0.4442 | 25.3536 | 0.3079 | 25.3536 | 0.3069 | 25.3536 | 0.307 | 25.3536 | 0.3072 | 25.3536 | 0.3068 | 25.3536 | 0.3051 |
| 26.5609 | 0.4442 | 26.5609 | 0.3048 | 26.5609 | 0.2996 | 26.5609 | 0.2979 | 26.5609 | 0.2979 | 26.5609 | 0.2986 | 26.5609 | 0.2992 |
| 27.8256 | 0.3666 | 27.8256 | 0.3037 | 27.8256 | 0.2996 | 27.8256 | 0.2979 | 27.8256 | 0.297 | 27.8256 | 0.296 | 27.8256 | 0.2956 |
| 29.1505 | 0.3342 | 29.1505 | 0.3037 | 29.1505 | 0.2996 | 29.1505 | 0.2979 | 29.1505 | 0.297 | 29.1505 | 0.296 | 29.1505 | 0.2951 |
| 30.5386 | 0.3342 | 30.5386 | 0.3037 | 30.5386 | 0.2996 | 30.5386 | 0.2979 | 30.5386 | 0.297 | 30.5386 | 0.296 | 30.5386 | 0.2951 |
| 31.9927 | 0.3088 | 31.9927 | 0.2994 | 31.9927 | 0.2977 | 31.9927 | 0.2968 | 31.9927 | 0.2961 | 31.9927 | 0.2952 | 31.9927 | 0.2943 |
| 33.516 | 0.2961 | 33.516 | 0.2957 | 33.516 | 0.2953 | 33.516 | 0.295 | 33.516 | 0.2948 | 33.516 | 0.2945 | 33.516 | 0.2942 |
| 35.1119 | 0.2952 | 35.1119 | 0.2948 | 35.1119 | 0.2947 | 35.1119 | 0.2946 | 35.1119 | 0.2944 | 35.1119 | 0.2942 | 35.1119 | 0.2939 |
| 36.7838 | 0.2943 | 36.7838 | 0.2943 | 36.7838 | 0.2942 | 36.7838 | 0.2941 | 36.7838 | 0.294 | 36.7838 | 0.2938 | 36.7838 | 0.2936 |
| 38.5353 | 0.2938 | 38.5353 | 0.2937 | 38.5353 | 0.2936 | 38.5353 | 0.2936 | 38.5353 | 0.2935 | 38.5353 | 0.2934 | 38.5353 | 0.2932 |
| 40.3702 | 0.2932 | 40.3702 | 0.2931 | 40.3702 | 0.2931 | 40.3702 | 0.293 | 40.3702 | 0.293 | 40.3702 | 0.2929 | 40.3702 | 0.2928 |
| 42.2924 | 0.2925 | 42.2924 | 0.2926 | 42.2924 | 0.2925 | 42.2924 | 0.2925 | 42.2924 | 0.2925 | 42.2924 | 0.2924 | 42.2924 | 0.2923 |
| 44.3062 | 0.2922 | 44.3062 | 0.2921 | 44.3062 | 0.2921 | 44.3062 | 0.2921 | 44.3062 | 0.292 | 44.3062 | 0.292 | 44.3062 | 0.2919 |
| 46.4159 | 0.2917 | 46.4159 | 0.2916 | 46.4159 | 0.2916 | 46.4159 | 0.2916 | 46.4159 | 0.2916 | 46.4159 | 0.2916 | 46.4159 | 0.2916 |
| 48.626 | 0.2913 | 48.626 | 0.2912 | 48.626 | 0.2912 | 48.626 | 0.2912 | 48.626 | 0.2912 | 48.626 | 0.2912 | 48.626 | 0.2912 |
| 50.9414 | 0.2907 | 50.9414 | 0.2908 | 50.9414 | 0.2908 | 50.9414 | 0.2908 | 50.9414 | 0.2908 | 50.9414 | 0.2908 | 50.9414 | 0.2909 |

PTWW068.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 68 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.1098 | 0.0404 | 0.1098 | 0.0365 | 0.1098 | 0.0342 | 0.1098 | 0.0321 | 0.1098 | 0.0302 | 0.1098 | 0.0271 | 0.1098 | 0.0235 |
| 0.115 | 0.0404 | 0.115 | 0.0365 | 0.115 | 0.0342 | 0.115 | 0.0321 | 0.115 | 0.0302 | 0.115 | 0.0271 | 0.115 | 0.0253 |
| 0.1204 | 0.0404 | 0.1204 | 0.0365 | 0.1204 | 0.0342 | 0.1204 | 0.0321 | 0.1204 | 0.0306 | 0.1204 | 0.0293 | 0.1204 | 0.0274 |
| 0.1262 | 0.0404 | 0.1262 | 0.0365 | 0.1262 | 0.0349 | 0.1262 | 0.034 | 0.1262 | 0.033 | 0.1262 | 0.0313 | 0.1262 | 0.0292 |
| 0.1322 | 0.0404 | 0.1322 | 0.038 | 0.1322 | 0.0368 | 0.1322 | 0.0356 | 0.1322 | 0.0346 | 0.1322 | 0.0328 | 0.1322 | 0.0312 |
| 0.1385 | 0.0409 | 0.1385 | 0.0389 | 0.1385 | 0.0377 | 0.1385 | 0.0368 | 0.1385 | 0.0359 | 0.1385 | 0.0344 | 0.1385 | 0.0325 |
| 0.1451 | 0.0414 | 0.1451 | 0.0395 | 0.1451 | 0.0384 | 0.1451 | 0.0375 | 0.1451 | 0.0366 | 0.1451 | 0.035 | 0.1451 | 0.033 |
| 0.152 | 0.0438 | 0.152 | 0.04 | 0.152 | 0.0384 | 0.152 | 0.0375 | 0.152 | 0.0366 | 0.152 | 0.035 | 0.152 | 0.033 |
| 0.1592 | 0.0461 | 0.1592 | 0.0415 | 0.1592 | 0.0394 | 0.1592 | 0.0375 | 0.1592 | 0.0366 | 0.1592 | 0.035 | 0.1592 | 0.033 |
| 0.1668 | 0.0583 | 0.1668 | 0.0505 | 0.1668 | 0.0462 | 0.1668 | 0.0425 | 0.1668 | 0.0394 | 0.1668 | 0.035 | 0.1668 | 0.033 |
| 0.1748 | 0.0643 | 0.1748 | 0.0565 | 0.1748 | 0.0521 | 0.1748 | 0.0482 | 0.1748 | 0.0448 | 0.1748 | 0.0392 | 0.1748 | 0.033 |
| 0.1831 | 0.0666 | 0.1831 | 0.0582 | 0.1831 | 0.0541 | 0.1831 | 0.0503 | 0.1831 | 0.047 | 0.1831 | 0.0413 | 0.1831 | 0.0351 |
| 0.1918 | 0.0676 | 0.1918 | 0.0584 | 0.1918 | 0.0541 | 0.1918 | 0.0505 | 0.1918 | 0.0472 | 0.1918 | 0.0415 | 0.1918 | 0.0376 |
| 0.2009 | 0.0695 | 0.2009 | 0.0594 | 0.2009 | 0.0541 | 0.2009 | 0.0509 | 0.2009 | 0.0481 | 0.2009 | 0.0431 | 0.2009 | 0.0405 |
| 0.2105 | 0.0719 | 0.2105 | 0.0616 | 0.2105 | 0.0578 | 0.2105 | 0.0543 | 0.2105 | 0.051 | 0.2105 | 0.0476 | 0.2105 | 0.0438 |
| 0.2205 | 0.0815 | 0.2205 | 0.0705 | 0.2205 | 0.0647 | 0.2205 | 0.0596 | 0.2205 | 0.0568 | 0.2205 | 0.0524 | 0.2205 | 0.0475 |
| 0.231 | 0.0953 | 0.231 | 0.0787 | 0.231 | 0.0702 | 0.231 | 0.0666 | 0.231 | 0.0632 | 0.231 | 0.0575 | 0.231 | 0.0509 |
| 0.242 | 0.0977 | 0.242 | 0.084 | 0.242 | 0.0771 | 0.242 | 0.071 | 0.242 | 0.0669 | 0.242 | 0.06 | 0.242 | 0.0529 |
| 0.2535 | 0.1051 | 0.2535 | 0.0906 | 0.2535 | 0.0825 | 0.2535 | 0.0755 | 0.2535 | 0.0694 | 0.2535 | 0.06 | 0.2535 | 0.0529 |
| 0.2656 | 0.1133 | 0.2656 | 0.094 | 0.2656 | 0.0837 | 0.2656 | 0.0755 | 0.2656 | 0.0694 | 0.2656 | 0.06 | 0.2656 | 0.0529 |
| 0.2783 | 0.1133 | 0.2783 | 0.094 | 0.2783 | 0.0837 | 0.2783 | 0.0776 | 0.2783 | 0.0736 | 0.2783 | 0.0666 | 0.2783 | 0.0591 |
| 0.2915 | 0.1133 | 0.2915 | 0.0994 | 0.2915 | 0.093 | 0.2915 | 0.0874 | 0.2915 | 0.0826 | 0.2915 | 0.0745 | 0.2915 | 0.0653 |
| 0.3054 | 0.1163 | 0.3054 | 0.104 | 0.3054 | 0.0971 | 0.3054 | 0.0909 | 0.3054 | 0.0855 | 0.3054 | 0.0765 | 0.3054 | 0.067 |
| 0.3199 | 0.1163 | 0.3199 | 0.104 | 0.3199 | 0.0971 | 0.3199 | 0.0909 | 0.3199 | 0.0864 | 0.3199 | 0.0812 | 0.3199 | 0.0747 |
| 0.3352 | 0.1163 | 0.3352 | 0.1068 | 0.3352 | 0.1025 | 0.3352 | 0.0986 | 0.3352 | 0.095 | 0.3352 | 0.0886 | 0.3352 | 0.0809 |
| 0.3511 | 0.1636 | 0.3511 | 0.1274 | 0.3511 | 0.1102 | 0.3511 | 0.1045 | 0.3511 | 0.1004 | 0.3511 | 0.0933 | 0.3511 | 0.0851 |
| 0.3678 | 0.2398 | 0.3678 | 0.1821 | 0.3678 | 0.1557 | 0.3678 | 0.1356 | 0.3678 | 0.1202 | 0.3678 | 0.0985 | 0.3678 | 0.0858 |
| 0.3853 | 0.2521 | 0.3853 | 0.185 | 0.3853 | 0.1576 | 0.3853 | 0.137 | 0.3853 | 0.123 | 0.3853 | 0.1052 | 0.3853 | 0.0881 |
| 0.4037 | 0.2521 | 0.4037 | 0.185 | 0.4037 | 0.1576 | 0.4037 | 0.137 | 0.4037 | 0.1254 | 0.4037 | 0.1131 | 0.4037 | 0.0996 |
| 0.4229 | 0.2521 | 0.4229 | 0.185 | 0.4229 | 0.1633 | 0.4229 | 0.1471 | 0.4229 | 0.1332 | 0.4229 | 0.1199 | 0.4229 | 0.1082 |
| 0.4431 | 0.3248 | 0.4431 | 0.2299 | 0.4431 | 0.1995 | 0.4431 | 0.1774 | 0.4431 | 0.1605 | 0.4431 | 0.137 | 0.4431 | 0.1162 |
| 0.4642 | 0.3248 | 0.4642 | 0.2299 | 0.4642 | 0.1995 | 0.4642 | 0.1774 | 0.4642 | 0.1605 | 0.4642 | 0.137 | 0.4642 | 0.1162 |
| 0.4863 | 0.3248 | 0.4863 | 0.2299 | 0.4863 | 0.1995 | 0.4863 | 0.1774 | 0.4863 | 0.1605 | 0.4863 | 0.1398 | 0.4863 | 0.123 |
| 0.5094 | 0.3248 | 0.5094 | 0.2299 | 0.5094 | 0.1995 | 0.5094 | 0.1774 | 0.5094 | 0.1605 | 0.5094 | 0.1461 | 0.5094 | 0.1281 |

PTWW068.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 68 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.5337 | 0.3307 | 0.5337 | 0.2342 | 0.5337 | 0.2031 | 0.5337 | 0.1861 | 0.5337 | 0.1756 | 0.5337 | 0.1572 | 0.5337 | 0.1357 |
| 0.5591 | 0.3864 | 0.5591 | 0.2681 | 0.5591 | 0.2359 | 0.5591 | 0.2104 | 0.5591 | 0.1922 | 0.5591 | 0.1683 | 0.5591 | 0.1505 |
| 0.5857 | 0.3864 | 0.5857 | 0.2751 | 0.5857 | 0.2466 | 0.5857 | 0.223 | 0.5857 | 0.2031 | 0.5857 | 0.1791 | 0.5857 | 0.1667 |
| 0.6136 | 0.3864 | 0.6136 | 0.2751 | 0.6136 | 0.2466 | 0.6136 | 0.223 | 0.6136 | 0.2035 | 0.6136 | 0.193 | 0.6136 | 0.1795 |
| 0.6428 | 0.3864 | 0.6428 | 0.2751 | 0.6428 | 0.2466 | 0.6428 | 0.2234 | 0.6428 | 0.2139 | 0.6428 | 0.2039 | 0.6428 | 0.1896 |
| 0.6734 | 0.3953 | 0.6734 | 0.2751 | 0.6734 | 0.251 | 0.6734 | 0.2354 | 0.6734 | 0.2284 | 0.6734 | 0.2154 | 0.6734 | 0.1984 |
| 0.7055 | 0.3953 | 0.7055 | 0.2852 | 0.7055 | 0.2641 | 0.7055 | 0.2526 | 0.7055 | 0.2425 | 0.7055 | 0.2254 | 0.7055 | 0.2061 |
| 0.7391 | 0.6097 | 0.7391 | 0.3987 | 0.7391 | 0.3252 | 0.7391 | 0.2766 | 0.7391 | 0.2575 | 0.7391 | 0.2289 | 0.7391 | 0.208 |
| 0.7743 | 0.6097 | 0.7743 | 0.3987 | 0.7743 | 0.3252 | 0.7743 | 0.2869 | 0.7743 | 0.2696 | 0.7743 | 0.2409 | 0.7743 | 0.2089 |
| 0.8111 | 0.6283 | 0.8111 | 0.4148 | 0.8111 | 0.3607 | 0.8111 | 0.3191 | 0.8111 | 0.2867 | 0.8111 | 0.2409 | 0.8111 | 0.2089 |
| 0.8497 | 0.6283 | 0.8497 | 0.4148 | 0.8497 | 0.3768 | 0.8497 | 0.3473 | 0.8497 | 0.3221 | 0.8497 | 0.2809 | 0.8497 | 0.2363 |
| 0.8902 | 0.6457 | 0.8902 | 0.4214 | 0.8902 | 0.3768 | 0.8902 | 0.3473 | 0.8902 | 0.3236 | 0.8902 | 0.2939 | 0.8902 | 0.2537 |
| 0.9326 | 0.6829 | 0.9326 | 0.4768 | 0.9326 | 0.4187 | 0.9326 | 0.376 | 0.9326 | 0.344 | 0.9326 | 0.299 | 0.9326 | 0.2562 |
| 0.977 | 0.9086 | 0.977 | 0.5785 | 0.977 | 0.4758 | 0.977 | 0.4112 | 0.977 | 0.3674 | 0.977 | 0.3135 | 0.977 | 0.2721 |
| 1.0235 | 0.9086 | 1.0235 | 0.5785 | 1.0235 | 0.517 | 1.0235 | 0.4689 | 1.0235 | 0.429 | 1.0235 | 0.368 | 1.0235 | 0.3069 |
| 1.0723 | 0.9086 | 1.0723 | 0.5886 | 1.0723 | 0.5252 | 1.0723 | 0.4728 | 1.0723 | 0.4295 | 1.0723 | 0.3754 | 1.0723 | 0.318 |
| 1.1233 | 1.2562 | 1.1233 | 0.759 | 1.1233 | 0.6339 | 1.1233 | 0.5449 | 1.1233 | 0.4784 | 1.1233 | 0.3889 | 1.1233 | 0.318 |
| 1.1768 | 1.2562 | 1.1768 | 0.759 | 1.1768 | 0.6339 | 1.1768 | 0.5449 | 1.1768 | 0.4784 | 1.1768 | 0.4006 | 1.1768 | 0.3289 |
| 1.2328 | 1.2562 | 1.2328 | 0.8302 | 1.2328 | 0.7291 | 1.2328 | 0.6491 | 1.2328 | 0.5837 | 1.2328 | 0.4845 | 1.2328 | 0.3864 |
| 1.2916 | 1.2562 | 1.2916 | 0.9189 | 1.2916 | 0.7993 | 1.2916 | 0.7058 | 1.2916 | 0.6308 | 1.2916 | 0.5188 | 1.2916 | 0.4097 |
| 1.353 | 1.2562 | 1.353 | 0.9189 | 1.353 | 0.7993 | 1.353 | 0.7058 | 1.353 | 0.6308 | 1.353 | 0.5188 | 1.353 | 0.4097 |
| 1.4175 | 1.3538 | 1.4175 | 0.9674 | 1.4175 | 0.8219 | 1.4175 | 0.7323 | 1.4175 | 0.6639 | 1.4175 | 0.5631 | 1.4175 | 0.4667 |
| 1.485 | 1.3538 | 1.485 | 0.9674 | 1.485 | 0.8219 | 1.485 | 0.7371 | 1.485 | 0.6874 | 1.485 | 0.5977 | 1.485 | 0.4967 |
| 1.5557 | 1.5417 | 1.5557 | 0.9739 | 1.5557 | 0.8219 | 1.5557 | 0.7371 | 1.5557 | 0.6874 | 1.5557 | 0.5977 | 1.5557 | 0.5028 |
| 1.6298 | 1.6087 | 1.6298 | 1.0257 | 1.6298 | 0.9121 | 1.6298 | 0.8203 | 1.6298 | 0.7505 | 1.6298 | 0.6443 | 1.6298 | 0.5288 |
| 1.7074 | 1.6087 | 1.7074 | 1.0361 | 1.7074 | 0.9722 | 1.7074 | 0.8761 | 1.7074 | 0.795 | 1.7074 | 0.6704 | 1.7074 | 0.5676 |
| 1.7887 | 1.8947 | 1.7887 | 1.0361 | 1.7887 | 0.9722 | 1.7887 | 0.8761 | 1.7887 | 0.795 | 1.7887 | 0.6869 | 1.7887 | 0.5915 |
| 1.8738 | 1.8947 | 1.8738 | 1.0361 | 1.8738 | 0.9722 | 1.8738 | 0.8761 | 1.8738 | 0.795 | 1.8738 | 0.7041 | 1.8738 | 0.6047 |
| 1.963 | 1.8947 | 1.963 | 1.0361 | 1.963 | 0.9722 | 1.963 | 0.8761 | 1.963 | 0.7962 | 1.963 | 0.7116 | 1.963 | 0.6087 |
| 2.0565 | 1.8947 | 2.0565 | 1.0361 | 2.0565 | 0.9722 | 2.0565 | 0.8761 | 2.0565 | 0.7962 | 2.0565 | 0.7116 | 2.0565 | 0.6087 |
| 2.1544 | 1.8947 | 2.1544 | 1.0361 | 2.1544 | 0.9581 | 2.1544 | 0.8481 | 2.1544 | 0.7962 | 2.1544 | 0.7116 | 2.1544 | 0.6087 |
| 2.257 | 1.6082 | 2.257 | 1.0361 | 2.257 | 0.9149 | 2.257 | 0.8481 | 2.257 | 0.7962 | 2.257 | 0.7116 | 2.257 | 0.6087 |
| 2.3645 | 1.6082 | 2.3645 | 0.9942 | 2.3645 | 0.9149 | 2.3645 | 0.8481 | 2.3645 | 0.7962 | 2.3645 | 0.7116 | 2.3645 | 0.6087 |
| 2.4771 | 1.6082 | 2.4771 | 0.9942 | 2.4771 | 0.9149 | 2.4771 | 0.8481 | 2.4771 | 0.7904 | 2.4771 | 0.7069 | 2.4771 | 0.6029 |
| 2.595 | 1.2397 | 2.595 | 0.9942 | 2.595 | 0.9149 | 2.595 | 0.8481 | 2.595 | 0.7904 | 2.595 | 0.6952 | 2.595 | 0.5873 |

PTWW068.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 68 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.7186 | 1.1953 | 2.7186 | 0.9202 | 2.7186 | 0.8531 | 2.7186 | 0.7931 | 2.7186 | 0.7395 | 2.7186 | 0.6495 | 2.7186 | 0.562 |
| 2.848 | 1.0844 | 2.848 | 0.8533 | 2.848 | 0.7801 | 2.848 | 0.7362 | 2.848 | 0.6948 | 2.848 | 0.6221 | 2.848 | 0.5376 |
| 2.9836 | 1.0844 | 2.9836 | 0.8533 | 2.9836 | 0.7663 | 2.9836 | 0.6995 | 2.9836 | 0.6477 | 2.9836 | 0.5712 | 2.9836 | 0.4918 |
| 3.1257 | 1.0608 | 3.1257 | 0.664 | 3.1257 | 0.6109 | 3.1257 | 0.5659 | 3.1257 | 0.5322 | 3.1257 | 0.4875 | 3.1257 | 0.4434 |
| 3.2745 | 1.0608 | 3.2745 | 0.664 | 3.2745 | 0.6109 | 3.2745 | 0.5637 | 3.2745 | 0.523 | 3.2745 | 0.464 | 3.2745 | 0.411 |
| 3.4305 | 1.0608 | 3.4305 | 0.664 | 3.4305 | 0.6109 | 3.4305 | 0.5637 | 3.4305 | 0.523 | 3.4305 | 0.464 | 3.4305 | 0.411 |
| 3.5938 | 1.0608 | 3.5938 | 0.664 | 3.5938 | 0.6109 | 3.5938 | 0.5637 | 3.5938 | 0.523 | 3.5938 | 0.464 | 3.5938 | 0.411 |
| 3.7649 | 1.0608 | 3.7649 | 0.664 | 3.7649 | 0.6109 | 3.7649 | 0.5637 | 3.7649 | 0.523 | 3.7649 | 0.464 | 3.7649 | 0.411 |
| 3.9442 | 1.0608 | 3.9442 | 0.664 | 3.9442 | 0.6109 | 3.9442 | 0.5637 | 3.9442 | 0.523 | 3.9442 | 0.464 | 3.9442 | 0.411 |
| 4.132 | 1.0608 | 4.132 | 0.664 | 4.132 | 0.6109 | 4.132 | 0.5637 | 4.132 | 0.523 | 4.132 | 0.464 | 4.132 | 0.411 |
| 4.3288 | 1.0608 | 4.3288 | 0.664 | 4.3288 | 0.6109 | 4.3288 | 0.5637 | 4.3288 | 0.523 | 4.3288 | 0.464 | 4.3288 | 0.411 |
| 4.5349 | 1.0608 | 4.5349 | 0.664 | 4.5349 | 0.6109 | 4.5349 | 0.5637 | 4.5349 | 0.523 | 4.5349 | 0.464 | 4.5349 | 0.411 |
| 4.7508 | 1.0608 | 4.7508 | 0.664 | 4.7508 | 0.6109 | 4.7508 | 0.5637 | 4.7508 | 0.523 | 4.7508 | 0.464 | 4.7508 | 0.411 |
| 4.977 | 1.0608 | 4.977 | 0.6825 | 4.977 | 0.6131 | 4.977 | 0.5637 | 4.977 | 0.523 | 4.977 | 0.464 | 4.977 | 0.411 |
| 5.214 | 1.0608 | 5.214 | 0.6825 | 5.214 | 0.6131 | 5.214 | 0.5637 | 5.214 | 0.523 | 5.214 | 0.464 | 5.214 | 0.411 |
| 5.4623 | 1.0608 | 5.4623 | 0.6825 | 5.4623 | 0.6131 | 5.4623 | 0.5637 | 5.4623 | 0.523 | 5.4623 | 0.464 | 5.4623 | 0.411 |
| 5.7224 | 1.5414 | 5.7224 | 0.7528 | 5.7224 | 0.6883 | 5.7224 | 0.5675 | 5.7224 | 0.523 | 5.7224 | 0.464 | 5.7224 | 0.411 |
| 5.9948 | 1.5414 | 5.9948 | 0.7528 | 5.9948 | 0.6883 | 5.9948 | 0.5707 | 5.9948 | 0.5166 | 5.9948 | 0.4624 | 5.9948 | 0.411 |
| 6.2803 | 1.5414 | 6.2803 | 0.7528 | 6.2803 | 0.6883 | 6.2803 | 0.5707 | 6.2803 | 0.5135 | 6.2803 | 0.4514 | 6.2803 | 0.4057 |
| 6.5793 | 1.5414 | 6.5793 | 0.7528 | 6.5793 | 0.6883 | 6.5793 | 0.5707 | 6.5793 | 0.5057 | 6.5793 | 0.4473 | 6.5793 | 0.4057 |
| 6.8926 | 1.5414 | 6.8926 | 0.7528 | 6.8926 | 0.6883 | 6.8926 | 0.5707 | 6.8926 | 0.5057 | 6.8926 | 0.4393 | 6.8926 | 0.4057 |
| 7.2208 | 1.2507 | 7.2208 | 0.7528 | 7.2208 | 0.6517 | 7.2208 | 0.5707 | 7.2208 | 0.5057 | 7.2208 | 0.43 | 7.2208 | 0.4057 |
| 7.5646 | 1.1914 | 7.5646 | 0.7042 | 7.5646 | 0.5868 | 7.5646 | 0.5157 | 7.5646 | 0.4615 | 7.5646 | 0.43 | 7.5646 | 0.4057 |
| 7.9248 | 1.0406 | 7.9248 | 0.5548 | 7.9248 | 0.4886 | 7.9248 | 0.4685 | 7.9248 | 0.4529 | 7.9248 | 0.43 | 7.9248 | 0.4057 |
| 8.3022 | 1.0406 | 8.3022 | 0.547 | 8.3022 | 0.4886 | 8.3022 | 0.4685 | 8.3022 | 0.4529 | 8.3022 | 0.43 | 8.3022 | 0.4057 |
| 8.6975 | 0.8232 | 8.6975 | 0.5221 | 8.6975 | 0.4886 | 8.6975 | 0.4685 | 8.6975 | 0.4529 | 8.6975 | 0.43 | 8.6975 | 0.4054 |
| 9.1116 | 0.8232 | 9.1116 | 0.5221 | 9.1116 | 0.4715 | 9.1116 | 0.4536 | 9.1116 | 0.442 | 9.1116 | 0.4229 | 9.1116 | 0.4013 |
| 9.5455 | 0.8232 | 9.5455 | 0.5221 | 9.5455 | 0.4715 | 9.5455 | 0.4536 | 9.5455 | 0.442 | 9.5455 | 0.4229 | 9.5455 | 0.4013 |
| 10 | 0.7266 | 10 | 0.5221 | 10 | 0.4715 | 10 | 0.4536 | 10 | 0.442 | 10 | 0.4229 | 10 | 0.4013 |
| 10.4762 | 0.7266 | 10.4762 | 0.5221 | 10.4762 | 0.4715 | 10.4762 | 0.4318 | 10.4762 | 0.4256 | 10.4762 | 0.4126 | 10.4762 | 0.3942 |
| 10.975 | 0.7266 | 10.975 | 0.5221 | 10.975 | 0.4715 | 10.975 | 0.4261 | 10.975 | 0.412 | 10.975 | 0.3988 | 10.975 | 0.3816 |
| 11.4976 | 0.7266 | 11.4976 | 0.5041 | 11.4976 | 0.4445 | 11.4976 | 0.4109 | 11.4976 | 0.4001 | 11.4976 | 0.3859 | 11.4976 | 0.3714 |
| 12.045 | 0.5193 | 12.045 | 0.4288 | 12.045 | 0.3925 | 12.045 | 0.3815 | 12.045 | 0.3795 | 12.045 | 0.3743 | 12.045 | 0.3648 |
| 12.6186 | 0.5193 | 12.6186 | 0.3891 | 12.6186 | 0.3839 | 12.6186 | 0.3789 | 12.6186 | 0.3746 | 12.6186 | 0.367 | 12.6186 | 0.3574 |
| 13.2194 | 0.5193 | 13.2194 | 0.3754 | 13.2194 | 0.3691 | 13.2194 | 0.3654 | 13.2194 | 0.3624 | 13.2194 | 0.3568 | 13.2194 | 0.3489 |

PTWW068.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 68 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 0.5193 | 13.8489 | 0.3622 | 13.8489 | 0.3539 | 13.8489 | 0.3531 | 13.8489 | 0.3514 | 13.8489 | 0.3468 | 13.8489 | 0.3398 |
| 14.5083 | 0.5193 | 14.5083 | 0.3622 | 14.5083 | 0.3539 | 14.5083 | 0.3479 | 14.5083 | 0.3436 | 14.5083 | 0.3374 | 14.5083 | 0.3305 |
| 15.1991 | 0.5193 | 15.1991 | 0.3331 | 15.1991 | 0.3298 | 15.1991 | 0.3285 | 15.1991 | 0.3274 | 15.1991 | 0.3248 | 15.1991 | 0.3203 |
| 15.9228 | 0.5193 | 15.9228 | 0.3275 | 15.9228 | 0.323 | 15.9228 | 0.3212 | 15.9228 | 0.3191 | 15.9228 | 0.3152 | 15.9228 | 0.3107 |
| 16.681 | 0.5193 | 16.681 | 0.3275 | 16.681 | 0.3163 | 16.681 | 0.3108 | 16.681 | 0.3078 | 16.681 | 0.304 | 16.681 | 0.301 |
| 17.4753 | 0.5193 | 17.4753 | 0.3271 | 17.4753 | 0.3111 | 17.4753 | 0.3037 | 17.4753 | 0.3025 | 17.4753 | 0.2998 | 17.4753 | 0.2959 |
| 18.3074 | 0.4409 | 18.3074 | 0.3004 | 18.3074 | 0.3011 | 18.3074 | 0.2998 | 18.3074 | 0.2981 | 18.3074 | 0.2949 | 18.3074 | 0.2912 |
| 19.1791 | 0.4409 | 19.1791 | 0.2999 | 19.1791 | 0.2901 | 19.1791 | 0.2881 | 19.1791 | 0.2874 | 19.1791 | 0.2867 | 19.1791 | 0.2854 |
| 20.0923 | 0.4409 | 20.0923 | 0.2999 | 20.0923 | 0.286 | 20.0923 | 0.2839 | 20.0923 | 0.2824 | 20.0923 | 0.2815 | 20.0923 | 0.2811 |
| 21.049 | 0.4409 | 21.049 | 0.2999 | 21.049 | 0.286 | 21.049 | 0.2839 | 21.049 | 0.2824 | 21.049 | 0.2803 | 21.049 | 0.2784 |
| 22.0513 | 0.4409 | 22.0513 | 0.2961 | 22.0513 | 0.2857 | 22.0513 | 0.2819 | 22.0513 | 0.279 | 22.0513 | 0.2775 | 22.0513 | 0.2758 |
| 23.1013 | 0.4409 | 23.1013 | 0.2902 | 23.1013 | 0.2857 | 23.1013 | 0.2819 | 23.1013 | 0.279 | 23.1013 | 0.2756 | 23.1013 | 0.2728 |
| 24.2013 | 0.4409 | 24.2013 | 0.2763 | 24.2013 | 0.2687 | 24.2013 | 0.2687 | 24.2013 | 0.2692 | 24.2013 | 0.2691 | 24.2013 | 0.2684 |
| 25.3536 | 0.304 | 25.3536 | 0.271 | 25.3536 | 0.2687 | 25.3536 | 0.267 | 25.3536 | 0.2657 | 25.3536 | 0.264 | 25.3536 | 0.2647 |
| 26.5609 | 0.304 | 26.5609 | 0.271 | 26.5609 | 0.2687 | 26.5609 | 0.267 | 26.5609 | 0.2657 | 26.5609 | 0.264 | 26.5609 | 0.2628 |
| 27.8256 | 0.2808 | 27.8256 | 0.2679 | 27.8256 | 0.2658 | 27.8256 | 0.2641 | 27.8256 | 0.2629 | 27.8256 | 0.2613 | 27.8256 | 0.2603 |
| 29.1505 | 0.2754 | 29.1505 | 0.2584 | 29.1505 | 0.2573 | 29.1505 | 0.2565 | 29.1505 | 0.2559 | 29.1505 | 0.2561 | 29.1505 | 0.2571 |
| 30.5386 | 0.2652 | 30.5386 | 0.2584 | 30.5386 | 0.2573 | 30.5386 | 0.2565 | 30.5386 | 0.2559 | 30.5386 | 0.2553 | 30.5386 | 0.2556 |
| 31.9927 | 0.2557 | 31.9927 | 0.2584 | 31.9927 | 0.2573 | 31.9927 | 0.2565 | 31.9927 | 0.2559 | 31.9927 | 0.2553 | 31.9927 | 0.2549 |
| 33.516 | 0.2539 | 33.516 | 0.2548 | 33.516 | 0.2549 | 33.516 | 0.2548 | 33.516 | 0.2546 | 33.516 | 0.2543 | 33.516 | 0.2539 |
| 35.1119 | 0.2533 | 35.1119 | 0.2532 | 35.1119 | 0.2531 | 35.1119 | 0.2531 | 35.1119 | 0.253 | 35.1119 | 0.2529 | 35.1119 | 0.2527 |
| 36.7838 | 0.252 | 36.7838 | 0.2519 | 36.7838 | 0.2518 | 36.7838 | 0.2518 | 36.7838 | 0.2518 | 36.7838 | 0.2517 | 36.7838 | 0.2516 |
| 38.5353 | 0.2507 | 38.5353 | 0.2507 | 38.5353 | 0.2506 | 38.5353 | 0.2506 | 38.5353 | 0.2506 | 38.5353 | 0.2506 | 38.5353 | 0.2505 |
| 40.3702 | 0.2496 | 40.3702 | 0.2496 | 40.3702 | 0.2496 | 40.3702 | 0.2496 | 40.3702 | 0.2496 | 40.3702 | 0.2496 | 40.3702 | 0.2495 |
| 42.2924 | 0.2486 | 42.2924 | 0.2487 | 42.2924 | 0.2487 | 42.2924 | 0.2487 | 42.2924 | 0.2487 | 42.2924 | 0.2487 | 42.2924 | 0.2487 |
| 44.3062 | 0.2478 | 44.3062 | 0.2479 | 44.3062 | 0.2479 | 44.3062 | 0.2479 | 44.3062 | 0.2479 | 44.3062 | 0.2479 | 44.3062 | 0.2479 |
| 46.4159 | 0.2472 | 46.4159 | 0.2471 | 46.4159 | 0.2471 | 46.4159 | 0.2471 | 46.4159 | 0.2471 | 46.4159 | 0.2471 | 46.4159 | 0.2472 |
| 48.626 | 0.2464 | 48.626 | 0.2464 | 48.626 | 0.2464 | 48.626 | 0.2464 | 48.626 | 0.2464 | 48.626 | 0.2465 | 48.626 | 0.2465 |
| 50.9414 | 0.2458 | 50.9414 | 0.2458 | 50.9414 | 0.2458 | 50.9414 | 0.2458 | 50.9414 | 0.2458 | 50.9414 | 0.2458 | 50.9414 | 0.2458 |

PTEE024.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 24E ~ Vertical Responses - Slab/Wall Joints ~ Elevation 0 ft. (Concrete) ~ Enveloped Spectra

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.1098 | 0.0291 | 0.1098 | 0.026 | 0.1098 | 0.0244 | 0.1098 | 0.0229 | 0.1098 | 0.022 | 0.1098 | 0.0212 | 0.1098 | 0.0204 |
| 0.115 | 0.0308 | 0.115 | 0.026 | 0.115 | 0.0244 | 0.115 | 0.0233 | 0.115 | 0.0229 | 0.115 | 0.0221 | 0.115 | 0.0213 |
| 0.1204 | 0.0313 | 0.1204 | 0.0262 | 0.1204 | 0.0245 | 0.1204 | 0.024 | 0.1204 | 0.0236 | 0.1204 | 0.0229 | 0.1204 | 0.0218 |
| 0.1262 | 0.0313 | 0.1262 | 0.027 | 0.1262 | 0.0257 | 0.1262 | 0.0246 | 0.1262 | 0.0241 | 0.1262 | 0.0233 | 0.1262 | 0.0221 |
| 0.1322 | 0.0313 | 0.1322 | 0.0271 | 0.1322 | 0.0258 | 0.1322 | 0.0247 | 0.1322 | 0.0242 | 0.1322 | 0.0234 | 0.1322 | 0.0225 |
| 0.1385 | 0.0313 | 0.1385 | 0.0277 | 0.1385 | 0.0265 | 0.1385 | 0.0254 | 0.1385 | 0.0245 | 0.1385 | 0.0235 | 0.1385 | 0.0225 |
| 0.1451 | 0.0316 | 0.1451 | 0.0294 | 0.1451 | 0.0282 | 0.1451 | 0.027 | 0.1451 | 0.0259 | 0.1451 | 0.0239 | 0.1451 | 0.0225 |
| 0.152 | 0.032 | 0.152 | 0.0299 | 0.152 | 0.0286 | 0.152 | 0.0273 | 0.152 | 0.0262 | 0.152 | 0.0241 | 0.152 | 0.0225 |
| 0.1592 | 0.033 | 0.1592 | 0.031 | 0.1592 | 0.0299 | 0.1592 | 0.0288 | 0.1592 | 0.0277 | 0.1592 | 0.0261 | 0.1592 | 0.0241 |
| 0.1668 | 0.0367 | 0.1668 | 0.0323 | 0.1668 | 0.0312 | 0.1668 | 0.0302 | 0.1668 | 0.0292 | 0.1668 | 0.0276 | 0.1668 | 0.0256 |
| 0.1748 | 0.0507 | 0.1748 | 0.0427 | 0.1748 | 0.0385 | 0.1748 | 0.035 | 0.1748 | 0.0321 | 0.1748 | 0.0284 | 0.1748 | 0.0264 |
| 0.1831 | 0.0586 | 0.1831 | 0.0492 | 0.1831 | 0.0442 | 0.1831 | 0.0399 | 0.1831 | 0.0362 | 0.1831 | 0.0306 | 0.1831 | 0.0266 |
| 0.1918 | 0.0586 | 0.1918 | 0.0492 | 0.1918 | 0.0442 | 0.1918 | 0.0399 | 0.1918 | 0.0362 | 0.1918 | 0.0306 | 0.1918 | 0.0267 |
| 0.2009 | 0.0586 | 0.2009 | 0.0492 | 0.2009 | 0.0442 | 0.2009 | 0.0399 | 0.2009 | 0.0362 | 0.2009 | 0.0323 | 0.2009 | 0.0293 |
| 0.2105 | 0.0586 | 0.2105 | 0.0492 | 0.2105 | 0.0442 | 0.2105 | 0.0399 | 0.2105 | 0.0384 | 0.2105 | 0.0357 | 0.2105 | 0.0322 |
| 0.2205 | 0.0586 | 0.2205 | 0.0492 | 0.2205 | 0.0453 | 0.2205 | 0.0426 | 0.2205 | 0.0406 | 0.2205 | 0.0376 | 0.2205 | 0.0337 |
| 0.231 | 0.0586 | 0.231 | 0.0492 | 0.231 | 0.0458 | 0.231 | 0.0439 | 0.231 | 0.042 | 0.231 | 0.0387 | 0.231 | 0.0352 |
| 0.242 | 0.0586 | 0.242 | 0.0509 | 0.242 | 0.0485 | 0.242 | 0.0463 | 0.242 | 0.0444 | 0.242 | 0.041 | 0.242 | 0.0368 |
| 0.2535 | 0.0648 | 0.2535 | 0.0572 | 0.2535 | 0.0528 | 0.2535 | 0.0488 | 0.2535 | 0.0453 | 0.2535 | 0.041 | 0.2535 | 0.0371 |
| 0.2656 | 0.0731 | 0.2656 | 0.0586 | 0.2656 | 0.0534 | 0.2656 | 0.049 | 0.2656 | 0.0453 | 0.2656 | 0.0424 | 0.2656 | 0.0402 |
| 0.2783 | 0.0816 | 0.2783 | 0.0598 | 0.2783 | 0.0534 | 0.2783 | 0.05 | 0.2783 | 0.0485 | 0.2783 | 0.0459 | 0.2783 | 0.0426 |
| 0.2915 | 0.0816 | 0.2915 | 0.0619 | 0.2915 | 0.058 | 0.2915 | 0.0546 | 0.2915 | 0.0516 | 0.2915 | 0.048 | 0.2915 | 0.0437 |
| 0.3054 | 0.0816 | 0.3054 | 0.0662 | 0.3054 | 0.062 | 0.3054 | 0.0583 | 0.3054 | 0.0548 | 0.3054 | 0.0488 | 0.3054 | 0.0448 |
| 0.3199 | 0.0816 | 0.3199 | 0.0701 | 0.3199 | 0.0659 | 0.3199 | 0.0622 | 0.3199 | 0.0588 | 0.3199 | 0.0531 | 0.3199 | 0.0468 |
| 0.3352 | 0.0871 | 0.3352 | 0.0766 | 0.3352 | 0.0706 | 0.3352 | 0.0658 | 0.3352 | 0.0624 | 0.3352 | 0.0565 | 0.3352 | 0.0496 |
| 0.3511 | 0.0905 | 0.3511 | 0.0805 | 0.3511 | 0.0748 | 0.3511 | 0.0698 | 0.3511 | 0.0653 | 0.3511 | 0.0578 | 0.3511 | 0.0502 |
| 0.3678 | 0.1216 | 0.3678 | 0.0951 | 0.3678 | 0.0823 | 0.3678 | 0.0722 | 0.3678 | 0.0653 | 0.3678 | 0.0578 | 0.3678 | 0.0502 |
| 0.3853 | 0.136 | 0.3853 | 0.1056 | 0.3853 | 0.0918 | 0.3853 | 0.0807 | 0.3853 | 0.0718 | 0.3853 | 0.0587 | 0.3853 | 0.0502 |
| 0.4037 | 0.136 | 0.4037 | 0.1056 | 0.4037 | 0.0918 | 0.4037 | 0.082 | 0.4037 | 0.076 | 0.4037 | 0.0663 | 0.4037 | 0.0569 |
| 0.4229 | 0.136 | 0.4229 | 0.1056 | 0.4229 | 0.0918 | 0.4229 | 0.0848 | 0.4229 | 0.0796 | 0.4229 | 0.0707 | 0.4229 | 0.0609 |
| 0.4431 | 0.136 | 0.4431 | 0.1056 | 0.4431 | 0.0932 | 0.4431 | 0.0884 | 0.4431 | 0.0838 | 0.4431 | 0.0755 | 0.4431 | 0.0652 |
| 0.4642 | 0.1375 | 0.4642 | 0.1059 | 0.4642 | 0.0974 | 0.4642 | 0.0915 | 0.4642 | 0.086 | 0.4642 | 0.0764 | 0.4642 | 0.0667 |
| 0.4863 | 0.1479 | 0.4863 | 0.1238 | 0.4863 | 0.1107 | 0.4863 | 0.0995 | 0.4863 | 0.0901 | 0.4863 | 0.082 | 0.4863 | 0.0725 |
| 0.5094 | 0.181 | 0.5094 | 0.138 | 0.5094 | 0.1214 | 0.5094 | 0.108 | 0.5094 | 0.0971 | 0.5094 | 0.0861 | 0.5094 | 0.0744 |

PTEE024.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~
Figure 24E ~ Vertical Responses - Slab/Wall Joints ~ Elevation 0 ft. (Concrete) ~ Enveloped Spectra

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.5337 | 0.2215 | 0.5337 | 0.1602 | 0.5337 | 0.134 | 0.5337 | 0.1151 | 0.5337 | 0.1024 | 0.5337 | 0.0861 | 0.5337 | 0.0744 |
| 0.5591 | 0.2215 | 0.5591 | 0.1602 | 0.5591 | 0.134 | 0.5591 | 0.1151 | 0.5591 | 0.1024 | 0.5591 | 0.0884 | 0.5591 | 0.0754 |
| 0.5857 | 0.2215 | 0.5857 | 0.1602 | 0.5857 | 0.134 | 0.5857 | 0.1151 | 0.5857 | 0.1024 | 0.5857 | 0.094 | 0.5857 | 0.0825 |
| 0.6136 | 0.2215 | 0.6136 | 0.1602 | 0.6136 | 0.134 | 0.6136 | 0.1175 | 0.6136 | 0.1108 | 0.6136 | 0.1001 | 0.6136 | 0.0874 |
| 0.6428 | 0.2268 | 0.6428 | 0.163 | 0.6428 | 0.1365 | 0.6428 | 0.1175 | 0.6428 | 0.1126 | 0.6428 | 0.1027 | 0.6428 | 0.0894 |
| 0.6734 | 0.2268 | 0.6734 | 0.163 | 0.6734 | 0.1377 | 0.6734 | 0.128 | 0.6734 | 0.12 | 0.6734 | 0.1074 | 0.6734 | 0.0928 |
| 0.7055 | 0.2268 | 0.7055 | 0.163 | 0.7055 | 0.1377 | 0.7055 | 0.128 | 0.7055 | 0.12 | 0.7055 | 0.1086 | 0.7055 | 0.0945 |
| 0.7391 | 0.2268 | 0.7391 | 0.163 | 0.7391 | 0.1413 | 0.7391 | 0.1333 | 0.7391 | 0.1253 | 0.7391 | 0.1108 | 0.7391 | 0.0945 |
| 0.7743 | 0.3163 | 0.7743 | 0.2131 | 0.7743 | 0.1804 | 0.7743 | 0.1581 | 0.7743 | 0.1421 | 0.7743 | 0.1213 | 0.7743 | 0.1037 |
| 0.8111 | 0.3163 | 0.8111 | 0.2131 | 0.8111 | 0.1804 | 0.8111 | 0.1581 | 0.8111 | 0.1421 | 0.8111 | 0.1213 | 0.8111 | 0.1064 |
| 0.8497 | 0.3163 | 0.8497 | 0.2131 | 0.8497 | 0.1804 | 0.8497 | 0.1652 | 0.8497 | 0.1528 | 0.8497 | 0.133 | 0.8497 | 0.112 |
| 0.8902 | 0.3163 | 0.8902 | 0.2131 | 0.8902 | 0.1856 | 0.8902 | 0.17 | 0.8902 | 0.1571 | 0.8902 | 0.1368 | 0.8902 | 0.1165 |
| 0.9326 | 0.484 | 0.9326 | 0.298 | 0.9326 | 0.2451 | 0.9326 | 0.2142 | 0.9326 | 0.192 | 0.9326 | 0.1628 | 0.9326 | 0.1368 |
| 0.977 | 0.484 | 0.977 | 0.298 | 0.977 | 0.2451 | 0.977 | 0.2142 | 0.977 | 0.192 | 0.977 | 0.171 | 0.977 | 0.15 |
| 1.0235 | 0.484 | 1.0235 | 0.298 | 1.0235 | 0.2451 | 1.0235 | 0.2142 | 1.0235 | 0.1926 | 1.0235 | 0.1805 | 1.0235 | 0.1621 |
| 1.0723 | 0.484 | 1.0723 | 0.298 | 1.0723 | 0.2615 | 1.0723 | 0.2409 | 1.0723 | 0.2242 | 1.0723 | 0.1989 | 1.0723 | 0.1731 |
| 1.1233 | 0.5753 | 1.1233 | 0.3411 | 1.1233 | 0.2701 | 1.1233 | 0.2409 | 1.1233 | 0.2242 | 1.1233 | 0.1989 | 1.1233 | 0.1746 |
| 1.1768 | 0.5753 | 1.1768 | 0.3734 | 1.1768 | 0.3107 | 1.1768 | 0.2749 | 1.1768 | 0.2469 | 1.1768 | 0.213 | 1.1768 | 0.1874 |
| 1.2328 | 0.5753 | 1.2328 | 0.3807 | 1.2328 | 0.3438 | 1.2328 | 0.3132 | 1.2328 | 0.2882 | 1.2328 | 0.2506 | 1.2328 | 0.2132 |
| 1.2916 | 0.5753 | 1.2916 | 0.4139 | 1.2916 | 0.3646 | 1.2916 | 0.3262 | 1.2916 | 0.2999 | 1.2916 | 0.2601 | 1.2916 | 0.2214 |
| 1.353 | 0.6629 | 1.353 | 0.4139 | 1.353 | 0.3646 | 1.353 | 0.3329 | 1.353 | 0.3146 | 1.353 | 0.2846 | 1.353 | 0.2493 |
| 1.4175 | 0.6629 | 1.4175 | 0.429 | 1.4175 | 0.3788 | 1.4175 | 0.3575 | 1.4175 | 0.3384 | 1.4175 | 0.3064 | 1.4175 | 0.271 |
| 1.485 | 0.6629 | 1.485 | 0.457 | 1.485 | 0.4099 | 1.485 | 0.3825 | 1.485 | 0.3581 | 1.485 | 0.32 | 1.485 | 0.2847 |
| 1.5557 | 0.6629 | 1.5557 | 0.4867 | 1.5557 | 0.4466 | 1.5557 | 0.4193 | 1.5557 | 0.3959 | 1.5557 | 0.3551 | 1.5557 | 0.3075 |
| 1.6298 | 0.8057 | 1.6298 | 0.5109 | 1.6298 | 0.4763 | 1.6298 | 0.4473 | 1.6298 | 0.4224 | 1.6298 | 0.3819 | 1.6298 | 0.335 |
| 1.7074 | 0.8379 | 1.7074 | 0.6416 | 1.7074 | 0.5704 | 1.7074 | 0.5139 | 1.7074 | 0.4676 | 1.7074 | 0.4014 | 1.7074 | 0.3559 |
| 1.7887 | 1.0345 | 1.7887 | 0.7676 | 1.7887 | 0.6799 | 1.7887 | 0.6122 | 1.7887 | 0.5562 | 1.7887 | 0.4772 | 1.7887 | 0.4004 |
| 1.8738 | 1.0345 | 1.8738 | 0.8046 | 1.8738 | 0.7255 | 1.8738 | 0.6502 | 1.8738 | 0.5996 | 1.8738 | 0.5318 | 1.8738 | 0.4441 |
| 1.963 | 1.2645 | 1.963 | 0.838 | 1.963 | 0.7316 | 1.963 | 0.6502 | 1.963 | 0.5996 | 1.963 | 0.5683 | 1.963 | 0.4717 |
| 2.0565 | 1.3932 | 2.0565 | 0.838 | 2.0565 | 0.7316 | 2.0565 | 0.6698 | 2.0565 | 0.6339 | 2.0565 | 0.584 | 2.0565 | 0.4802 |
| 2.1544 | 1.3932 | 2.1544 | 0.838 | 2.1544 | 0.7316 | 2.1544 | 0.6698 | 2.1544 | 0.6389 | 2.1544 | 0.584 | 2.1544 | 0.4802 |
| 2.257 | 1.3932 | 2.257 | 0.838 | 2.257 | 0.7519 | 2.257 | 0.6898 | 2.257 | 0.6389 | 2.257 | 0.584 | 2.257 | 0.4802 |
| 2.3645 | 1.7479 | 2.3645 | 0.9979 | 2.3645 | 0.8154 | 2.3645 | 0.7361 | 2.3645 | 0.6766 | 2.3645 | 0.584 | 2.3645 | 0.4889 |
| 2.4771 | 2.068 | 2.4771 | 1.1705 | 2.4771 | 0.9105 | 2.4771 | 0.7993 | 2.4771 | 0.7332 | 2.4771 | 0.6216 | 2.4771 | 0.5073 |
| 2.595 | 2.142 | 2.595 | 1.1705 | 2.595 | 0.9105 | 2.595 | 0.871 | 2.595 | 0.7663 | 2.595 | 0.6393 | 2.595 | 0.5251 |

PTEE024.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 24E ~ Vertical Responses - Slab/Wall Joints ~ Elevation 0 ft. (Concrete) ~ Enveloped Spectra

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 2.7186 | 2.142 | 2.7186 | 1.1705 | 2.7186 | 0.9105 | 2.7186 | 0.871 | 2.7186 | 0.7663 | 2.7186 | 0.6554 | 2.7186 | 0.5385 |
| 2.848 | 2.142 | 2.848 | 1.1705 | 2.848 | 0.9105 | 2.848 | 0.871 | 2.848 | 0.7663 | 2.848 | 0.6554 | 2.848 | 0.5385 |
| 2.9836 | 2.142 | 2.9836 | 1.1705 | 2.9836 | 0.9105 | 2.9836 | 0.871 | 2.9836 | 0.7663 | 2.9836 | 0.6554 | 2.9836 | 0.5385 |
| 3.1257 | 2.142 | 3.1257 | 1.1705 | 3.1257 | 0.9105 | 3.1257 | 0.871 | 3.1257 | 0.7663 | 3.1257 | 0.6554 | 3.1257 | 0.5385 |
| 3.2745 | 1.9687 | 3.2745 | 1.1168 | 3.2745 | 0.9105 | 3.2745 | 0.831 | 3.2745 | 0.7634 | 3.2745 | 0.6554 | 3.2745 | 0.5385 |
| 3.4305 | 1.4171 | 3.4305 | 0.9374 | 3.4305 | 0.8241 | 3.4305 | 0.7591 | 3.4305 | 0.7116 | 3.4305 | 0.628 | 3.4305 | 0.5317 |
| 3.5938 | 1.4171 | 3.5938 | 0.9374 | 3.5938 | 0.8241 | 3.5938 | 0.7511 | 3.5938 | 0.6929 | 3.5938 | 0.6087 | 3.5938 | 0.5317 |
| 3.7649 | 1.4171 | 3.7649 | 0.9374 | 3.7649 | 0.8241 | 3.7649 | 0.7511 | 3.7649 | 0.6929 | 3.7649 | 0.6075 | 3.7649 | 0.5317 |
| 3.9442 | 1.4171 | 3.9442 | 0.9374 | 3.9442 | 0.8199 | 3.9442 | 0.7511 | 3.9442 | 0.6929 | 3.9442 | 0.605 | 3.9442 | 0.5317 |
| 4.132 | 1.4171 | 4.132 | 0.9374 | 4.132 | 0.8199 | 4.132 | 0.7511 | 4.132 | 0.6929 | 4.132 | 0.605 | 4.132 | 0.5317 |
| 4.3288 | 1.4171 | 4.3288 | 0.9374 | 4.3288 | 0.8199 | 4.3288 | 0.7511 | 4.3288 | 0.6929 | 4.3288 | 0.605 | 4.3288 | 0.5317 |
| 4.5349 | 1.4171 | 4.5349 | 0.9374 | 4.5349 | 0.8199 | 4.5349 | 0.7511 | 4.5349 | 0.6929 | 4.5349 | 0.605 | 4.5349 | 0.5317 |
| 4.7508 | 1.4171 | 4.7508 | 0.9374 | 4.7508 | 0.8199 | 4.7508 | 0.7511 | 4.7508 | 0.6929 | 4.7508 | 0.605 | 4.7508 | 0.5317 |
| 4.977 | 1.4171 | 4.977 | 0.9374 | 4.977 | 0.8199 | 4.977 | 0.7511 | 4.977 | 0.6929 | 4.977 | 0.605 | 4.977 | 0.5317 |
| 5.214 | 1.4171 | 5.214 | 0.9374 | 5.214 | 0.8199 | 5.214 | 0.7511 | 5.214 | 0.6929 | 5.214 | 0.605 | 5.214 | 0.5317 |
| 5.4623 | 1.5403 | 5.4623 | 0.9374 | 5.4623 | 0.8199 | 5.4623 | 0.7511 | 5.4623 | 0.6929 | 5.4623 | 0.605 | 5.4623 | 0.5317 |
| 5.7224 | 1.7489 | 5.7224 | 0.9374 | 5.7224 | 0.8199 | 5.7224 | 0.7937 | 5.7224 | 0.7092 | 5.7224 | 0.6012 | 5.7224 | 0.5234 |
| 5.9948 | 1.7489 | 5.9948 | 0.9374 | 5.9948 | 0.8199 | 5.9948 | 0.7937 | 5.9948 | 0.7092 | 5.9948 | 0.6012 | 5.9948 | 0.5079 |
| 6.2803 | 1.7489 | 6.2803 | 0.9374 | 6.2803 | 0.8199 | 6.2803 | 0.7937 | 6.2803 | 0.7092 | 6.2803 | 0.6012 | 6.2803 | 0.5079 |
| 6.5793 | 1.7489 | 6.5793 | 0.9374 | 6.5793 | 0.8199 | 6.5793 | 0.7937 | 6.5793 | 0.7092 | 6.5793 | 0.6012 | 6.5793 | 0.5079 |
| 6.8926 | 1.7489 | 6.8926 | 0.9374 | 6.8926 | 0.8199 | 6.8926 | 0.7937 | 6.8926 | 0.7092 | 6.8926 | 0.6012 | 6.8926 | 0.5079 |
| 7.2208 | 1.6603 | 7.2208 | 0.9374 | 7.2208 | 0.8199 | 7.2208 | 0.7553 | 7.2208 | 0.6892 | 7.2208 | 0.5885 | 7.2208 | 0.5079 |
| 7.5646 | 1.5723 | 7.5646 | 0.9134 | 7.5646 | 0.7926 | 7.5646 | 0.7147 | 7.5646 | 0.6591 | 7.5646 | 0.5747 | 7.5646 | 0.4988 |
| 7.9248 | 1.5723 | 7.9248 | 0.9134 | 7.9248 | 0.7814 | 7.9248 | 0.6958 | 7.9248 | 0.6399 | 7.9248 | 0.564 | 7.9248 | 0.4979 |
| 8.3022 | 1.5723 | 8.3022 | 0.9134 | 8.3022 | 0.7814 | 8.3022 | 0.6958 | 8.3022 | 0.6399 | 8.3022 | 0.564 | 8.3022 | 0.4979 |
| 8.6975 | 1.2382 | 8.6975 | 0.7934 | 8.6975 | 0.6919 | 8.6975 | 0.6496 | 8.6975 | 0.6135 | 8.6975 | 0.5519 | 8.6975 | 0.4907 |
| 9.1116 | 1.2382 | 9.1116 | 0.7934 | 9.1116 | 0.6874 | 9.1116 | 0.6253 | 9.1116 | 0.5914 | 9.1116 | 0.5425 | 9.1116 | 0.4886 |
| 9.5455 | 1.2382 | 9.5455 | 0.7934 | 9.5455 | 0.6874 | 9.5455 | 0.6253 | 9.5455 | 0.5832 | 9.5455 | 0.5235 | 9.5455 | 0.4755 |
| 10 | 1.2382 | 10 | 0.7934 | 10 | 0.6874 | 10 | 0.6253 | 10 | 0.5832 | 10 | 0.5229 | 10 | 0.4655 |
| 10.4762 | 1.2382 | 10.4762 | 0.7934 | 10.4762 | 0.6874 | 10.4762 | 0.6253 | 10.4762 | 0.5832 | 10.4762 | 0.5229 | 10.4762 | 0.4646 |
| 10.975 | 1.1339 | 10.975 | 0.7934 | 10.975 | 0.6874 | 10.975 | 0.6253 | 10.975 | 0.5832 | 10.975 | 0.5219 | 10.975 | 0.4646 |
| 11.4976 | 1.0079 | 11.4976 | 0.6912 | 11.4976 | 0.6174 | 11.4976 | 0.5657 | 11.4976 | 0.5336 | 11.4976 | 0.4943 | 11.4976 | 0.4547 |
| 12.045 | 1.0079 | 12.045 | 0.6323 | 12.045 | 0.5726 | 12.045 | 0.5241 | 12.045 | 0.4881 | 12.045 | 0.4608 | 12.045 | 0.4296 |
| 12.6186 | 1.0079 | 12.6186 | 0.6123 | 12.6186 | 0.5153 | 12.6186 | 0.4854 | 12.6186 | 0.4686 | 12.6186 | 0.44 | 12.6186 | 0.4071 |
| 13.2194 | 1.0079 | 13.2194 | 0.6123 | 13.2194 | 0.5102 | 13.2194 | 0.4731 | 13.2194 | 0.452 | 13.2194 | 0.4197 | 13.2194 | 0.3883 |

PTEE024.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 24E ~ Vertical Responses - Slab/Wall Joints ~ Elevation 0 ft. (Concrete) ~ Enveloped Spectra

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 1.0079 | 13.8489 | 0.6123 | 13.8489 | 0.5102 | 13.8489 | 0.4615 | 13.8489 | 0.4386 | 13.8489 | 0.4022 | 13.8489 | 0.3633 |
| 14.5083 | 1.0079 | 14.5083 | 0.6123 | 14.5083 | 0.5102 | 14.5083 | 0.4547 | 14.5083 | 0.4329 | 14.5083 | 0.3988 | 14.5083 | 0.3633 |
| 15.1991 | 1.0079 | 15.1991 | 0.6123 | 15.1991 | 0.5102 | 15.1991 | 0.4217 | 15.1991 | 0.4105 | 15.1991 | 0.3706 | 15.1991 | 0.3433 |
| 15.9228 | 1.0079 | 15.9228 | 0.6123 | 15.9228 | 0.5102 | 15.9228 | 0.4217 | 15.9228 | 0.4105 | 15.9228 | 0.3706 | 15.9228 | 0.3385 |
| 16.681 | 1.0079 | 16.681 | 0.6123 | 16.681 | 0.5102 | 16.681 | 0.4217 | 16.681 | 0.4105 | 16.681 | 0.3706 | 16.681 | 0.3385 |
| 17.4753 | 1.0079 | 17.4753 | 0.6123 | 17.4753 | 0.5102 | 17.4753 | 0.4217 | 17.4753 | 0.4105 | 17.4753 | 0.3703 | 17.4753 | 0.3348 |
| 18.3074 | 1.0079 | 18.3074 | 0.6123 | 18.3074 | 0.5102 | 18.3074 | 0.4136 | 18.3074 | 0.4017 | 18.3074 | 0.3481 | 18.3074 | 0.3209 |
| 19.1791 | 1.0079 | 19.1791 | 0.6123 | 19.1791 | 0.5102 | 19.1791 | 0.4136 | 19.1791 | 0.4017 | 19.1791 | 0.3481 | 19.1791 | 0.3122 |
| 20.0923 | 0.6551 | 20.0923 | 0.4391 | 20.0923 | 0.419 | 20.0923 | 0.3759 | 20.0923 | 0.3461 | 20.0923 | 0.319 | 20.0923 | 0.2989 |
| 21.049 | 0.6551 | 21.049 | 0.4391 | 21.049 | 0.419 | 21.049 | 0.3759 | 21.049 | 0.3461 | 21.049 | 0.3119 | 21.049 | 0.2909 |
| 22.0513 | 0.6551 | 22.0513 | 0.4391 | 22.0513 | 0.419 | 22.0513 | 0.3759 | 22.0513 | 0.3461 | 22.0513 | 0.3119 | 22.0513 | 0.2881 |
| 23.1013 | 0.4513 | 23.1013 | 0.3434 | 23.1013 | 0.3322 | 23.1013 | 0.3192 | 23.1013 | 0.3064 | 23.1013 | 0.2882 | 23.1013 | 0.278 |
| 24.2013 | 0.4513 | 24.2013 | 0.3354 | 24.2013 | 0.3097 | 24.2013 | 0.2945 | 24.2013 | 0.286 | 24.2013 | 0.2772 | 24.2013 | 0.2733 |
| 25.3536 | 0.4513 | 25.3536 | 0.2912 | 25.3536 | 0.2849 | 25.3536 | 0.2812 | 25.3536 | 0.2777 | 25.3536 | 0.2725 | 25.3536 | 0.269 |
| 26.5609 | 0.4513 | 26.5609 | 0.2865 | 26.5609 | 0.2793 | 26.5609 | 0.2755 | 26.5609 | 0.2728 | 26.5609 | 0.269 | 26.5609 | 0.265 |
| 27.8256 | 0.4513 | 27.8256 | 0.2865 | 27.8256 | 0.2752 | 27.8256 | 0.2694 | 27.8256 | 0.2651 | 27.8256 | 0.2626 | 27.8256 | 0.2598 |
| 29.1505 | 0.4513 | 29.1505 | 0.2865 | 29.1505 | 0.2672 | 29.1505 | 0.2622 | 29.1505 | 0.2586 | 29.1505 | 0.2556 | 29.1505 | 0.2542 |
| 30.5386 | 0.4513 | 30.5386 | 0.2865 | 30.5386 | 0.2637 | 30.5386 | 0.2581 | 30.5386 | 0.2572 | 30.5386 | 0.2554 | 30.5386 | 0.2534 |
| 31.9927 | 0.2716 | 31.9927 | 0.2566 | 31.9927 | 0.2561 | 31.9927 | 0.2556 | 31.9927 | 0.2551 | 31.9927 | 0.2541 | 31.9927 | 0.2527 |
| 33.516 | 0.2543 | 33.516 | 0.2538 | 33.516 | 0.2536 | 33.516 | 0.2533 | 33.516 | 0.253 | 33.516 | 0.2524 | 33.516 | 0.2515 |
| 35.1119 | 0.2519 | 35.1119 | 0.2517 | 35.1119 | 0.2515 | 35.1119 | 0.2514 | 35.1119 | 0.2512 | 35.1119 | 0.2508 | 35.1119 | 0.2502 |
| 36.7838 | 0.2501 | 36.7838 | 0.25 | 36.7838 | 0.2499 | 36.7838 | 0.2498 | 36.7838 | 0.2496 | 36.7838 | 0.2494 | 36.7838 | 0.249 |
| 38.5353 | 0.2486 | 38.5353 | 0.2485 | 38.5353 | 0.2485 | 38.5353 | 0.2484 | 38.5353 | 0.2483 | 38.5353 | 0.2481 | 38.5353 | 0.2479 |
| 40.3702 | 0.2474 | 40.3702 | 0.2473 | 40.3702 | 0.2473 | 40.3702 | 0.2472 | 40.3702 | 0.2472 | 40.3702 | 0.247 | 40.3702 | 0.2468 |
| 42.2924 | 0.2463 | 42.2924 | 0.2463 | 42.2924 | 0.2462 | 42.2924 | 0.2462 | 42.2924 | 0.2461 | 42.2924 | 0.2461 | 42.2924 | 0.2459 |
| 44.3062 | 0.2454 | 44.3062 | 0.2453 | 44.3062 | 0.2453 | 44.3062 | 0.2453 | 44.3062 | 0.2453 | 44.3062 | 0.2452 | 44.3062 | 0.2451 |
| 46.4159 | 0.2446 | 46.4159 | 0.2445 | 46.4159 | 0.2445 | 46.4159 | 0.2445 | 46.4159 | 0.2445 | 46.4159 | 0.2444 | 46.4159 | 0.2444 |
| 48.626 | 0.2438 | 48.626 | 0.2438 | 48.626 | 0.2438 | 48.626 | 0.2438 | 48.626 | 0.2438 | 48.626 | 0.2437 | 48.626 | 0.2437 |
| 50.9414 | 0.2431 | 50.9414 | 0.2431 | 50.9414 | 0.2431 | 50.9414 | 0.2431 | 50.9414 | 0.2431 | 50.9414 | 0.2431 | 50.9414 | 0.2431 |

| | | |
|---|---|---|
| BECHTEL | **MECHANICAL SYSTEMS DATA SHEET: VESSEL** | PLANT ITEM No. 5<br>*24590-PTF-MW-FEP-SEP-00001B*<br>Data Sheet No.<br>*24590-PTF-MVD-FEP-00007* |

| | | | |
|---|---|---|---|
| Project: | ***RPP-WTP*** | P&ID: | ALG 10/29/08 ***24590-PTF-M6-FEP-00004001*** |
| Project No: | ***24590*** | Process ~~Information~~ DATA | ***24590-QL-POA-MEVV-00001-04-04*** |
| Project Site: | ***Hanford*** | Vessel Drawing: | ***24590-QL-POA-MEVV-00001-01-195*** |
| Description: | ***Waste Feed Evaporator Separator Vessel FEP-SEP-00001B*** | | |

ISSUED BY
RPP-WTP PDC

R11042828

## Reference Data

| | |
|---|---|
| Charge Vessels (Tag Numbers) | ***None*** |
| Pulsejet Mixers / Agitators (Tag Numbers) | ***None*** |
| RFDs/Pumps (Tag Numbers) | ***None*** |

| | | | | |
|---|---|---|---|---|
| Quality Level | | ***Q (See Note 12)*** | Fabrication Specs | ***24590-WTP-3PS-MV00-T0001*** |
| Seismic Category | | ***SC-1*** | Design Code | ***ASME VIII Div 1*** |
| Service/Contents | | ***Radioactive Slurry*** | Code Stamp | ***U1 Stamp*** |
| Design Specific Gravity | | ***1.50*** | NB Registration | ***Yes*** |
| Maximum Operating Volume | gal | ***3,817*** | Wind Design | ***None*** |
| Total Volume | gal | ***14,512*** | Snow/Ash Design | ***None*** |
| Postweld Heat Treat | | ***Not Required*** | Seismic Design | ***24590-WTP-3PS-MV00-T0002***<br>***24590-WTP-3PS-SS90-T0001***<br>***See attachment 1*** 5 |
| Seismic Base Moment | ft*lb | ***N/A*** | | |

## Design Data

| | | | | | |
|---|---|---|---|---|---|
| Inside Diameter | inch | ***7'-6" (Upper), 11'-5" (Lower)*** | | Corrosion Allowance inch | ***0.04*** |
| Length/Height (TL-TL) | inch | ***417-3/4"*** | | | |
| | | Vessel Operating | Vessel Design | Coil / Jacket Design | Notes |
| Internal Pressure | psig | ***-13.4*** | ***50*** | ***N/A*** | ***Vessel Operating at 1.3 psia*** |
| External Pressure | psig | ***0*** | ***14.7*** | ***N/A*** | |
| Temperature | °F | ***129*** | ***175*** | ***N/A*** | |
| Min. Design Metal Temp. | °F | ***49*** | | Hydrostatic Test Pressure PSIG | ***65 - Horizontal*** |

## Materials of Construction

| Component | Material | Containment | Notes |
|---|---|---|---|
| Top Head | ***SA 240 304 SS*** | ***Auxiliary (See Note 6)*** | ***1/2" Nom. thickness; maximum carbon content of 0.030% for welded components*** |
| Shell | ***SA 240 304 SS*** | ***Primary (See Note 6)*** | ***1/2" thickness; maximum carbon content of 0.030% for welded components*** |
| Lower Cone | ***SA 240 304 SS*** | ***Primary (See Note 6)*** | ***1/2" thickness; maximum carbon content of 0.030% for welded components*** |
| Vessel Support | ***SA 240 304 SS*** | ***N/A*** | ***Maximum carbon content of 0.030% for welded components*** |
| Jacket/Coils/Half-Pipe Jacket | ***N/A*** | ***N/A*** | |
| Internals | ***SA 403 304 SS and SA 240 304 SS*** | ***Thermowell Primary (See Note 6)*** | ***Maximum carbon content of 0.030% for welded components*** |
| Pipe | ***SA 312 304 SS*** | ***Note 6*** | ***Maximum carbon content of 0.030% for welded components*** |
| Forgings/ Bar stock | ***SA 182 304 SS / SA 479 304 SS*** | ***Note 1*** | ***Maximum carbon content of 0.030% for welded components*** |
| Gaskets | ***SA 240 304 SS*** | | ***Flexitallic spiral wound with Thermiculite Filler*** |
| Bolting (Captive Bolts) | ***Nitronic 60, SA 193 B8S*** | | ***Drawing 24590-QL-POA-MEVV-00001-01-00317.*** |
| Other (Fittings) | ***SA 182 304 SS*** | ***Auxiliary*** | ***Maximum carbon content of 0.030% for welded components*** |

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

| | | |
|---|---|---|
| BECHTEL | **MECHANICAL SYSTEMS DATA SHEET: VESSEL** | PLANT ITEM No. 5<br>*24590-PTF-MW-FEP-SEP-00001B*<br>Data Sheet No.<br>*24590-PTF-MVD-FEP-00007* |

## Miscellaneous Data

| | |
|---|---|
| Orientation | ***Vertical*** |
| Support Type | ***Stainless Steel Legs, A 554-304 SS*** |
| Insulation Function | ***None*** |
| Insulation Thickness (inch) | ***None*** |
| Insulation Material | ***None*** |
| External Finish | ***Welds Descaled as Laid*** |
| Internal Finish | ***Welds Ground Smooth; lower 15'-4 15/16" shell and cone to be #4 polished finish.*** |

## Notes

***(1) Nozzles located below the top of the overflow nozzle are primary containment. See 24590-WTP-3PS-MV00-T0001 for NDE requirements.***
***(2) Nozzle tolerance +/- 1/4"***
***(3) Material for demister pad is Inconel 625 fine mesh. See FANP Drawings 24590-QL-POA-MEVV-00001-01-00794 and 24590-QL-POA-MEVV-00001-01-00795. Upper Mesh is Style 1899 and Lower Mesh is Style 346.***
***(4) Non-replaceable 40 years design life (except demister pads section).***
***(5) NDE for this vessel must meet requirements per para 6.1, 6.2 and 7.2 of specification 24590-WTP-3PS-MV00-T0001.***
***(6) All welds forming part of the primary and auxiliary containment including nozzle attachment welds shall be subject to 100% volumetric examination.***
***(7) This vessel is in a Black Cell.***
***(8) Vendor to specify all metal thickness. See Vendor Drawing 24590-QL-POA-MEVV-00001-01-00733.***
***(9) Contents of this document are Dangerous Waste Permit affecting.***
***(10) All vessel nozzle loads due to thermal expansion are estimated based on the maximum operating temperature of 150 degree F.***
***(11) Deleted.*** 5
***(12) Vendor will provide Item at BNI quality level Q specifications, which correlates to vendors quality level of QL-2.***
***(13) Final Vendor Design Process information is from document 24590-QL-POA-MEVV-00001-02-00056.***
***(14) Equipment cyclic data is from document 24590-QL-POA-MEVV-00001-04-03.***
***(15) Vendor to provide manufacturer, chemical make-up, waste chemical composition, acceptable temperature range and maximum radiation dose allowed.***
***(16) When combining vessel loading with seismic, seller shall use design pressure. Seller has the option to use 2 psi or 15% over maximum operating pressure, whichever is greatest, not to exceed vessel design pressure and full vacuum in lieu of vessel design pressure.***
5 ***(17) Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.***

***Safety screening/evaluation required? ☒Yes ☐No If yes per 24590-WTP-GPP-SREG-002, E&NS signature required below.***

## Revision History

| Rev | Description | By | Checked | EN&S | Approved | Date |
|---|---|---|---|---|---|---|
| 5 | Updated to reflect WSGM analysis, 24590-PTF-U0N-W16T-00003 and Incorporate DOE AEA note (17). | D. Tate | R. Rickenbach | Butt Hall | J. Julyk | 2/19/09 |
| 4 | Incorporated vendor design information, Equipment Qualification Data and SDDR 24590-WTP-SDDR-M-06-00158. | R. Rickenbach | C. Knauss | S. Sontag | J. Julyk | 08/07/2008 |
| 3 | Clarified vessel nozzle load design | E. Le | R. Nowak | N/A | J. Julyk | 03/28/2005 |
| 2 | Incorporated vendor final design information | E. Le | S. Crow | N/A | J. Julyk | 02/10/2005 |
| 1 | Incorporated SDDR-PROC-04-00104 and vendor design information | E. Le | G. Butt | N/A | J. Julyk | 04/02/2004 |
| 0 | Issued for Procurement | E. Le | A. Donnelly | N/A | M. Hoffmann | 05/01/2003 |

# EQUIPMENT QUALIFICATION DATASHEET (EQD)

## Equipment Identification

| | | | |
|---|---|---|---|
| Component Tag Number | 24590-PTF-MW-FEP-SEP-00001B | Safety Classification | ☒ SC ☐ SS ☐ APC ☐ SDC ☐ SDS ☐ RRC Note 13 5 |
| Manufacturer / Supplier | TBD | | |
| Requisition Number | 24590-QL-POA-MEVV-00001 | | |
| Model | TBD | Seismic Category | ☒ SC-I ☐ SC-II ☐ SC-III ☐ SC-IV Note 13 5 |
| Description (Include descriptive text [e.g., location, elevation]) | Waste Feed Separator Vessel FEP-SEP-00001B, room P-0106, elevation 0'-0" | | |
| Safety Function(s) | Confinement (ref. 1) 5<br>Hydrogen Purging (ref. 1) 5<br>Initiate purge upon low steam flow to the reboiler (ref. 1) 5 | | |

| | | | |
|---|---|---|---|
| Seismic Safety Function | ☒ Yes ☐ No | Room Number(s): P-0106 | |
| Maintenance Accessible | ☐ Yes ☒ No | Method of Maintenance Access: | ☐ Remote ☐ Hands On ☒ None |
| Seismic Operability Requirements: 5 | ☐ During Seismic Event 5 | ☐ After Seismic Event | |
| ITS Equipment Type: | ☒ Passive Mechanical | ☐ Active Mechanical | ☐ Electrical |

## Equipment Environmental Qualification (EEQ)

| | | |
|---|---|---|
| Environment ☐ Mild ☒ Harsh<br>Contamination Class: C5<br>Radiation Class: R5 | Hi Rad Service ☒ Yes ☐ No | Design Life (yrs) ☒ 40 ☐ Other 5<br>Not applicable for Demister Pad. (Note 3). |

| Parameter Type/Units | Parameter Value | Time Duration (number) | Time Units | WTP Document Number (BUYER) | Submittal Number (SELLER) |
|---|---|---|---|---|---|
| **Normal** | | | | | |
| Normal High Temperature (°F) | 113 | 40 | yrs | 24590-PTF-U0D-W16T-00001, Note 8 | Note 1 |
| Normal Low Temperature (°F) | 59 | 40 | yrs | 24590-PTF-U0D-W16T-00001, Note 8 | Note 1 |
| Normal High Relative Humidity (%RH) | 100 | 40 | yrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Normal Low Relative Humidity (%RH) | 5 | 40 | yrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Normal High Pressure (in.-w.g.) | 0 | 40 | yrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Normal Low Pressure (in.-w.g.) | -1.4 | 40 | yrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Normal Radiation Dose Rate (mR/hr) | 5 Note 5 | 40 | yrs | Note 5 | Note 1 |
| Vibration Magnitude (g) | N/A | N/A | N/A | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Vibration Frequency (Hz) | N/A | N/A | N/A | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Additional Normal Information: | See Note 2 for pressure units. | | | | |

**Equipment Environmental Qualification (EEQ)** *(continued)*

| Parameter Type/Units | Parameter Value | Time Duration (number) | Time units | WTP Document Number (BUYER) | Submittal Number (SELLER) |
|---|---|---|---|---|---|
| **Abnormal** | | | | | |
| Abnormal High Temperature (°F) | 5 128 | 8 | hr/yr | 24590-PTF-U0D-W16T-00001, Note 8 5 | Note 1 |
| Abnormal Low Temperature (°F) | 59 | 8 | hr/yr | 24590-WTP-DB-01-001, Notes 8 & 11 | Note 1 |
| Abnormal High Relative Humidity (%RH) | 100 | 24 | hr/yr | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Abnormal Low Relative Humidity (%RH) | 2 | 22 | hr/yr | 24590-PTF-U0D-W16T-00001, Note 12 5 | Note 1 |
| Abnormal High Pressure (in.-w.g.) | 4 | 8 | hr/yr | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Abnormal Low Pressure (in.-w.g.) | -7.3 | 8 | hr/yr | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Abnormal Radiation Dose Rate (mR/hr) | 5 Notes 4&5 | 5 0 | 5 hr/yr | Note 5 | Note 1 |
| Wet Sprinkler System Present | No | N/A | N/A | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Additional Abnormal Information | See Note 2 for pressure units. | | | | |
| **Design Basis Events (DBE)** | | | | | |
| DBE High Temperature (°F) | 5 138 | 1000 | hrs | 24590-PTF-U0D-W16T-00001, Note 8 5 | Note 1 |
| DBE Low Temperature (°F) | 40 | 1000 | hrs | 24590-PTF-U0D-W16T-00001, Note 8 | Note 1 |
| DBE High Relative Humidity (%RH) | 100 | 1000 | hrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| DBE Low Relative Humidity (%RH) | 4 | 1000 | hrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| DBE High Pressure (in.-w.g.) | 4 | 1000 | hrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| DBE Low Pressure (in.-w.g.) | -7.3 | 1000 | hrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| DBE Radiation Dose Rate (mR/hr) | 5 Notes 4&5 | 5 0 | 5 hr | Note 5 | Note 1 |
| Flood Height (ft) | 2.08 | 1000 | hrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Submergence (ft) | 0, Note 6 | 1000 5 | hrs | 24590-PTF-U0D-W16T-00001<br>24590-QL-POA-MEVV-00001-01-00288 | Note 1 |
| Chemical/Spray Exposure | Yes | 1000 5 | hrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Additional DBE Information | See Note 2 for pressure units. | | | | |

| DBE Chemical Exposure Details | |
|---|---|
| DBE Chemical Types/Concentrations | 19M Sodium Hydroxide<br>Anti-foaming agent 5<br>1M Sodium Permanganate 5<br>1M Strontium Nitrate 5 |

| Interfaces (Electrical) | |
|---|---|
| Power Supply Voltage (VAC, VDC) | N/A |
| Power Supply Frequency (Hz) | N/A |
| Power Connection Method | N/A |
| I/O Signals to/from Equipment | N/A |
| I/O Connection Method | N/A |

| Interfaces (Mechanical) | |
|---|---|
| Mounting Configuration (orientation) | Vertical |
| Mounting Method (bolts, welds, etc.) | Welded, Studs, FEP-SKID-00007B, FEP-SKID-00008B, 24590-PTF-DD-S13T-00028 |
| Auxiliary Devices | N/A |

**Equipment Seismic Qualification (ESQ)**

| Parameter | Title | Reference/Document Number | Version / Revision | Remarks |
|---|---|---|---|---|
| WTP Seismic Design Specification (BUYER) | ENGINEERING SPECIFICATION FOR SEISMIC QUALIFICATION CRITERIA FOR PRESSURE VESSELS | 24590-WTP-3PS-MV00-T0002 | 002 | |
| Specified Seismic Load (BUYER) | Seismic Analysis of Pretreatment Building - WSGM In-Structure Response Spectre (ISRS) 5 | 24590-PTF-S0C-S15T-00057 5 | 00A 5 | Calculation is not included in MR, see attached figures 37, 38, 67, 68 and 24E per CCN 185267. 5 |
| Design Seismic Load (SELLER | Note 1 | Note 1 | Note 1 | Note 1 |
| Qualification Method (SELLER) | Note 1 | Note 1 | Note 1 | Note 1 |
| Qualification Report Number (SELLER) | Note 1 | Note 1 | Note 1 | Note 1 |
| Submittal Number (BUYER) | TBD | TBD | TBD | TBD |

## Notes and Additional Information

Notes

1. Data to be provided by SELLER through the submittal process as required on the G-321E.
2. Where pressure is given in inches of water column (in-w.c.) in the source document, it is generally assumed that this is in reference to atmospheric pressure and is therefore equivalent to inches of water gage (in-w.g.).
3. A shield plug is provided above the vessel for access to the demister pad section of the separator vessel.
4. Abnormal and DBE Radiation dose rates are the same as the normal and do not contribute to the total integrated dose.
5. Beta radiation dose is 1.39 E+07 mRad/hr based on the ratio of Strontium-90 from reference 8 as compared to the Strontium and Beta dose given in reference 9. Gamma dose rate is not to exceed 2.0 E+06 mRad/hr per CCN 175006.
6. Submergence is determined from the lowest point of the vessel in relation to the flood height above the floor.
7. Environmental data given in reference 3 is for room environment only.
8. For application of AISC N690, the normal temperatures are not used. Abnormal temperatures shall be applied as Normal Operation Temperature, $T_O$, with seismic effects, $E_S$. The Design basis event temperature shall be applied as a Thermal Load generated by a postulated accident, $T_A$, without seismic effects, $E_s$ or $E_o$.
9. Deleted . 5
10. Deleted . 5
11. Abnormal low temperature, as calculated in reference 3, is based on a Loss of Heating Accident (LOHA) which occurs when steam supply to the building is lost. Since the evaporators are run on steam, this would cause the evaporators to go off-line. Abnormal low temperature will be based on reference 5 at 59°F.
12. Parameter value used on data sheet has been previously established and determined more conservative than values 5 derived from the reference document noted.
13. For commercial reasons, safety and seismic classification may be higher than elsewhere documented, and therefore 5 conservative.

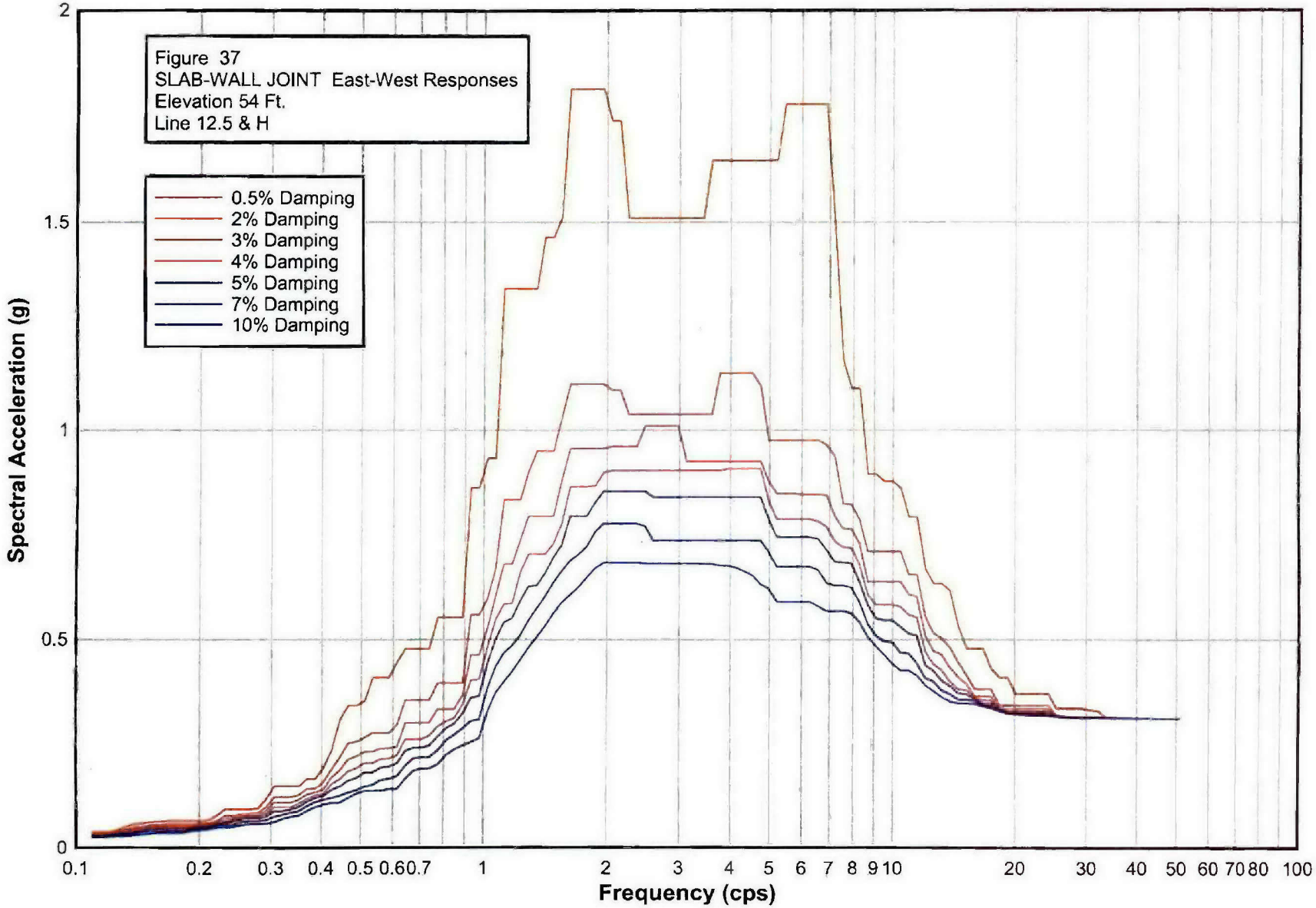
References

1. 24590-WTP-PSAR-ESH-01-002-02, Rev. 04A, Preliminary documented safety analysis to support construction 5 authorization; PT facility specific information.
2. CCN #096661, FEP and CNP Evaporator Vent Problems with New PVP Isolation Valve.
3. 24590-PTF-U0D-W16T-00001, Rev. 0, PTF Room Environment Datasheet.
4. 24590-PTF-DD-S13T-00028, Rev. 15, Pretreatment Facility Structural Concrete Embedments Plan El. 0'-0", Sh 6.
5. 24590-WTP-DB-ENG-01-001, Rev. 1M, Basis Of Design. 5
6. 24590-PTF-U0N-W16T-00003, Revised temperature & relative humidity data for PTF rooms. 5
7. 24590-PTF-U0N-W16T-00001, Add data for room P-0427. Incorporate additional steam break analysis. 5
8. 24590-WTP-Z0C-50-00008, Rev. B, Comparison of Source Terms for use in Shielding Calculations. 5
9. 24590-LAB-Z0C-80-00001, Rev. D, Beta and Gamma Dose Rate Determinations from Laboratory Sample Bottles. 5

# RPP-WTP Pretreatment Facility ISRS

5

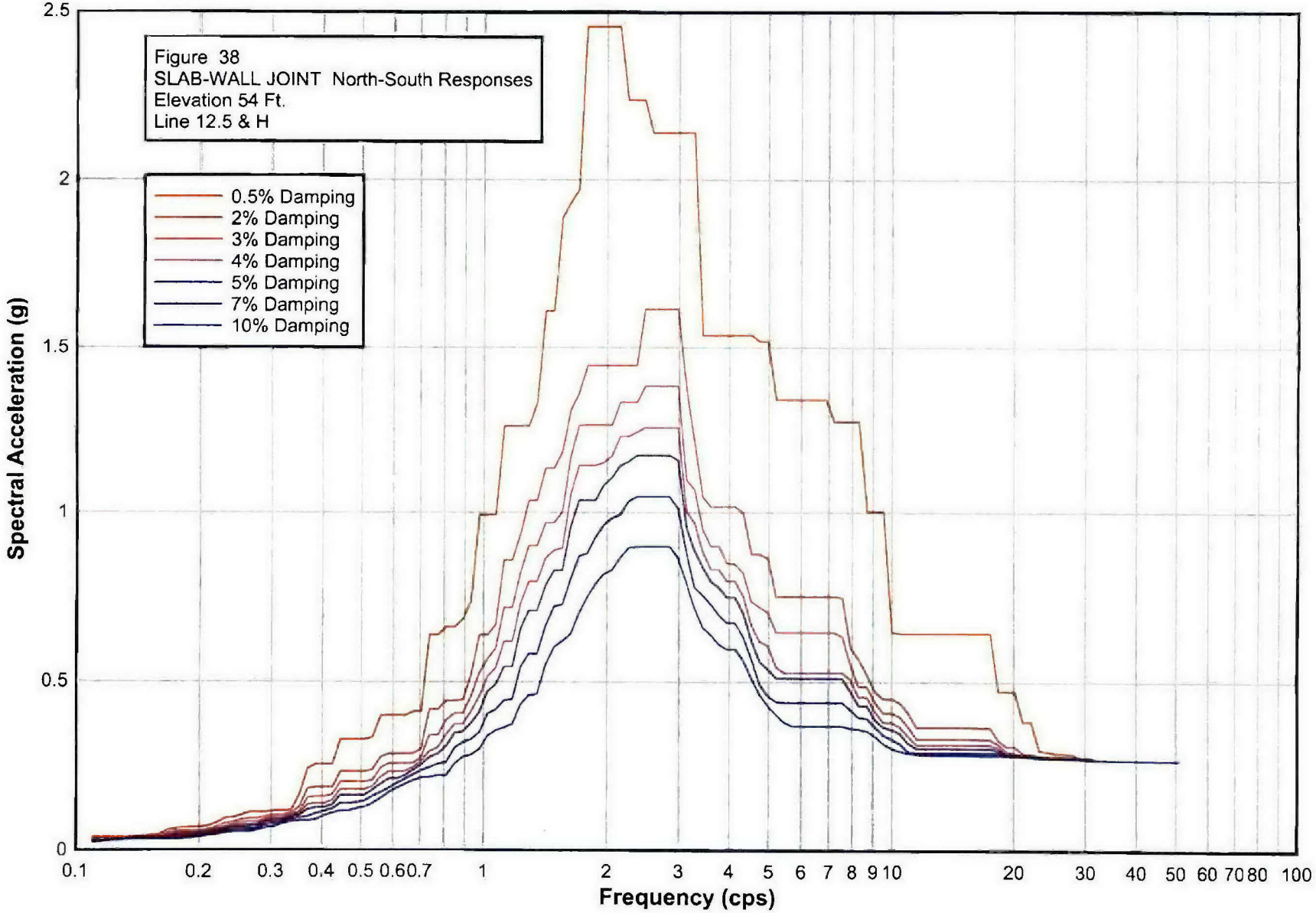
**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



# RPP-WTP Pretreatment Facility ISRS

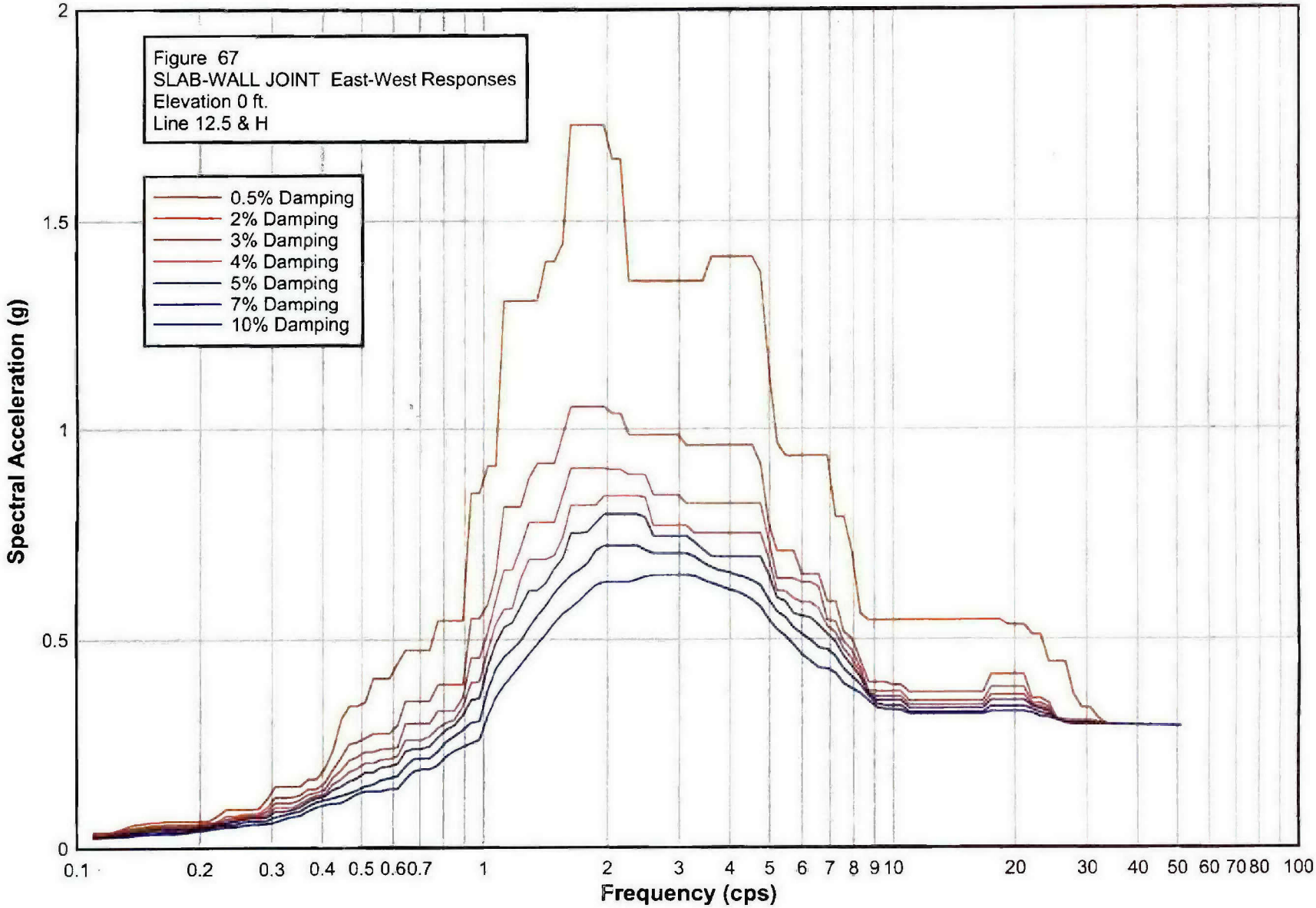
5

**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



# 5 RPP-WTP Pretreatment Facility ISRS

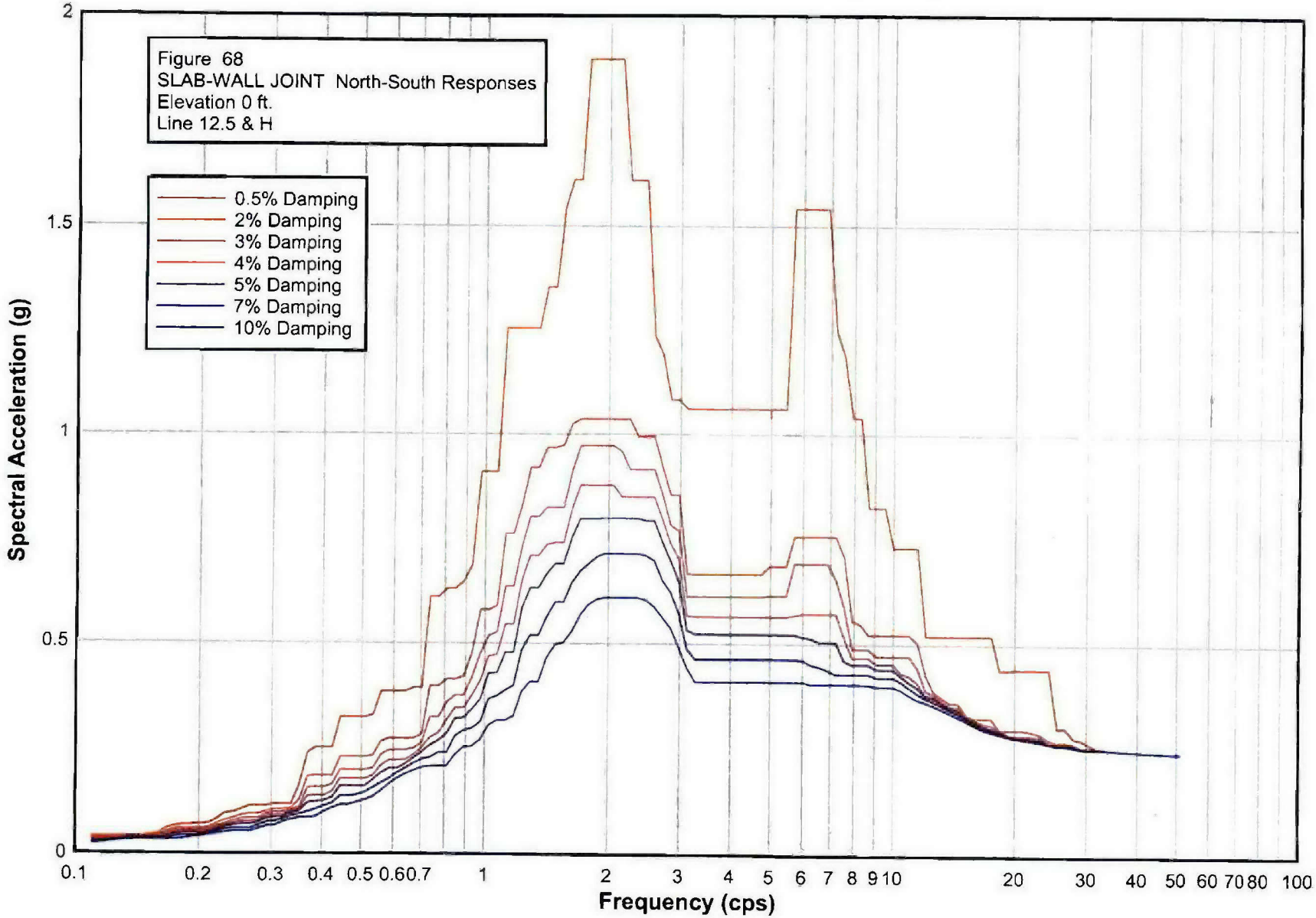
**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



# RPP-WTP Pretreatment Facility ISRS

5

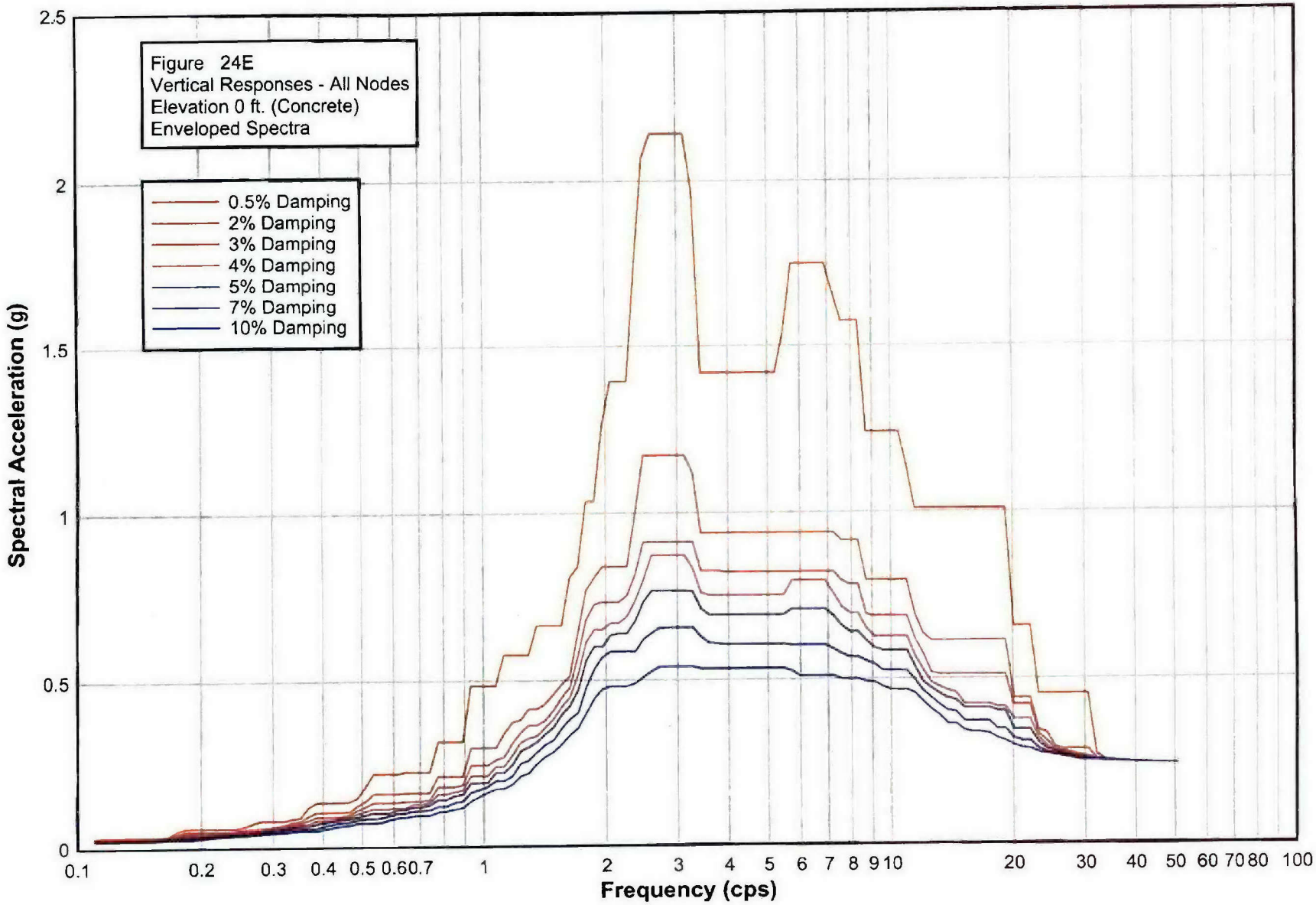
**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



# RPP-WTP Pretreatment Facility ISRS

5

**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



PTWW037.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 37 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.1098 | 0.0375 | 0.1098 | 0.0344 | 0.1098 | 0.0327 | 0.1098 | 0.0312 | 0.1098 | 0.0298 | 0.1098 | 0.0274 | 0.1098 | 0.0252 |
| 0.115 | 0.0375 | 0.115 | 0.0344 | 0.115 | 0.0327 | 0.115 | 0.0312 | 0.115 | 0.0299 | 0.115 | 0.0277 | 0.115 | 0.0258 |
| 0.1204 | 0.0375 | 0.1204 | 0.0344 | 0.1204 | 0.0331 | 0.1204 | 0.0322 | 0.1204 | 0.0312 | 0.1204 | 0.0294 | 0.1204 | 0.0269 |
| 0.1262 | 0.0431 | 0.1262 | 0.0397 | 0.1262 | 0.0378 | 0.1262 | 0.036 | 0.1262 | 0.0343 | 0.1262 | 0.0314 | 0.1262 | 0.0278 |
| 0.1322 | 0.0504 | 0.1322 | 0.045 | 0.1322 | 0.042 | 0.1322 | 0.0393 | 0.1322 | 0.0369 | 0.1322 | 0.0328 | 0.1322 | 0.0281 |
| 0.1385 | 0.056 | 0.1385 | 0.0489 | 0.1385 | 0.0449 | 0.1385 | 0.0414 | 0.1385 | 0.0384 | 0.1385 | 0.0344 | 0.1385 | 0.0303 |
| 0.1451 | 0.058 | 0.1451 | 0.0509 | 0.1451 | 0.0475 | 0.1451 | 0.0445 | 0.1451 | 0.0419 | 0.1451 | 0.0375 | 0.1451 | 0.0325 |
| 0.152 | 0.0616 | 0.152 | 0.0546 | 0.152 | 0.0506 | 0.152 | 0.0472 | 0.152 | 0.0442 | 0.152 | 0.0391 | 0.152 | 0.0338 |
| 0.1592 | 0.062 | 0.1592 | 0.0546 | 0.1592 | 0.0506 | 0.1592 | 0.0472 | 0.1592 | 0.0442 | 0.1592 | 0.0396 | 0.1592 | 0.0351 |
| 0.1668 | 0.064 | 0.1668 | 0.056 | 0.1668 | 0.0517 | 0.1668 | 0.0481 | 0.1668 | 0.0451 | 0.1668 | 0.0403 | 0.1668 | 0.0356 |
| 0.1748 | 0.064 | 0.1748 | 0.056 | 0.1748 | 0.0517 | 0.1748 | 0.0481 | 0.1748 | 0.0451 | 0.1748 | 0.0403 | 0.1748 | 0.0356 |
| 0.1831 | 0.064 | 0.1831 | 0.056 | 0.1831 | 0.0517 | 0.1831 | 0.0481 | 0.1831 | 0.0451 | 0.1831 | 0.0403 | 0.1831 | 0.0368 |
| 0.1918 | 0.0641 | 0.1918 | 0.0561 | 0.1918 | 0.0517 | 0.1918 | 0.0495 | 0.1918 | 0.0477 | 0.1918 | 0.0445 | 0.1918 | 0.0404 |
| 0.2009 | 0.0642 | 0.2009 | 0.0583 | 0.2009 | 0.0558 | 0.2009 | 0.0535 | 0.2009 | 0.0513 | 0.2009 | 0.0474 | 0.2009 | 0.0424 |
| 0.2105 | 0.0665 | 0.2105 | 0.0603 | 0.2105 | 0.0575 | 0.2105 | 0.0549 | 0.2105 | 0.0525 | 0.2105 | 0.049 | 0.2105 | 0.0448 |
| 0.2205 | 0.078 | 0.2205 | 0.0647 | 0.2205 | 0.062 | 0.2205 | 0.0595 | 0.2205 | 0.0573 | 0.2205 | 0.0533 | 0.2205 | 0.0484 |
| 0.231 | 0.0933 | 0.231 | 0.0774 | 0.231 | 0.0694 | 0.231 | 0.063 | 0.231 | 0.0598 | 0.231 | 0.0556 | 0.231 | 0.0503 |
| 0.242 | 0.0933 | 0.242 | 0.0774 | 0.242 | 0.0723 | 0.242 | 0.0678 | 0.242 | 0.0638 | 0.242 | 0.0567 | 0.242 | 0.0513 |
| 0.2535 | 0.0933 | 0.2535 | 0.0817 | 0.2535 | 0.0771 | 0.2535 | 0.0729 | 0.2535 | 0.0692 | 0.2535 | 0.0628 | 0.2535 | 0.0553 |
| 0.2656 | 0.0933 | 0.2656 | 0.0839 | 0.2656 | 0.0794 | 0.2656 | 0.0754 | 0.2656 | 0.0718 | 0.2656 | 0.0653 | 0.2656 | 0.0575 |
| 0.2783 | 0.0954 | 0.2783 | 0.0847 | 0.2783 | 0.0794 | 0.2783 | 0.0754 | 0.2783 | 0.0718 | 0.2783 | 0.0653 | 0.2783 | 0.058 |
| 0.2915 | 0.1187 | 0.2915 | 0.0987 | 0.2915 | 0.089 | 0.2915 | 0.0813 | 0.2915 | 0.0753 | 0.2915 | 0.0668 | 0.2915 | 0.0592 |
| 0.3054 | 0.1504 | 0.3054 | 0.1235 | 0.3054 | 0.1097 | 0.3054 | 0.0985 | 0.3054 | 0.0894 | 0.3054 | 0.0758 | 0.3054 | 0.0633 |
| 0.3199 | 0.1504 | 0.3199 | 0.1235 | 0.3199 | 0.1097 | 0.3199 | 0.0985 | 0.3199 | 0.0894 | 0.3199 | 0.0801 | 0.3199 | 0.0706 |
| 0.3352 | 0.1504 | 0.3352 | 0.1235 | 0.3352 | 0.1097 | 0.3352 | 0.0985 | 0.3352 | 0.0931 | 0.3352 | 0.0857 | 0.3352 | 0.0762 |
| 0.3511 | 0.1504 | 0.3511 | 0.1289 | 0.3511 | 0.1172 | 0.3511 | 0.107 | 0.3511 | 0.0997 | 0.3511 | 0.0894 | 0.3511 | 0.0786 |
| 0.3678 | 0.168 | 0.3678 | 0.1438 | 0.3678 | 0.1303 | 0.3678 | 0.1186 | 0.3678 | 0.1121 | 0.3678 | 0.1017 | 0.3678 | 0.0898 |
| 0.3853 | 0.168 | 0.3853 | 0.1438 | 0.3853 | 0.1346 | 0.3853 | 0.1279 | 0.3853 | 0.1219 | 0.3853 | 0.1115 | 0.3853 | 0.0992 |
| 0.4037 | 0.194 | 0.4037 | 0.1598 | 0.4037 | 0.1426 | 0.4037 | 0.1306 | 0.4037 | 0.1259 | 0.4037 | 0.117 | 0.4037 | 0.1054 |
| 0.4229 | 0.2368 | 0.4229 | 0.1906 | 0.4229 | 0.1721 | 0.4229 | 0.1558 | 0.4229 | 0.1416 | 0.4229 | 0.1217 | 0.4229 | 0.1092 |
| 0.4431 | 0.3088 | 0.4431 | 0.2193 | 0.4431 | 0.1881 | 0.4431 | 0.1671 | 0.4431 | 0.1496 | 0.4431 | 0.1273 | 0.4431 | 0.1097 |
| 0.4642 | 0.3417 | 0.4642 | 0.2524 | 0.4642 | 0.2138 | 0.4642 | 0.1852 | 0.4642 | 0.1637 | 0.4642 | 0.1345 | 0.4642 | 0.1211 |
| 0.4863 | 0.3417 | 0.4863 | 0.256 | 0.4863 | 0.2208 | 0.4863 | 0.1928 | 0.4863 | 0.1701 | 0.4863 | 0.1409 | 0.4863 | 0.1323 |
| 0.5094 | 0.3522 | 0.5094 | 0.2656 | 0.5094 | 0.2325 | 0.5094 | 0.2054 | 0.5094 | 0.1831 | 0.5094 | 0.1497 | 0.5094 | 0.1391 |

PTWW037.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 37 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.5337 | 0.4096 | 0.5337 | 0.2771 | 0.5337 | 0.2325 | 0.5337 | 0.2054 | 0.5337 | 0.1831 | 0.5337 | 0.1539 | 0.5337 | 0.1396 |
| 0.5591 | 0.4096 | 0.5591 | 0.2771 | 0.5591 | 0.2398 | 0.5591 | 0.2148 | 0.5591 | 0.1949 | 0.5591 | 0.1654 | 0.5591 | 0.1396 |
| 0.5857 | 0.4096 | 0.5857 | 0.2771 | 0.5857 | 0.2404 | 0.5857 | 0.2159 | 0.5857 | 0.1975 | 0.5857 | 0.1686 | 0.5857 | 0.1441 |
| 0.6136 | 0.4475 | 0.6136 | 0.2969 | 0.6136 | 0.2444 | 0.6136 | 0.2234 | 0.6136 | 0.2051 | 0.6136 | 0.1751 | 0.6136 | 0.1441 |
| 0.6428 | 0.478 | 0.6428 | 0.3547 | 0.6428 | 0.3006 | 0.6428 | 0.2612 | 0.6428 | 0.2347 | 0.6428 | 0.1988 | 0.6428 | 0.168 |
| 0.6734 | 0.478 | 0.6734 | 0.3547 | 0.6734 | 0.3006 | 0.6734 | 0.2612 | 0.6734 | 0.2413 | 0.6734 | 0.2165 | 0.6734 | 0.1872 |
| 0.7055 | 0.478 | 0.7055 | 0.3547 | 0.7055 | 0.3006 | 0.7055 | 0.2612 | 0.7055 | 0.2413 | 0.7055 | 0.2186 | 0.7055 | 0.1922 |
| 0.7391 | 0.478 | 0.7391 | 0.3547 | 0.7391 | 0.3006 | 0.7391 | 0.2692 | 0.7391 | 0.2463 | 0.7391 | 0.2186 | 0.7391 | 0.1922 |
| 0.7743 | 0.5518 | 0.7743 | 0.3958 | 0.7743 | 0.3332 | 0.7743 | 0.2918 | 0.7743 | 0.268 | 0.7743 | 0.2351 | 0.7743 | 0.2018 |
| 0.8111 | 0.5518 | 0.8111 | 0.3958 | 0.8111 | 0.3332 | 0.8111 | 0.3035 | 0.8111 | 0.2874 | 0.8111 | 0.2587 | 0.8111 | 0.2236 |
| 0.8497 | 0.5518 | 0.8497 | 0.3958 | 0.8497 | 0.3332 | 0.8497 | 0.3117 | 0.8497 | 0.2984 | 0.8497 | 0.2723 | 0.8497 | 0.2373 |
| 0.8902 | 0.5518 | 0.8902 | 0.3958 | 0.8902 | 0.3656 | 0.8902 | 0.3431 | 0.8902 | 0.3226 | 0.8902 | 0.2873 | 0.8902 | 0.2462 |
| 0.9326 | 0.8605 | 0.9326 | 0.5585 | 0.9326 | 0.4629 | 0.9326 | 0.4023 | 0.9326 | 0.3602 | 0.9326 | 0.3049 | 0.9326 | 0.2549 |
| 0.977 | 0.8605 | 0.977 | 0.5585 | 0.977 | 0.4629 | 0.977 | 0.4045 | 0.977 | 0.3644 | 0.977 | 0.3083 | 0.977 | 0.2637 |
| 1.0235 | 0.9315 | 1.0235 | 0.5965 | 1.0235 | 0.5261 | 1.0235 | 0.4814 | 1.0235 | 0.4436 | 1.0235 | 0.3837 | 1.0235 | 0.3277 |
| 1.0723 | 0.9315 | 1.0723 | 0.6685 | 1.0723 | 0.603 | 1.0723 | 0.5467 | 1.0723 | 0.4995 | 1.0723 | 0.4355 | 1.0723 | 0.3729 |
| 1.1233 | 1.3398 | 1.1233 | 0.8315 | 1.1233 | 0.6788 | 1.1233 | 0.5837 | 1.1233 | 0.5408 | 1.1233 | 0.4681 | 1.1233 | 0.3987 |
| 1.1768 | 1.3398 | 1.1768 | 0.8315 | 1.1768 | 0.6788 | 1.1768 | 0.5855 | 1.1768 | 0.5505 | 1.1768 | 0.4858 | 1.1768 | 0.4238 |
| 1.2328 | 1.3398 | 1.2328 | 0.8315 | 1.2328 | 0.7369 | 1.2328 | 0.6596 | 1.2328 | 0.5925 | 1.2328 | 0.5105 | 1.2328 | 0.452 |
| 1.2916 | 1.3398 | 1.2916 | 0.9002 | 1.2916 | 0.7926 | 1.2916 | 0.7024 | 1.2916 | 0.6263 | 1.2916 | 0.5455 | 1.2916 | 0.4806 |
| 1.353 | 1.3398 | 1.353 | 0.9485 | 1.353 | 0.7926 | 1.353 | 0.7024 | 1.353 | 0.6282 | 1.353 | 0.574 | 1.353 | 0.5058 |
| 1.4175 | 1.4626 | 1.4175 | 0.9485 | 1.4175 | 0.7926 | 1.4175 | 0.7024 | 1.4175 | 0.6579 | 1.4175 | 0.6026 | 1.4175 | 0.5321 |
| 1.485 | 1.4626 | 1.485 | 0.9485 | 1.485 | 0.7926 | 1.485 | 0.7282 | 1.485 | 0.6958 | 1.485 | 0.636 | 1.485 | 0.5624 |
| 1.5557 | 1.5113 | 1.5557 | 1.0297 | 1.5557 | 0.8797 | 1.5557 | 0.7754 | 1.5557 | 0.726 | 1.5557 | 0.6634 | 1.5557 | 0.5886 |
| 1.6298 | 1.8158 | 1.6298 | 1.1086 | 1.6298 | 0.9552 | 1.6298 | 0.8627 | 1.6298 | 0.7931 | 1.6298 | 0.6875 | 1.6298 | 0.6064 |
| 1.7074 | 1.8158 | 1.7074 | 1.1086 | 1.7074 | 0.9552 | 1.7074 | 0.8627 | 1.7074 | 0.7931 | 1.7074 | 0.7024 | 1.7074 | 0.6246 |
| 1.7887 | 1.8158 | 1.7887 | 1.1086 | 1.7887 | 0.9552 | 1.7887 | 0.8627 | 1.7887 | 0.7931 | 1.7887 | 0.7213 | 1.7887 | 0.6476 |
| 1.8738 | 1.8158 | 1.8738 | 1.1086 | 1.8738 | 0.9552 | 1.8738 | 0.8651 | 1.8738 | 0.8263 | 1.8738 | 0.7567 | 1.8738 | 0.6698 |
| 1.963 | 1.8158 | 1.963 | 1.1086 | 1.963 | 0.9552 | 1.963 | 0.8972 | 1.963 | 0.8525 | 1.963 | 0.7755 | 1.963 | 0.683 |
| 2.0565 | 1.7414 | 2.0565 | 1.0948 | 2.0565 | 0.9593 | 2.0565 | 0.9017 | 2.0565 | 0.8525 | 2.0565 | 0.7755 | 2.0565 | 0.683 |
| 2.1544 | 1.7414 | 2.1544 | 1.0948 | 2.1544 | 0.9593 | 2.1544 | 0.9017 | 2.1544 | 0.8525 | 2.1544 | 0.7755 | 2.1544 | 0.683 |
| 2.257 | 1.5091 | 2.257 | 1.0367 | 2.257 | 0.9593 | 2.257 | 0.9017 | 2.257 | 0.8525 | 2.257 | 0.7755 | 2.257 | 0.683 |
| 2.3645 | 1.5091 | 2.3645 | 1.0367 | 2.3645 | 0.9593 | 2.3645 | 0.9017 | 2.3645 | 0.8525 | 2.3645 | 0.7755 | 2.3645 | 0.683 |
| 2.4771 | 1.5091 | 2.4771 | 1.0367 | 2.4771 | 1.009 | 2.4771 | 0.9017 | 2.4771 | 0.852 | 2.4771 | 0.7697 | 2.4771 | 0.6811 |
| 2.595 | 1.5091 | 2.595 | 1.0367 | 2.595 | 1.009 | 2.595 | 0.9017 | 2.595 | 0.8387 | 2.595 | 0.7357 | 2.595 | 0.6811 |

PTWW037.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 37 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.7186 | 1.5091 | 2.7186 | 1.0367 | 2.7186 | 1.009 | 2.7186 | 0.9017 | 2.7186 | 0.8387 | 2.7186 | 0.7357 | 2.7186 | 0.6811 |
| 2.848 | 1.5091 | 2.848 | 1.0367 | 2.848 | 1.009 | 2.848 | 0.9017 | 2.848 | 0.8387 | 2.848 | 0.7357 | 2.848 | 0.6811 |
| 2.9836 | 1.5091 | 2.9836 | 1.0367 | 2.9836 | 1.009 | 2.9836 | 0.9017 | 2.9836 | 0.8387 | 2.9836 | 0.7357 | 2.9836 | 0.6811 |
| 3.1257 | 1.5091 | 3.1257 | 1.0367 | 3.1257 | 0.9237 | 3.1257 | 0.9017 | 3.1257 | 0.8387 | 3.1257 | 0.7357 | 3.1257 | 0.6811 |
| 3.2745 | 1.5091 | 3.2745 | 1.0367 | 3.2745 | 0.9237 | 3.2745 | 0.9017 | 3.2745 | 0.8387 | 3.2745 | 0.7357 | 3.2745 | 0.6811 |
| 3.4305 | 1.5091 | 3.4305 | 1.0367 | 3.4305 | 0.9237 | 3.4305 | 0.9017 | 3.4305 | 0.8387 | 3.4305 | 0.7357 | 3.4305 | 0.6801 |
| 3.5938 | 1.6472 | 3.5938 | 1.0367 | 3.5938 | 0.9237 | 3.5938 | 0.9017 | 3.5938 | 0.8387 | 3.5938 | 0.7357 | 3.5938 | 0.6801 |
| 3.7649 | 1.6472 | 3.7649 | 1.1356 | 3.7649 | 0.9237 | 3.7649 | 0.9017 | 3.7649 | 0.8387 | 3.7649 | 0.7357 | 3.7649 | 0.6766 |
| 3.9442 | 1.6472 | 3.9442 | 1.1356 | 3.9442 | 0.9237 | 3.9442 | 0.906 | 3.9442 | 0.8387 | 3.9442 | 0.7357 | 3.9442 | 0.6759 |
| 4.132 | 1.6472 | 4.132 | 1.1356 | 4.132 | 0.9237 | 4.132 | 0.906 | 4.132 | 0.8387 | 4.132 | 0.7357 | 4.132 | 0.6712 |
| 4.3288 | 1.6472 | 4.3288 | 1.1356 | 4.3288 | 0.9237 | 4.3288 | 0.906 | 4.3288 | 0.8387 | 4.3288 | 0.7357 | 4.3288 | 0.6626 |
| 4.5349 | 1.6472 | 4.5349 | 1.1356 | 4.5349 | 0.9237 | 4.5349 | 0.906 | 4.5349 | 0.8387 | 4.5349 | 0.7357 | 4.5349 | 0.6525 |
| 4.7508 | 1.6472 | 4.7508 | 1.1048 | 4.7508 | 0.9237 | 4.7508 | 0.906 | 4.7508 | 0.8387 | 4.7508 | 0.7357 | 4.7508 | 0.6316 |
| 4.977 | 1.6472 | 4.977 | 0.9746 | 4.977 | 0.8757 | 4.977 | 0.829 | 4.977 | 0.7851 | 4.977 | 0.7083 | 4.977 | 0.6206 |
| 5.214 | 1.6472 | 5.214 | 0.9746 | 5.214 | 0.8463 | 5.214 | 0.785 | 5.214 | 0.7434 | 5.214 | 0.6732 | 5.214 | 0.5898 |
| 5.4623 | 1.7798 | 5.4623 | 0.9746 | 5.4623 | 0.8463 | 5.4623 | 0.785 | 5.4623 | 0.7434 | 5.4623 | 0.6732 | 5.4623 | 0.5898 |
| 5.7224 | 1.7798 | 5.7224 | 0.9746 | 5.7224 | 0.8463 | 5.7224 | 0.785 | 5.7224 | 0.7434 | 5.7224 | 0.6732 | 5.7224 | 0.5898 |
| 5.9948 | 1.7798 | 5.9948 | 0.9746 | 5.9948 | 0.8438 | 5.9948 | 0.785 | 5.9948 | 0.7434 | 5.9948 | 0.6732 | 5.9948 | 0.5898 |
| 6.2803 | 1.7798 | 6.2803 | 0.9746 | 6.2803 | 0.8438 | 6.2803 | 0.785 | 6.2803 | 0.7434 | 6.2803 | 0.6732 | 6.2803 | 0.5898 |
| 6.5793 | 1.7798 | 6.5793 | 0.9746 | 6.5793 | 0.8438 | 6.5793 | 0.7804 | 6.5793 | 0.7393 | 6.5793 | 0.6657 | 6.5793 | 0.5795 |
| 6.8926 | 1.7798 | 6.8926 | 0.963 | 6.8926 | 0.8429 | 6.8926 | 0.7674 | 6.8926 | 0.7128 | 6.8926 | 0.6345 | 6.8926 | 0.5677 |
| 7.2208 | 1.4914 | 7.2208 | 0.935 | 7.2208 | 0.7922 | 7.2208 | 0.7331 | 7.2208 | 0.6844 | 7.2208 | 0.6283 | 7.2208 | 0.5677 |
| 7.5646 | 1.168 | 7.5646 | 0.822 | 7.5646 | 0.7632 | 7.5646 | 0.7188 | 7.5646 | 0.6833 | 7.5646 | 0.6283 | 7.5646 | 0.5677 |
| 7.9248 | 1.0987 | 7.9248 | 0.8201 | 7.9248 | 0.7623 | 7.9248 | 0.7176 | 7.9248 | 0.6811 | 7.9248 | 0.6237 | 7.9248 | 0.5627 |
| 8.3022 | 1.0987 | 8.3022 | 0.7845 | 8.3022 | 0.7283 | 8.3022 | 0.6777 | 8.3022 | 0.6364 | 8.3022 | 0.5884 | 8.3022 | 0.5417 |
| 8.6975 | 0.8935 | 8.6975 | 0.7092 | 8.6975 | 0.6368 | 8.6975 | 0.6061 | 8.6975 | 0.5819 | 8.6975 | 0.5373 | 8.6975 | 0.5059 |
| 9.1116 | 0.8935 | 9.1116 | 0.7092 | 9.1116 | 0.6368 | 9.1116 | 0.5827 | 9.1116 | 0.5505 | 9.1116 | 0.5085 | 9.1116 | 0.4846 |
| 9.5455 | 0.8763 | 9.5455 | 0.7092 | 9.5455 | 0.6368 | 9.5455 | 0.5827 | 9.5455 | 0.5459 | 9.5455 | 0.4951 | 9.5455 | 0.4643 |
| 10 | 0.8763 | 10 | 0.7092 | 10 | 0.6368 | 10 | 0.5827 | 10 | 0.5459 | 10 | 0.4934 | 10 | 0.4429 |
| 10.4762 | 0.8603 | 10.4762 | 0.7092 | 10.4762 | 0.6368 | 10.4762 | 0.5774 | 10.4762 | 0.5297 | 10.4762 | 0.4688 | 10.4762 | 0.4271 |
| 10.975 | 0.791 | 10.975 | 0.6543 | 10.975 | 0.6067 | 10.975 | 0.5582 | 10.975 | 0.5137 | 10.975 | 0.4674 | 10.975 | 0.4271 |
| 11.4976 | 0.791 | 11.4976 | 0.6543 | 11.4976 | 0.6014 | 11.4976 | 0.5519 | 11.4976 | 0.5094 | 11.4976 | 0.4435 | 11.4976 | 0.4142 |
| 12.045 | 0.6677 | 12.045 | 0.5543 | 12.045 | 0.5086 | 12.045 | 0.4716 | 12.045 | 0.4394 | 12.045 | 0.4081 | 12.045 | 0.3915 |
| 12.6186 | 0.6325 | 12.6186 | 0.5145 | 12.6186 | 0.4727 | 12.6186 | 0.4409 | 12.6186 | 0.4251 | 12.6186 | 0.4004 | 12.6186 | 0.3774 |
| 13.2194 | 0.6325 | 13.2194 | 0.5025 | 13.2194 | 0.4639 | 13.2194 | 0.4269 | 13.2194 | 0.4021 | 13.2194 | 0.379 | 13.2194 | 0.3634 |

PTWW037.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 37 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13.8489 | 0.6152 | 13.8489 | 0.4815 | 13.8489 | 0.433 | 13.8489 | 0.3995 | 13.8489 | 0.3896 | 13.8489 | 0.3705 | 13.8489 | 0.3527 |
| 14.5083 | 0.5318 | 14.5083 | 0.4455 | 14.5083 | 0.4096 | 14.5083 | 0.381 | 14.5083 | 0.3726 | 14.5083 | 0.3575 | 14.5083 | 0.3484 |
| 15.1991 | 0.4787 | 15.1991 | 0.4141 | 15.1991 | 0.3936 | 15.1991 | 0.3795 | 15.1991 | 0.3697 | 15.1991 | 0.3575 | 15.1991 | 0.3484 |
| 15.9228 | 0.4787 | 15.9228 | 0.3815 | 15.9228 | 0.3644 | 15.9228 | 0.3609 | 15.9228 | 0.358 | 15.9228 | 0.3528 | 15.9228 | 0.3467 |
| 16.681 | 0.4787 | 16.681 | 0.3815 | 16.681 | 0.3644 | 16.681 | 0.3544 | 16.681 | 0.3483 | 16.681 | 0.3439 | 16.681 | 0.3416 |
| 17.4753 | 0.4307 | 17.4753 | 0.3815 | 17.4753 | 0.3644 | 17.4753 | 0.3544 | 17.4753 | 0.3483 | 17.4753 | 0.3418 | 17.4753 | 0.337 |
| 18.3074 | 0.4095 | 18.3074 | 0.3431 | 18.3074 | 0.3367 | 18.3074 | 0.3354 | 18.3074 | 0.3336 | 18.3074 | 0.3315 | 18.3074 | 0.3305 |
| 19.1791 | 0.4095 | 19.1791 | 0.3431 | 19.1791 | 0.3349 | 19.1791 | 0.3293 | 19.1791 | 0.3262 | 19.1791 | 0.3251 | 19.1791 | 0.325 |
| 20.0923 | 0.3708 | 20.0923 | 0.3431 | 20.0923 | 0.3349 | 20.0923 | 0.3293 | 20.0923 | 0.3262 | 20.0923 | 0.3243 | 20.0923 | 0.323 |
| 21.049 | 0.3708 | 21.049 | 0.3431 | 21.049 | 0.3349 | 21.049 | 0.3293 | 21.049 | 0.3262 | 21.049 | 0.3236 | 21.049 | 0.3215 |
| 22.0513 | 0.3708 | 22.0513 | 0.3431 | 22.0513 | 0.3349 | 22.0513 | 0.3293 | 22.0513 | 0.3262 | 22.0513 | 0.323 | 22.0513 | 0.3199 |
| 23.1013 | 0.3708 | 23.1013 | 0.3431 | 23.1013 | 0.3349 | 23.1013 | 0.3293 | 23.1013 | 0.3262 | 23.1013 | 0.323 | 23.1013 | 0.3199 |
| 24.2013 | 0.3708 | 24.2013 | 0.3431 | 24.2013 | 0.3349 | 24.2013 | 0.3293 | 24.2013 | 0.3255 | 24.2013 | 0.3206 | 24.2013 | 0.3186 |
| 25.3536 | 0.3358 | 25.3536 | 0.3197 | 25.3536 | 0.3192 | 25.3536 | 0.3187 | 25.3536 | 0.3181 | 25.3536 | 0.317 | 25.3536 | 0.3164 |
| 26.5609 | 0.3358 | 26.5609 | 0.3169 | 26.5609 | 0.3159 | 26.5609 | 0.3158 | 26.5609 | 0.3158 | 26.5609 | 0.3155 | 26.5609 | 0.3148 |
| 27.8256 | 0.3358 | 27.8256 | 0.3169 | 27.8256 | 0.3159 | 27.8256 | 0.3153 | 27.8256 | 0.3149 | 27.8256 | 0.3143 | 27.8256 | 0.3137 |
| 29.1505 | 0.3358 | 29.1505 | 0.3165 | 29.1505 | 0.3153 | 29.1505 | 0.3142 | 29.1505 | 0.3137 | 29.1505 | 0.3132 | 29.1505 | 0.313 |
| 30.5386 | 0.3312 | 30.5386 | 0.3165 | 30.5386 | 0.3153 | 30.5386 | 0.3142 | 30.5386 | 0.3133 | 30.5386 | 0.3131 | 30.5386 | 0.313 |
| 31.9927 | 0.3297 | 31.9927 | 0.3163 | 31.9927 | 0.3146 | 31.9927 | 0.3138 | 31.9927 | 0.3132 | 31.9927 | 0.3131 | 31.9927 | 0.313 |
| 33.516 | 0.3144 | 33.516 | 0.3134 | 33.516 | 0.3133 | 33.516 | 0.3132 | 33.516 | 0.3132 | 33.516 | 0.3131 | 33.516 | 0.313 |
| 35.1119 | 0.3135 | 35.1119 | 0.3134 | 35.1119 | 0.3133 | 35.1119 | 0.3132 | 35.1119 | 0.3132 | 35.1119 | 0.3131 | 35.1119 | 0.313 |
| 36.7838 | 0.3134 | 36.7838 | 0.3133 | 36.7838 | 0.3132 | 36.7838 | 0.3132 | 36.7838 | 0.3132 | 36.7838 | 0.3131 | 36.7838 | 0.313 |
| 38.5353 | 0.3132 | 38.5353 | 0.3132 | 38.5353 | 0.3131 | 38.5353 | 0.3131 | 38.5353 | 0.3131 | 38.5353 | 0.3131 | 38.5353 | 0.313 |
| 40.3702 | 0.3131 | 40.3702 | 0.3131 | 40.3702 | 0.3131 | 40.3702 | 0.313 | 40.3702 | 0.313 | 40.3702 | 0.313 | 40.3702 | 0.3129 |
| 42.2924 | 0.313 | 42.2924 | 0.3129 | 42.2924 | 0.3129 | 42.2924 | 0.3129 | 42.2924 | 0.3129 | 42.2924 | 0.3129 | 42.2924 | 0.3129 |
| 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 |
| 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 |
| 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 |
| 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 |

PTWW038.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 38 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.1098 | 0.0405 | 0.1098 | 0.0365 | 0.1098 | 0.0342 | 0.1098 | 0.0322 | 0.1098 | 0.0303 | 0.1098 | 0.0272 | 0.1098 | 0.0235 |
| 0.115 | 0.0405 | 0.115 | 0.0365 | 0.115 | 0.0342 | 0.115 | 0.0322 | 0.115 | 0.0303 | 0.115 | 0.0272 | 0.115 | 0.0259 |
| 0.1204 | 0.0405 | 0.1204 | 0.0365 | 0.1204 | 0.0342 | 0.1204 | 0.0322 | 0.1204 | 0.031 | 0.1204 | 0.0297 | 0.1204 | 0.028 |
| 0.1262 | 0.0405 | 0.1262 | 0.0365 | 0.1262 | 0.0352 | 0.1262 | 0.0342 | 0.1262 | 0.0334 | 0.1262 | 0.0318 | 0.1262 | 0.0297 |
| 0.1322 | 0.0405 | 0.1322 | 0.0382 | 0.1322 | 0.037 | 0.1322 | 0.0359 | 0.1322 | 0.0349 | 0.1322 | 0.0333 | 0.1322 | 0.0316 |
| 0.1385 | 0.0411 | 0.1385 | 0.0392 | 0.1385 | 0.0382 | 0.1385 | 0.0372 | 0.1385 | 0.0363 | 0.1385 | 0.0348 | 0.1385 | 0.0328 |
| 0.1451 | 0.0417 | 0.1451 | 0.0398 | 0.1451 | 0.0387 | 0.1451 | 0.0377 | 0.1451 | 0.0368 | 0.1451 | 0.0352 | 0.1451 | 0.0332 |
| 0.152 | 0.0439 | 0.152 | 0.0401 | 0.152 | 0.0387 | 0.152 | 0.0377 | 0.152 | 0.0368 | 0.152 | 0.0352 | 0.152 | 0.0332 |
| 0.1592 | 0.0462 | 0.1592 | 0.0416 | 0.1592 | 0.0396 | 0.1592 | 0.0377 | 0.1592 | 0.0368 | 0.1592 | 0.0352 | 0.1592 | 0.0332 |
| 0.1668 | 0.0584 | 0.1668 | 0.0506 | 0.1668 | 0.0463 | 0.1668 | 0.0426 | 0.1668 | 0.0395 | 0.1668 | 0.0352 | 0.1668 | 0.0332 |
| 0.1748 | 0.0645 | 0.1748 | 0.0566 | 0.1748 | 0.0522 | 0.1748 | 0.0484 | 0.1748 | 0.045 | 0.1748 | 0.0394 | 0.1748 | 0.0332 |
| 0.1831 | 0.0668 | 0.1831 | 0.0583 | 0.1831 | 0.0541 | 0.1831 | 0.0504 | 0.1831 | 0.0471 | 0.1831 | 0.0415 | 0.1831 | 0.0354 |
| 0.1918 | 0.0678 | 0.1918 | 0.0586 | 0.1918 | 0.0543 | 0.1918 | 0.0507 | 0.1918 | 0.0474 | 0.1918 | 0.0418 | 0.1918 | 0.038 |
| 0.2009 | 0.0697 | 0.2009 | 0.0596 | 0.2009 | 0.0543 | 0.2009 | 0.0514 | 0.2009 | 0.0487 | 0.2009 | 0.0438 | 0.2009 | 0.0411 |
| 0.2105 | 0.0722 | 0.2105 | 0.062 | 0.2105 | 0.0582 | 0.2105 | 0.0547 | 0.2105 | 0.0516 | 0.2105 | 0.0482 | 0.2105 | 0.0446 |
| 0.2205 | 0.0819 | 0.2205 | 0.0709 | 0.2205 | 0.0651 | 0.2205 | 0.06 | 0.2205 | 0.0574 | 0.2205 | 0.0531 | 0.2205 | 0.0475 |
| 0.231 | 0.0959 | 0.231 | 0.0792 | 0.231 | 0.0703 | 0.231 | 0.0665 | 0.231 | 0.063 | 0.231 | 0.0578 | 0.231 | 0.0525 |
| 0.242 | 0.0984 | 0.242 | 0.0845 | 0.242 | 0.0774 | 0.242 | 0.0721 | 0.242 | 0.0681 | 0.242 | 0.0618 | 0.242 | 0.0551 |
| 0.2535 | 0.1059 | 0.2535 | 0.0913 | 0.2535 | 0.0833 | 0.2535 | 0.0763 | 0.2535 | 0.0702 | 0.2535 | 0.0618 | 0.2535 | 0.0551 |
| 0.2656 | 0.1138 | 0.2656 | 0.0944 | 0.2656 | 0.084 | 0.2656 | 0.0763 | 0.2656 | 0.0702 | 0.2656 | 0.0618 | 0.2656 | 0.0551 |
| 0.2783 | 0.1138 | 0.2783 | 0.0944 | 0.2783 | 0.084 | 0.2783 | 0.0779 | 0.2783 | 0.074 | 0.2783 | 0.0677 | 0.2783 | 0.0611 |
| 0.2915 | 0.1138 | 0.2915 | 0.1008 | 0.2915 | 0.0946 | 0.2915 | 0.0892 | 0.2915 | 0.0843 | 0.2915 | 0.0764 | 0.2915 | 0.0677 |
| 0.3054 | 0.1179 | 0.3054 | 0.1056 | 0.3054 | 0.0987 | 0.3054 | 0.0926 | 0.3054 | 0.0872 | 0.3054 | 0.0785 | 0.3054 | 0.0706 |
| 0.3199 | 0.1179 | 0.3199 | 0.1056 | 0.3199 | 0.0987 | 0.3199 | 0.0926 | 0.3199 | 0.0894 | 0.3199 | 0.0844 | 0.3199 | 0.0786 |
| 0.3352 | 0.1179 | 0.3352 | 0.1098 | 0.3352 | 0.1056 | 0.3352 | 0.1017 | 0.3352 | 0.0982 | 0.3352 | 0.0921 | 0.3352 | 0.0848 |
| 0.3511 | 0.1654 | 0.3511 | 0.129 | 0.3511 | 0.1133 | 0.3511 | 0.1075 | 0.3511 | 0.1035 | 0.3511 | 0.0964 | 0.3511 | 0.088 |
| 0.3678 | 0.2415 | 0.3678 | 0.1832 | 0.3678 | 0.1565 | 0.3678 | 0.1364 | 0.3678 | 0.1213 | 0.3678 | 0.1006 | 0.3678 | 0.088 |
| 0.3853 | 0.2549 | 0.3853 | 0.187 | 0.3853 | 0.1595 | 0.3853 | 0.1387 | 0.3853 | 0.1269 | 0.3853 | 0.1092 | 0.3853 | 0.091 |
| 0.4037 | 0.2549 | 0.4037 | 0.187 | 0.4037 | 0.1595 | 0.4037 | 0.1387 | 0.4037 | 0.1279 | 0.4037 | 0.1163 | 0.4037 | 0.1034 |
| 0.4229 | 0.2549 | 0.4229 | 0.187 | 0.4229 | 0.1651 | 0.4229 | 0.1485 | 0.4229 | 0.1344 | 0.4229 | 0.1233 | 0.4229 | 0.1111 |
| 0.4431 | 0.3288 | 0.4431 | 0.2339 | 0.4431 | 0.2038 | 0.4431 | 0.1813 | 0.4431 | 0.1641 | 0.4431 | 0.1399 | 0.4431 | 0.1181 |
| 0.4642 | 0.3288 | 0.4642 | 0.2339 | 0.4642 | 0.2038 | 0.4642 | 0.1813 | 0.4642 | 0.1641 | 0.4642 | 0.1399 | 0.4642 | 0.1181 |
| 0.4863 | 0.3288 | 0.4863 | 0.2339 | 0.4863 | 0.2038 | 0.4863 | 0.1813 | 0.4863 | 0.1641 | 0.4863 | 0.1421 | 0.4863 | 0.1246 |
| 0.5094 | 0.3288 | 0.5094 | 0.2339 | 0.5094 | 0.2038 | 0.5094 | 0.1813 | 0.5094 | 0.1641 | 0.5094 | 0.1472 | 0.5094 | 0.1295 |

PTWW038.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 38 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5337 | 0.3356 | 0.5337 | 0.2387 | 0.5337 | 0.2081 | 0.5337 | 0.19 | 0.5337 | 0.1796 | 0.5337 | 0.1614 | 0.5337 | 0.1401 |
| 0.5591 | 0.3997 | 0.5591 | 0.2762 | 0.5591 | 0.244 | 0.5591 | 0.2179 | 0.5591 | 0.1971 | 0.5591 | 0.1724 | 0.5591 | 0.1556 |
| 0.5857 | 0.3997 | 0.5857 | 0.2863 | 0.5857 | 0.2573 | 0.5857 | 0.2332 | 0.5857 | 0.2128 | 0.5857 | 0.1853 | 0.5857 | 0.1724 |
| 0.6136 | 0.3997 | 0.6136 | 0.2863 | 0.6136 | 0.2573 | 0.6136 | 0.2332 | 0.6136 | 0.2128 | 0.6136 | 0.1998 | 0.6136 | 0.1858 |
| 0.6428 | 0.3997 | 0.6428 | 0.2863 | 0.6428 | 0.2573 | 0.6428 | 0.2332 | 0.6428 | 0.2219 | 0.6428 | 0.2115 | 0.6428 | 0.1969 |
| 0.6734 | 0.411 | 0.6734 | 0.2863 | 0.6734 | 0.2574 | 0.6734 | 0.2449 | 0.6734 | 0.2378 | 0.6734 | 0.2244 | 0.6734 | 0.2072 |
| 0.7055 | 0.411 | 0.7055 | 0.301 | 0.7055 | 0.2757 | 0.7055 | 0.2638 | 0.7055 | 0.2534 | 0.7055 | 0.2357 | 0.7055 | 0.2156 |
| 0.7391 | 0.6367 | 0.7391 | 0.4169 | 0.7391 | 0.3404 | 0.7391 | 0.2927 | 0.7391 | 0.2746 | 0.7391 | 0.2445 | 0.7391 | 0.217 |
| 0.7743 | 0.6367 | 0.7743 | 0.4169 | 0.7743 | 0.3404 | 0.7743 | 0.3038 | 0.7743 | 0.2858 | 0.7743 | 0.2555 | 0.7743 | 0.2218 |
| 0.8111 | 0.6596 | 0.8111 | 0.4428 | 0.8111 | 0.386 | 0.8111 | 0.3422 | 0.8111 | 0.3081 | 0.8111 | 0.2598 | 0.8111 | 0.2218 |
| 0.8497 | 0.6596 | 0.8497 | 0.4428 | 0.8497 | 0.4051 | 0.8497 | 0.3738 | 0.8497 | 0.347 | 0.8497 | 0.3034 | 0.8497 | 0.256 |
| 0.8902 | 0.6828 | 0.8902 | 0.4451 | 0.8902 | 0.4051 | 0.8902 | 0.3738 | 0.8902 | 0.3511 | 0.8902 | 0.3194 | 0.8902 | 0.2761 |
| 0.9326 | 0.737 | 0.9326 | 0.5191 | 0.9326 | 0.4567 | 0.9326 | 0.411 | 0.9326 | 0.3766 | 0.9326 | 0.328 | 0.9326 | 0.2821 |
| 0.977 | 0.9914 | 0.977 | 0.6358 | 0.977 | 0.525 | 0.977 | 0.4553 | 0.977 | 0.408 | 0.977 | 0.3484 | 0.977 | 0.2994 |
| 1.0235 | 0.9914 | 1.0235 | 0.6358 | 1.0235 | 0.5662 | 1.0235 | 0.5139 | 1.0235 | 0.4702 | 1.0235 | 0.4041 | 1.0235 | 0.3384 |
| 1.0723 | 0.9914 | 1.0723 | 0.6668 | 1.0723 | 0.5976 | 1.0723 | 0.5399 | 1.0723 | 0.4914 | 1.0723 | 0.4166 | 1.0723 | 0.3541 |
| 1.1233 | 1.2606 | 1.1233 | 0.8561 | 1.1233 | 0.7168 | 1.1233 | 0.6174 | 1.1233 | 0.5433 | 1.1233 | 0.4431 | 1.1233 | 0.3633 |
| 1.1768 | 1.2606 | 1.1768 | 0.8561 | 1.1768 | 0.7168 | 1.1768 | 0.6174 | 1.1768 | 0.5433 | 1.1768 | 0.4467 | 1.1768 | 0.3729 |
| 1.2328 | 1.2606 | 1.2328 | 0.935 | 1.2328 | 0.8202 | 1.2328 | 0.7293 | 1.2328 | 0.6556 | 1.2328 | 0.5433 | 1.2328 | 0.4321 |
| 1.2916 | 1.2606 | 1.2916 | 1.0351 | 1.2916 | 0.8991 | 1.2916 | 0.793 | 1.2916 | 0.708 | 1.2916 | 0.5814 | 1.2916 | 0.4586 |
| 1.353 | 1.3319 | 1.353 | 1.0351 | 1.353 | 0.8991 | 1.353 | 0.793 | 1.353 | 0.708 | 1.353 | 0.5814 | 1.353 | 0.4631 |
| 1.4175 | 1.6092 | 1.4175 | 1.1325 | 1.4175 | 0.9683 | 1.4175 | 0.8621 | 1.4175 | 0.7817 | 1.4175 | 0.6627 | 1.4175 | 0.5486 |
| 1.485 | 1.6092 | 1.485 | 1.1325 | 1.485 | 0.9683 | 1.485 | 0.885 | 1.485 | 0.8264 | 1.485 | 0.7199 | 1.485 | 0.6006 |
| 1.5557 | 1.8872 | 1.5557 | 1.1818 | 1.5557 | 1.0008 | 1.5557 | 0.892 | 1.5557 | 0.8264 | 1.5557 | 0.7265 | 1.5557 | 0.6185 |
| 1.6298 | 1.9322 | 1.6298 | 1.3084 | 1.6298 | 1.1683 | 1.6298 | 1.0534 | 1.6298 | 0.9565 | 1.6298 | 0.8016 | 1.6298 | 0.6401 |
| 1.7074 | 1.9702 | 1.7074 | 1.3601 | 1.7074 | 1.2627 | 1.7074 | 1.1415 | 1.7074 | 1.0371 | 1.7074 | 0.8692 | 1.7074 | 0.7006 |
| 1.7887 | 2.4552 | 1.7887 | 1.4456 | 1.7887 | 1.2629 | 1.7887 | 1.1415 | 1.7887 | 1.0371 | 1.7887 | 0.8773 | 1.7887 | 0.7486 |
| 1.8738 | 2.4552 | 1.8738 | 1.4456 | 1.8738 | 1.2629 | 1.8738 | 1.1415 | 1.8738 | 1.0371 | 1.8738 | 0.9259 | 1.8738 | 0.788 |
| 1.963 | 2.4552 | 1.963 | 1.4456 | 1.963 | 1.2629 | 1.963 | 1.1498 | 1.963 | 1.0818 | 1.963 | 0.9626 | 1.963 | 0.8157 |
| 2.0565 | 2.4552 | 2.0565 | 1.4456 | 2.0565 | 1.2629 | 2.0565 | 1.1701 | 2.0565 | 1.1049 | 2.0565 | 0.9829 | 2.0565 | 0.8288 |
| 2.1544 | 2.4552 | 2.1544 | 1.4456 | 2.1544 | 1.3316 | 2.1544 | 1.2297 | 2.1544 | 1.1411 | 2.1544 | 0.9932 | 2.1544 | 0.8645 |
| 2.257 | 2.2367 | 2.257 | 1.4456 | 2.257 | 1.3316 | 2.257 | 1.2297 | 2.257 | 1.1534 | 2.257 | 1.0344 | 2.257 | 0.8939 |
| 2.3645 | 2.2367 | 2.3645 | 1.4456 | 2.3645 | 1.3316 | 2.3645 | 1.2422 | 2.3645 | 1.1724 | 2.3645 | 1.0471 | 2.3645 | 0.898 |
| 2.4771 | 2.2367 | 2.4771 | 1.6143 | 2.4771 | 1.3804 | 2.4771 | 1.2551 | 2.4771 | 1.1724 | 2.4771 | 1.0471 | 2.4771 | 0.898 |
| 2.595 | 2.138 | 2.595 | 1.6143 | 2.595 | 1.3804 | 2.595 | 1.2551 | 2.595 | 1.1724 | 2.595 | 1.0471 | 2.595 | 0.898 |

PTWW038.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 38 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.7186 | 2.138 | 2.7186 | 1.6143 | 2.7186 | 1.3804 | 2.7186 | 1.2551 | 2.7186 | 1.1724 | 2.7186 | 1.0471 | 2.7186 | 0.898 |
| 2.848 | 2.138 | 2.848 | 1.6143 | 2.848 | 1.3804 | 2.848 | 1.2551 | 2.848 | 1.1724 | 2.848 | 1.0471 | 2.848 | 0.898 |
| 2.9836 | 2.138 | 2.9836 | 1.6143 | 2.9836 | 1.3804 | 2.9836 | 1.2551 | 2.9836 | 1.1568 | 2.9836 | 1.0114 | 2.9836 | 0.8645 |
| 3.1257 | 2.138 | 3.1257 | 1.3773 | 3.1257 | 1.0982 | 3.1257 | 1.0035 | 3.1257 | 0.9573 | 3.1257 | 0.8829 | 3.1257 | 0.7931 |
| 3.2745 | 2.138 | 3.2745 | 1.2119 | 3.2745 | 1.0686 | 3.2745 | 0.9673 | 3.2745 | 0.886 | 3.2745 | 0.778 | 3.2745 | 0.7168 |
| 3.4305 | 1.5368 | 3.4305 | 1.0471 | 3.4305 | 0.9495 | 3.4305 | 0.8824 | 3.4305 | 0.8379 | 3.4305 | 0.7547 | 3.4305 | 0.6598 |
| 3.5938 | 1.5368 | 3.5938 | 1.0165 | 3.5938 | 0.898 | 3.5938 | 0.8299 | 3.5938 | 0.7946 | 3.5938 | 0.7273 | 3.5938 | 0.6376 |
| 3.7649 | 1.5368 | 3.7649 | 1.0165 | 3.7649 | 0.898 | 3.7649 | 0.8299 | 3.7649 | 0.7769 | 3.7649 | 0.6958 | 3.7649 | 0.6089 |
| 3.9442 | 1.5368 | 3.9442 | 1.0165 | 3.9442 | 0.8472 | 3.9442 | 0.7941 | 3.9442 | 0.7477 | 3.9442 | 0.6723 | 3.9442 | 0.5955 |
| 4.132 | 1.5368 | 4.132 | 1.0165 | 4.132 | 0.845 | 4.132 | 0.7941 | 4.132 | 0.7477 | 4.132 | 0.6723 | 4.132 | 0.5955 |
| 4.3288 | 1.5368 | 4.3288 | 0.9973 | 4.3288 | 0.8194 | 4.3288 | 0.7522 | 4.3288 | 0.7017 | 4.3288 | 0.6303 | 4.3288 | 0.5622 |
| 4.5349 | 1.5368 | 4.5349 | 0.8745 | 4.5349 | 0.7347 | 4.5349 | 0.6652 | 4.5349 | 0.6197 | 4.5349 | 0.5656 | 4.5349 | 0.5097 |
| 4.7508 | 1.518 | 4.7508 | 0.8745 | 4.7508 | 0.7183 | 4.7508 | 0.6169 | 4.7508 | 0.5587 | 4.7508 | 0.4909 | 4.7508 | 0.4618 |
| 4.977 | 1.518 | 4.977 | 0.8614 | 4.977 | 0.7025 | 4.977 | 0.6052 | 4.977 | 0.5367 | 4.977 | 0.4572 | 4.977 | 0.4284 |
| 5.214 | 1.3404 | 5.214 | 0.7497 | 5.214 | 0.6443 | 5.214 | 0.5421 | 5.214 | 0.5109 | 5.214 | 0.4398 | 5.214 | 0.4021 |
| 5.4623 | 1.3404 | 5.4623 | 0.7497 | 5.4623 | 0.6443 | 5.4623 | 0.5254 | 5.4623 | 0.5109 | 5.4623 | 0.438 | 5.4623 | 0.3783 |
| 5.7224 | 1.3404 | 5.7224 | 0.7497 | 5.7224 | 0.6443 | 5.7224 | 0.5254 | 5.7224 | 0.5109 | 5.7224 | 0.438 | 5.7224 | 0.3681 |
| 5.9948 | 1.3404 | 5.9948 | 0.7497 | 5.9948 | 0.6443 | 5.9948 | 0.5254 | 5.9948 | 0.5109 | 5.9948 | 0.438 | 5.9948 | 0.3681 |
| 6.2803 | 1.3404 | 6.2803 | 0.7497 | 6.2803 | 0.6443 | 6.2803 | 0.5254 | 6.2803 | 0.5109 | 6.2803 | 0.438 | 6.2803 | 0.3681 |
| 6.5793 | 1.3404 | 6.5793 | 0.7497 | 6.5793 | 0.6443 | 6.5793 | 0.5254 | 6.5793 | 0.5109 | 6.5793 | 0.438 | 6.5793 | 0.3681 |
| 6.8926 | 1.3404 | 6.8926 | 0.7497 | 6.8926 | 0.6443 | 6.8926 | 0.5254 | 6.8926 | 0.5109 | 6.8926 | 0.438 | 6.8926 | 0.3681 |
| 7.2208 | 1.274 | 7.2208 | 0.7497 | 7.2208 | 0.6443 | 7.2208 | 0.5254 | 7.2208 | 0.5109 | 7.2208 | 0.438 | 7.2208 | 0.3681 |
| 7.5646 | 1.274 | 7.5646 | 0.7455 | 7.5646 | 0.6309 | 7.5646 | 0.5254 | 7.5646 | 0.5092 | 7.5646 | 0.438 | 7.5646 | 0.3681 |
| 7.9248 | 1.274 | 7.9248 | 0.6003 | 7.9248 | 0.5494 | 7.9248 | 0.5064 | 7.9248 | 0.471 | 7.9248 | 0.4168 | 7.9248 | 0.3609 |
| 8.3022 | 1.274 | 8.3022 | 0.5659 | 8.3022 | 0.4849 | 8.3022 | 0.454 | 8.3022 | 0.4288 | 8.3022 | 0.394 | 8.3022 | 0.3594 |
| 8.6975 | 1.0027 | 8.6975 | 0.521 | 8.6975 | 0.4849 | 8.6975 | 0.454 | 8.6975 | 0.4288 | 8.6975 | 0.3913 | 8.6975 | 0.3536 |
| 9.1116 | 1.0027 | 9.1116 | 0.4701 | 9.1116 | 0.4386 | 9.1116 | 0.4105 | 9.1116 | 0.3865 | 9.1116 | 0.3654 | 9.1116 | 0.3376 |
| 9.5455 | 1.0027 | 9.5455 | 0.4494 | 9.5455 | 0.4069 | 9.5455 | 0.3794 | 9.5455 | 0.3652 | 9.5455 | 0.3418 | 9.5455 | 0.3167 |
| 10 | 0.6463 | 10 | 0.4494 | 10 | 0.4069 | 10 | 0.3794 | 10 | 0.3585 | 10 | 0.3293 | 10 | 0.3015 |
| 10.4762 | 0.6411 | 10.4762 | 0.4371 | 10.4762 | 0.3959 | 10.4762 | 0.3648 | 10.4762 | 0.347 | 10.4762 | 0.3169 | 10.4762 | 0.2936 |
| 10.975 | 0.6411 | 10.975 | 0.4085 | 10.975 | 0.3668 | 10.975 | 0.3387 | 10.975 | 0.3179 | 10.975 | 0.2923 | 10.975 | 0.2891 |
| 11.4976 | 0.6411 | 11.4976 | 0.3647 | 11.4976 | 0.3304 | 11.4976 | 0.3133 | 11.4976 | 0.3024 | 11.4976 | 0.2893 | 11.4976 | 0.2857 |
| 12.045 | 0.6411 | 12.045 | 0.3647 | 12.045 | 0.3304 | 12.045 | 0.3133 | 12.045 | 0.3024 | 12.045 | 0.2893 | 12.045 | 0.2839 |
| 12.6186 | 0.6411 | 12.6186 | 0.3647 | 12.6186 | 0.3304 | 12.6186 | 0.3133 | 12.6186 | 0.3024 | 12.6186 | 0.2893 | 12.6186 | 0.2831 |
| 13.2194 | 0.6411 | 13.2194 | 0.3647 | 13.2194 | 0.3304 | 13.2194 | 0.3133 | 13.2194 | 0.3024 | 13.2194 | 0.2893 | 13.2194 | 0.2831 |

PTWW038.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 38 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 0.6411 | 13.8489 | 0.3647 | 13.8489 | 0.3304 | 13.8489 | 0.3133 | 13.8489 | 0.3024 | 13.8489 | 0.2893 | 13.8489 | 0.2831 |
| 14.5083 | 0.6411 | 14.5083 | 0.3647 | 14.5083 | 0.3304 | 14.5083 | 0.3133 | 14.5083 | 0.3024 | 14.5083 | 0.2893 | 14.5083 | 0.2831 |
| 15.1991 | 0.6411 | 15.1991 | 0.3647 | 15.1991 | 0.3304 | 15.1991 | 0.3133 | 15.1991 | 0.3024 | 15.1991 | 0.2893 | 15.1991 | 0.2831 |
| 15.9228 | 0.6411 | 15.9228 | 0.3647 | 15.9228 | 0.3304 | 15.9228 | 0.3133 | 15.9228 | 0.3024 | 15.9228 | 0.2893 | 15.9228 | 0.2831 |
| 16.681 | 0.6411 | 16.681 | 0.3647 | 16.681 | 0.3304 | 16.681 | 0.3133 | 16.681 | 0.3024 | 16.681 | 0.2893 | 16.681 | 0.2831 |
| 17.4753 | 0.6411 | 17.4753 | 0.3647 | 17.4753 | 0.3304 | 17.4753 | 0.3133 | 17.4753 | 0.3024 | 17.4753 | 0.2893 | 17.4753 | 0.2831 |
| 18.3074 | 0.4714 | 18.3074 | 0.3284 | 18.3074 | 0.3152 | 18.3074 | 0.3052 | 18.3074 | 0.298 | 18.3074 | 0.2893 | 18.3074 | 0.2831 |
| 19.1791 | 0.4714 | 19.1791 | 0.3088 | 19.1791 | 0.2936 | 19.1791 | 0.2872 | 19.1791 | 0.2851 | 19.1791 | 0.2842 | 19.1791 | 0.2825 |
| 20.0923 | 0.4714 | 20.0923 | 0.3088 | 20.0923 | 0.2886 | 20.0923 | 0.2865 | 20.0923 | 0.2851 | 20.0923 | 0.2833 | 20.0923 | 0.2814 |
| 21.049 | 0.3824 | 21.049 | 0.2877 | 21.049 | 0.2842 | 21.049 | 0.2843 | 21.049 | 0.2836 | 21.049 | 0.2819 | 21.049 | 0.2801 |
| 22.0513 | 0.3824 | 22.0513 | 0.2873 | 22.0513 | 0.2834 | 22.0513 | 0.2816 | 22.0513 | 0.2806 | 22.0513 | 0.2795 | 22.0513 | 0.2783 |
| 23.1013 | 0.2973 | 23.1013 | 0.2832 | 23.1013 | 0.2814 | 23.1013 | 0.2802 | 23.1013 | 0.2793 | 23.1013 | 0.2779 | 23.1013 | 0.2765 |
| 24.2013 | 0.2947 | 24.2013 | 0.2805 | 24.2013 | 0.2788 | 24.2013 | 0.2776 | 24.2013 | 0.2768 | 24.2013 | 0.2763 | 24.2013 | 0.2756 |
| 25.3536 | 0.288 | 25.3536 | 0.2805 | 25.3536 | 0.2788 | 25.3536 | 0.2776 | 25.3536 | 0.2768 | 25.3536 | 0.2757 | 25.3536 | 0.2749 |
| 26.5609 | 0.288 | 26.5609 | 0.2805 | 26.5609 | 0.2788 | 26.5609 | 0.2776 | 26.5609 | 0.2768 | 26.5609 | 0.2757 | 26.5609 | 0.2747 |
| 27.8256 | 0.2867 | 27.8256 | 0.28 | 27.8256 | 0.2782 | 27.8256 | 0.2771 | 27.8256 | 0.2762 | 27.8256 | 0.2751 | 27.8256 | 0.2741 |
| 29.1505 | 0.2773 | 29.1505 | 0.2753 | 29.1505 | 0.2749 | 29.1505 | 0.2745 | 29.1505 | 0.2742 | 29.1505 | 0.2738 | 29.1505 | 0.2732 |
| 30.5386 | 0.2773 | 30.5386 | 0.2727 | 30.5386 | 0.2726 | 30.5386 | 0.2725 | 30.5386 | 0.2724 | 30.5386 | 0.2723 | 30.5386 | 0.2721 |
| 31.9927 | 0.2707 | 31.9927 | 0.271 | 31.9927 | 0.271 | 31.9927 | 0.2711 | 31.9927 | 0.2711 | 31.9927 | 0.2712 | 31.9927 | 0.2712 |
| 33.516 | 0.2707 | 33.516 | 0.2707 | 33.516 | 0.2706 | 33.516 | 0.2706 | 33.516 | 0.2706 | 33.516 | 0.2706 | 33.516 | 0.2706 |
| 35.1119 | 0.27 | 35.1119 | 0.27 | 35.1119 | 0.27 | 35.1119 | 0.2701 | 35.1119 | 0.2701 | 35.1119 | 0.2701 | 35.1119 | 0.2701 |
| 36.7838 | 0.2695 | 36.7838 | 0.2696 | 36.7838 | 0.2696 | 36.7838 | 0.2696 | 36.7838 | 0.2697 | 36.7838 | 0.2697 | 36.7838 | 0.2697 |
| 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 |
| 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 |
| 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2688 |
| 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 |
| 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 |
| 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 |
| 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 |

PTWW067.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 67 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.1098 | 0.0375 | 0.1098 | 0.0345 | 0.1098 | 0.0327 | 0.1098 | 0.0312 | 0.1098 | 0.0298 | 0.1098 | 0.0274 | 0.1098 | 0.0252 |
| 0.115 | 0.0375 | 0.115 | 0.0345 | 0.115 | 0.0327 | 0.115 | 0.0312 | 0.115 | 0.0299 | 0.115 | 0.0277 | 0.115 | 0.0259 |
| 0.1204 | 0.0375 | 0.1204 | 0.0345 | 0.1204 | 0.0331 | 0.1204 | 0.0322 | 0.1204 | 0.0312 | 0.1204 | 0.0294 | 0.1204 | 0.0268 |
| 0.1262 | 0.0431 | 0.1262 | 0.0397 | 0.1262 | 0.0378 | 0.1262 | 0.036 | 0.1262 | 0.0343 | 0.1262 | 0.0314 | 0.1262 | 0.0277 |
| 0.1322 | 0.0505 | 0.1322 | 0.0451 | 0.1322 | 0.042 | 0.1322 | 0.0393 | 0.1322 | 0.0369 | 0.1322 | 0.0327 | 0.1322 | 0.0281 |
| 0.1385 | 0.0561 | 0.1385 | 0.049 | 0.1385 | 0.045 | 0.1385 | 0.0415 | 0.1385 | 0.0384 | 0.1385 | 0.0344 | 0.1385 | 0.0303 |
| 0.1451 | 0.0582 | 0.1451 | 0.0509 | 0.1451 | 0.0474 | 0.1451 | 0.0444 | 0.1451 | 0.0417 | 0.1451 | 0.0373 | 0.1451 | 0.0324 |
| 0.152 | 0.0617 | 0.152 | 0.0546 | 0.152 | 0.0507 | 0.152 | 0.0472 | 0.152 | 0.0442 | 0.152 | 0.0392 | 0.152 | 0.0336 |
| 0.1592 | 0.0619 | 0.1592 | 0.0546 | 0.1592 | 0.0507 | 0.1592 | 0.0472 | 0.1592 | 0.0442 | 0.1592 | 0.0394 | 0.1592 | 0.0347 |
| 0.1668 | 0.0639 | 0.1668 | 0.056 | 0.1668 | 0.0516 | 0.1668 | 0.0479 | 0.1668 | 0.0448 | 0.1668 | 0.04 | 0.1668 | 0.0352 |
| 0.1748 | 0.0639 | 0.1748 | 0.056 | 0.1748 | 0.0516 | 0.1748 | 0.0479 | 0.1748 | 0.0448 | 0.1748 | 0.04 | 0.1748 | 0.0352 |
| 0.1831 | 0.0639 | 0.1831 | 0.056 | 0.1831 | 0.0516 | 0.1831 | 0.0479 | 0.1831 | 0.0448 | 0.1831 | 0.04 | 0.1831 | 0.0364 |
| 0.1918 | 0.064 | 0.1918 | 0.056 | 0.1918 | 0.0516 | 0.1918 | 0.0491 | 0.1918 | 0.0473 | 0.1918 | 0.0442 | 0.1918 | 0.0401 |
| 0.2009 | 0.0641 | 0.2009 | 0.0581 | 0.2009 | 0.0556 | 0.2009 | 0.0533 | 0.2009 | 0.0511 | 0.2009 | 0.0472 | 0.2009 | 0.0422 |
| 0.2105 | 0.0664 | 0.2105 | 0.0603 | 0.2105 | 0.0575 | 0.2105 | 0.0549 | 0.2105 | 0.0525 | 0.2105 | 0.049 | 0.2105 | 0.0448 |
| 0.2205 | 0.078 | 0.2205 | 0.0645 | 0.2205 | 0.0618 | 0.2205 | 0.0594 | 0.2205 | 0.0571 | 0.2205 | 0.0531 | 0.2205 | 0.0482 |
| 0.231 | 0.0931 | 0.231 | 0.0772 | 0.231 | 0.0692 | 0.231 | 0.0628 | 0.231 | 0.0596 | 0.231 | 0.0553 | 0.231 | 0.0502 |
| 0.242 | 0.0931 | 0.242 | 0.0772 | 0.242 | 0.072 | 0.242 | 0.0676 | 0.242 | 0.0636 | 0.242 | 0.0564 | 0.242 | 0.051 |
| 0.2535 | 0.0931 | 0.2535 | 0.0817 | 0.2535 | 0.077 | 0.2535 | 0.0728 | 0.2535 | 0.069 | 0.2535 | 0.0625 | 0.2535 | 0.0547 |
| 0.2656 | 0.0931 | 0.2656 | 0.0839 | 0.2656 | 0.0794 | 0.2656 | 0.0753 | 0.2656 | 0.0716 | 0.2656 | 0.065 | 0.2656 | 0.0571 |
| 0.2783 | 0.0955 | 0.2783 | 0.0842 | 0.2783 | 0.0794 | 0.2783 | 0.0753 | 0.2783 | 0.0716 | 0.2783 | 0.065 | 0.2783 | 0.0574 |
| 0.2915 | 0.1183 | 0.2915 | 0.0982 | 0.2915 | 0.0885 | 0.2915 | 0.081 | 0.2915 | 0.075 | 0.2915 | 0.0664 | 0.2915 | 0.0586 |
| 0.3054 | 0.1496 | 0.3054 | 0.1228 | 0.3054 | 0.1092 | 0.3054 | 0.0981 | 0.3054 | 0.089 | 0.3054 | 0.0756 | 0.3054 | 0.063 |
| 0.3199 | 0.1496 | 0.3199 | 0.1228 | 0.3199 | 0.1092 | 0.3199 | 0.0981 | 0.3199 | 0.089 | 0.3199 | 0.0797 | 0.3199 | 0.07 |
| 0.3352 | 0.1496 | 0.3352 | 0.1228 | 0.3352 | 0.1092 | 0.3352 | 0.0981 | 0.3352 | 0.0927 | 0.3352 | 0.0852 | 0.3352 | 0.0755 |
| 0.3511 | 0.1496 | 0.3511 | 0.1285 | 0.3511 | 0.1168 | 0.3511 | 0.1065 | 0.3511 | 0.0994 | 0.3511 | 0.0891 | 0.3511 | 0.0782 |
| 0.3678 | 0.1677 | 0.3678 | 0.1435 | 0.3678 | 0.13 | 0.3678 | 0.1183 | 0.3678 | 0.112 | 0.3678 | 0.1014 | 0.3678 | 0.0894 |
| 0.3853 | 0.1677 | 0.3853 | 0.1435 | 0.3853 | 0.134 | 0.3853 | 0.1273 | 0.3853 | 0.1213 | 0.3853 | 0.1109 | 0.3853 | 0.0986 |
| 0.4037 | 0.1925 | 0.4037 | 0.1587 | 0.4037 | 0.1415 | 0.4037 | 0.1298 | 0.4037 | 0.1251 | 0.4037 | 0.1163 | 0.4037 | 0.1044 |
| 0.4229 | 0.2358 | 0.4229 | 0.1897 | 0.4229 | 0.1713 | 0.4229 | 0.1551 | 0.4229 | 0.1411 | 0.4229 | 0.1206 | 0.4229 | 0.1079 |
| 0.4431 | 0.3083 | 0.4431 | 0.219 | 0.4431 | 0.1881 | 0.4431 | 0.167 | 0.4431 | 0.1495 | 0.4431 | 0.1263 | 0.4431 | 0.1088 |
| 0.4642 | 0.3407 | 0.4642 | 0.2508 | 0.4642 | 0.2123 | 0.4642 | 0.1837 | 0.4642 | 0.1622 | 0.4642 | 0.1328 | 0.4642 | 0.1192 |
| 0.4863 | 0.3407 | 0.4863 | 0.2548 | 0.4863 | 0.2198 | 0.4863 | 0.1918 | 0.4863 | 0.1692 | 0.4863 | 0.1398 | 0.4863 | 0.1303 |
| 0.5094 | 0.3496 | 0.5094 | 0.2641 | 0.5094 | 0.2311 | 0.5094 | 0.2042 | 0.5094 | 0.182 | 0.5094 | 0.1485 | 0.5094 | 0.1369 |

PTWW067.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 67 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.5337 | 0.4063 | 0.5337 | 0.2745 | 0.5337 | 0.2311 | 0.5337 | 0.2042 | 0.5337 | 0.182 | 0.5337 | 0.1529 | 0.5337 | 0.1371 |
| 0.5591 | 0.4063 | 0.5591 | 0.2745 | 0.5591 | 0.2378 | 0.5591 | 0.213 | 0.5591 | 0.194 | 0.5591 | 0.1646 | 0.5591 | 0.1371 |
| 0.5857 | 0.4063 | 0.5857 | 0.2745 | 0.5857 | 0.2385 | 0.5857 | 0.2142 | 0.5857 | 0.1966 | 0.5857 | 0.1681 | 0.5857 | 0.1425 |
| 0.6136 | 0.4438 | 0.6136 | 0.2944 | 0.6136 | 0.2421 | 0.6136 | 0.2213 | 0.6136 | 0.2032 | 0.6136 | 0.1733 | 0.6136 | 0.1425 |
| 0.6428 | 0.4742 | 0.6428 | 0.3514 | 0.6428 | 0.2975 | 0.6428 | 0.2588 | 0.6428 | 0.2323 | 0.6428 | 0.1964 | 0.6428 | 0.1655 |
| 0.6734 | 0.4742 | 0.6734 | 0.3514 | 0.6734 | 0.2975 | 0.6734 | 0.2588 | 0.6734 | 0.2383 | 0.6734 | 0.2137 | 0.6734 | 0.1844 |
| 0.7055 | 0.4742 | 0.7055 | 0.3514 | 0.7055 | 0.2975 | 0.7055 | 0.2588 | 0.7055 | 0.2383 | 0.7055 | 0.2155 | 0.7055 | 0.1892 |
| 0.7391 | 0.4742 | 0.7391 | 0.3514 | 0.7391 | 0.2975 | 0.7391 | 0.2667 | 0.7391 | 0.2438 | 0.7391 | 0.2155 | 0.7391 | 0.1892 |
| 0.7743 | 0.5449 | 0.7743 | 0.3911 | 0.7743 | 0.3284 | 0.7743 | 0.2875 | 0.7743 | 0.2646 | 0.7743 | 0.2323 | 0.7743 | 0.1993 |
| 0.8111 | 0.5449 | 0.8111 | 0.3911 | 0.8111 | 0.3284 | 0.8111 | 0.2996 | 0.8111 | 0.2837 | 0.8111 | 0.2551 | 0.8111 | 0.2205 |
| 0.8497 | 0.5449 | 0.8497 | 0.3911 | 0.8497 | 0.3284 | 0.8497 | 0.3072 | 0.8497 | 0.2942 | 0.8497 | 0.2684 | 0.8497 | 0.2339 |
| 0.8902 | 0.5449 | 0.8902 | 0.3911 | 0.8902 | 0.3604 | 0.8902 | 0.3382 | 0.8902 | 0.318 | 0.8902 | 0.2831 | 0.8902 | 0.2427 |
| 0.9326 | 0.8469 | 0.9326 | 0.5495 | 0.9326 | 0.4554 | 0.9326 | 0.3957 | 0.9326 | 0.3545 | 0.9326 | 0.3003 | 0.9326 | 0.2517 |
| 0.977 | 0.8469 | 0.977 | 0.5495 | 0.977 | 0.4554 | 0.977 | 0.3975 | 0.977 | 0.3585 | 0.977 | 0.3036 | 0.977 | 0.2596 |
| 1.0235 | 0.9107 | 1.0235 | 0.5826 | 1.0235 | 0.5168 | 1.0235 | 0.4731 | 1.0235 | 0.4362 | 1.0235 | 0.3776 | 1.0235 | 0.3164 |
| 1.0723 | 0.9107 | 1.0723 | 0.6542 | 1.0723 | 0.5901 | 1.0723 | 0.535 | 1.0723 | 0.4906 | 1.0723 | 0.4288 | 1.0723 | 0.36 |
| 1.1233 | 1.3081 | 1.1233 | 0.8142 | 1.1233 | 0.6641 | 1.1233 | 0.5708 | 1.1233 | 0.5287 | 1.1233 | 0.4575 | 1.1233 | 0.3904 |
| 1.1768 | 1.3081 | 1.1768 | 0.8142 | 1.1768 | 0.6641 | 1.1768 | 0.5735 | 1.1768 | 0.5393 | 1.1768 | 0.4764 | 1.1768 | 0.4143 |
| 1.2328 | 1.3081 | 1.2328 | 0.8142 | 1.2328 | 0.7174 | 1.2328 | 0.6427 | 1.2328 | 0.577 | 1.2328 | 0.4965 | 1.2328 | 0.439 |
| 1.2916 | 1.3081 | 1.2916 | 0.8822 | 1.2916 | 0.7774 | 1.2916 | 0.6895 | 1.2916 | 0.6157 | 1.2916 | 0.5283 | 1.2916 | 0.4653 |
| 1.353 | 1.3081 | 1.353 | 0.9165 | 1.353 | 0.7774 | 1.353 | 0.6895 | 1.353 | 0.6157 | 1.353 | 0.5556 | 1.353 | 0.4889 |
| 1.4175 | 1.4021 | 1.4175 | 0.9165 | 1.4175 | 0.7774 | 1.4175 | 0.6895 | 1.4175 | 0.6326 | 1.4175 | 0.5795 | 1.4175 | 0.5119 |
| 1.485 | 1.4021 | 1.485 | 0.9165 | 1.485 | 0.7774 | 1.485 | 0.6984 | 1.485 | 0.6672 | 1.485 | 0.6099 | 1.485 | 0.539 |
| 1.5557 | 1.4438 | 1.5557 | 0.9843 | 1.5557 | 0.8409 | 1.5557 | 0.7415 | 1.5557 | 0.6919 | 1.5557 | 0.6323 | 1.5557 | 0.5603 |
| 1.6298 | 1.729 | 1.6298 | 1.0527 | 1.6298 | 0.9055 | 1.6298 | 0.8177 | 1.6298 | 0.7518 | 1.6298 | 0.6519 | 1.6298 | 0.5748 |
| 1.7074 | 1.729 | 1.7074 | 1.0527 | 1.7074 | 0.9055 | 1.7074 | 0.8177 | 1.7074 | 0.7518 | 1.7074 | 0.6652 | 1.7074 | 0.5915 |
| 1.7887 | 1.729 | 1.7887 | 1.0527 | 1.7887 | 0.9055 | 1.7887 | 0.8185 | 1.7887 | 0.7553 | 1.7887 | 0.6808 | 1.7887 | 0.6117 |
| 1.8738 | 1.729 | 1.8738 | 1.0527 | 1.8738 | 0.9055 | 1.8738 | 0.8185 | 1.8738 | 0.7765 | 1.8738 | 0.7113 | 1.8738 | 0.6287 |
| 1.963 | 1.729 | 1.963 | 1.0527 | 1.963 | 0.9055 | 1.963 | 0.8397 | 1.963 | 0.7973 | 1.963 | 0.7229 | 1.963 | 0.6359 |
| 2.0565 | 1.6472 | 2.0565 | 1.0359 | 2.0565 | 0.902 | 2.0565 | 0.8397 | 2.0565 | 0.7973 | 2.0565 | 0.7229 | 2.0565 | 0.6359 |
| 2.1544 | 1.6472 | 2.1544 | 1.0359 | 2.1544 | 0.902 | 2.1544 | 0.8397 | 2.1544 | 0.7973 | 2.1544 | 0.7229 | 2.1544 | 0.6359 |
| 2.257 | 1.3558 | 2.257 | 0.9839 | 2.257 | 0.8903 | 2.257 | 0.8397 | 2.257 | 0.7973 | 2.257 | 0.7229 | 2.257 | 0.6361 |
| 2.3645 | 1.3558 | 2.3645 | 0.9839 | 2.3645 | 0.8903 | 2.3645 | 0.8397 | 2.3645 | 0.7973 | 2.3645 | 0.7229 | 2.3645 | 0.6418 |
| 2.4771 | 1.3558 | 2.4771 | 0.9839 | 2.4771 | 0.8903 | 2.4771 | 0.8363 | 2.4771 | 0.7896 | 2.4771 | 0.7121 | 2.4771 | 0.6484 |
| 2.595 | 1.3558 | 2.595 | 0.9839 | 2.595 | 0.8416 | 2.595 | 0.7692 | 2.595 | 0.745 | 2.595 | 0.7036 | 2.595 | 0.6522 |

PTWW067.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 67 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 2.7186 | 1.3558 | 2.7186 | 0.9839 | 2.7186 | 0.8416 | 2.7186 | 0.7692 | 2.7186 | 0.745 | 2.7186 | 0.7036 | 2.7186 | 0.6522 |
| 2.848 | 1.3558 | 2.848 | 0.9839 | 2.848 | 0.8416 | 2.848 | 0.7692 | 2.848 | 0.745 | 2.848 | 0.7036 | 2.848 | 0.6522 |
| 2.9836 | 1.3558 | 2.9836 | 0.9839 | 2.9836 | 0.8416 | 2.9836 | 0.7692 | 2.9836 | 0.745 | 2.9836 | 0.7036 | 2.9836 | 0.6522 |
| 3.1257 | 1.3558 | 3.1257 | 0.9586 | 3.1257 | 0.8211 | 3.1257 | 0.7692 | 3.1257 | 0.745 | 3.1257 | 0.7036 | 3.1257 | 0.6522 |
| 3.2745 | 1.3558 | 3.2745 | 0.9586 | 3.2745 | 0.8211 | 3.2745 | 0.751 | 3.2745 | 0.7299 | 3.2745 | 0.6954 | 3.2745 | 0.6492 |
| 3.4305 | 1.3558 | 3.4305 | 0.9586 | 3.4305 | 0.8211 | 3.4305 | 0.751 | 3.4305 | 0.7126 | 3.4305 | 0.681 | 3.4305 | 0.6403 |
| 3.5938 | 1.4127 | 3.5938 | 0.9586 | 3.5938 | 0.8211 | 3.5938 | 0.751 | 3.5938 | 0.6971 | 3.5938 | 0.671 | 3.5938 | 0.6329 |
| 3.7649 | 1.4127 | 3.7649 | 0.9586 | 3.7649 | 0.8211 | 3.7649 | 0.751 | 3.7649 | 0.6954 | 3.7649 | 0.6626 | 3.7649 | 0.6263 |
| 3.9442 | 1.4127 | 3.9442 | 0.9586 | 3.9442 | 0.8211 | 3.9442 | 0.751 | 3.9442 | 0.6954 | 3.9442 | 0.659 | 3.9442 | 0.6182 |
| 4.132 | 1.4127 | 4.132 | 0.9586 | 4.132 | 0.8211 | 4.132 | 0.751 | 4.132 | 0.6954 | 4.132 | 0.6519 | 4.132 | 0.6132 |
| 4.3288 | 1.4127 | 4.3288 | 0.9586 | 4.3288 | 0.8211 | 4.3288 | 0.751 | 4.3288 | 0.6954 | 4.3288 | 0.6467 | 4.3288 | 0.6045 |
| 4.5349 | 1.4127 | 4.5349 | 0.9586 | 4.5349 | 0.8211 | 4.5349 | 0.751 | 4.5349 | 0.6954 | 4.5349 | 0.6383 | 4.5349 | 0.5926 |
| 4.7508 | 1.376 | 4.7508 | 0.9153 | 4.7508 | 0.8211 | 4.7508 | 0.751 | 4.7508 | 0.6954 | 4.7508 | 0.6271 | 4.7508 | 0.5766 |
| 4.977 | 1.1452 | 4.977 | 0.7722 | 4.977 | 0.7324 | 4.977 | 0.6911 | 4.977 | 0.6525 | 4.977 | 0.5927 | 4.977 | 0.5466 |
| 5.214 | 0.9648 | 5.214 | 0.7082 | 5.214 | 0.6425 | 5.214 | 0.6138 | 5.214 | 0.5972 | 5.214 | 0.5647 | 5.214 | 0.5221 |
| 5.4623 | 0.9342 | 5.4623 | 0.7082 | 5.4623 | 0.6425 | 5.4623 | 0.6129 | 5.4623 | 0.5893 | 5.4623 | 0.5516 | 5.4623 | 0.5074 |
| 5.7224 | 0.9342 | 5.7224 | 0.7082 | 5.7224 | 0.6425 | 5.7224 | 0.5954 | 5.7224 | 0.5597 | 5.7224 | 0.5268 | 5.7224 | 0.486 |
| 5.9948 | 0.9342 | 5.9948 | 0.6534 | 5.9948 | 0.6337 | 5.9948 | 0.5864 | 5.9948 | 0.5544 | 5.9948 | 0.5117 | 5.9948 | 0.4626 |
| 6.2803 | 0.9342 | 6.2803 | 0.6534 | 6.2803 | 0.6337 | 6.2803 | 0.5864 | 6.2803 | 0.5504 | 6.2803 | 0.4978 | 6.2803 | 0.448 |
| 6.5793 | 0.9342 | 6.5793 | 0.6534 | 6.5793 | 0.6231 | 6.5793 | 0.5714 | 6.5793 | 0.5325 | 6.5793 | 0.4789 | 6.5793 | 0.4308 |
| 6.8926 | 0.9342 | 6.8926 | 0.5885 | 6.8926 | 0.5443 | 6.8926 | 0.5297 | 6.8926 | 0.5115 | 6.8926 | 0.4747 | 6.8926 | 0.4289 |
| 7.2208 | 0.7892 | 7.2208 | 0.5885 | 7.2208 | 0.5404 | 7.2208 | 0.5146 | 7.2208 | 0.4932 | 7.2208 | 0.4582 | 7.2208 | 0.4179 |
| 7.5646 | 0.7892 | 7.5646 | 0.515 | 7.5646 | 0.4923 | 7.5646 | 0.4748 | 7.5646 | 0.4577 | 7.5646 | 0.4273 | 7.5646 | 0.3917 |
| 7.9248 | 0.7038 | 7.9248 | 0.5002 | 7.9248 | 0.4721 | 7.9248 | 0.4509 | 7.9248 | 0.4342 | 7.9248 | 0.4082 | 7.9248 | 0.3799 |
| 8.3022 | 0.5601 | 8.3022 | 0.4481 | 8.3022 | 0.4293 | 8.3022 | 0.4172 | 8.3022 | 0.4072 | 8.3022 | 0.3901 | 8.3022 | 0.3692 |
| 8.6975 | 0.5437 | 8.6975 | 0.3949 | 8.6975 | 0.3739 | 8.6975 | 0.371 | 8.6975 | 0.3686 | 8.6975 | 0.3626 | 8.6975 | 0.3516 |
| 9.1116 | 0.5437 | 9.1116 | 0.3949 | 9.1116 | 0.3729 | 9.1116 | 0.3608 | 9.1116 | 0.3515 | 9.1116 | 0.3431 | 9.1116 | 0.3349 |
| 9.5455 | 0.5437 | 9.5455 | 0.3949 | 9.5455 | 0.3729 | 9.5455 | 0.3608 | 9.5455 | 0.3515 | 9.5455 | 0.3389 | 9.5455 | 0.3303 |
| 10 | 0.5437 | 10 | 0.3883 | 10 | 0.3729 | 10 | 0.3608 | 10 | 0.3515 | 10 | 0.3389 | 10 | 0.3303 |
| 10.4762 | 0.5437 | 10.4762 | 0.3883 | 10.4762 | 0.3729 | 10.4762 | 0.3608 | 10.4762 | 0.3515 | 10.4762 | 0.3389 | 10.4762 | 0.3284 |
| 10.975 | 0.5437 | 10.975 | 0.3711 | 10.975 | 0.3496 | 10.975 | 0.3401 | 10.975 | 0.3328 | 10.975 | 0.3231 | 10.975 | 0.3197 |
| 11.4976 | 0.5437 | 11.4976 | 0.3711 | 11.4976 | 0.3496 | 11.4976 | 0.3401 | 11.4976 | 0.3328 | 11.4976 | 0.3231 | 11.4976 | 0.3197 |
| 12.045 | 0.5437 | 12.045 | 0.3711 | 12.045 | 0.3496 | 12.045 | 0.3401 | 12.045 | 0.3328 | 12.045 | 0.3231 | 12.045 | 0.3197 |
| 12.6186 | 0.5437 | 12.6186 | 0.3711 | 12.6186 | 0.3496 | 12.6186 | 0.3401 | 12.6186 | 0.3328 | 12.6186 | 0.3231 | 12.6186 | 0.3197 |
| 13.2194 | 0.5437 | 13.2194 | 0.3711 | 13.2194 | 0.3496 | 13.2194 | 0.3401 | 13.2194 | 0.3328 | 13.2194 | 0.3231 | 13.2194 | 0.3197 |

PTWW067.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 67 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 0.5437 | 13.8489 | 0.3711 | 13.8489 | 0.3496 | 13.8489 | 0.3401 | 13.8489 | 0.3328 | 13.8489 | 0.3231 | 13.8489 | 0.3197 |
| 14.5083 | 0.5437 | 14.5083 | 0.3711 | 14.5083 | 0.3496 | 14.5083 | 0.3401 | 14.5083 | 0.3328 | 14.5083 | 0.3231 | 14.5083 | 0.3197 |
| 15.1991 | 0.5451 | 15.1991 | 0.3711 | 15.1991 | 0.3496 | 15.1991 | 0.3401 | 15.1991 | 0.3328 | 15.1991 | 0.3231 | 15.1991 | 0.3197 |
| 15.9228 | 0.5451 | 15.9228 | 0.3711 | 15.9228 | 0.3496 | 15.9228 | 0.3401 | 15.9228 | 0.3328 | 15.9228 | 0.3231 | 15.9228 | 0.3197 |
| 16.681 | 0.5451 | 16.681 | 0.3711 | 16.681 | 0.3496 | 16.681 | 0.3401 | 16.681 | 0.3328 | 16.681 | 0.3231 | 16.681 | 0.3197 |
| 17.4753 | 0.5451 | 17.4753 | 0.4145 | 17.4753 | 0.384 | 17.4753 | 0.3654 | 17.4753 | 0.3531 | 17.4753 | 0.338 | 17.4753 | 0.3258 |
| 18.3074 | 0.5451 | 18.3074 | 0.4145 | 18.3074 | 0.384 | 18.3074 | 0.3654 | 18.3074 | 0.3531 | 18.3074 | 0.338 | 18.3074 | 0.3258 |
| 19.1791 | 0.5325 | 19.1791 | 0.4145 | 19.1791 | 0.384 | 19.1791 | 0.3654 | 19.1791 | 0.3531 | 19.1791 | 0.338 | 19.1791 | 0.3258 |
| 20.0923 | 0.5325 | 20.0923 | 0.4145 | 20.0923 | 0.384 | 20.0923 | 0.3654 | 20.0923 | 0.3531 | 20.0923 | 0.338 | 20.0923 | 0.3258 |
| 21.049 | 0.5325 | 21.049 | 0.4145 | 21.049 | 0.384 | 21.049 | 0.3654 | 21.049 | 0.3531 | 21.049 | 0.338 | 21.049 | 0.3258 |
| 22.0513 | 0.5093 | 22.0513 | 0.357 | 22.0513 | 0.345 | 22.0513 | 0.3404 | 22.0513 | 0.3377 | 22.0513 | 0.3309 | 22.0513 | 0.3223 |
| 23.1013 | 0.5093 | 23.1013 | 0.357 | 23.1013 | 0.345 | 23.1013 | 0.3371 | 23.1013 | 0.3312 | 23.1013 | 0.3223 | 23.1013 | 0.3135 |
| 24.2013 | 0.4442 | 24.2013 | 0.3461 | 24.2013 | 0.3355 | 24.2013 | 0.3293 | 24.2013 | 0.3248 | 24.2013 | 0.3182 | 24.2013 | 0.3115 |
| 25.3536 | 0.4442 | 25.3536 | 0.3079 | 25.3536 | 0.3069 | 25.3536 | 0.307 | 25.3536 | 0.3072 | 25.3536 | 0.3068 | 25.3536 | 0.3051 |
| 26.5609 | 0.4442 | 26.5609 | 0.3048 | 26.5609 | 0.2996 | 26.5609 | 0.2979 | 26.5609 | 0.2979 | 26.5609 | 0.2986 | 26.5609 | 0.2992 |
| 27.8256 | 0.3666 | 27.8256 | 0.3037 | 27.8256 | 0.2996 | 27.8256 | 0.2979 | 27.8256 | 0.297 | 27.8256 | 0.296 | 27.8256 | 0.2956 |
| 29.1505 | 0.3342 | 29.1505 | 0.3037 | 29.1505 | 0.2996 | 29.1505 | 0.2979 | 29.1505 | 0.297 | 29.1505 | 0.296 | 29.1505 | 0.2951 |
| 30.5386 | 0.3342 | 30.5386 | 0.3037 | 30.5386 | 0.2996 | 30.5386 | 0.2979 | 30.5386 | 0.297 | 30.5386 | 0.296 | 30.5386 | 0.2951 |
| 31.9927 | 0.3088 | 31.9927 | 0.2994 | 31.9927 | 0.2977 | 31.9927 | 0.2968 | 31.9927 | 0.2961 | 31.9927 | 0.2952 | 31.9927 | 0.2943 |
| 33.516 | 0.2961 | 33.516 | 0.2957 | 33.516 | 0.2953 | 33.516 | 0.295 | 33.516 | 0.2948 | 33.516 | 0.2945 | 33.516 | 0.2942 |
| 35.1119 | 0.2952 | 35.1119 | 0.2948 | 35.1119 | 0.2947 | 35.1119 | 0.2946 | 35.1119 | 0.2944 | 35.1119 | 0.2942 | 35.1119 | 0.2939 |
| 36.7838 | 0.2943 | 36.7838 | 0.2943 | 36.7838 | 0.2942 | 36.7838 | 0.2941 | 36.7838 | 0.294 | 36.7838 | 0.2938 | 36.7838 | 0.2936 |
| 38.5353 | 0.2938 | 38.5353 | 0.2937 | 38.5353 | 0.2936 | 38.5353 | 0.2936 | 38.5353 | 0.2935 | 38.5353 | 0.2934 | 38.5353 | 0.2932 |
| 40.3702 | 0.2932 | 40.3702 | 0.2931 | 40.3702 | 0.2931 | 40.3702 | 0.293 | 40.3702 | 0.293 | 40.3702 | 0.2929 | 40.3702 | 0.2928 |
| 42.2924 | 0.2925 | 42.2924 | 0.2926 | 42.2924 | 0.2925 | 42.2924 | 0.2925 | 42.2924 | 0.2925 | 42.2924 | 0.2924 | 42.2924 | 0.2923 |
| 44.3062 | 0.2922 | 44.3062 | 0.2921 | 44.3062 | 0.2921 | 44.3062 | 0.2921 | 44.3062 | 0.292 | 44.3062 | 0.292 | 44.3062 | 0.2919 |
| 46.4159 | 0.2917 | 46.4159 | 0.2916 | 46.4159 | 0.2916 | 46.4159 | 0.2916 | 46.4159 | 0.2916 | 46.4159 | 0.2916 | 46.4159 | 0.2916 |
| 48.626 | 0.2913 | 48.626 | 0.2912 | 48.626 | 0.2912 | 48.626 | 0.2912 | 48.626 | 0.2912 | 48.626 | 0.2912 | 48.626 | 0.2912 |
| 50.9414 | 0.2907 | 50.9414 | 0.2908 | 50.9414 | 0.2908 | 50.9414 | 0.2908 | 50.9414 | 0.2908 | 50.9414 | 0.2908 | 50.9414 | 0.2909 |

PTWW068.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 68 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.1098 | 0.0404 | 0.1098 | 0.0365 | 0.1098 | 0.0342 | 0.1098 | 0.0321 | 0.1098 | 0.0302 | 0.1098 | 0.0271 | 0.1098 | 0.0235 |
| 0.115 | 0.0404 | 0.115 | 0.0365 | 0.115 | 0.0342 | 0.115 | 0.0321 | 0.115 | 0.0302 | 0.115 | 0.0271 | 0.115 | 0.0253 |
| 0.1204 | 0.0404 | 0.1204 | 0.0365 | 0.1204 | 0.0342 | 0.1204 | 0.0321 | 0.1204 | 0.0306 | 0.1204 | 0.0293 | 0.1204 | 0.0274 |
| 0.1262 | 0.0404 | 0.1262 | 0.0365 | 0.1262 | 0.0349 | 0.1262 | 0.034 | 0.1262 | 0.033 | 0.1262 | 0.0313 | 0.1262 | 0.0292 |
| 0.1322 | 0.0404 | 0.1322 | 0.038 | 0.1322 | 0.0368 | 0.1322 | 0.0356 | 0.1322 | 0.0346 | 0.1322 | 0.0328 | 0.1322 | 0.0312 |
| 0.1385 | 0.0409 | 0.1385 | 0.0389 | 0.1385 | 0.0377 | 0.1385 | 0.0368 | 0.1385 | 0.0359 | 0.1385 | 0.0344 | 0.1385 | 0.0325 |
| 0.1451 | 0.0414 | 0.1451 | 0.0395 | 0.1451 | 0.0384 | 0.1451 | 0.0375 | 0.1451 | 0.0366 | 0.1451 | 0.035 | 0.1451 | 0.033 |
| 0.152 | 0.0438 | 0.152 | 0.04 | 0.152 | 0.0384 | 0.152 | 0.0375 | 0.152 | 0.0366 | 0.152 | 0.035 | 0.152 | 0.033 |
| 0.1592 | 0.0461 | 0.1592 | 0.0415 | 0.1592 | 0.0394 | 0.1592 | 0.0375 | 0.1592 | 0.0366 | 0.1592 | 0.035 | 0.1592 | 0.033 |
| 0.1668 | 0.0583 | 0.1668 | 0.0505 | 0.1668 | 0.0462 | 0.1668 | 0.0425 | 0.1668 | 0.0394 | 0.1668 | 0.035 | 0.1668 | 0.033 |
| 0.1748 | 0.0643 | 0.1748 | 0.0565 | 0.1748 | 0.0521 | 0.1748 | 0.0482 | 0.1748 | 0.0448 | 0.1748 | 0.0392 | 0.1748 | 0.033 |
| 0.1831 | 0.0666 | 0.1831 | 0.0582 | 0.1831 | 0.0541 | 0.1831 | 0.0503 | 0.1831 | 0.047 | 0.1831 | 0.0413 | 0.1831 | 0.0351 |
| 0.1918 | 0.0676 | 0.1918 | 0.0584 | 0.1918 | 0.0541 | 0.1918 | 0.0505 | 0.1918 | 0.0472 | 0.1918 | 0.0415 | 0.1918 | 0.0376 |
| 0.2009 | 0.0695 | 0.2009 | 0.0594 | 0.2009 | 0.0541 | 0.2009 | 0.0509 | 0.2009 | 0.0481 | 0.2009 | 0.0431 | 0.2009 | 0.0405 |
| 0.2105 | 0.0719 | 0.2105 | 0.0616 | 0.2105 | 0.0578 | 0.2105 | 0.0543 | 0.2105 | 0.051 | 0.2105 | 0.0476 | 0.2105 | 0.0438 |
| 0.2205 | 0.0815 | 0.2205 | 0.0705 | 0.2205 | 0.0647 | 0.2205 | 0.0596 | 0.2205 | 0.0568 | 0.2205 | 0.0524 | 0.2205 | 0.0475 |
| 0.231 | 0.0953 | 0.231 | 0.0787 | 0.231 | 0.0702 | 0.231 | 0.0666 | 0.231 | 0.0632 | 0.231 | 0.0575 | 0.231 | 0.0509 |
| 0.242 | 0.0977 | 0.242 | 0.084 | 0.242 | 0.0771 | 0.242 | 0.071 | 0.242 | 0.0669 | 0.242 | 0.06 | 0.242 | 0.0529 |
| 0.2535 | 0.1051 | 0.2535 | 0.0906 | 0.2535 | 0.0825 | 0.2535 | 0.0755 | 0.2535 | 0.0694 | 0.2535 | 0.06 | 0.2535 | 0.0529 |
| 0.2656 | 0.1133 | 0.2656 | 0.094 | 0.2656 | 0.0837 | 0.2656 | 0.0755 | 0.2656 | 0.0694 | 0.2656 | 0.06 | 0.2656 | 0.0529 |
| 0.2783 | 0.1133 | 0.2783 | 0.094 | 0.2783 | 0.0837 | 0.2783 | 0.0776 | 0.2783 | 0.0736 | 0.2783 | 0.0666 | 0.2783 | 0.0591 |
| 0.2915 | 0.1133 | 0.2915 | 0.0994 | 0.2915 | 0.093 | 0.2915 | 0.0874 | 0.2915 | 0.0826 | 0.2915 | 0.0745 | 0.2915 | 0.0653 |
| 0.3054 | 0.1163 | 0.3054 | 0.104 | 0.3054 | 0.0971 | 0.3054 | 0.0909 | 0.3054 | 0.0855 | 0.3054 | 0.0765 | 0.3054 | 0.067 |
| 0.3199 | 0.1163 | 0.3199 | 0.104 | 0.3199 | 0.0971 | 0.3199 | 0.0909 | 0.3199 | 0.0864 | 0.3199 | 0.0812 | 0.3199 | 0.0747 |
| 0.3352 | 0.1163 | 0.3352 | 0.1068 | 0.3352 | 0.1025 | 0.3352 | 0.0986 | 0.3352 | 0.095 | 0.3352 | 0.0886 | 0.3352 | 0.0809 |
| 0.3511 | 0.1636 | 0.3511 | 0.1274 | 0.3511 | 0.1102 | 0.3511 | 0.1045 | 0.3511 | 0.1004 | 0.3511 | 0.0933 | 0.3511 | 0.0851 |
| 0.3678 | 0.2398 | 0.3678 | 0.1821 | 0.3678 | 0.1557 | 0.3678 | 0.1356 | 0.3678 | 0.1202 | 0.3678 | 0.0985 | 0.3678 | 0.0858 |
| 0.3853 | 0.2521 | 0.3853 | 0.185 | 0.3853 | 0.1576 | 0.3853 | 0.137 | 0.3853 | 0.123 | 0.3853 | 0.1052 | 0.3853 | 0.0881 |
| 0.4037 | 0.2521 | 0.4037 | 0.185 | 0.4037 | 0.1576 | 0.4037 | 0.137 | 0.4037 | 0.1254 | 0.4037 | 0.1131 | 0.4037 | 0.0996 |
| 0.4229 | 0.2521 | 0.4229 | 0.185 | 0.4229 | 0.1633 | 0.4229 | 0.1471 | 0.4229 | 0.1332 | 0.4229 | 0.1199 | 0.4229 | 0.1082 |
| 0.4431 | 0.3248 | 0.4431 | 0.2299 | 0.4431 | 0.1995 | 0.4431 | 0.1774 | 0.4431 | 0.1605 | 0.4431 | 0.137 | 0.4431 | 0.1162 |
| 0.4642 | 0.3248 | 0.4642 | 0.2299 | 0.4642 | 0.1995 | 0.4642 | 0.1774 | 0.4642 | 0.1605 | 0.4642 | 0.137 | 0.4642 | 0.1162 |
| 0.4863 | 0.3248 | 0.4863 | 0.2299 | 0.4863 | 0.1995 | 0.4863 | 0.1774 | 0.4863 | 0.1605 | 0.4863 | 0.1398 | 0.4863 | 0.123 |
| 0.5094 | 0.3248 | 0.5094 | 0.2299 | 0.5094 | 0.1995 | 0.5094 | 0.1774 | 0.5094 | 0.1605 | 0.5094 | 0.1461 | 0.5094 | 0.1281 |

PTWW068.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 68 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.5337 | 0.3307 | 0.5337 | 0.2342 | 0.5337 | 0.2031 | 0.5337 | 0.1861 | 0.5337 | 0.1756 | 0.5337 | 0.1572 | 0.5337 | 0.1357 |
| 0.5591 | 0.3864 | 0.5591 | 0.2681 | 0.5591 | 0.2359 | 0.5591 | 0.2104 | 0.5591 | 0.1922 | 0.5591 | 0.1683 | 0.5591 | 0.1505 |
| 0.5857 | 0.3864 | 0.5857 | 0.2751 | 0.5857 | 0.2466 | 0.5857 | 0.223 | 0.5857 | 0.2031 | 0.5857 | 0.1791 | 0.5857 | 0.1667 |
| 0.6136 | 0.3864 | 0.6136 | 0.2751 | 0.6136 | 0.2466 | 0.6136 | 0.223 | 0.6136 | 0.2035 | 0.6136 | 0.193 | 0.6136 | 0.1795 |
| 0.6428 | 0.3864 | 0.6428 | 0.2751 | 0.6428 | 0.2466 | 0.6428 | 0.2234 | 0.6428 | 0.2139 | 0.6428 | 0.2039 | 0.6428 | 0.1896 |
| 0.6734 | 0.3953 | 0.6734 | 0.2751 | 0.6734 | 0.251 | 0.6734 | 0.2354 | 0.6734 | 0.2284 | 0.6734 | 0.2154 | 0.6734 | 0.1984 |
| 0.7055 | 0.3953 | 0.7055 | 0.2852 | 0.7055 | 0.2641 | 0.7055 | 0.2526 | 0.7055 | 0.2425 | 0.7055 | 0.2254 | 0.7055 | 0.2061 |
| 0.7391 | 0.6097 | 0.7391 | 0.3987 | 0.7391 | 0.3252 | 0.7391 | 0.2766 | 0.7391 | 0.2575 | 0.7391 | 0.2289 | 0.7391 | 0.208 |
| 0.7743 | 0.6097 | 0.7743 | 0.3987 | 0.7743 | 0.3252 | 0.7743 | 0.2869 | 0.7743 | 0.2696 | 0.7743 | 0.2409 | 0.7743 | 0.2089 |
| 0.8111 | 0.6283 | 0.8111 | 0.4148 | 0.8111 | 0.3607 | 0.8111 | 0.3191 | 0.8111 | 0.2867 | 0.8111 | 0.2409 | 0.8111 | 0.2089 |
| 0.8497 | 0.6283 | 0.8497 | 0.4148 | 0.8497 | 0.3768 | 0.8497 | 0.3473 | 0.8497 | 0.3221 | 0.8497 | 0.2809 | 0.8497 | 0.2363 |
| 0.8902 | 0.6457 | 0.8902 | 0.4214 | 0.8902 | 0.3768 | 0.8902 | 0.3473 | 0.8902 | 0.3236 | 0.8902 | 0.2939 | 0.8902 | 0.2537 |
| 0.9326 | 0.6829 | 0.9326 | 0.4768 | 0.9326 | 0.4187 | 0.9326 | 0.376 | 0.9326 | 0.344 | 0.9326 | 0.299 | 0.9326 | 0.2562 |
| 0.977 | 0.9086 | 0.977 | 0.5785 | 0.977 | 0.4758 | 0.977 | 0.4112 | 0.977 | 0.3674 | 0.977 | 0.3135 | 0.977 | 0.2721 |
| 1.0235 | 0.9086 | 1.0235 | 0.5785 | 1.0235 | 0.517 | 1.0235 | 0.4689 | 1.0235 | 0.429 | 1.0235 | 0.368 | 1.0235 | 0.3069 |
| 1.0723 | 0.9086 | 1.0723 | 0.5886 | 1.0723 | 0.5252 | 1.0723 | 0.4728 | 1.0723 | 0.4295 | 1.0723 | 0.3754 | 1.0723 | 0.318 |
| 1.1233 | 1.2562 | 1.1233 | 0.759 | 1.1233 | 0.6339 | 1.1233 | 0.5449 | 1.1233 | 0.4784 | 1.1233 | 0.3889 | 1.1233 | 0.318 |
| 1.1768 | 1.2562 | 1.1768 | 0.759 | 1.1768 | 0.6339 | 1.1768 | 0.5449 | 1.1768 | 0.4784 | 1.1768 | 0.4006 | 1.1768 | 0.3289 |
| 1.2328 | 1.2562 | 1.2328 | 0.8302 | 1.2328 | 0.7291 | 1.2328 | 0.6491 | 1.2328 | 0.5837 | 1.2328 | 0.4845 | 1.2328 | 0.3864 |
| 1.2916 | 1.2562 | 1.2916 | 0.9189 | 1.2916 | 0.7993 | 1.2916 | 0.7058 | 1.2916 | 0.6308 | 1.2916 | 0.5188 | 1.2916 | 0.4097 |
| 1.353 | 1.2562 | 1.353 | 0.9189 | 1.353 | 0.7993 | 1.353 | 0.7058 | 1.353 | 0.6308 | 1.353 | 0.5188 | 1.353 | 0.4097 |
| 1.4175 | 1.3538 | 1.4175 | 0.9674 | 1.4175 | 0.8219 | 1.4175 | 0.7323 | 1.4175 | 0.6639 | 1.4175 | 0.5631 | 1.4175 | 0.4667 |
| 1.485 | 1.3538 | 1.485 | 0.9674 | 1.485 | 0.8219 | 1.485 | 0.7371 | 1.485 | 0.6874 | 1.485 | 0.5977 | 1.485 | 0.4967 |
| 1.5557 | 1.5417 | 1.5557 | 0.9739 | 1.5557 | 0.8219 | 1.5557 | 0.7371 | 1.5557 | 0.6874 | 1.5557 | 0.5977 | 1.5557 | 0.5028 |
| 1.6298 | 1.6087 | 1.6298 | 1.0257 | 1.6298 | 0.9121 | 1.6298 | 0.8203 | 1.6298 | 0.7505 | 1.6298 | 0.6443 | 1.6298 | 0.5288 |
| 1.7074 | 1.6087 | 1.7074 | 1.0361 | 1.7074 | 0.9722 | 1.7074 | 0.8761 | 1.7074 | 0.795 | 1.7074 | 0.6704 | 1.7074 | 0.5676 |
| 1.7887 | 1.8947 | 1.7887 | 1.0361 | 1.7887 | 0.9722 | 1.7887 | 0.8761 | 1.7887 | 0.795 | 1.7887 | 0.6869 | 1.7887 | 0.5915 |
| 1.8738 | 1.8947 | 1.8738 | 1.0361 | 1.8738 | 0.9722 | 1.8738 | 0.8761 | 1.8738 | 0.795 | 1.8738 | 0.7041 | 1.8738 | 0.6047 |
| 1.963 | 1.8947 | 1.963 | 1.0361 | 1.963 | 0.9722 | 1.963 | 0.8761 | 1.963 | 0.7962 | 1.963 | 0.7116 | 1.963 | 0.6087 |
| 2.0565 | 1.8947 | 2.0565 | 1.0361 | 2.0565 | 0.9722 | 2.0565 | 0.8761 | 2.0565 | 0.7962 | 2.0565 | 0.7116 | 2.0565 | 0.6087 |
| 2.1544 | 1.8947 | 2.1544 | 1.0361 | 2.1544 | 0.9581 | 2.1544 | 0.8481 | 2.1544 | 0.7962 | 2.1544 | 0.7116 | 2.1544 | 0.6087 |
| 2.257 | 1.6082 | 2.257 | 1.0361 | 2.257 | 0.9149 | 2.257 | 0.8481 | 2.257 | 0.7962 | 2.257 | 0.7116 | 2.257 | 0.6087 |
| 2.3645 | 1.6082 | 2.3645 | 0.9942 | 2.3645 | 0.9149 | 2.3645 | 0.8481 | 2.3645 | 0.7962 | 2.3645 | 0.7116 | 2.3645 | 0.6087 |
| 2.4771 | 1.6082 | 2.4771 | 0.9942 | 2.4771 | 0.9149 | 2.4771 | 0.8481 | 2.4771 | 0.7904 | 2.4771 | 0.7069 | 2.4771 | 0.6029 |
| 2.595 | 1.2397 | 2.595 | 0.9942 | 2.595 | 0.9149 | 2.595 | 0.8481 | 2.595 | 0.7904 | 2.595 | 0.6952 | 2.595 | 0.5873 |

PTWW068.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 68 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.7186 | 1.1953 | 2.7186 | 0.9202 | 2.7186 | 0.8531 | 2.7186 | 0.7931 | 2.7186 | 0.7395 | 2.7186 | 0.6495 | 2.7186 | 0.562 |
| 2.848 | 1.0844 | 2.848 | 0.8533 | 2.848 | 0.7801 | 2.848 | 0.7362 | 2.848 | 0.6948 | 2.848 | 0.6221 | 2.848 | 0.5376 |
| 2.9836 | 1.0844 | 2.9836 | 0.8533 | 2.9836 | 0.7663 | 2.9836 | 0.6995 | 2.9836 | 0.6477 | 2.9836 | 0.5712 | 2.9836 | 0.4918 |
| 3.1257 | 1.0608 | 3.1257 | 0.664 | 3.1257 | 0.6109 | 3.1257 | 0.5659 | 3.1257 | 0.5322 | 3.1257 | 0.4875 | 3.1257 | 0.4434 |
| 3.2745 | 1.0608 | 3.2745 | 0.664 | 3.2745 | 0.6109 | 3.2745 | 0.5637 | 3.2745 | 0.523 | 3.2745 | 0.464 | 3.2745 | 0.411 |
| 3.4305 | 1.0608 | 3.4305 | 0.664 | 3.4305 | 0.6109 | 3.4305 | 0.5637 | 3.4305 | 0.523 | 3.4305 | 0.464 | 3.4305 | 0.411 |
| 3.5938 | 1.0608 | 3.5938 | 0.664 | 3.5938 | 0.6109 | 3.5938 | 0.5637 | 3.5938 | 0.523 | 3.5938 | 0.464 | 3.5938 | 0.411 |
| 3.7649 | 1.0608 | 3.7649 | 0.664 | 3.7649 | 0.6109 | 3.7649 | 0.5637 | 3.7649 | 0.523 | 3.7649 | 0.464 | 3.7649 | 0.411 |
| 3.9442 | 1.0608 | 3.9442 | 0.664 | 3.9442 | 0.6109 | 3.9442 | 0.5637 | 3.9442 | 0.523 | 3.9442 | 0.464 | 3.9442 | 0.411 |
| 4.132 | 1.0608 | 4.132 | 0.664 | 4.132 | 0.6109 | 4.132 | 0.5637 | 4.132 | 0.523 | 4.132 | 0.464 | 4.132 | 0.411 |
| 4.3288 | 1.0608 | 4.3288 | 0.664 | 4.3288 | 0.6109 | 4.3288 | 0.5637 | 4.3288 | 0.523 | 4.3288 | 0.464 | 4.3288 | 0.411 |
| 4.5349 | 1.0608 | 4.5349 | 0.664 | 4.5349 | 0.6109 | 4.5349 | 0.5637 | 4.5349 | 0.523 | 4.5349 | 0.464 | 4.5349 | 0.411 |
| 4.7508 | 1.0608 | 4.7508 | 0.664 | 4.7508 | 0.6109 | 4.7508 | 0.5637 | 4.7508 | 0.523 | 4.7508 | 0.464 | 4.7508 | 0.411 |
| 4.977 | 1.0608 | 4.977 | 0.6825 | 4.977 | 0.6131 | 4.977 | 0.5637 | 4.977 | 0.523 | 4.977 | 0.464 | 4.977 | 0.411 |
| 5.214 | 1.0608 | 5.214 | 0.6825 | 5.214 | 0.6131 | 5.214 | 0.5637 | 5.214 | 0.523 | 5.214 | 0.464 | 5.214 | 0.411 |
| 5.4623 | 1.0608 | 5.4623 | 0.6825 | 5.4623 | 0.6131 | 5.4623 | 0.5637 | 5.4623 | 0.523 | 5.4623 | 0.464 | 5.4623 | 0.411 |
| 5.7224 | 1.5414 | 5.7224 | 0.7528 | 5.7224 | 0.6883 | 5.7224 | 0.5675 | 5.7224 | 0.523 | 5.7224 | 0.464 | 5.7224 | 0.411 |
| 5.9948 | 1.5414 | 5.9948 | 0.7528 | 5.9948 | 0.6883 | 5.9948 | 0.5707 | 5.9948 | 0.5166 | 5.9948 | 0.4624 | 5.9948 | 0.411 |
| 6.2803 | 1.5414 | 6.2803 | 0.7528 | 6.2803 | 0.6883 | 6.2803 | 0.5707 | 6.2803 | 0.5135 | 6.2803 | 0.4514 | 6.2803 | 0.4057 |
| 6.5793 | 1.5414 | 6.5793 | 0.7528 | 6.5793 | 0.6883 | 6.5793 | 0.5707 | 6.5793 | 0.5057 | 6.5793 | 0.4473 | 6.5793 | 0.4057 |
| 6.8926 | 1.5414 | 6.8926 | 0.7528 | 6.8926 | 0.6883 | 6.8926 | 0.5707 | 6.8926 | 0.5057 | 6.8926 | 0.4393 | 6.8926 | 0.4057 |
| 7.2208 | 1.2507 | 7.2208 | 0.7528 | 7.2208 | 0.6517 | 7.2208 | 0.5707 | 7.2208 | 0.5057 | 7.2208 | 0.43 | 7.2208 | 0.4057 |
| 7.5646 | 1.1914 | 7.5646 | 0.7042 | 7.5646 | 0.5868 | 7.5646 | 0.5157 | 7.5646 | 0.4615 | 7.5646 | 0.43 | 7.5646 | 0.4057 |
| 7.9248 | 1.0406 | 7.9248 | 0.5548 | 7.9248 | 0.4886 | 7.9248 | 0.4685 | 7.9248 | 0.4529 | 7.9248 | 0.43 | 7.9248 | 0.4057 |
| 8.3022 | 1.0406 | 8.3022 | 0.547 | 8.3022 | 0.4886 | 8.3022 | 0.4685 | 8.3022 | 0.4529 | 8.3022 | 0.43 | 8.3022 | 0.4057 |
| 8.6975 | 0.8232 | 8.6975 | 0.5221 | 8.6975 | 0.4886 | 8.6975 | 0.4685 | 8.6975 | 0.4529 | 8.6975 | 0.43 | 8.6975 | 0.4054 |
| 9.1116 | 0.8232 | 9.1116 | 0.5221 | 9.1116 | 0.4715 | 9.1116 | 0.4536 | 9.1116 | 0.442 | 9.1116 | 0.4229 | 9.1116 | 0.4013 |
| 9.5455 | 0.8232 | 9.5455 | 0.5221 | 9.5455 | 0.4715 | 9.5455 | 0.4536 | 9.5455 | 0.442 | 9.5455 | 0.4229 | 9.5455 | 0.4013 |
| 10 | 0.7266 | 10 | 0.5221 | 10 | 0.4715 | 10 | 0.4536 | 10 | 0.442 | 10 | 0.4229 | 10 | 0.4013 |
| 10.4762 | 0.7266 | 10.4762 | 0.5221 | 10.4762 | 0.4715 | 10.4762 | 0.4318 | 10.4762 | 0.4256 | 10.4762 | 0.4126 | 10.4762 | 0.3942 |
| 10.975 | 0.7266 | 10.975 | 0.5221 | 10.975 | 0.4715 | 10.975 | 0.4261 | 10.975 | 0.412 | 10.975 | 0.3988 | 10.975 | 0.3816 |
| 11.4976 | 0.7266 | 11.4976 | 0.5041 | 11.4976 | 0.4445 | 11.4976 | 0.4109 | 11.4976 | 0.4001 | 11.4976 | 0.3859 | 11.4976 | 0.3714 |
| 12.045 | 0.5193 | 12.045 | 0.4288 | 12.045 | 0.3925 | 12.045 | 0.3815 | 12.045 | 0.3795 | 12.045 | 0.3743 | 12.045 | 0.3648 |
| 12.6186 | 0.5193 | 12.6186 | 0.3891 | 12.6186 | 0.3839 | 12.6186 | 0.3789 | 12.6186 | 0.3746 | 12.6186 | 0.367 | 12.6186 | 0.3574 |
| 13.2194 | 0.5193 | 13.2194 | 0.3754 | 13.2194 | 0.3691 | 13.2194 | 0.3654 | 13.2194 | 0.3624 | 13.2194 | 0.3568 | 13.2194 | 0.3489 |

PTWW068.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 68 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 0.5193 | 13.8489 | 0.3622 | 13.8489 | 0.3539 | 13.8489 | 0.3531 | 13.8489 | 0.3514 | 13.8489 | 0.3468 | 13.8489 | 0.3398 |
| 14.5083 | 0.5193 | 14.5083 | 0.3622 | 14.5083 | 0.3539 | 14.5083 | 0.3479 | 14.5083 | 0.3436 | 14.5083 | 0.3374 | 14.5083 | 0.3305 |
| 15.1991 | 0.5193 | 15.1991 | 0.3331 | 15.1991 | 0.3298 | 15.1991 | 0.3285 | 15.1991 | 0.3274 | 15.1991 | 0.3248 | 15.1991 | 0.3203 |
| 15.9228 | 0.5193 | 15.9228 | 0.3275 | 15.9228 | 0.323 | 15.9228 | 0.3212 | 15.9228 | 0.3191 | 15.9228 | 0.3152 | 15.9228 | 0.3107 |
| 16.681 | 0.5193 | 16.681 | 0.3275 | 16.681 | 0.3163 | 16.681 | 0.3108 | 16.681 | 0.3078 | 16.681 | 0.304 | 16.681 | 0.301 |
| 17.4753 | 0.5193 | 17.4753 | 0.3271 | 17.4753 | 0.3111 | 17.4753 | 0.3037 | 17.4753 | 0.3025 | 17.4753 | 0.2998 | 17.4753 | 0.2959 |
| 18.3074 | 0.4409 | 18.3074 | 0.3004 | 18.3074 | 0.3011 | 18.3074 | 0.2998 | 18.3074 | 0.2981 | 18.3074 | 0.2949 | 18.3074 | 0.2912 |
| 19.1791 | 0.4409 | 19.1791 | 0.2999 | 19.1791 | 0.2901 | 19.1791 | 0.2881 | 19.1791 | 0.2874 | 19.1791 | 0.2867 | 19.1791 | 0.2854 |
| 20.0923 | 0.4409 | 20.0923 | 0.2999 | 20.0923 | 0.286 | 20.0923 | 0.2839 | 20.0923 | 0.2824 | 20.0923 | 0.2815 | 20.0923 | 0.2811 |
| 21.049 | 0.4409 | 21.049 | 0.2999 | 21.049 | 0.286 | 21.049 | 0.2839 | 21.049 | 0.2824 | 21.049 | 0.2803 | 21.049 | 0.2784 |
| 22.0513 | 0.4409 | 22.0513 | 0.2961 | 22.0513 | 0.2857 | 22.0513 | 0.2819 | 22.0513 | 0.279 | 22.0513 | 0.2775 | 22.0513 | 0.2758 |
| 23.1013 | 0.4409 | 23.1013 | 0.2902 | 23.1013 | 0.2857 | 23.1013 | 0.2819 | 23.1013 | 0.279 | 23.1013 | 0.2756 | 23.1013 | 0.2728 |
| 24.2013 | 0.4409 | 24.2013 | 0.2763 | 24.2013 | 0.2687 | 24.2013 | 0.2687 | 24.2013 | 0.2692 | 24.2013 | 0.2691 | 24.2013 | 0.2684 |
| 25.3536 | 0.304 | 25.3536 | 0.271 | 25.3536 | 0.2687 | 25.3536 | 0.267 | 25.3536 | 0.2657 | 25.3536 | 0.264 | 25.3536 | 0.2647 |
| 26.5609 | 0.304 | 26.5609 | 0.271 | 26.5609 | 0.2687 | 26.5609 | 0.267 | 26.5609 | 0.2657 | 26.5609 | 0.264 | 26.5609 | 0.2628 |
| 27.8256 | 0.2808 | 27.8256 | 0.2679 | 27.8256 | 0.2658 | 27.8256 | 0.2641 | 27.8256 | 0.2629 | 27.8256 | 0.2613 | 27.8256 | 0.2603 |
| 29.1505 | 0.2754 | 29.1505 | 0.2584 | 29.1505 | 0.2573 | 29.1505 | 0.2565 | 29.1505 | 0.2559 | 29.1505 | 0.2561 | 29.1505 | 0.2571 |
| 30.5386 | 0.2652 | 30.5386 | 0.2584 | 30.5386 | 0.2573 | 30.5386 | 0.2565 | 30.5386 | 0.2559 | 30.5386 | 0.2553 | 30.5386 | 0.2556 |
| 31.9927 | 0.2557 | 31.9927 | 0.2584 | 31.9927 | 0.2573 | 31.9927 | 0.2565 | 31.9927 | 0.2559 | 31.9927 | 0.2553 | 31.9927 | 0.2549 |
| 33.516 | 0.2539 | 33.516 | 0.2548 | 33.516 | 0.2549 | 33.516 | 0.2548 | 33.516 | 0.2546 | 33.516 | 0.2543 | 33.516 | 0.2539 |
| 35.1119 | 0.2533 | 35.1119 | 0.2532 | 35.1119 | 0.2531 | 35.1119 | 0.2531 | 35.1119 | 0.253 | 35.1119 | 0.2529 | 35.1119 | 0.2527 |
| 36.7838 | 0.252 | 36.7838 | 0.2519 | 36.7838 | 0.2518 | 36.7838 | 0.2518 | 36.7838 | 0.2518 | 36.7838 | 0.2517 | 36.7838 | 0.2516 |
| 38.5353 | 0.2507 | 38.5353 | 0.2507 | 38.5353 | 0.2506 | 38.5353 | 0.2506 | 38.5353 | 0.2506 | 38.5353 | 0.2506 | 38.5353 | 0.2505 |
| 40.3702 | 0.2496 | 40.3702 | 0.2496 | 40.3702 | 0.2496 | 40.3702 | 0.2496 | 40.3702 | 0.2496 | 40.3702 | 0.2496 | 40.3702 | 0.2495 |
| 42.2924 | 0.2486 | 42.2924 | 0.2487 | 42.2924 | 0.2487 | 42.2924 | 0.2487 | 42.2924 | 0.2487 | 42.2924 | 0.2487 | 42.2924 | 0.2487 |
| 44.3062 | 0.2478 | 44.3062 | 0.2479 | 44.3062 | 0.2479 | 44.3062 | 0.2479 | 44.3062 | 0.2479 | 44.3062 | 0.2479 | 44.3062 | 0.2479 |
| 46.4159 | 0.2472 | 46.4159 | 0.2471 | 46.4159 | 0.2471 | 46.4159 | 0.2471 | 46.4159 | 0.2471 | 46.4159 | 0.2471 | 46.4159 | 0.2472 |
| 48.626 | 0.2464 | 48.626 | 0.2464 | 48.626 | 0.2464 | 48.626 | 0.2464 | 48.626 | 0.2464 | 48.626 | 0.2465 | 48.626 | 0.2465 |
| 50.9414 | 0.2458 | 50.9414 | 0.2458 | 50.9414 | 0.2458 | 50.9414 | 0.2458 | 50.9414 | 0.2458 | 50.9414 | 0.2458 | 50.9414 | 0.2458 |

PTEE024.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~
Figure 24E ~ Vertical Responses - Slab/Wall Joints ~ Elevation 0 ft. (Concrete) ~ Enveloped Spectra

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.1098 | 0.0291 | 0.1098 | 0.026 | 0.1098 | 0.0244 | 0.1098 | 0.0229 | 0.1098 | 0.022 | 0.1098 | 0.0212 | 0.1098 | 0.0204 |
| 0.115 | 0.0308 | 0.115 | 0.026 | 0.115 | 0.0244 | 0.115 | 0.0233 | 0.115 | 0.0229 | 0.115 | 0.0221 | 0.115 | 0.0213 |
| 0.1204 | 0.0313 | 0.1204 | 0.0262 | 0.1204 | 0.0245 | 0.1204 | 0.024 | 0.1204 | 0.0236 | 0.1204 | 0.0229 | 0.1204 | 0.0218 |
| 0.1262 | 0.0313 | 0.1262 | 0.027 | 0.1262 | 0.0257 | 0.1262 | 0.0246 | 0.1262 | 0.0241 | 0.1262 | 0.0233 | 0.1262 | 0.0221 |
| 0.1322 | 0.0313 | 0.1322 | 0.0271 | 0.1322 | 0.0258 | 0.1322 | 0.0247 | 0.1322 | 0.0242 | 0.1322 | 0.0234 | 0.1322 | 0.0225 |
| 0.1385 | 0.0313 | 0.1385 | 0.0277 | 0.1385 | 0.0265 | 0.1385 | 0.0254 | 0.1385 | 0.0245 | 0.1385 | 0.0235 | 0.1385 | 0.0225 |
| 0.1451 | 0.0316 | 0.1451 | 0.0294 | 0.1451 | 0.0282 | 0.1451 | 0.027 | 0.1451 | 0.0259 | 0.1451 | 0.0239 | 0.1451 | 0.0225 |
| 0.152 | 0.032 | 0.152 | 0.0299 | 0.152 | 0.0286 | 0.152 | 0.0273 | 0.152 | 0.0262 | 0.152 | 0.0241 | 0.152 | 0.0225 |
| 0.1592 | 0.033 | 0.1592 | 0.031 | 0.1592 | 0.0299 | 0.1592 | 0.0288 | 0.1592 | 0.0277 | 0.1592 | 0.0261 | 0.1592 | 0.0241 |
| 0.1668 | 0.0367 | 0.1668 | 0.0323 | 0.1668 | 0.0312 | 0.1668 | 0.0302 | 0.1668 | 0.0292 | 0.1668 | 0.0276 | 0.1668 | 0.0256 |
| 0.1748 | 0.0507 | 0.1748 | 0.0427 | 0.1748 | 0.0385 | 0.1748 | 0.035 | 0.1748 | 0.0321 | 0.1748 | 0.0284 | 0.1748 | 0.0264 |
| 0.1831 | 0.0586 | 0.1831 | 0.0492 | 0.1831 | 0.0442 | 0.1831 | 0.0399 | 0.1831 | 0.0362 | 0.1831 | 0.0306 | 0.1831 | 0.0266 |
| 0.1918 | 0.0586 | 0.1918 | 0.0492 | 0.1918 | 0.0442 | 0.1918 | 0.0399 | 0.1918 | 0.0362 | 0.1918 | 0.0306 | 0.1918 | 0.0267 |
| 0.2009 | 0.0586 | 0.2009 | 0.0492 | 0.2009 | 0.0442 | 0.2009 | 0.0399 | 0.2009 | 0.0362 | 0.2009 | 0.0323 | 0.2009 | 0.0293 |
| 0.2105 | 0.0586 | 0.2105 | 0.0492 | 0.2105 | 0.0442 | 0.2105 | 0.0399 | 0.2105 | 0.0384 | 0.2105 | 0.0357 | 0.2105 | 0.0322 |
| 0.2205 | 0.0586 | 0.2205 | 0.0492 | 0.2205 | 0.0453 | 0.2205 | 0.0426 | 0.2205 | 0.0406 | 0.2205 | 0.0376 | 0.2205 | 0.0337 |
| 0.231 | 0.0586 | 0.231 | 0.0492 | 0.231 | 0.0458 | 0.231 | 0.0439 | 0.231 | 0.042 | 0.231 | 0.0387 | 0.231 | 0.0352 |
| 0.242 | 0.0586 | 0.242 | 0.0509 | 0.242 | 0.0485 | 0.242 | 0.0463 | 0.242 | 0.0444 | 0.242 | 0.041 | 0.242 | 0.0368 |
| 0.2535 | 0.0648 | 0.2535 | 0.0572 | 0.2535 | 0.0528 | 0.2535 | 0.0488 | 0.2535 | 0.0453 | 0.2535 | 0.041 | 0.2535 | 0.0371 |
| 0.2656 | 0.0731 | 0.2656 | 0.0586 | 0.2656 | 0.0534 | 0.2656 | 0.049 | 0.2656 | 0.0453 | 0.2656 | 0.0424 | 0.2656 | 0.0402 |
| 0.2783 | 0.0816 | 0.2783 | 0.0598 | 0.2783 | 0.0534 | 0.2783 | 0.05 | 0.2783 | 0.0485 | 0.2783 | 0.0459 | 0.2783 | 0.0426 |
| 0.2915 | 0.0816 | 0.2915 | 0.0619 | 0.2915 | 0.058 | 0.2915 | 0.0546 | 0.2915 | 0.0516 | 0.2915 | 0.048 | 0.2915 | 0.0437 |
| 0.3054 | 0.0816 | 0.3054 | 0.0662 | 0.3054 | 0.062 | 0.3054 | 0.0583 | 0.3054 | 0.0548 | 0.3054 | 0.0488 | 0.3054 | 0.0448 |
| 0.3199 | 0.0816 | 0.3199 | 0.0701 | 0.3199 | 0.0659 | 0.3199 | 0.0622 | 0.3199 | 0.0588 | 0.3199 | 0.0531 | 0.3199 | 0.0468 |
| 0.3352 | 0.0871 | 0.3352 | 0.0766 | 0.3352 | 0.0706 | 0.3352 | 0.0658 | 0.3352 | 0.0624 | 0.3352 | 0.0565 | 0.3352 | 0.0496 |
| 0.3511 | 0.0905 | 0.3511 | 0.0805 | 0.3511 | 0.0748 | 0.3511 | 0.0698 | 0.3511 | 0.0653 | 0.3511 | 0.0578 | 0.3511 | 0.0502 |
| 0.3678 | 0.1216 | 0.3678 | 0.0951 | 0.3678 | 0.0823 | 0.3678 | 0.0722 | 0.3678 | 0.0653 | 0.3678 | 0.0578 | 0.3678 | 0.0502 |
| 0.3853 | 0.136 | 0.3853 | 0.1056 | 0.3853 | 0.0918 | 0.3853 | 0.0807 | 0.3853 | 0.0718 | 0.3853 | 0.0587 | 0.3853 | 0.0502 |
| 0.4037 | 0.136 | 0.4037 | 0.1056 | 0.4037 | 0.0918 | 0.4037 | 0.082 | 0.4037 | 0.076 | 0.4037 | 0.0663 | 0.4037 | 0.0569 |
| 0.4229 | 0.136 | 0.4229 | 0.1056 | 0.4229 | 0.0918 | 0.4229 | 0.0848 | 0.4229 | 0.0796 | 0.4229 | 0.0707 | 0.4229 | 0.0609 |
| 0.4431 | 0.136 | 0.4431 | 0.1056 | 0.4431 | 0.0932 | 0.4431 | 0.0884 | 0.4431 | 0.0838 | 0.4431 | 0.0755 | 0.4431 | 0.0652 |
| 0.4642 | 0.1375 | 0.4642 | 0.1059 | 0.4642 | 0.0974 | 0.4642 | 0.0915 | 0.4642 | 0.086 | 0.4642 | 0.0764 | 0.4642 | 0.0667 |
| 0.4863 | 0.1479 | 0.4863 | 0.1238 | 0.4863 | 0.1107 | 0.4863 | 0.0995 | 0.4863 | 0.0901 | 0.4863 | 0.082 | 0.4863 | 0.0725 |
| 0.5094 | 0.181 | 0.5094 | 0.138 | 0.5094 | 0.1214 | 0.5094 | 0.108 | 0.5094 | 0.0971 | 0.5094 | 0.0861 | 0.5094 | 0.0744 |

PTEE024.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~
Figure 24E ~ Vertical Responses - Slab/Wall Joints ~ Elevation 0 ft. (Concrete) ~ Enveloped Spectra

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.5337 | 0.2215 | 0.5337 | 0.1602 | 0.5337 | 0.134 | 0.5337 | 0.1151 | 0.5337 | 0.1024 | 0.5337 | 0.0861 | 0.5337 | 0.0744 |
| 0.5591 | 0.2215 | 0.5591 | 0.1602 | 0.5591 | 0.134 | 0.5591 | 0.1151 | 0.5591 | 0.1024 | 0.5591 | 0.0884 | 0.5591 | 0.0754 |
| 0.5857 | 0.2215 | 0.5857 | 0.1602 | 0.5857 | 0.134 | 0.5857 | 0.1151 | 0.5857 | 0.1024 | 0.5857 | 0.094 | 0.5857 | 0.0825 |
| 0.6136 | 0.2215 | 0.6136 | 0.1602 | 0.6136 | 0.134 | 0.6136 | 0.1175 | 0.6136 | 0.1108 | 0.6136 | 0.1001 | 0.6136 | 0.0874 |
| 0.6428 | 0.2268 | 0.6428 | 0.163 | 0.6428 | 0.1365 | 0.6428 | 0.1175 | 0.6428 | 0.1126 | 0.6428 | 0.1027 | 0.6428 | 0.0894 |
| 0.6734 | 0.2268 | 0.6734 | 0.163 | 0.6734 | 0.1377 | 0.6734 | 0.128 | 0.6734 | 0.12 | 0.6734 | 0.1074 | 0.6734 | 0.0928 |
| 0.7055 | 0.2268 | 0.7055 | 0.163 | 0.7055 | 0.1377 | 0.7055 | 0.128 | 0.7055 | 0.12 | 0.7055 | 0.1086 | 0.7055 | 0.0945 |
| 0.7391 | 0.2268 | 0.7391 | 0.163 | 0.7391 | 0.1413 | 0.7391 | 0.1333 | 0.7391 | 0.1253 | 0.7391 | 0.1108 | 0.7391 | 0.0945 |
| 0.7743 | 0.3163 | 0.7743 | 0.2131 | 0.7743 | 0.1804 | 0.7743 | 0.1581 | 0.7743 | 0.1421 | 0.7743 | 0.1213 | 0.7743 | 0.1037 |
| 0.8111 | 0.3163 | 0.8111 | 0.2131 | 0.8111 | 0.1804 | 0.8111 | 0.1581 | 0.8111 | 0.1421 | 0.8111 | 0.1213 | 0.8111 | 0.1064 |
| 0.8497 | 0.3163 | 0.8497 | 0.2131 | 0.8497 | 0.1804 | 0.8497 | 0.1652 | 0.8497 | 0.1528 | 0.8497 | 0.133 | 0.8497 | 0.112 |
| 0.8902 | 0.3163 | 0.8902 | 0.2131 | 0.8902 | 0.1856 | 0.8902 | 0.17 | 0.8902 | 0.1571 | 0.8902 | 0.1368 | 0.8902 | 0.1165 |
| 0.9326 | 0.484 | 0.9326 | 0.298 | 0.9326 | 0.2451 | 0.9326 | 0.2142 | 0.9326 | 0.192 | 0.9326 | 0.1628 | 0.9326 | 0.1368 |
| 0.977 | 0.484 | 0.977 | 0.298 | 0.977 | 0.2451 | 0.977 | 0.2142 | 0.977 | 0.192 | 0.977 | 0.171 | 0.977 | 0.15 |
| 1.0235 | 0.484 | 1.0235 | 0.298 | 1.0235 | 0.2451 | 1.0235 | 0.2142 | 1.0235 | 0.1926 | 1.0235 | 0.1805 | 1.0235 | 0.1621 |
| 1.0723 | 0.484 | 1.0723 | 0.298 | 1.0723 | 0.2615 | 1.0723 | 0.2409 | 1.0723 | 0.2242 | 1.0723 | 0.1989 | 1.0723 | 0.1731 |
| 1.1233 | 0.5753 | 1.1233 | 0.3411 | 1.1233 | 0.2701 | 1.1233 | 0.2409 | 1.1233 | 0.2242 | 1.1233 | 0.1989 | 1.1233 | 0.1746 |
| 1.1768 | 0.5753 | 1.1768 | 0.3734 | 1.1768 | 0.3107 | 1.1768 | 0.2749 | 1.1768 | 0.2469 | 1.1768 | 0.213 | 1.1768 | 0.1874 |
| 1.2328 | 0.5753 | 1.2328 | 0.3807 | 1.2328 | 0.3438 | 1.2328 | 0.3132 | 1.2328 | 0.2882 | 1.2328 | 0.2506 | 1.2328 | 0.2132 |
| 1.2916 | 0.5753 | 1.2916 | 0.4139 | 1.2916 | 0.3646 | 1.2916 | 0.3262 | 1.2916 | 0.2999 | 1.2916 | 0.2601 | 1.2916 | 0.2214 |
| 1.353 | 0.6629 | 1.353 | 0.4139 | 1.353 | 0.3646 | 1.353 | 0.3329 | 1.353 | 0.3146 | 1.353 | 0.2846 | 1.353 | 0.2493 |
| 1.4175 | 0.6629 | 1.4175 | 0.429 | 1.4175 | 0.3788 | 1.4175 | 0.3575 | 1.4175 | 0.3384 | 1.4175 | 0.3064 | 1.4175 | 0.271 |
| 1.485 | 0.6629 | 1.485 | 0.457 | 1.485 | 0.4099 | 1.485 | 0.3825 | 1.485 | 0.3581 | 1.485 | 0.32 | 1.485 | 0.2847 |
| 1.5557 | 0.6629 | 1.5557 | 0.4867 | 1.5557 | 0.4466 | 1.5557 | 0.4193 | 1.5557 | 0.3959 | 1.5557 | 0.3551 | 1.5557 | 0.3075 |
| 1.6298 | 0.8057 | 1.6298 | 0.5109 | 1.6298 | 0.4763 | 1.6298 | 0.4473 | 1.6298 | 0.4224 | 1.6298 | 0.3819 | 1.6298 | 0.335 |
| 1.7074 | 0.8379 | 1.7074 | 0.6416 | 1.7074 | 0.5704 | 1.7074 | 0.5139 | 1.7074 | 0.4676 | 1.7074 | 0.4014 | 1.7074 | 0.3559 |
| 1.7887 | 1.0345 | 1.7887 | 0.7676 | 1.7887 | 0.6799 | 1.7887 | 0.6122 | 1.7887 | 0.5562 | 1.7887 | 0.4772 | 1.7887 | 0.4004 |
| 1.8738 | 1.0345 | 1.8738 | 0.8046 | 1.8738 | 0.7255 | 1.8738 | 0.6502 | 1.8738 | 0.5996 | 1.8738 | 0.5318 | 1.8738 | 0.4441 |
| 1.963 | 1.2645 | 1.963 | 0.838 | 1.963 | 0.7316 | 1.963 | 0.6502 | 1.963 | 0.5996 | 1.963 | 0.5683 | 1.963 | 0.4717 |
| 2.0565 | 1.3932 | 2.0565 | 0.838 | 2.0565 | 0.7316 | 2.0565 | 0.6698 | 2.0565 | 0.6339 | 2.0565 | 0.584 | 2.0565 | 0.4802 |
| 2.1544 | 1.3932 | 2.1544 | 0.838 | 2.1544 | 0.7316 | 2.1544 | 0.6698 | 2.1544 | 0.6389 | 2.1544 | 0.584 | 2.1544 | 0.4802 |
| 2.257 | 1.3932 | 2.257 | 0.838 | 2.257 | 0.7519 | 2.257 | 0.6898 | 2.257 | 0.6389 | 2.257 | 0.584 | 2.257 | 0.4802 |
| 2.3645 | 1.7479 | 2.3645 | 0.9979 | 2.3645 | 0.8154 | 2.3645 | 0.7361 | 2.3645 | 0.6766 | 2.3645 | 0.584 | 2.3645 | 0.4889 |
| 2.4771 | 2.068 | 2.4771 | 1.1705 | 2.4771 | 0.9105 | 2.4771 | 0.7993 | 2.4771 | 0.7332 | 2.4771 | 0.6216 | 2.4771 | 0.5073 |
| 2.595 | 2.142 | 2.595 | 1.1705 | 2.595 | 0.9105 | 2.595 | 0.871 | 2.595 | 0.7663 | 2.595 | 0.6393 | 2.595 | 0.5251 |

PTEE024.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~
Figure 24E ~ Vertical Responses - Slab/Wall Joints ~ Elevation 0 ft. (Concrete) ~ Enveloped Spectra

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.7186 | 2.142 | 2.7186 | 1.1705 | 2.7186 | 0.9105 | 2.7186 | 0.871 | 2.7186 | 0.7663 | 2.7186 | 0.6554 | 2.7186 | 0.5385 |
| 2.848 | 2.142 | 2.848 | 1.1705 | 2.848 | 0.9105 | 2.848 | 0.871 | 2.848 | 0.7663 | 2.848 | 0.6554 | 2.848 | 0.5385 |
| 2.9836 | 2.142 | 2.9836 | 1.1705 | 2.9836 | 0.9105 | 2.9836 | 0.871 | 2.9836 | 0.7663 | 2.9836 | 0.6554 | 2.9836 | 0.5385 |
| 3.1257 | 2.142 | 3.1257 | 1.1705 | 3.1257 | 0.9105 | 3.1257 | 0.871 | 3.1257 | 0.7663 | 3.1257 | 0.6554 | 3.1257 | 0.5385 |
| 3.2745 | 1.9687 | 3.2745 | 1.1168 | 3.2745 | 0.9105 | 3.2745 | 0.831 | 3.2745 | 0.7634 | 3.2745 | 0.6554 | 3.2745 | 0.5385 |
| 3.4305 | 1.4171 | 3.4305 | 0.9374 | 3.4305 | 0.8241 | 3.4305 | 0.7591 | 3.4305 | 0.7116 | 3.4305 | 0.628 | 3.4305 | 0.5317 |
| 3.5938 | 1.4171 | 3.5938 | 0.9374 | 3.5938 | 0.8241 | 3.5938 | 0.7511 | 3.5938 | 0.6929 | 3.5938 | 0.6087 | 3.5938 | 0.5317 |
| 3.7649 | 1.4171 | 3.7649 | 0.9374 | 3.7649 | 0.8241 | 3.7649 | 0.7511 | 3.7649 | 0.6929 | 3.7649 | 0.6075 | 3.7649 | 0.5317 |
| 3.9442 | 1.4171 | 3.9442 | 0.9374 | 3.9442 | 0.8199 | 3.9442 | 0.7511 | 3.9442 | 0.6929 | 3.9442 | 0.605 | 3.9442 | 0.5317 |
| 4.132 | 1.4171 | 4.132 | 0.9374 | 4.132 | 0.8199 | 4.132 | 0.7511 | 4.132 | 0.6929 | 4.132 | 0.605 | 4.132 | 0.5317 |
| 4.3288 | 1.4171 | 4.3288 | 0.9374 | 4.3288 | 0.8199 | 4.3288 | 0.7511 | 4.3288 | 0.6929 | 4.3288 | 0.605 | 4.3288 | 0.5317 |
| 4.5349 | 1.4171 | 4.5349 | 0.9374 | 4.5349 | 0.8199 | 4.5349 | 0.7511 | 4.5349 | 0.6929 | 4.5349 | 0.605 | 4.5349 | 0.5317 |
| 4.7508 | 1.4171 | 4.7508 | 0.9374 | 4.7508 | 0.8199 | 4.7508 | 0.7511 | 4.7508 | 0.6929 | 4.7508 | 0.605 | 4.7508 | 0.5317 |
| 4.977 | 1.4171 | 4.977 | 0.9374 | 4.977 | 0.8199 | 4.977 | 0.7511 | 4.977 | 0.6929 | 4.977 | 0.605 | 4.977 | 0.5317 |
| 5.214 | 1.4171 | 5.214 | 0.9374 | 5.214 | 0.8199 | 5.214 | 0.7511 | 5.214 | 0.6929 | 5.214 | 0.605 | 5.214 | 0.5317 |
| 5.4623 | 1.5403 | 5.4623 | 0.9374 | 5.4623 | 0.8199 | 5.4623 | 0.7511 | 5.4623 | 0.6929 | 5.4623 | 0.605 | 5.4623 | 0.5317 |
| 5.7224 | 1.7489 | 5.7224 | 0.9374 | 5.7224 | 0.8199 | 5.7224 | 0.7937 | 5.7224 | 0.7092 | 5.7224 | 0.6012 | 5.7224 | 0.5234 |
| 5.9948 | 1.7489 | 5.9948 | 0.9374 | 5.9948 | 0.8199 | 5.9948 | 0.7937 | 5.9948 | 0.7092 | 5.9948 | 0.6012 | 5.9948 | 0.5079 |
| 6.2803 | 1.7489 | 6.2803 | 0.9374 | 6.2803 | 0.8199 | 6.2803 | 0.7937 | 6.2803 | 0.7092 | 6.2803 | 0.6012 | 6.2803 | 0.5079 |
| 6.5793 | 1.7489 | 6.5793 | 0.9374 | 6.5793 | 0.8199 | 6.5793 | 0.7937 | 6.5793 | 0.7092 | 6.5793 | 0.6012 | 6.5793 | 0.5079 |
| 6.8926 | 1.7489 | 6.8926 | 0.9374 | 6.8926 | 0.8199 | 6.8926 | 0.7937 | 6.8926 | 0.7092 | 6.8926 | 0.6012 | 6.8926 | 0.5079 |
| 7.2208 | 1.6603 | 7.2208 | 0.9374 | 7.2208 | 0.8199 | 7.2208 | 0.7553 | 7.2208 | 0.6892 | 7.2208 | 0.5885 | 7.2208 | 0.5079 |
| 7.5646 | 1.5723 | 7.5646 | 0.9134 | 7.5646 | 0.7926 | 7.5646 | 0.7147 | 7.5646 | 0.6591 | 7.5646 | 0.5747 | 7.5646 | 0.4988 |
| 7.9248 | 1.5723 | 7.9248 | 0.9134 | 7.9248 | 0.7814 | 7.9248 | 0.6958 | 7.9248 | 0.6399 | 7.9248 | 0.564 | 7.9248 | 0.4979 |
| 8.3022 | 1.5723 | 8.3022 | 0.9134 | 8.3022 | 0.7814 | 8.3022 | 0.6958 | 8.3022 | 0.6399 | 8.3022 | 0.564 | 8.3022 | 0.4979 |
| 8.6975 | 1.2382 | 8.6975 | 0.7934 | 8.6975 | 0.6919 | 8.6975 | 0.6496 | 8.6975 | 0.6135 | 8.6975 | 0.5519 | 8.6975 | 0.4907 |
| 9.1116 | 1.2382 | 9.1116 | 0.7934 | 9.1116 | 0.6874 | 9.1116 | 0.6253 | 9.1116 | 0.5914 | 9.1116 | 0.5425 | 9.1116 | 0.4886 |
| 9.5455 | 1.2382 | 9.5455 | 0.7934 | 9.5455 | 0.6874 | 9.5455 | 0.6253 | 9.5455 | 0.5832 | 9.5455 | 0.5235 | 9.5455 | 0.4755 |
| 10 | 1.2382 | 10 | 0.7934 | 10 | 0.6874 | 10 | 0.6253 | 10 | 0.5832 | 10 | 0.5229 | 10 | 0.4655 |
| 10.4762 | 1.2382 | 10.4762 | 0.7934 | 10.4762 | 0.6874 | 10.4762 | 0.6253 | 10.4762 | 0.5832 | 10.4762 | 0.5229 | 10.4762 | 0.4646 |
| 10.975 | 1.1339 | 10.975 | 0.7934 | 10.975 | 0.6874 | 10.975 | 0.6253 | 10.975 | 0.5832 | 10.975 | 0.5219 | 10.975 | 0.4646 |
| 11.4976 | 1.0079 | 11.4976 | 0.6912 | 11.4976 | 0.6174 | 11.4976 | 0.5657 | 11.4976 | 0.5336 | 11.4976 | 0.4943 | 11.4976 | 0.4547 |
| 12.045 | 1.0079 | 12.045 | 0.6323 | 12.045 | 0.5726 | 12.045 | 0.5241 | 12.045 | 0.4881 | 12.045 | 0.4608 | 12.045 | 0.4296 |
| 12.6186 | 1.0079 | 12.6186 | 0.6123 | 12.6186 | 0.5153 | 12.6186 | 0.4854 | 12.6186 | 0.4686 | 12.6186 | 0.44 | 12.6186 | 0.4071 |
| 13.2194 | 1.0079 | 13.2194 | 0.6123 | 13.2194 | 0.5102 | 13.2194 | 0.4731 | 13.2194 | 0.452 | 13.2194 | 0.4197 | 13.2194 | 0.3883 |

PTEE024.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~
Figure 24E ~ Vertical Responses - Slab/Wall Joints ~ Elevation 0 ft. (Concrete) ~ Enveloped Spectra

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 1.0079 | 13.8489 | 0.6123 | 13.8489 | 0.5102 | 13.8489 | 0.4615 | 13.8489 | 0.4386 | 13.8489 | 0.4022 | 13.8489 | 0.3633 |
| 14.5083 | 1.0079 | 14.5083 | 0.6123 | 14.5083 | 0.5102 | 14.5083 | 0.4547 | 14.5083 | 0.4329 | 14.5083 | 0.3988 | 14.5083 | 0.3633 |
| 15.1991 | 1.0079 | 15.1991 | 0.6123 | 15.1991 | 0.5102 | 15.1991 | 0.4217 | 15.1991 | 0.4105 | 15.1991 | 0.3706 | 15.1991 | 0.3433 |
| 15.9228 | 1.0079 | 15.9228 | 0.6123 | 15.9228 | 0.5102 | 15.9228 | 0.4217 | 15.9228 | 0.4105 | 15.9228 | 0.3706 | 15.9228 | 0.3385 |
| 16.681 | 1.0079 | 16.681 | 0.6123 | 16.681 | 0.5102 | 16.681 | 0.4217 | 16.681 | 0.4105 | 16.681 | 0.3706 | 16.681 | 0.3385 |
| 17.4753 | 1.0079 | 17.4753 | 0.6123 | 17.4753 | 0.5102 | 17.4753 | 0.4217 | 17.4753 | 0.4105 | 17.4753 | 0.3703 | 17.4753 | 0.3348 |
| 18.3074 | 1.0079 | 18.3074 | 0.6123 | 18.3074 | 0.5102 | 18.3074 | 0.4136 | 18.3074 | 0.4017 | 18.3074 | 0.3481 | 18.3074 | 0.3209 |
| 19.1791 | 1.0079 | 19.1791 | 0.6123 | 19.1791 | 0.5102 | 19.1791 | 0.4136 | 19.1791 | 0.4017 | 19.1791 | 0.3481 | 19.1791 | 0.3122 |
| 20.0923 | 0.6551 | 20.0923 | 0.4391 | 20.0923 | 0.419 | 20.0923 | 0.3759 | 20.0923 | 0.3461 | 20.0923 | 0.319 | 20.0923 | 0.2989 |
| 21.049 | 0.6551 | 21.049 | 0.4391 | 21.049 | 0.419 | 21.049 | 0.3759 | 21.049 | 0.3461 | 21.049 | 0.3119 | 21.049 | 0.2909 |
| 22.0513 | 0.6551 | 22.0513 | 0.4391 | 22.0513 | 0.419 | 22.0513 | 0.3759 | 22.0513 | 0.3461 | 22.0513 | 0.3119 | 22.0513 | 0.2881 |
| 23.1013 | 0.4513 | 23.1013 | 0.3434 | 23.1013 | 0.3322 | 23.1013 | 0.3192 | 23.1013 | 0.3064 | 23.1013 | 0.2882 | 23.1013 | 0.278 |
| 24.2013 | 0.4513 | 24.2013 | 0.3354 | 24.2013 | 0.3097 | 24.2013 | 0.2945 | 24.2013 | 0.286 | 24.2013 | 0.2772 | 24.2013 | 0.2733 |
| 25.3536 | 0.4513 | 25.3536 | 0.2912 | 25.3536 | 0.2849 | 25.3536 | 0.2812 | 25.3536 | 0.2777 | 25.3536 | 0.2725 | 25.3536 | 0.269 |
| 26.5609 | 0.4513 | 26.5609 | 0.2865 | 26.5609 | 0.2793 | 26.5609 | 0.2755 | 26.5609 | 0.2728 | 26.5609 | 0.269 | 26.5609 | 0.265 |
| 27.8256 | 0.4513 | 27.8256 | 0.2865 | 27.8256 | 0.2752 | 27.8256 | 0.2694 | 27.8256 | 0.2651 | 27.8256 | 0.2626 | 27.8256 | 0.2598 |
| 29.1505 | 0.4513 | 29.1505 | 0.2865 | 29.1505 | 0.2672 | 29.1505 | 0.2622 | 29.1505 | 0.2586 | 29.1505 | 0.2556 | 29.1505 | 0.2542 |
| 30.5386 | 0.4513 | 30.5386 | 0.2865 | 30.5386 | 0.2637 | 30.5386 | 0.2581 | 30.5386 | 0.2572 | 30.5386 | 0.2554 | 30.5386 | 0.2534 |
| 31.9927 | 0.2716 | 31.9927 | 0.2566 | 31.9927 | 0.2561 | 31.9927 | 0.2556 | 31.9927 | 0.2551 | 31.9927 | 0.2541 | 31.9927 | 0.2527 |
| 33.516 | 0.2543 | 33.516 | 0.2538 | 33.516 | 0.2536 | 33.516 | 0.2533 | 33.516 | 0.253 | 33.516 | 0.2524 | 33.516 | 0.2515 |
| 35.1119 | 0.2519 | 35.1119 | 0.2517 | 35.1119 | 0.2515 | 35.1119 | 0.2514 | 35.1119 | 0.2512 | 35.1119 | 0.2508 | 35.1119 | 0.2502 |
| 36.7838 | 0.2501 | 36.7838 | 0.25 | 36.7838 | 0.2499 | 36.7838 | 0.2498 | 36.7838 | 0.2496 | 36.7838 | 0.2494 | 36.7838 | 0.249 |
| 38.5353 | 0.2486 | 38.5353 | 0.2485 | 38.5353 | 0.2485 | 38.5353 | 0.2484 | 38.5353 | 0.2483 | 38.5353 | 0.2481 | 38.5353 | 0.2479 |
| 40.3702 | 0.2474 | 40.3702 | 0.2473 | 40.3702 | 0.2473 | 40.3702 | 0.2472 | 40.3702 | 0.2472 | 40.3702 | 0.247 | 40.3702 | 0.2468 |
| 42.2924 | 0.2463 | 42.2924 | 0.2463 | 42.2924 | 0.2462 | 42.2924 | 0.2462 | 42.2924 | 0.2461 | 42.2924 | 0.2461 | 42.2924 | 0.2459 |
| 44.3062 | 0.2454 | 44.3062 | 0.2453 | 44.3062 | 0.2453 | 44.3062 | 0.2453 | 44.3062 | 0.2453 | 44.3062 | 0.2452 | 44.3062 | 0.2451 |
| 46.4159 | 0.2446 | 46.4159 | 0.2445 | 46.4159 | 0.2445 | 46.4159 | 0.2445 | 46.4159 | 0.2445 | 46.4159 | 0.2444 | 46.4159 | 0.2444 |
| 48.626 | 0.2438 | 48.626 | 0.2438 | 48.626 | 0.2438 | 48.626 | 0.2438 | 48.626 | 0.2438 | 48.626 | 0.2437 | 48.626 | 0.2437 |
| 50.9414 | 0.2431 | 50.9414 | 0.2431 | 50.9414 | 0.2431 | 50.9414 | 0.2431 | 50.9414 | 0.2431 | 50.9414 | 0.2431 | 50.9414 | 0.2431 |

# MECHANICAL SYSTEMS DATA SHEET: VESSEL

7 PLANT ITEM No.
*24590-PTF-MW-TLP-SEP-00001*
Data Sheet No.
*24590-PTF-MVD-TLP-00005*

| | | | |
|---|---|---|---|
| Project: | *RPP-WTP* | P&ID: | *24590-PTF-M6-TLP-00003* 7 |
| Project No: | *24590* | | |
| Project Site: | *DOE Hanford* | Process Data Sheet: | *24590-PTF-MVC-TLP-00002* 7 |
| System No. | *TLP* | | |
| Building | *PTF* | Vessel Drawing | *24590-QL-POA-MEVV-00001-01-196* |
| | | | |
| Description: | *Treated LAW Evaporator Separator Vessel TLP-SEP-00001* | | |

ALG 18FEB09

ISSUED BY
RPP-WTP PDC

R11042836

## Reference Data

| | |
|---|---|
| Charge Vessels (Tag Numbers) | *None* |
| Pulsejet Mixers / Agitators (Tag Numbers) | *None* |
| RFDs/Pumps (Tag Numbers) | *None* |

## Design Data

| | | | | |
|---|---|---|---|---|
| Quality Level | | *Q (12)* | Fabrication Specs | *24590-WTP-3PS-MV00-T0001* |
| Seismic Category | | *SC-I* | Design Code | *ASME Section VIII Division 1* |
| Service/Contents | | *Radioactive Slurry* | Code Stamp | *U1 Stamp* |
| Design Specific Gravity | | *1.57* | NB Registration | *Yes* |
| Maximum Operating Volume | gal | *3817* | Wind Design | *None* |
| Total Volume | gal | *14,512* | Snow/Ash Load | *None* |
| Postweld Heat Treat | | *Not Required* | Seismic Design | *24590-WTP-3PS-MV00-T0002* |
| Seismic Base Moment | ft lb | *N/A* | | *24590-WTP-3PS-SS90-T0001* |

| | | | | | |
|---|---|---|---|---|---|
| Inside Diameter | inch | *7'-6"(Upper), 11'-5" (Lower)* | | Corrosion Allowance inch | *0.04* |
| Length/Height (TL-TL) | inch | *417 3/4* | | | |
| | | Vessel Operating | Vessel Design | Coil/Jacket Design | Notes |
| Internal Pressure | psig | *-13.4* | *50* | *N/A* | *Vessel operating at 1.3 psia* |
| External Pressure | psig | *0* | *14.7* | *N/A* | |
| Temperature | °F | *135* | *175* | *N/A* | |
| Min. Design Metal Temp. | °F | *49* | | Hydrostatic Test Pressure PSIG | *65 - Horizontal* |

## Materials of Construction

| Component | Material | Minimum Thickness / Size | Containment |
|---|---|---|---|
| Top Head | *SA 240 304 SS* | *Auxillary (6)* | *1/2" Nominal Thickness; maximum carbon content of 0.030% for welded components.* |
| Shell | *SA 240 304 SS* | *Primary (6)* | *1/2" Thickness; maximum carbon content of 0.030% for welded components.* |
| Bottom Head | *SA 240 304 SS* | *Primary (6)* | *1/2" Thickness; maximum carbon content of 0.030% for welded components.* |
| Support | *SA 240 304 SS* | *N/A* | *Maximum carbon content of 0.030% for welded components* |
| Jacket/Coils/Half-Pipe Jacket | *N/A* | *N/A* | |
| Internals | *SA 403 304 SS and SA 240 304 SS* | *Thermowell Primary (6)* | *Maximum carbon content of 0.030% for welded components* |
| Pipe | *SA 312 304 SS* | *(6)* | *Maximum carbon content of 0.030% for welded components* |
| Forgings/ Bar stock | *SA 182 304 SS SA 479 304 SS* | *(1)* | *Maximum carbon content of 0.030% for welded components* |
| Gaskets | *SA 240 304 SS* | | *Flexitallic spiral wound with Thermiculite Filler.* |
| Bolting | *Nitronic 60 SA 193 B8S* | | *See dwg. 24590-QL-POA-MEVV-00001-01-00317* 7 |
| Head and Body Flanges | *SA 182 304 SS* | | *Maximum carbon content of 0.030% for welded components* |

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

| | | |
|---|---|---|
| BECHTEL | **MECHANICAL SYSTEMS DATA SHEET: VESSEL** | 7 **PLANT ITEM No.** ***24590-PTF-MW-TLP-SEP-00001*** **Data Sheet No.** ***24590-PTF-MVD-TLP-00005*** |

## Miscellaneous Data

| | |
|---|---|
| Orientation | ***Vertical*** |
| Support Type | ***Stainless Steel Legs, A554-304 SS*** |
| Insulation Function | ***None*** |
| Insulation Thickness (inch) | ***None*** |
| Insulation Material | ***None*** |
| External Finish | ***Welds descaled as laid.*** |
| Internal Finish | ***Welds ground smooth; Lower 15'-4 15/16" shell and cone to be #4 polished finish.*** |

## Remarks

***Notes:***

***(1) Nozzles located below the top of the overflow nozzle are primary containment. See 24590-WTP-3PS-MV00-T0001 for NDE requirements.***

***(2) Nozzle tolerance +/- 1/4".***

***(3) Material for demister pad is inconel 625 fine mesh.***

***(4) Non-replaceable 40 years design life (except demister pads section).***

***(5) NDE for this vessel must meet requirements per paragraphs 6.1, 6.2 and 7.2 of specification 24590-WTP-3PS-MV00-T0001.***

***(6) All welds forming part of the primary and auxiliary containment, including the nozzle attachment welds shall be subjected to 100% volumetric examination.***

***(7) This vessel is located in a Black Cell.***

***(8) Vendor to specify all metal thicknesses.***

***(9) Contents of this document are Dangerous Waste Permit affecting.***

***(10) Not Used.***

***(11) For nozzles loads, see 24590-PTF-3PS-MEVV-T0001.***

***(12) Component will be procured at Bechtel quality level Q 7, which corresponds with Vendor quality level QL-2.***

***(13) All welds forming part of the primary and auxiliary containment including nozzle attachment welds shall be subject to 100% volumetric examination.***

***(14) Equipment cyclic data is from document 24590-QL-POA-MEVV-00001-04-03.***

***(15) Vendor design information is from document 24590-QL-POA-MEVV-00001-02-00056.***

***(16) When combining vessel loading with seismic, seller shall use design pressure. Seller has the option to use 2 psi or 15% over maximum operating pressure, whichever is greatest, not to exceed vessel design pressure and full vacuum in lieu of vessel design pressure.***

***(17) Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.***

*(Safety screening/evaluation required? ☒Yes ☐No If yes per 24590-WTP-GPP-SREG-002, E&NS signature required below.)*

## Approval

| Rev | Description | By | Checked | E&NS | Approved | Date |
|---|---|---|---|---|---|---|
| 7 | Updated to reflect WSGM analysis and 24590-PTF-U0N-W16T-00003. | D. Tate | R. Rickenbach | B. Hall | J. Julyk | 2/19/09 |
| 6 | Update safety functions to match current SED and update datasheet for Dangerous Waste Permit use. | R. Rickenbach | E. Le | B. Hall | J. Julyk | 09/23/2008 |
| 5 | Incorporated Vendor Design Data, Equipment Qualification Data, and SDDR 24590-WTP-SDDR-M-06-00158. | R. Rickenbach | E. Le | S. Sontag | J. Julyk | 07/22/2008 |
| 4 | Clarified vessel nozzle load design. | E. Le | R. Nowak | N/A | J. Julyk | 03/28/2005 |
| 3 | Incorporated vendor final design information | E. Le | S. Crow | N/A | J. Julyk | 02/10/2005 |
| 2 | Incorporated vendor design information | E. Le | G. Butt | N/A | J. Julyk | 04/28/2004 |
| 1 | Corrected references and Incorporated 24590-WTP-SDDR-PROC-04-00104 | E. Le | G. Butt | N/A | J. Julyk | 03/25/2004 |
| 0 | Issued for Procurement | E. Le | A. Donnelly | N/A | M. Hoffman | 04/30/2003 |

# EQUIPMENT QUALIFICATION DATASHEET (EQD)

7

## Equipment Identification

| | | | |
|---|---|---|---|
| Component Tag Number | 24590-PTF-MW-TLP-SEP-00001 | Safety Classification | ☒ SC ☐ SS ☐ APC ☐ SDC ☐ SDS ☐ RRC Note 13 7 |
| Manufacturer / Supplier | AREVA NP, Inc. | | |
| Requisition Number | 24590-QL-POA-MEVV-00001 | | |
| Model | N/A | Seismic Category | ☒ SC-I ☐ SC-II ☐ SC-III ☐ SC-IV Note 13 7 |
| Description (Include descriptive text [e.g., location, elevation]) | Treated LAW Evaporator Separator Vessel, room P-0117, Elevation 0'-0" | | |
| Safety Function(s) | Confinement (ref. 1) 7 | | |

| | | | |
|---|---|---|---|
| Seismic Safety Function | ☒ Yes ☐ No | Room Number(s): | P-0117, Note 3 |
| Maintenance Accessible | ☐ Yes ☒ No | Method of Maintenance Access: | ☐ Remote ☐ Hands On ☒ None |

Seismic Operability Requirements: 7 ☐ During Seismic Event 7 ☐ After Seismic Event

ITS Equipment Type: ☒ Passive Mechanical ☐ Active Mechanical ☐ Electrical

## 7 Equipment Environmental Qualification (EEQ)

| | | |
|---|---|---|
| Environment ☐ Mild ☒ Harsh<br>Contamination Class: C5<br>Radiation Class: R5 | Hi Rad Service ☒ Yes ☐ No | Design Life (yrs) ☒ 40 ☐ Other ____<br>Design life of vessel is 40 years, demister pad section of vessel may require replacement prior to 40 year life cycle. |

| Parameter Type/Units | Parameter Value | Time Duration (number) | Time Units | WTP Document Number (BUYER) | Submittal Number (SELLER) |
|---|---|---|---|---|---|
| **Normal** | | | | | |
| Normal High Temperature (°F) | 113 | 40 | yrs | 24590-PTF-U0D-W16T-00001, Note 7 | Note 1 |
| Normal Low Temperature (°F) | 59 | 40 | yrs | 24590-PTF-U0D-W16T-00001, Note 7 | Note 1 |
| Normal High Relative Humidity (%RH) | 100 | 40 | yrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Normal Low Relative Humidity (%RH) | 5 | 40 | yrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Normal High Pressure (in.-w.g.) | 0 | 40 | yrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Normal Low Pressure (in.-w.g.) | -1.4 | 40 | yrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Normal Radiation Dose Rate (mR/hr) 7 | Note 8 | 40 | yrs | Note 8 | Note 1 |
| Vibration Magnitude (g) | N/A | N/A | N/A | N/A | Note 1 |
| Vibration Frequency (Hz) | N/A | N/A | N/A | N/A | Note 1 |
| Additional Normal Information: | See Note 2 for Pressure Units. | | | | |

## Equipment Environmental Qualification (EEQ) *(continued)*

7

| Parameter Type/Units | Parameter Value | Time Duration (number) | Time units | WTP Document Number (BUYER) | Submittal Number (SELLER) |
|---|---|---|---|---|---|
| **Abnormal** | | | | | |
| Abnormal High Temperature (°F) | 7 133 | 8 | hr/yr | 24590-PTF-U0D-W16T-00001, Note 7 7 | Note 1 |
| Abnormal Low Temperature (°F) | 59 | 8 | hr/yr | 24590-PTF-U0D-W16T-00001, Note 7 & 10 | Note 1 |
| Abnormal High Relative Humidity (%RH) | 100 | 24 | hr/yr | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Abnormal Low Relative Humidity (%RH) | 2 | 22 | hr/yr | 24590-PTF-U0D-W16T-00001, Note 12 7 | Note 1 |
| Abnormal High Pressure (in.-w.g.) | 4 | 8 | hr/yr | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Abnormal Low Pressure (in.-w.g.) | -7.3 | 8 | hr/yr | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Abnormal Radiation Dose Rate (mR/hr) 7 | Notes 4&8 | 0 | hr/yr | Note 8 | Note 1 |
| Wet Sprinkler System Present | No | N/A | N/A | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Additional Abnormal Information | See Note 2 for Pressure Units | | | | |
| **Design Basis Events (DBE)** | | | | | |
| DBE High Temperature (°F) | 144 | 1000 | hrs | 24590-PTF-U0D-W16T-00001, Note 7 & 12 7 | Note 1 |
| DBE Low Temperature (°F) | 40 | 1000 | hrs | 24590-PTF-U0D-W16T-00001, Note 7 | Note 1 |
| DBE High Relative Humidity (%RH) | 100 | 482 | hrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| DBE Low Relative Humidity (%RH) | 2 | 1000 | hrs | 24590-PTF-U0D-W16T-00001, Note 12 7 | Note 1 |
| DBE High Pressure (in.-w.g.) | 4 | 1000 | hrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| DBE Low Pressure (in.-w.g.) | -7.3 | 1000 | hrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| DBE Radiation Dose Rate (mR/hr) | Notes 4&8 | 0 | hrs | Note 8 | Note 1 |
| Flood Height (ft) | 2.08 | 1000 | hrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Submergence (ft) | 0 Note 5 | 7 N/A | hrs | 24590-PTF-U0D-W16T-00001 24590-QL-POA-MEVV-00001-01-226 7 | Note 1 |
| Chemical/Spray Exposure | YES | 1000 7 | hrs | 24590-PTF-U0D-W16T-00001 | Note 1 |
| Additional DBE Information | See Note 2 for Pressure Units | | | | |

| DBE Chemical Exposure Details | |
|---|---|
| DBE Chemical Types/Concentrations | Anti-Foaming Agent<br>Sodium Hydroxide, 5M |

| Interfaces (Electrical) | |
|---|---|
| Power Supply Voltage (VAC, VDC) | N/A |
| Power Supply Frequency (Hz) | N/A |
| Power Connection Method | N/A |
| I/O Signals to/from Equipment | N/A |
| I/O Connection Method | N/A |

| Interfaces (Mechanical) | |
|---|---|
| Mounting Configuration (orientation) | See dwg. 24590-QL-POA-MEVV-00001-01-226 |
| Mounting Method (bolts, welds, etc.) | Welded, TLP-SKID-00009, TLP-SKID-00010, 24590-PTF-DD-S13T-00025 |
| Auxiliary Devices | N/A |

**Equipment Seismic Qualification (ESQ)**

| Parameter | Title | Reference/Document Number | Version / Revision | Remarks |
|---|---|---|---|---|
| WTP Seismic Design Specification (BUYER) | Engineering Specification for Seismic Qualification Criteria for Pressure Vessels | 24590-WTP-3PS-MV00-T0002 | 002 | N/A |
| Specified Seismic Load (BUYER) | Seismic Analysis of Pretreatment Building - WSGM In-Structure Response Spectre (ISRS) 7 | 24590-PTF-S0C-S15T-00057 7 | 00A 7 | Calculation is not included in MR, see attached figures 37, 38, 67, 68 and 24E per CCN 185267. 7 |
| Design Seismic Load (SELLER | Calculation - 60% Design - HEP 1 FEP and TLP Separator Qualification | 24590-QL-POA-MEVV-00001-04-00065 7 | 00A 7 | |
| Qualification Method (SELLER) | Calculation - 60% Design - HEP 1 FEP and TLP Separator Qualification | 24590-QL-POA-MEVV-00001-04-00065 7 | 00A 7 | |
| Qualification Report Number (SELLER) | Calculation - 60% Design - HEP 1 FEP and TLP Separator Qualification | 24590-QL-POA-MEVV-00001-04-00065 7 | 00A 7 | |
| Submittal Number (BUYER) | Calculation - 60% Design - HEP 1 FEP and TLP Separator Qualification | 24590-QL-POA-MEVV-00001-04-00065 7 | 00A 7 | |

7

## Notes and Additional Information

Notes:

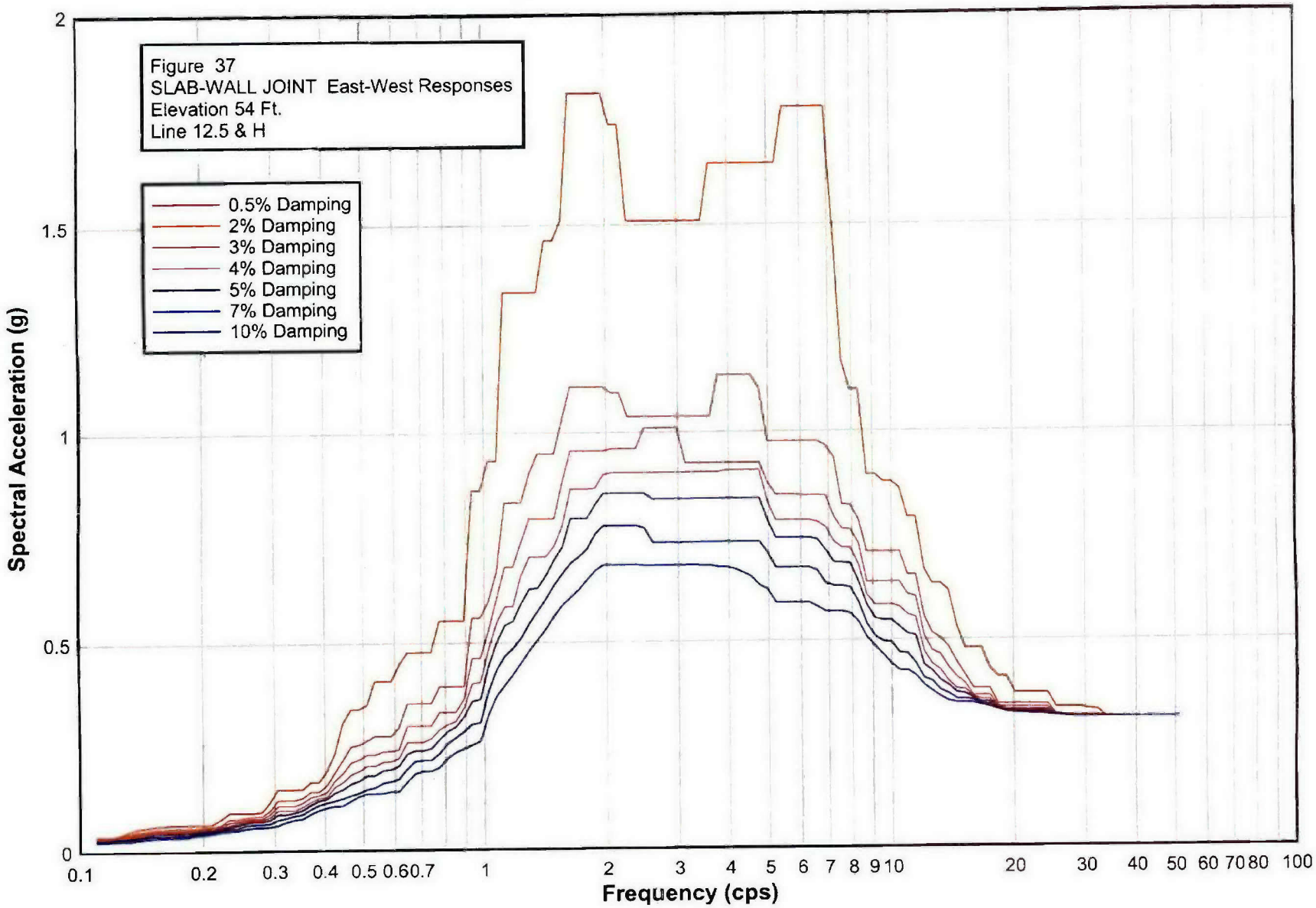
1. Data to be provided by SELLER through the submittal process as required on the G-321-E form.
2. Where pressure is given in inches of water column (in.-w.c.) in the source document, it is generally assumed that this is in reference to atmospheric pressure and is therefore equivalent to inches of water gage (in.-w.g.).
3. A shield plug is provided above the vessel for access to the demister pad section of the separator vessel.
4. Abnormal and DBE radiation dose rates are set equal to normal dose rate and do not contribute to the total integrated dose.
5. Submergence is determined from the lowest point of the vessel in relation to the flood height above the floor.
6. Environmental data given document 24590-PTF-U0D-W16T-00001 is for room environment only.
7. For application of AISC N690, the normal temperatures given in this document are not used. Abnormal temperatures shall be applied as Normal Operation Temperature, $T_O$, with seismic effects, $E_S$. The Design Basis Event Temperature shall be applied as a Thermal Load generated by a postulated accident, $T_A$, without seismic effects, $E_S$ or $E_O$.
8. Gamma radiation dose rate will not exceed 2.0 E+06 mRad/hr per CCN 175006 7. Beta radiation dose rate is 3.46E+03 mRad/hr based on the ratio of Strontium-90 from reference 6 as compared to the beta dose rate of Strontium-90 found in reference 7. The beta dose found in reference 7 is considered bounding. Beta dose rate source is process fluid from within the equipment. Dose rates are preliminary and subject to confirmation prior to shipment.
9. Deleted. 7
10. Abnormal low temperature, as calculated in reference 2, is based on a Loss of Heating Accident (LOHA) which occurs when steam supply to the building is lost. Since the evaporators are run on steam, this would cause the evaporators to go off-line. Abnormal low temperature will be based on reference 3 at 59°F.
11. The equipment qualification will be documented in accordance with the requirements in Appendix D of Engineering Specification for Environmental Qualification of Mechanical Equipment, document number 24590-WTP-3PS-G000-T0015 for the passive and active safety functions.
12. Parameter value used on data sheet has been previously established and determined more conservative than values 7 derived from the reference document noted.
13. For commercial reasons, safety and seismic classification may be higher than elsewhere documented, and therefore 7 conservative.

References:

1. 24590-WTP-PSAR-ESH-01-002-02, Rev. 04A, Preliminary documented safety analysis to support construction 7 authorization; PT facility specific information.
2. 24590-PTF-U0D-W16T-00001, Rev. 0, PTF Room Environment Datasheet.
3. 24590-WTP-DB-ENG-01-001, Rev. 1M, Basis of Design. 7
4. 24590-PTF-U0N-W16T-00001, Add data for room p-0427. Incorporate additional steam break analysis. 7
5. 24590-PTF-U0N-W16T-00003, Revised temperature & relative humidity data for PTF rooms. 7
6. 24590-WTP-Z0C-50-00008, Rev. B, Comparison of Source Terms for Use in Shielding Calculations.
7. 24590-LAB-Z0C-80-00001, Rev. D, Beta and Gamma Dose Rate Determinations from Laboratory Sample Bottles.

# RPP-WTP Pretreatment Facility ISRS

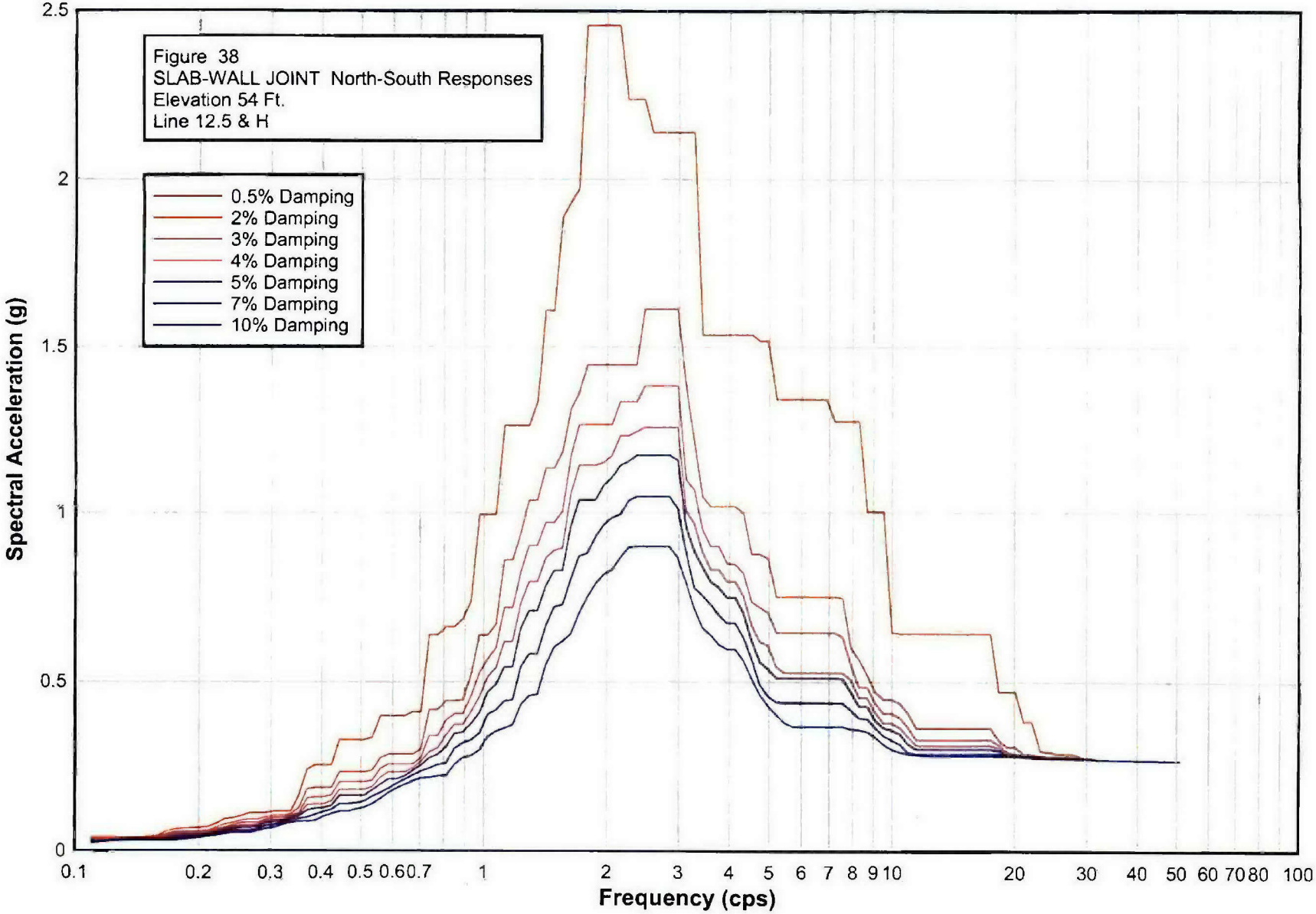
**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



# RPP-WTP Pretreatment Facility ISRS

7

**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**

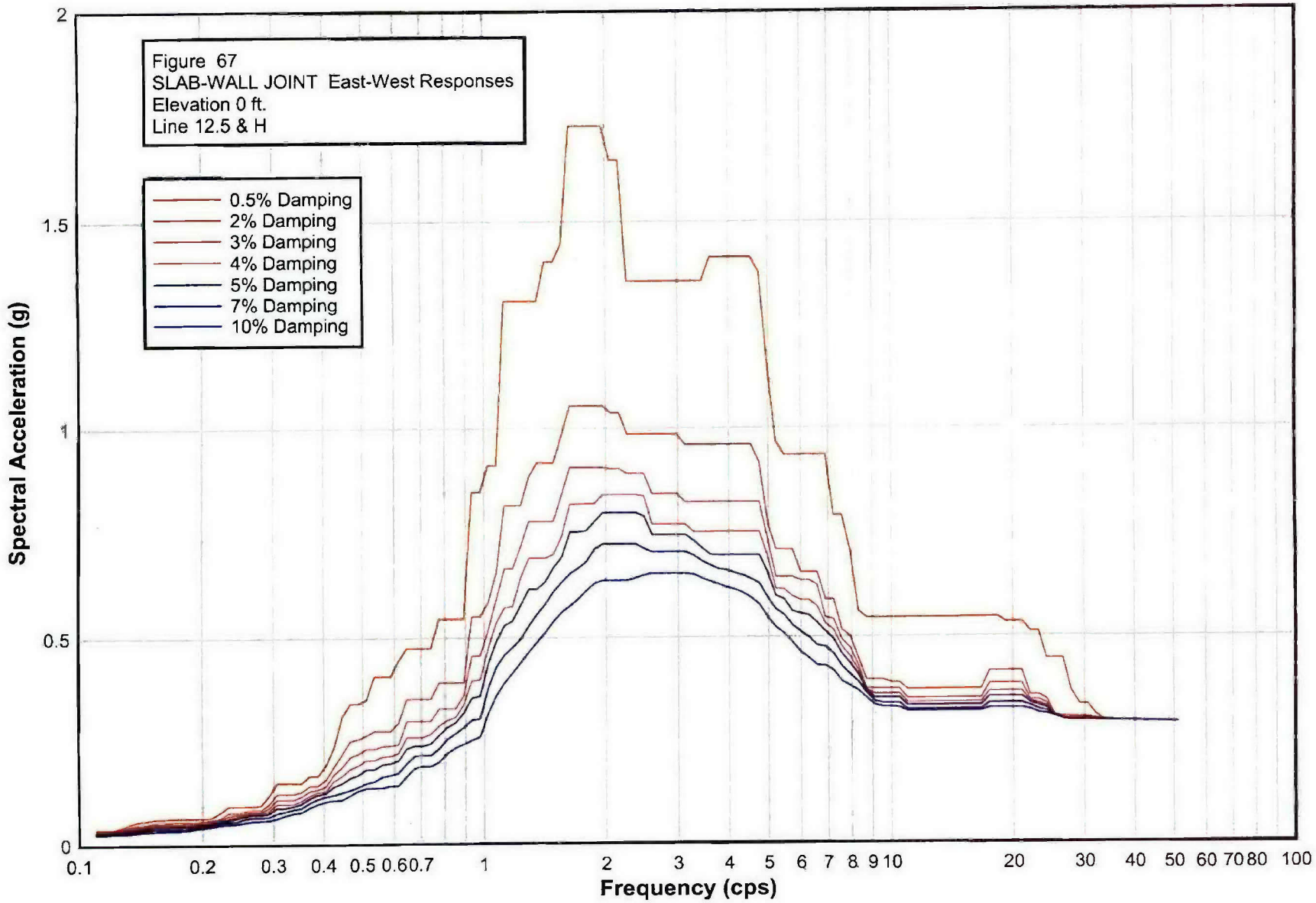





7

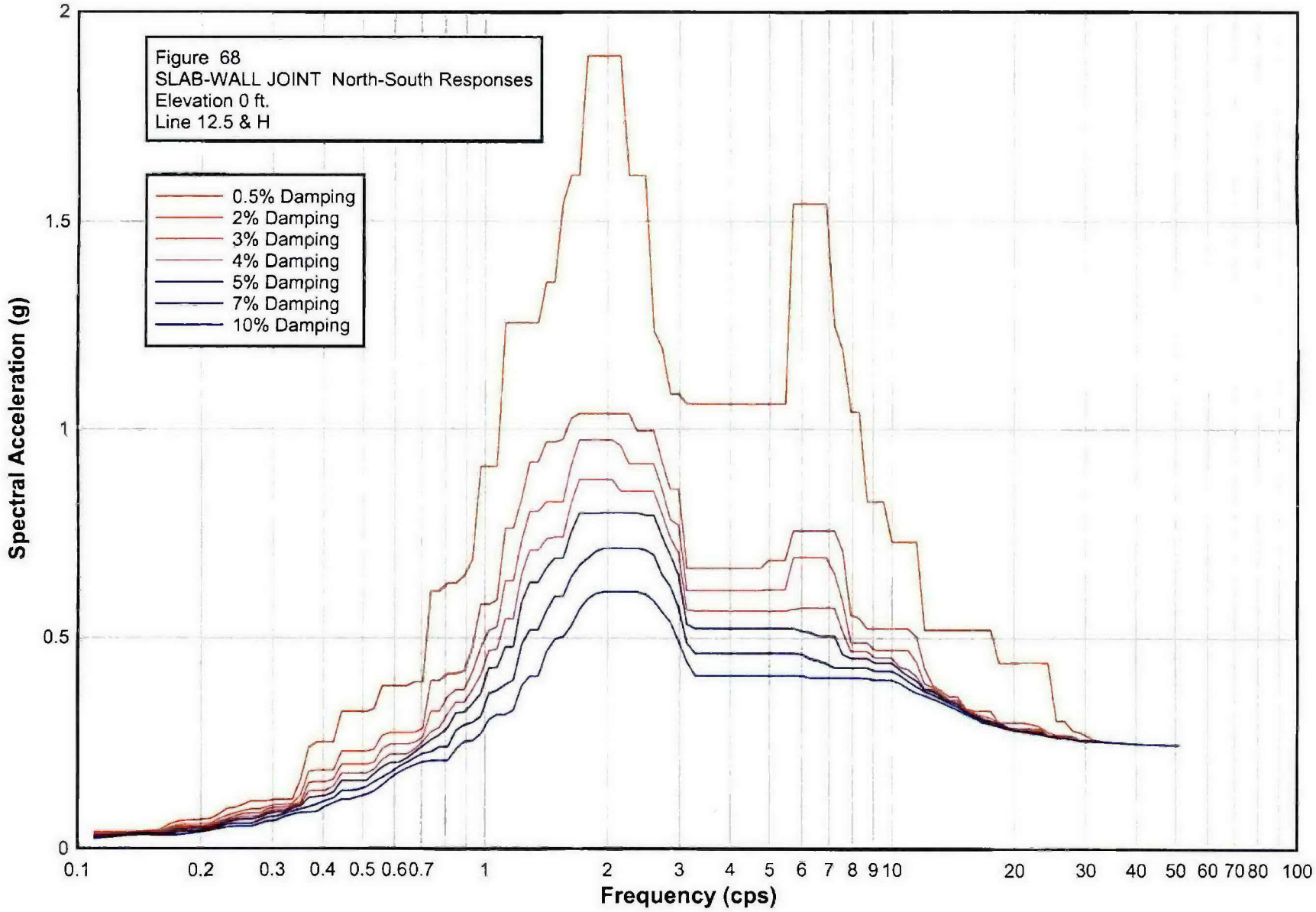
# RPP-WTP Pretreatment Facility ISRS

**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



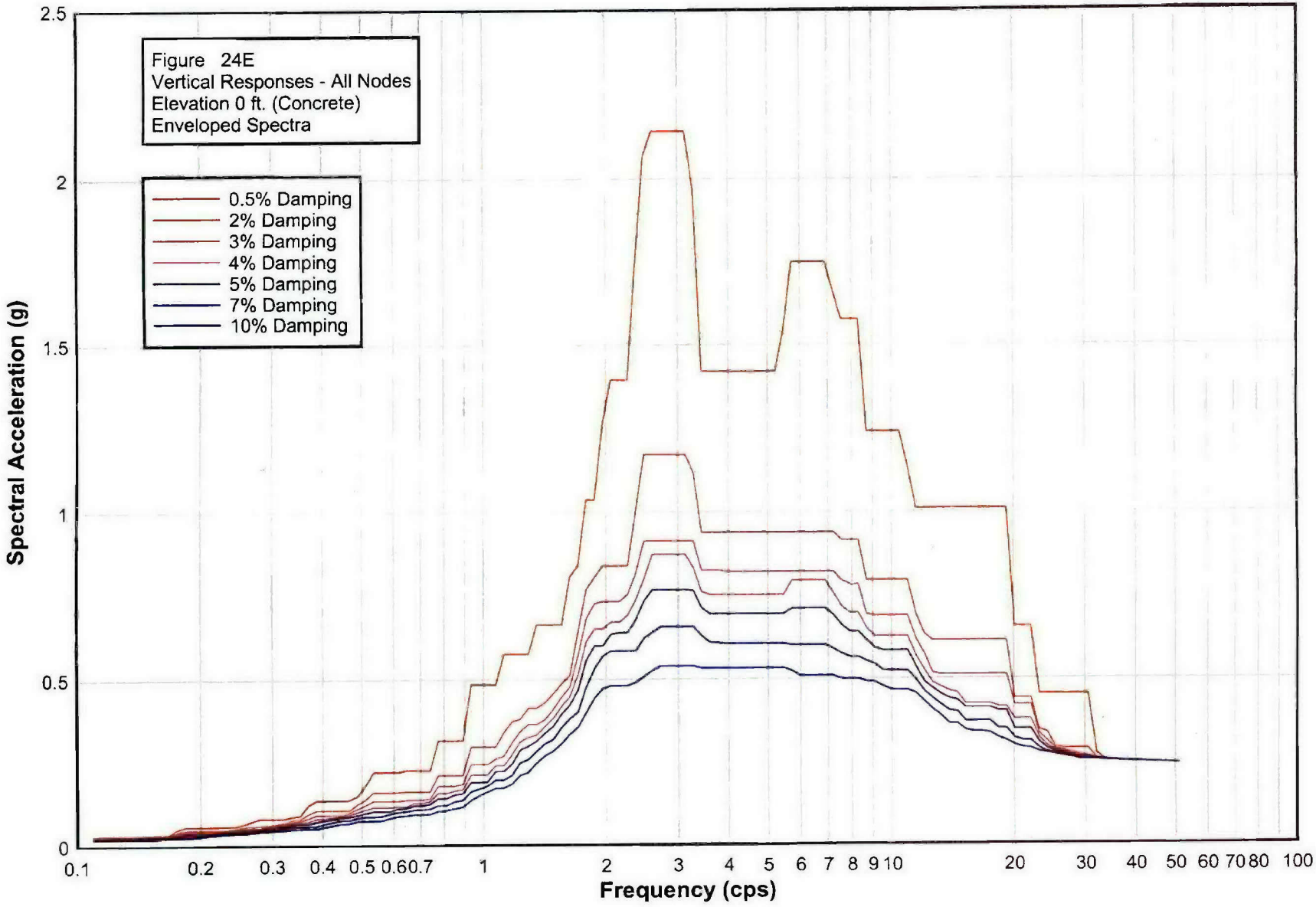
# RPP-WTP Pretreatment Facility ISRS

**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



# RPP-WTP Pretreatment Facility ISRS

**Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A**



PTWW037.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 37 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.1098 | 0.0375 | 0.1098 | 0.0344 | 0.1098 | 0.0327 | 0.1098 | 0.0312 | 0.1098 | 0.0298 | 0.1098 | 0.0274 | 0.1098 | 0.0252 |
| 0.115 | 0.0375 | 0.115 | 0.0344 | 0.115 | 0.0327 | 0.115 | 0.0312 | 0.115 | 0.0299 | 0.115 | 0.0277 | 0.115 | 0.0258 |
| 0.1204 | 0.0375 | 0.1204 | 0.0344 | 0.1204 | 0.0331 | 0.1204 | 0.0322 | 0.1204 | 0.0312 | 0.1204 | 0.0294 | 0.1204 | 0.0269 |
| 0.1262 | 0.0431 | 0.1262 | 0.0397 | 0.1262 | 0.0378 | 0.1262 | 0.036 | 0.1262 | 0.0343 | 0.1262 | 0.0314 | 0.1262 | 0.0278 |
| 0.1322 | 0.0504 | 0.1322 | 0.045 | 0.1322 | 0.042 | 0.1322 | 0.0393 | 0.1322 | 0.0369 | 0.1322 | 0.0328 | 0.1322 | 0.0281 |
| 0.1385 | 0.056 | 0.1385 | 0.0489 | 0.1385 | 0.0449 | 0.1385 | 0.0414 | 0.1385 | 0.0384 | 0.1385 | 0.0344 | 0.1385 | 0.0303 |
| 0.1451 | 0.058 | 0.1451 | 0.0509 | 0.1451 | 0.0475 | 0.1451 | 0.0445 | 0.1451 | 0.0419 | 0.1451 | 0.0375 | 0.1451 | 0.0325 |
| 0.152 | 0.0616 | 0.152 | 0.0546 | 0.152 | 0.0506 | 0.152 | 0.0472 | 0.152 | 0.0442 | 0.152 | 0.0391 | 0.152 | 0.0338 |
| 0.1592 | 0.062 | 0.1592 | 0.0546 | 0.1592 | 0.0506 | 0.1592 | 0.0472 | 0.1592 | 0.0442 | 0.1592 | 0.0396 | 0.1592 | 0.0351 |
| 0.1668 | 0.064 | 0.1668 | 0.056 | 0.1668 | 0.0517 | 0.1668 | 0.0481 | 0.1668 | 0.0451 | 0.1668 | 0.0403 | 0.1668 | 0.0356 |
| 0.1748 | 0.064 | 0.1748 | 0.056 | 0.1748 | 0.0517 | 0.1748 | 0.0481 | 0.1748 | 0.0451 | 0.1748 | 0.0403 | 0.1748 | 0.0356 |
| 0.1831 | 0.064 | 0.1831 | 0.056 | 0.1831 | 0.0517 | 0.1831 | 0.0481 | 0.1831 | 0.0451 | 0.1831 | 0.0403 | 0.1831 | 0.0368 |
| 0.1918 | 0.0641 | 0.1918 | 0.0561 | 0.1918 | 0.0517 | 0.1918 | 0.0495 | 0.1918 | 0.0477 | 0.1918 | 0.0445 | 0.1918 | 0.0404 |
| 0.2009 | 0.0642 | 0.2009 | 0.0583 | 0.2009 | 0.0558 | 0.2009 | 0.0535 | 0.2009 | 0.0513 | 0.2009 | 0.0474 | 0.2009 | 0.0424 |
| 0.2105 | 0.0665 | 0.2105 | 0.0603 | 0.2105 | 0.0575 | 0.2105 | 0.0549 | 0.2105 | 0.0525 | 0.2105 | 0.049 | 0.2105 | 0.0448 |
| 0.2205 | 0.078 | 0.2205 | 0.0647 | 0.2205 | 0.062 | 0.2205 | 0.0595 | 0.2205 | 0.0573 | 0.2205 | 0.0533 | 0.2205 | 0.0484 |
| 0.231 | 0.0933 | 0.231 | 0.0774 | 0.231 | 0.0694 | 0.231 | 0.063 | 0.231 | 0.0598 | 0.231 | 0.0556 | 0.231 | 0.0503 |
| 0.242 | 0.0933 | 0.242 | 0.0774 | 0.242 | 0.0723 | 0.242 | 0.0678 | 0.242 | 0.0638 | 0.242 | 0.0567 | 0.242 | 0.0513 |
| 0.2535 | 0.0933 | 0.2535 | 0.0817 | 0.2535 | 0.0771 | 0.2535 | 0.0729 | 0.2535 | 0.0692 | 0.2535 | 0.0628 | 0.2535 | 0.0553 |
| 0.2656 | 0.0933 | 0.2656 | 0.0839 | 0.2656 | 0.0794 | 0.2656 | 0.0754 | 0.2656 | 0.0718 | 0.2656 | 0.0653 | 0.2656 | 0.0575 |
| 0.2783 | 0.0954 | 0.2783 | 0.0847 | 0.2783 | 0.0794 | 0.2783 | 0.0754 | 0.2783 | 0.0718 | 0.2783 | 0.0653 | 0.2783 | 0.058 |
| 0.2915 | 0.1187 | 0.2915 | 0.0987 | 0.2915 | 0.089 | 0.2915 | 0.0813 | 0.2915 | 0.0753 | 0.2915 | 0.0668 | 0.2915 | 0.0592 |
| 0.3054 | 0.1504 | 0.3054 | 0.1235 | 0.3054 | 0.1097 | 0.3054 | 0.0985 | 0.3054 | 0.0894 | 0.3054 | 0.0758 | 0.3054 | 0.0633 |
| 0.3199 | 0.1504 | 0.3199 | 0.1235 | 0.3199 | 0.1097 | 0.3199 | 0.0985 | 0.3199 | 0.0894 | 0.3199 | 0.0801 | 0.3199 | 0.0706 |
| 0.3352 | 0.1504 | 0.3352 | 0.1235 | 0.3352 | 0.1097 | 0.3352 | 0.0985 | 0.3352 | 0.0931 | 0.3352 | 0.0857 | 0.3352 | 0.0762 |
| 0.3511 | 0.1504 | 0.3511 | 0.1289 | 0.3511 | 0.1172 | 0.3511 | 0.107 | 0.3511 | 0.0997 | 0.3511 | 0.0894 | 0.3511 | 0.0786 |
| 0.3678 | 0.168 | 0.3678 | 0.1438 | 0.3678 | 0.1303 | 0.3678 | 0.1186 | 0.3678 | 0.1121 | 0.3678 | 0.1017 | 0.3678 | 0.0898 |
| 0.3853 | 0.168 | 0.3853 | 0.1438 | 0.3853 | 0.1346 | 0.3853 | 0.1279 | 0.3853 | 0.1219 | 0.3853 | 0.1115 | 0.3853 | 0.0992 |
| 0.4037 | 0.194 | 0.4037 | 0.1598 | 0.4037 | 0.1426 | 0.4037 | 0.1306 | 0.4037 | 0.1259 | 0.4037 | 0.117 | 0.4037 | 0.1054 |
| 0.4229 | 0.2368 | 0.4229 | 0.1906 | 0.4229 | 0.1721 | 0.4229 | 0.1558 | 0.4229 | 0.1416 | 0.4229 | 0.1217 | 0.4229 | 0.1092 |
| 0.4431 | 0.3088 | 0.4431 | 0.2193 | 0.4431 | 0.1881 | 0.4431 | 0.1671 | 0.4431 | 0.1496 | 0.4431 | 0.1273 | 0.4431 | 0.1097 |
| 0.4642 | 0.3417 | 0.4642 | 0.2524 | 0.4642 | 0.2138 | 0.4642 | 0.1852 | 0.4642 | 0.1637 | 0.4642 | 0.1345 | 0.4642 | 0.1211 |
| 0.4863 | 0.3417 | 0.4863 | 0.256 | 0.4863 | 0.2208 | 0.4863 | 0.1928 | 0.4863 | 0.1701 | 0.4863 | 0.1409 | 0.4863 | 0.1323 |
| 0.5094 | 0.3522 | 0.5094 | 0.2656 | 0.5094 | 0.2325 | 0.5094 | 0.2054 | 0.5094 | 0.1831 | 0.5094 | 0.1497 | 0.5094 | 0.1391 |

PTWW037.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 37 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.5337 | 0.4096 | 0.5337 | 0.2771 | 0.5337 | 0.2325 | 0.5337 | 0.2054 | 0.5337 | 0.1831 | 0.5337 | 0.1539 | 0.5337 | 0.1396 |
| 0.5591 | 0.4096 | 0.5591 | 0.2771 | 0.5591 | 0.2398 | 0.5591 | 0.2148 | 0.5591 | 0.1949 | 0.5591 | 0.1654 | 0.5591 | 0.1396 |
| 0.5857 | 0.4096 | 0.5857 | 0.2771 | 0.5857 | 0.2404 | 0.5857 | 0.2159 | 0.5857 | 0.1975 | 0.5857 | 0.1686 | 0.5857 | 0.1441 |
| 0.6136 | 0.4475 | 0.6136 | 0.2969 | 0.6136 | 0.2444 | 0.6136 | 0.2234 | 0.6136 | 0.2051 | 0.6136 | 0.1751 | 0.6136 | 0.1441 |
| 0.6428 | 0.478 | 0.6428 | 0.3547 | 0.6428 | 0.3006 | 0.6428 | 0.2612 | 0.6428 | 0.2347 | 0.6428 | 0.1988 | 0.6428 | 0.168 |
| 0.6734 | 0.478 | 0.6734 | 0.3547 | 0.6734 | 0.3006 | 0.6734 | 0.2612 | 0.6734 | 0.2413 | 0.6734 | 0.2165 | 0.6734 | 0.1872 |
| 0.7055 | 0.478 | 0.7055 | 0.3547 | 0.7055 | 0.3006 | 0.7055 | 0.2612 | 0.7055 | 0.2413 | 0.7055 | 0.2186 | 0.7055 | 0.1922 |
| 0.7391 | 0.478 | 0.7391 | 0.3547 | 0.7391 | 0.3006 | 0.7391 | 0.2692 | 0.7391 | 0.2463 | 0.7391 | 0.2186 | 0.7391 | 0.1922 |
| 0.7743 | 0.5518 | 0.7743 | 0.3958 | 0.7743 | 0.3332 | 0.7743 | 0.2918 | 0.7743 | 0.268 | 0.7743 | 0.2351 | 0.7743 | 0.2018 |
| 0.8111 | 0.5518 | 0.8111 | 0.3958 | 0.8111 | 0.3332 | 0.8111 | 0.3035 | 0.8111 | 0.2874 | 0.8111 | 0.2587 | 0.8111 | 0.2236 |
| 0.8497 | 0.5518 | 0.8497 | 0.3958 | 0.8497 | 0.3332 | 0.8497 | 0.3117 | 0.8497 | 0.2984 | 0.8497 | 0.2723 | 0.8497 | 0.2373 |
| 0.8902 | 0.5518 | 0.8902 | 0.3958 | 0.8902 | 0.3656 | 0.8902 | 0.3431 | 0.8902 | 0.3226 | 0.8902 | 0.2873 | 0.8902 | 0.2462 |
| 0.9326 | 0.8605 | 0.9326 | 0.5585 | 0.9326 | 0.4629 | 0.9326 | 0.4023 | 0.9326 | 0.3602 | 0.9326 | 0.3049 | 0.9326 | 0.2549 |
| 0.977 | 0.8605 | 0.977 | 0.5585 | 0.977 | 0.4629 | 0.977 | 0.4045 | 0.977 | 0.3644 | 0.977 | 0.3083 | 0.977 | 0.2637 |
| 1.0235 | 0.9315 | 1.0235 | 0.5965 | 1.0235 | 0.5261 | 1.0235 | 0.4814 | 1.0235 | 0.4436 | 1.0235 | 0.3837 | 1.0235 | 0.3277 |
| 1.0723 | 0.9315 | 1.0723 | 0.6685 | 1.0723 | 0.603 | 1.0723 | 0.5467 | 1.0723 | 0.4995 | 1.0723 | 0.4355 | 1.0723 | 0.3729 |
| 1.1233 | 1.3398 | 1.1233 | 0.8315 | 1.1233 | 0.6788 | 1.1233 | 0.5837 | 1.1233 | 0.5408 | 1.1233 | 0.4681 | 1.1233 | 0.3987 |
| 1.1768 | 1.3398 | 1.1768 | 0.8315 | 1.1768 | 0.6788 | 1.1768 | 0.5855 | 1.1768 | 0.5505 | 1.1768 | 0.4858 | 1.1768 | 0.4238 |
| 1.2328 | 1.3398 | 1.2328 | 0.8315 | 1.2328 | 0.7369 | 1.2328 | 0.6596 | 1.2328 | 0.5925 | 1.2328 | 0.5105 | 1.2328 | 0.452 |
| 1.2916 | 1.3398 | 1.2916 | 0.9002 | 1.2916 | 0.7926 | 1.2916 | 0.7024 | 1.2916 | 0.6263 | 1.2916 | 0.5455 | 1.2916 | 0.4806 |
| 1.353 | 1.3398 | 1.353 | 0.9485 | 1.353 | 0.7926 | 1.353 | 0.7024 | 1.353 | 0.6282 | 1.353 | 0.574 | 1.353 | 0.5058 |
| 1.4175 | 1.4626 | 1.4175 | 0.9485 | 1.4175 | 0.7926 | 1.4175 | 0.7024 | 1.4175 | 0.6579 | 1.4175 | 0.6026 | 1.4175 | 0.5321 |
| 1.485 | 1.4626 | 1.485 | 0.9485 | 1.485 | 0.7926 | 1.485 | 0.7282 | 1.485 | 0.6958 | 1.485 | 0.636 | 1.485 | 0.5624 |
| 1.5557 | 1.5113 | 1.5557 | 1.0297 | 1.5557 | 0.8797 | 1.5557 | 0.7754 | 1.5557 | 0.726 | 1.5557 | 0.6634 | 1.5557 | 0.5886 |
| 1.6298 | 1.8158 | 1.6298 | 1.1086 | 1.6298 | 0.9552 | 1.6298 | 0.8627 | 1.6298 | 0.7931 | 1.6298 | 0.6875 | 1.6298 | 0.6064 |
| 1.7074 | 1.8158 | 1.7074 | 1.1086 | 1.7074 | 0.9552 | 1.7074 | 0.8627 | 1.7074 | 0.7931 | 1.7074 | 0.7024 | 1.7074 | 0.6246 |
| 1.7887 | 1.8158 | 1.7887 | 1.1086 | 1.7887 | 0.9552 | 1.7887 | 0.8627 | 1.7887 | 0.7931 | 1.7887 | 0.7213 | 1.7887 | 0.6476 |
| 1.8738 | 1.8158 | 1.8738 | 1.1086 | 1.8738 | 0.9552 | 1.8738 | 0.8651 | 1.8738 | 0.8263 | 1.8738 | 0.7567 | 1.8738 | 0.6698 |
| 1.963 | 1.8158 | 1.963 | 1.1086 | 1.963 | 0.9552 | 1.963 | 0.8972 | 1.963 | 0.8525 | 1.963 | 0.7755 | 1.963 | 0.683 |
| 2.0565 | 1.7414 | 2.0565 | 1.0948 | 2.0565 | 0.9593 | 2.0565 | 0.9017 | 2.0565 | 0.8525 | 2.0565 | 0.7755 | 2.0565 | 0.683 |
| 2.1544 | 1.7414 | 2.1544 | 1.0948 | 2.1544 | 0.9593 | 2.1544 | 0.9017 | 2.1544 | 0.8525 | 2.1544 | 0.7755 | 2.1544 | 0.683 |
| 2.257 | 1.5091 | 2.257 | 1.0367 | 2.257 | 0.9593 | 2.257 | 0.9017 | 2.257 | 0.8525 | 2.257 | 0.7755 | 2.257 | 0.683 |
| 2.3645 | 1.5091 | 2.3645 | 1.0367 | 2.3645 | 0.9593 | 2.3645 | 0.9017 | 2.3645 | 0.8525 | 2.3645 | 0.7755 | 2.3645 | 0.683 |
| 2.4771 | 1.5091 | 2.4771 | 1.0367 | 2.4771 | 1.009 | 2.4771 | 0.9017 | 2.4771 | 0.852 | 2.4771 | 0.7697 | 2.4771 | 0.6811 |
| 2.595 | 1.5091 | 2.595 | 1.0367 | 2.595 | 1.009 | 2.595 | 0.9017 | 2.595 | 0.8387 | 2.595 | 0.7357 | 2.595 | 0.6811 |

PTWW037.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 37 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.7186 | 1.5091 | 2.7186 | 1.0367 | 2.7186 | 1.009 | 2.7186 | 0.9017 | 2.7186 | 0.8387 | 2.7186 | 0.7357 | 2.7186 | 0.6811 |
| 2.848 | 1.5091 | 2.848 | 1.0367 | 2.848 | 1.009 | 2.848 | 0.9017 | 2.848 | 0.8387 | 2.848 | 0.7357 | 2.848 | 0.6811 |
| 2.9836 | 1.5091 | 2.9836 | 1.0367 | 2.9836 | 1.009 | 2.9836 | 0.9017 | 2.9836 | 0.8387 | 2.9836 | 0.7357 | 2.9836 | 0.6811 |
| 3.1257 | 1.5091 | 3.1257 | 1.0367 | 3.1257 | 0.9237 | 3.1257 | 0.9017 | 3.1257 | 0.8387 | 3.1257 | 0.7357 | 3.1257 | 0.6811 |
| 3.2745 | 1.5091 | 3.2745 | 1.0367 | 3.2745 | 0.9237 | 3.2745 | 0.9017 | 3.2745 | 0.8387 | 3.2745 | 0.7357 | 3.2745 | 0.6811 |
| 3.4305 | 1.5091 | 3.4305 | 1.0367 | 3.4305 | 0.9237 | 3.4305 | 0.9017 | 3.4305 | 0.8387 | 3.4305 | 0.7357 | 3.4305 | 0.6801 |
| 3.5938 | 1.6472 | 3.5938 | 1.0367 | 3.5938 | 0.9237 | 3.5938 | 0.9017 | 3.5938 | 0.8387 | 3.5938 | 0.7357 | 3.5938 | 0.6801 |
| 3.7649 | 1.6472 | 3.7649 | 1.1356 | 3.7649 | 0.9237 | 3.7649 | 0.9017 | 3.7649 | 0.8387 | 3.7649 | 0.7357 | 3.7649 | 0.6766 |
| 3.9442 | 1.6472 | 3.9442 | 1.1356 | 3.9442 | 0.9237 | 3.9442 | 0.906 | 3.9442 | 0.8387 | 3.9442 | 0.7357 | 3.9442 | 0.6759 |
| 4.132 | 1.6472 | 4.132 | 1.1356 | 4.132 | 0.9237 | 4.132 | 0.906 | 4.132 | 0.8387 | 4.132 | 0.7357 | 4.132 | 0.6712 |
| 4.3288 | 1.6472 | 4.3288 | 1.1356 | 4.3288 | 0.9237 | 4.3288 | 0.906 | 4.3288 | 0.8387 | 4.3288 | 0.7357 | 4.3288 | 0.6626 |
| 4.5349 | 1.6472 | 4.5349 | 1.1356 | 4.5349 | 0.9237 | 4.5349 | 0.906 | 4.5349 | 0.8387 | 4.5349 | 0.7357 | 4.5349 | 0.6525 |
| 4.7508 | 1.6472 | 4.7508 | 1.1048 | 4.7508 | 0.9237 | 4.7508 | 0.906 | 4.7508 | 0.8387 | 4.7508 | 0.7357 | 4.7508 | 0.6316 |
| 4.977 | 1.6472 | 4.977 | 0.9746 | 4.977 | 0.8757 | 4.977 | 0.829 | 4.977 | 0.7851 | 4.977 | 0.7083 | 4.977 | 0.6206 |
| 5.214 | 1.6472 | 5.214 | 0.9746 | 5.214 | 0.8463 | 5.214 | 0.785 | 5.214 | 0.7434 | 5.214 | 0.6732 | 5.214 | 0.5898 |
| 5.4623 | 1.7798 | 5.4623 | 0.9746 | 5.4623 | 0.8463 | 5.4623 | 0.785 | 5.4623 | 0.7434 | 5.4623 | 0.6732 | 5.4623 | 0.5898 |
| 5.7224 | 1.7798 | 5.7224 | 0.9746 | 5.7224 | 0.8463 | 5.7224 | 0.785 | 5.7224 | 0.7434 | 5.7224 | 0.6732 | 5.7224 | 0.5898 |
| 5.9948 | 1.7798 | 5.9948 | 0.9746 | 5.9948 | 0.8438 | 5.9948 | 0.785 | 5.9948 | 0.7434 | 5.9948 | 0.6732 | 5.9948 | 0.5898 |
| 6.2803 | 1.7798 | 6.2803 | 0.9746 | 6.2803 | 0.8438 | 6.2803 | 0.785 | 6.2803 | 0.7434 | 6.2803 | 0.6732 | 6.2803 | 0.5898 |
| 6.5793 | 1.7798 | 6.5793 | 0.9746 | 6.5793 | 0.8438 | 6.5793 | 0.7804 | 6.5793 | 0.7393 | 6.5793 | 0.6657 | 6.5793 | 0.5795 |
| 6.8926 | 1.7798 | 6.8926 | 0.963 | 6.8926 | 0.8429 | 6.8926 | 0.7674 | 6.8926 | 0.7128 | 6.8926 | 0.6345 | 6.8926 | 0.5677 |
| 7.2208 | 1.4914 | 7.2208 | 0.935 | 7.2208 | 0.7922 | 7.2208 | 0.7331 | 7.2208 | 0.6844 | 7.2208 | 0.6283 | 7.2208 | 0.5677 |
| 7.5646 | 1.168 | 7.5646 | 0.822 | 7.5646 | 0.7632 | 7.5646 | 0.7188 | 7.5646 | 0.6833 | 7.5646 | 0.6283 | 7.5646 | 0.5677 |
| 7.9248 | 1.0987 | 7.9248 | 0.8201 | 7.9248 | 0.7623 | 7.9248 | 0.7176 | 7.9248 | 0.6811 | 7.9248 | 0.6237 | 7.9248 | 0.5627 |
| 8.3022 | 1.0987 | 8.3022 | 0.7845 | 8.3022 | 0.7283 | 8.3022 | 0.6777 | 8.3022 | 0.6364 | 8.3022 | 0.5884 | 8.3022 | 0.5417 |
| 8.6975 | 0.8935 | 8.6975 | 0.7092 | 8.6975 | 0.6368 | 8.6975 | 0.6061 | 8.6975 | 0.5819 | 8.6975 | 0.5373 | 8.6975 | 0.5059 |
| 9.1116 | 0.8935 | 9.1116 | 0.7092 | 9.1116 | 0.6368 | 9.1116 | 0.5827 | 9.1116 | 0.5505 | 9.1116 | 0.5085 | 9.1116 | 0.4846 |
| 9.5455 | 0.8763 | 9.5455 | 0.7092 | 9.5455 | 0.6368 | 9.5455 | 0.5827 | 9.5455 | 0.5459 | 9.5455 | 0.4951 | 9.5455 | 0.4643 |
| 10 | 0.8763 | 10 | 0.7092 | 10 | 0.6368 | 10 | 0.5827 | 10 | 0.5459 | 10 | 0.4934 | 10 | 0.4429 |
| 10.4762 | 0.8603 | 10.4762 | 0.7092 | 10.4762 | 0.6368 | 10.4762 | 0.5774 | 10.4762 | 0.5297 | 10.4762 | 0.4688 | 10.4762 | 0.4271 |
| 10.975 | 0.791 | 10.975 | 0.6543 | 10.975 | 0.6067 | 10.975 | 0.5582 | 10.975 | 0.5137 | 10.975 | 0.4674 | 10.975 | 0.4271 |
| 11.4976 | 0.791 | 11.4976 | 0.6543 | 11.4976 | 0.6014 | 11.4976 | 0.5519 | 11.4976 | 0.5094 | 11.4976 | 0.4435 | 11.4976 | 0.4142 |
| 12.045 | 0.6677 | 12.045 | 0.5543 | 12.045 | 0.5086 | 12.045 | 0.4716 | 12.045 | 0.4394 | 12.045 | 0.4081 | 12.045 | 0.3915 |
| 12.6186 | 0.6325 | 12.6186 | 0.5145 | 12.6186 | 0.4727 | 12.6186 | 0.4409 | 12.6186 | 0.4251 | 12.6186 | 0.4004 | 12.6186 | 0.3774 |
| 13.2194 | 0.6325 | 13.2194 | 0.5025 | 13.2194 | 0.4639 | 13.2194 | 0.4269 | 13.2194 | 0.4021 | 13.2194 | 0.379 | 13.2194 | 0.3634 |

PTWW037.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 37 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 0.6152 | 13.8489 | 0.4815 | 13.8489 | 0.433 | 13.8489 | 0.3995 | 13.8489 | 0.3896 | 13.8489 | 0.3705 | 13.8489 | 0.3527 |
| 14.5083 | 0.5318 | 14.5083 | 0.4455 | 14.5083 | 0.4096 | 14.5083 | 0.381 | 14.5083 | 0.3726 | 14.5083 | 0.3575 | 14.5083 | 0.3484 |
| 15.1991 | 0.4787 | 15.1991 | 0.4141 | 15.1991 | 0.3936 | 15.1991 | 0.3795 | 15.1991 | 0.3697 | 15.1991 | 0.3575 | 15.1991 | 0.3484 |
| 15.9228 | 0.4787 | 15.9228 | 0.3815 | 15.9228 | 0.3644 | 15.9228 | 0.3609 | 15.9228 | 0.358 | 15.9228 | 0.3528 | 15.9228 | 0.3467 |
| 16.681 | 0.4787 | 16.681 | 0.3815 | 16.681 | 0.3644 | 16.681 | 0.3544 | 16.681 | 0.3483 | 16.681 | 0.3439 | 16.681 | 0.3416 |
| 17.4753 | 0.4307 | 17.4753 | 0.3815 | 17.4753 | 0.3644 | 17.4753 | 0.3544 | 17.4753 | 0.3483 | 17.4753 | 0.3418 | 17.4753 | 0.337 |
| 18.3074 | 0.4095 | 18.3074 | 0.3431 | 18.3074 | 0.3367 | 18.3074 | 0.3354 | 18.3074 | 0.3336 | 18.3074 | 0.3315 | 18.3074 | 0.3305 |
| 19.1791 | 0.4095 | 19.1791 | 0.3431 | 19.1791 | 0.3349 | 19.1791 | 0.3293 | 19.1791 | 0.3262 | 19.1791 | 0.3251 | 19.1791 | 0.325 |
| 20.0923 | 0.3708 | 20.0923 | 0.3431 | 20.0923 | 0.3349 | 20.0923 | 0.3293 | 20.0923 | 0.3262 | 20.0923 | 0.3243 | 20.0923 | 0.323 |
| 21.049 | 0.3708 | 21.049 | 0.3431 | 21.049 | 0.3349 | 21.049 | 0.3293 | 21.049 | 0.3262 | 21.049 | 0.3236 | 21.049 | 0.3215 |
| 22.0513 | 0.3708 | 22.0513 | 0.3431 | 22.0513 | 0.3349 | 22.0513 | 0.3293 | 22.0513 | 0.3262 | 22.0513 | 0.323 | 22.0513 | 0.3199 |
| 23.1013 | 0.3708 | 23.1013 | 0.3431 | 23.1013 | 0.3349 | 23.1013 | 0.3293 | 23.1013 | 0.3262 | 23.1013 | 0.323 | 23.1013 | 0.3199 |
| 24.2013 | 0.3708 | 24.2013 | 0.3431 | 24.2013 | 0.3349 | 24.2013 | 0.3293 | 24.2013 | 0.3255 | 24.2013 | 0.3206 | 24.2013 | 0.3186 |
| 25.3536 | 0.3358 | 25.3536 | 0.3197 | 25.3536 | 0.3192 | 25.3536 | 0.3187 | 25.3536 | 0.3181 | 25.3536 | 0.317 | 25.3536 | 0.3164 |
| 26.5609 | 0.3358 | 26.5609 | 0.3169 | 26.5609 | 0.3159 | 26.5609 | 0.3158 | 26.5609 | 0.3158 | 26.5609 | 0.3155 | 26.5609 | 0.3148 |
| 27.8256 | 0.3358 | 27.8256 | 0.3169 | 27.8256 | 0.3159 | 27.8256 | 0.3153 | 27.8256 | 0.3149 | 27.8256 | 0.3143 | 27.8256 | 0.3137 |
| 29.1505 | 0.3358 | 29.1505 | 0.3165 | 29.1505 | 0.3153 | 29.1505 | 0.3142 | 29.1505 | 0.3137 | 29.1505 | 0.3132 | 29.1505 | 0.313 |
| 30.5386 | 0.3312 | 30.5386 | 0.3165 | 30.5386 | 0.3153 | 30.5386 | 0.3142 | 30.5386 | 0.3133 | 30.5386 | 0.3131 | 30.5386 | 0.313 |
| 31.9927 | 0.3297 | 31.9927 | 0.3163 | 31.9927 | 0.3146 | 31.9927 | 0.3138 | 31.9927 | 0.3132 | 31.9927 | 0.3131 | 31.9927 | 0.313 |
| 33.516 | 0.3144 | 33.516 | 0.3134 | 33.516 | 0.3133 | 33.516 | 0.3132 | 33.516 | 0.3132 | 33.516 | 0.3131 | 33.516 | 0.313 |
| 35.1119 | 0.3135 | 35.1119 | 0.3134 | 35.1119 | 0.3133 | 35.1119 | 0.3132 | 35.1119 | 0.3132 | 35.1119 | 0.3131 | 35.1119 | 0.313 |
| 36.7838 | 0.3134 | 36.7838 | 0.3133 | 36.7838 | 0.3132 | 36.7838 | 0.3132 | 36.7838 | 0.3132 | 36.7838 | 0.3131 | 36.7838 | 0.313 |
| 38.5353 | 0.3132 | 38.5353 | 0.3132 | 38.5353 | 0.3131 | 38.5353 | 0.3131 | 38.5353 | 0.3131 | 38.5353 | 0.3131 | 38.5353 | 0.313 |
| 40.3702 | 0.3131 | 40.3702 | 0.3131 | 40.3702 | 0.3131 | 40.3702 | 0.313 | 40.3702 | 0.313 | 40.3702 | 0.313 | 40.3702 | 0.3129 |
| 42.2924 | 0.313 | 42.2924 | 0.3129 | 42.2924 | 0.3129 | 42.2924 | 0.3129 | 42.2924 | 0.3129 | 42.2924 | 0.3129 | 42.2924 | 0.3129 |
| 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 | 44.3062 | 0.3128 |
| 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 | 46.4159 | 0.3127 |
| 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 | 48.626 | 0.3126 |
| 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 | 50.9414 | 0.3125 |

PTWW038.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 38 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.1098 | 0.0405 | 0.1098 | 0.0365 | 0.1098 | 0.0342 | 0.1098 | 0.0322 | 0.1098 | 0.0303 | 0.1098 | 0.0272 | 0.1098 | 0.0235 |
| 0.115 | 0.0405 | 0.115 | 0.0365 | 0.115 | 0.0342 | 0.115 | 0.0322 | 0.115 | 0.0303 | 0.115 | 0.0272 | 0.115 | 0.0259 |
| 0.1204 | 0.0405 | 0.1204 | 0.0365 | 0.1204 | 0.0342 | 0.1204 | 0.0322 | 0.1204 | 0.031 | 0.1204 | 0.0297 | 0.1204 | 0.028 |
| 0.1262 | 0.0405 | 0.1262 | 0.0365 | 0.1262 | 0.0352 | 0.1262 | 0.0342 | 0.1262 | 0.0334 | 0.1262 | 0.0318 | 0.1262 | 0.0297 |
| 0.1322 | 0.0405 | 0.1322 | 0.0382 | 0.1322 | 0.037 | 0.1322 | 0.0359 | 0.1322 | 0.0349 | 0.1322 | 0.0333 | 0.1322 | 0.0316 |
| 0.1385 | 0.0411 | 0.1385 | 0.0392 | 0.1385 | 0.0382 | 0.1385 | 0.0372 | 0.1385 | 0.0363 | 0.1385 | 0.0348 | 0.1385 | 0.0328 |
| 0.1451 | 0.0417 | 0.1451 | 0.0398 | 0.1451 | 0.0387 | 0.1451 | 0.0377 | 0.1451 | 0.0368 | 0.1451 | 0.0352 | 0.1451 | 0.0332 |
| 0.152 | 0.0439 | 0.152 | 0.0401 | 0.152 | 0.0387 | 0.152 | 0.0377 | 0.152 | 0.0368 | 0.152 | 0.0352 | 0.152 | 0.0332 |
| 0.1592 | 0.0462 | 0.1592 | 0.0416 | 0.1592 | 0.0396 | 0.1592 | 0.0377 | 0.1592 | 0.0368 | 0.1592 | 0.0352 | 0.1592 | 0.0332 |
| 0.1668 | 0.0584 | 0.1668 | 0.0506 | 0.1668 | 0.0463 | 0.1668 | 0.0426 | 0.1668 | 0.0395 | 0.1668 | 0.0352 | 0.1668 | 0.0332 |
| 0.1748 | 0.0645 | 0.1748 | 0.0566 | 0.1748 | 0.0522 | 0.1748 | 0.0484 | 0.1748 | 0.045 | 0.1748 | 0.0394 | 0.1748 | 0.0332 |
| 0.1831 | 0.0668 | 0.1831 | 0.0583 | 0.1831 | 0.0541 | 0.1831 | 0.0504 | 0.1831 | 0.0471 | 0.1831 | 0.0415 | 0.1831 | 0.0354 |
| 0.1918 | 0.0678 | 0.1918 | 0.0586 | 0.1918 | 0.0543 | 0.1918 | 0.0507 | 0.1918 | 0.0474 | 0.1918 | 0.0418 | 0.1918 | 0.038 |
| 0.2009 | 0.0697 | 0.2009 | 0.0596 | 0.2009 | 0.0543 | 0.2009 | 0.0514 | 0.2009 | 0.0487 | 0.2009 | 0.0438 | 0.2009 | 0.0411 |
| 0.2105 | 0.0722 | 0.2105 | 0.062 | 0.2105 | 0.0582 | 0.2105 | 0.0547 | 0.2105 | 0.0516 | 0.2105 | 0.0482 | 0.2105 | 0.0446 |
| 0.2205 | 0.0819 | 0.2205 | 0.0709 | 0.2205 | 0.0651 | 0.2205 | 0.06 | 0.2205 | 0.0574 | 0.2205 | 0.0531 | 0.2205 | 0.0475 |
| 0.231 | 0.0959 | 0.231 | 0.0792 | 0.231 | 0.0703 | 0.231 | 0.0665 | 0.231 | 0.063 | 0.231 | 0.0578 | 0.231 | 0.0525 |
| 0.242 | 0.0984 | 0.242 | 0.0845 | 0.242 | 0.0774 | 0.242 | 0.0721 | 0.242 | 0.0681 | 0.242 | 0.0618 | 0.242 | 0.0551 |
| 0.2535 | 0.1059 | 0.2535 | 0.0913 | 0.2535 | 0.0833 | 0.2535 | 0.0763 | 0.2535 | 0.0702 | 0.2535 | 0.0618 | 0.2535 | 0.0551 |
| 0.2656 | 0.1138 | 0.2656 | 0.0944 | 0.2656 | 0.084 | 0.2656 | 0.0763 | 0.2656 | 0.0702 | 0.2656 | 0.0618 | 0.2656 | 0.0551 |
| 0.2783 | 0.1138 | 0.2783 | 0.0944 | 0.2783 | 0.084 | 0.2783 | 0.0779 | 0.2783 | 0.074 | 0.2783 | 0.0677 | 0.2783 | 0.0611 |
| 0.2915 | 0.1138 | 0.2915 | 0.1008 | 0.2915 | 0.0946 | 0.2915 | 0.0892 | 0.2915 | 0.0843 | 0.2915 | 0.0764 | 0.2915 | 0.0677 |
| 0.3054 | 0.1179 | 0.3054 | 0.1056 | 0.3054 | 0.0987 | 0.3054 | 0.0926 | 0.3054 | 0.0872 | 0.3054 | 0.0785 | 0.3054 | 0.0706 |
| 0.3199 | 0.1179 | 0.3199 | 0.1056 | 0.3199 | 0.0987 | 0.3199 | 0.0926 | 0.3199 | 0.0894 | 0.3199 | 0.0844 | 0.3199 | 0.0786 |
| 0.3352 | 0.1179 | 0.3352 | 0.1098 | 0.3352 | 0.1056 | 0.3352 | 0.1017 | 0.3352 | 0.0982 | 0.3352 | 0.0921 | 0.3352 | 0.0848 |
| 0.3511 | 0.1654 | 0.3511 | 0.129 | 0.3511 | 0.1133 | 0.3511 | 0.1075 | 0.3511 | 0.1035 | 0.3511 | 0.0964 | 0.3511 | 0.088 |
| 0.3678 | 0.2415 | 0.3678 | 0.1832 | 0.3678 | 0.1565 | 0.3678 | 0.1364 | 0.3678 | 0.1213 | 0.3678 | 0.1006 | 0.3678 | 0.088 |
| 0.3853 | 0.2549 | 0.3853 | 0.187 | 0.3853 | 0.1595 | 0.3853 | 0.1387 | 0.3853 | 0.1269 | 0.3853 | 0.1092 | 0.3853 | 0.091 |
| 0.4037 | 0.2549 | 0.4037 | 0.187 | 0.4037 | 0.1595 | 0.4037 | 0.1387 | 0.4037 | 0.1279 | 0.4037 | 0.1163 | 0.4037 | 0.1034 |
| 0.4229 | 0.2549 | 0.4229 | 0.187 | 0.4229 | 0.1651 | 0.4229 | 0.1485 | 0.4229 | 0.1344 | 0.4229 | 0.1233 | 0.4229 | 0.1111 |
| 0.4431 | 0.3288 | 0.4431 | 0.2339 | 0.4431 | 0.2038 | 0.4431 | 0.1813 | 0.4431 | 0.1641 | 0.4431 | 0.1399 | 0.4431 | 0.1181 |
| 0.4642 | 0.3288 | 0.4642 | 0.2339 | 0.4642 | 0.2038 | 0.4642 | 0.1813 | 0.4642 | 0.1641 | 0.4642 | 0.1399 | 0.4642 | 0.1181 |
| 0.4863 | 0.3288 | 0.4863 | 0.2339 | 0.4863 | 0.2038 | 0.4863 | 0.1813 | 0.4863 | 0.1641 | 0.4863 | 0.1421 | 0.4863 | 0.1246 |
| 0.5094 | 0.3288 | 0.5094 | 0.2339 | 0.5094 | 0.2038 | 0.5094 | 0.1813 | 0.5094 | 0.1641 | 0.5094 | 0.1472 | 0.5094 | 0.1295 |

PTWW038.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 38 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.5337 | 0.3356 | 0.5337 | 0.2387 | 0.5337 | 0.2081 | 0.5337 | 0.19 | 0.5337 | 0.1796 | 0.5337 | 0.1614 | 0.5337 | 0.1401 |
| 0.5591 | 0.3997 | 0.5591 | 0.2762 | 0.5591 | 0.244 | 0.5591 | 0.2179 | 0.5591 | 0.1971 | 0.5591 | 0.1724 | 0.5591 | 0.1556 |
| 0.5857 | 0.3997 | 0.5857 | 0.2863 | 0.5857 | 0.2573 | 0.5857 | 0.2332 | 0.5857 | 0.2128 | 0.5857 | 0.1853 | 0.5857 | 0.1724 |
| 0.6136 | 0.3997 | 0.6136 | 0.2863 | 0.6136 | 0.2573 | 0.6136 | 0.2332 | 0.6136 | 0.2128 | 0.6136 | 0.1998 | 0.6136 | 0.1858 |
| 0.6428 | 0.3997 | 0.6428 | 0.2863 | 0.6428 | 0.2573 | 0.6428 | 0.2332 | 0.6428 | 0.2219 | 0.6428 | 0.2115 | 0.6428 | 0.1969 |
| 0.6734 | 0.411 | 0.6734 | 0.2863 | 0.6734 | 0.2574 | 0.6734 | 0.2449 | 0.6734 | 0.2378 | 0.6734 | 0.2244 | 0.6734 | 0.2072 |
| 0.7055 | 0.411 | 0.7055 | 0.301 | 0.7055 | 0.2757 | 0.7055 | 0.2638 | 0.7055 | 0.2534 | 0.7055 | 0.2357 | 0.7055 | 0.2156 |
| 0.7391 | 0.6367 | 0.7391 | 0.4169 | 0.7391 | 0.3404 | 0.7391 | 0.2927 | 0.7391 | 0.2746 | 0.7391 | 0.2445 | 0.7391 | 0.217 |
| 0.7743 | 0.6367 | 0.7743 | 0.4169 | 0.7743 | 0.3404 | 0.7743 | 0.3038 | 0.7743 | 0.2858 | 0.7743 | 0.2555 | 0.7743 | 0.2218 |
| 0.8111 | 0.6596 | 0.8111 | 0.4428 | 0.8111 | 0.386 | 0.8111 | 0.3422 | 0.8111 | 0.3081 | 0.8111 | 0.2598 | 0.8111 | 0.2218 |
| 0.8497 | 0.6596 | 0.8497 | 0.4428 | 0.8497 | 0.4051 | 0.8497 | 0.3738 | 0.8497 | 0.347 | 0.8497 | 0.3034 | 0.8497 | 0.256 |
| 0.8902 | 0.6828 | 0.8902 | 0.4451 | 0.8902 | 0.4051 | 0.8902 | 0.3738 | 0.8902 | 0.3511 | 0.8902 | 0.3194 | 0.8902 | 0.2761 |
| 0.9326 | 0.737 | 0.9326 | 0.5191 | 0.9326 | 0.4567 | 0.9326 | 0.411 | 0.9326 | 0.3766 | 0.9326 | 0.328 | 0.9326 | 0.2821 |
| 0.977 | 0.9914 | 0.977 | 0.6358 | 0.977 | 0.525 | 0.977 | 0.4553 | 0.977 | 0.408 | 0.977 | 0.3484 | 0.977 | 0.2994 |
| 1.0235 | 0.9914 | 1.0235 | 0.6358 | 1.0235 | 0.5662 | 1.0235 | 0.5139 | 1.0235 | 0.4702 | 1.0235 | 0.4041 | 1.0235 | 0.3384 |
| 1.0723 | 0.9914 | 1.0723 | 0.6668 | 1.0723 | 0.5976 | 1.0723 | 0.5399 | 1.0723 | 0.4914 | 1.0723 | 0.4166 | 1.0723 | 0.3541 |
| 1.1233 | 1.2606 | 1.1233 | 0.8561 | 1.1233 | 0.7168 | 1.1233 | 0.6174 | 1.1233 | 0.5433 | 1.1233 | 0.4431 | 1.1233 | 0.3633 |
| 1.1768 | 1.2606 | 1.1768 | 0.8561 | 1.1768 | 0.7168 | 1.1768 | 0.6174 | 1.1768 | 0.5433 | 1.1768 | 0.4467 | 1.1768 | 0.3729 |
| 1.2328 | 1.2606 | 1.2328 | 0.935 | 1.2328 | 0.8202 | 1.2328 | 0.7293 | 1.2328 | 0.6556 | 1.2328 | 0.5433 | 1.2328 | 0.4321 |
| 1.2916 | 1.2606 | 1.2916 | 1.0351 | 1.2916 | 0.8991 | 1.2916 | 0.793 | 1.2916 | 0.708 | 1.2916 | 0.5814 | 1.2916 | 0.4586 |
| 1.353 | 1.3319 | 1.353 | 1.0351 | 1.353 | 0.8991 | 1.353 | 0.793 | 1.353 | 0.708 | 1.353 | 0.5814 | 1.353 | 0.4631 |
| 1.4175 | 1.6092 | 1.4175 | 1.1325 | 1.4175 | 0.9683 | 1.4175 | 0.8621 | 1.4175 | 0.7817 | 1.4175 | 0.6627 | 1.4175 | 0.5486 |
| 1.485 | 1.6092 | 1.485 | 1.1325 | 1.485 | 0.9683 | 1.485 | 0.885 | 1.485 | 0.8264 | 1.485 | 0.7199 | 1.485 | 0.6006 |
| 1.5557 | 1.8872 | 1.5557 | 1.1818 | 1.5557 | 1.0008 | 1.5557 | 0.892 | 1.5557 | 0.8264 | 1.5557 | 0.7265 | 1.5557 | 0.6185 |
| 1.6298 | 1.9322 | 1.6298 | 1.3084 | 1.6298 | 1.1683 | 1.6298 | 1.0534 | 1.6298 | 0.9565 | 1.6298 | 0.8016 | 1.6298 | 0.6401 |
| 1.7074 | 1.9702 | 1.7074 | 1.3601 | 1.7074 | 1.2627 | 1.7074 | 1.1415 | 1.7074 | 1.0371 | 1.7074 | 0.8692 | 1.7074 | 0.7006 |
| 1.7887 | 2.4552 | 1.7887 | 1.4456 | 1.7887 | 1.2629 | 1.7887 | 1.1415 | 1.7887 | 1.0371 | 1.7887 | 0.8773 | 1.7887 | 0.7486 |
| 1.8738 | 2.4552 | 1.8738 | 1.4456 | 1.8738 | 1.2629 | 1.8738 | 1.1415 | 1.8738 | 1.0371 | 1.8738 | 0.9259 | 1.8738 | 0.788 |
| 1.963 | 2.4552 | 1.963 | 1.4456 | 1.963 | 1.2629 | 1.963 | 1.1498 | 1.963 | 1.0818 | 1.963 | 0.9626 | 1.963 | 0.8157 |
| 2.0565 | 2.4552 | 2.0565 | 1.4456 | 2.0565 | 1.2629 | 2.0565 | 1.1701 | 2.0565 | 1.1049 | 2.0565 | 0.9829 | 2.0565 | 0.8288 |
| 2.1544 | 2.4552 | 2.1544 | 1.4456 | 2.1544 | 1.3316 | 2.1544 | 1.2297 | 2.1544 | 1.1411 | 2.1544 | 0.9932 | 2.1544 | 0.8645 |
| 2.257 | 2.2367 | 2.257 | 1.4456 | 2.257 | 1.3316 | 2.257 | 1.2297 | 2.257 | 1.1534 | 2.257 | 1.0344 | 2.257 | 0.8939 |
| 2.3645 | 2.2367 | 2.3645 | 1.4456 | 2.3645 | 1.3316 | 2.3645 | 1.2422 | 2.3645 | 1.1724 | 2.3645 | 1.0471 | 2.3645 | 0.898 |
| 2.4771 | 2.2367 | 2.4771 | 1.6143 | 2.4771 | 1.3804 | 2.4771 | 1.2551 | 2.4771 | 1.1724 | 2.4771 | 1.0471 | 2.4771 | 0.898 |
| 2.595 | 2.138 | 2.595 | 1.6143 | 2.595 | 1.3804 | 2.595 | 1.2551 | 2.595 | 1.1724 | 2.595 | 1.0471 | 2.595 | 0.898 |

PTWW038.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 38 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.7186 | 2.138 | 2.7186 | 1.6143 | 2.7186 | 1.3804 | 2.7186 | 1.2551 | 2.7186 | 1.1724 | 2.7186 | 1.0471 | 2.7186 | 0.898 |
| 2.848 | 2.138 | 2.848 | 1.6143 | 2.848 | 1.3804 | 2.848 | 1.2551 | 2.848 | 1.1724 | 2.848 | 1.0471 | 2.848 | 0.898 |
| 2.9836 | 2.138 | 2.9836 | 1.6143 | 2.9836 | 1.3804 | 2.9836 | 1.2551 | 2.9836 | 1.1568 | 2.9836 | 1.0114 | 2.9836 | 0.8645 |
| 3.1257 | 2.138 | 3.1257 | 1.3773 | 3.1257 | 1.0982 | 3.1257 | 1.0035 | 3.1257 | 0.9573 | 3.1257 | 0.8829 | 3.1257 | 0.7931 |
| 3.2745 | 2.138 | 3.2745 | 1.2119 | 3.2745 | 1.0686 | 3.2745 | 0.9673 | 3.2745 | 0.886 | 3.2745 | 0.778 | 3.2745 | 0.7168 |
| 3.4305 | 1.5368 | 3.4305 | 1.0471 | 3.4305 | 0.9495 | 3.4305 | 0.8824 | 3.4305 | 0.8379 | 3.4305 | 0.7547 | 3.4305 | 0.6598 |
| 3.5938 | 1.5368 | 3.5938 | 1.0165 | 3.5938 | 0.898 | 3.5938 | 0.8299 | 3.5938 | 0.7946 | 3.5938 | 0.7273 | 3.5938 | 0.6376 |
| 3.7649 | 1.5368 | 3.7649 | 1.0165 | 3.7649 | 0.898 | 3.7649 | 0.8299 | 3.7649 | 0.7769 | 3.7649 | 0.6958 | 3.7649 | 0.6089 |
| 3.9442 | 1.5368 | 3.9442 | 1.0165 | 3.9442 | 0.8472 | 3.9442 | 0.7941 | 3.9442 | 0.7477 | 3.9442 | 0.6723 | 3.9442 | 0.5955 |
| 4.132 | 1.5368 | 4.132 | 1.0165 | 4.132 | 0.845 | 4.132 | 0.7941 | 4.132 | 0.7477 | 4.132 | 0.6723 | 4.132 | 0.5955 |
| 4.3288 | 1.5368 | 4.3288 | 0.9973 | 4.3288 | 0.8194 | 4.3288 | 0.7522 | 4.3288 | 0.7017 | 4.3288 | 0.6303 | 4.3288 | 0.5622 |
| 4.5349 | 1.5368 | 4.5349 | 0.8745 | 4.5349 | 0.7347 | 4.5349 | 0.6652 | 4.5349 | 0.6197 | 4.5349 | 0.5656 | 4.5349 | 0.5097 |
| 4.7508 | 1.518 | 4.7508 | 0.8745 | 4.7508 | 0.7183 | 4.7508 | 0.6169 | 4.7508 | 0.5587 | 4.7508 | 0.4909 | 4.7508 | 0.4618 |
| 4.977 | 1.518 | 4.977 | 0.8614 | 4.977 | 0.7025 | 4.977 | 0.6052 | 4.977 | 0.5367 | 4.977 | 0.4572 | 4.977 | 0.4284 |
| 5.214 | 1.3404 | 5.214 | 0.7497 | 5.214 | 0.6443 | 5.214 | 0.5421 | 5.214 | 0.5109 | 5.214 | 0.4398 | 5.214 | 0.4021 |
| 5.4623 | 1.3404 | 5.4623 | 0.7497 | 5.4623 | 0.6443 | 5.4623 | 0.5254 | 5.4623 | 0.5109 | 5.4623 | 0.438 | 5.4623 | 0.3783 |
| 5.7224 | 1.3404 | 5.7224 | 0.7497 | 5.7224 | 0.6443 | 5.7224 | 0.5254 | 5.7224 | 0.5109 | 5.7224 | 0.438 | 5.7224 | 0.3681 |
| 5.9948 | 1.3404 | 5.9948 | 0.7497 | 5.9948 | 0.6443 | 5.9948 | 0.5254 | 5.9948 | 0.5109 | 5.9948 | 0.438 | 5.9948 | 0.3681 |
| 6.2803 | 1.3404 | 6.2803 | 0.7497 | 6.2803 | 0.6443 | 6.2803 | 0.5254 | 6.2803 | 0.5109 | 6.2803 | 0.438 | 6.2803 | 0.3681 |
| 6.5793 | 1.3404 | 6.5793 | 0.7497 | 6.5793 | 0.6443 | 6.5793 | 0.5254 | 6.5793 | 0.5109 | 6.5793 | 0.438 | 6.5793 | 0.3681 |
| 6.8926 | 1.3404 | 6.8926 | 0.7497 | 6.8926 | 0.6443 | 6.8926 | 0.5254 | 6.8926 | 0.5109 | 6.8926 | 0.438 | 6.8926 | 0.3681 |
| 7.2208 | 1.274 | 7.2208 | 0.7497 | 7.2208 | 0.6443 | 7.2208 | 0.5254 | 7.2208 | 0.5109 | 7.2208 | 0.438 | 7.2208 | 0.3681 |
| 7.5646 | 1.274 | 7.5646 | 0.7455 | 7.5646 | 0.6309 | 7.5646 | 0.5254 | 7.5646 | 0.5092 | 7.5646 | 0.438 | 7.5646 | 0.3681 |
| 7.9248 | 1.274 | 7.9248 | 0.6003 | 7.9248 | 0.5494 | 7.9248 | 0.5064 | 7.9248 | 0.471 | 7.9248 | 0.4168 | 7.9248 | 0.3609 |
| 8.3022 | 1.274 | 8.3022 | 0.5659 | 8.3022 | 0.4849 | 8.3022 | 0.454 | 8.3022 | 0.4288 | 8.3022 | 0.394 | 8.3022 | 0.3594 |
| 8.6975 | 1.0027 | 8.6975 | 0.521 | 8.6975 | 0.4849 | 8.6975 | 0.454 | 8.6975 | 0.4288 | 8.6975 | 0.3913 | 8.6975 | 0.3536 |
| 9.1116 | 1.0027 | 9.1116 | 0.4701 | 9.1116 | 0.4386 | 9.1116 | 0.4105 | 9.1116 | 0.3865 | 9.1116 | 0.3654 | 9.1116 | 0.3376 |
| 9.5455 | 1.0027 | 9.5455 | 0.4494 | 9.5455 | 0.4069 | 9.5455 | 0.3794 | 9.5455 | 0.3652 | 9.5455 | 0.3418 | 9.5455 | 0.3167 |
| 10 | 0.6463 | 10 | 0.4494 | 10 | 0.4069 | 10 | 0.3794 | 10 | 0.3585 | 10 | 0.3293 | 10 | 0.3015 |
| 10.4762 | 0.6411 | 10.4762 | 0.4371 | 10.4762 | 0.3959 | 10.4762 | 0.3648 | 10.4762 | 0.347 | 10.4762 | 0.3169 | 10.4762 | 0.2936 |
| 10.975 | 0.6411 | 10.975 | 0.4085 | 10.975 | 0.3668 | 10.975 | 0.3387 | 10.975 | 0.3179 | 10.975 | 0.2923 | 10.975 | 0.2891 |
| 11.4976 | 0.6411 | 11.4976 | 0.3647 | 11.4976 | 0.3304 | 11.4976 | 0.3133 | 11.4976 | 0.3024 | 11.4976 | 0.2893 | 11.4976 | 0.2857 |
| 12.045 | 0.6411 | 12.045 | 0.3647 | 12.045 | 0.3304 | 12.045 | 0.3133 | 12.045 | 0.3024 | 12.045 | 0.2893 | 12.045 | 0.2839 |
| 12.6186 | 0.6411 | 12.6186 | 0.3647 | 12.6186 | 0.3304 | 12.6186 | 0.3133 | 12.6186 | 0.3024 | 12.6186 | 0.2893 | 12.6186 | 0.2831 |
| 13.2194 | 0.6411 | 13.2194 | 0.3647 | 13.2194 | 0.3304 | 13.2194 | 0.3133 | 13.2194 | 0.3024 | 13.2194 | 0.2893 | 13.2194 | 0.2831 |

PTWW038.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 38 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 54 Ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 0.6411 | 13.8489 | 0.3647 | 13.8489 | 0.3304 | 13.8489 | 0.3133 | 13.8489 | 0.3024 | 13.8489 | 0.2893 | 13.8489 | 0.2831 |
| 14.5083 | 0.6411 | 14.5083 | 0.3647 | 14.5083 | 0.3304 | 14.5083 | 0.3133 | 14.5083 | 0.3024 | 14.5083 | 0.2893 | 14.5083 | 0.2831 |
| 15.1991 | 0.6411 | 15.1991 | 0.3647 | 15.1991 | 0.3304 | 15.1991 | 0.3133 | 15.1991 | 0.3024 | 15.1991 | 0.2893 | 15.1991 | 0.2831 |
| 15.9228 | 0.6411 | 15.9228 | 0.3647 | 15.9228 | 0.3304 | 15.9228 | 0.3133 | 15.9228 | 0.3024 | 15.9228 | 0.2893 | 15.9228 | 0.2831 |
| 16.681 | 0.6411 | 16.681 | 0.3647 | 16.681 | 0.3304 | 16.681 | 0.3133 | 16.681 | 0.3024 | 16.681 | 0.2893 | 16.681 | 0.2831 |
| 17.4753 | 0.6411 | 17.4753 | 0.3647 | 17.4753 | 0.3304 | 17.4753 | 0.3133 | 17.4753 | 0.3024 | 17.4753 | 0.2893 | 17.4753 | 0.2831 |
| 18.3074 | 0.4714 | 18.3074 | 0.3284 | 18.3074 | 0.3152 | 18.3074 | 0.3052 | 18.3074 | 0.298 | 18.3074 | 0.2893 | 18.3074 | 0.2831 |
| 19.1791 | 0.4714 | 19.1791 | 0.3088 | 19.1791 | 0.2936 | 19.1791 | 0.2872 | 19.1791 | 0.2851 | 19.1791 | 0.2842 | 19.1791 | 0.2825 |
| 20.0923 | 0.4714 | 20.0923 | 0.3088 | 20.0923 | 0.2886 | 20.0923 | 0.2865 | 20.0923 | 0.2851 | 20.0923 | 0.2833 | 20.0923 | 0.2814 |
| 21.049 | 0.3824 | 21.049 | 0.2877 | 21.049 | 0.2842 | 21.049 | 0.2843 | 21.049 | 0.2836 | 21.049 | 0.2819 | 21.049 | 0.2801 |
| 22.0513 | 0.3824 | 22.0513 | 0.2873 | 22.0513 | 0.2834 | 22.0513 | 0.2816 | 22.0513 | 0.2806 | 22.0513 | 0.2795 | 22.0513 | 0.2783 |
| 23.1013 | 0.2973 | 23.1013 | 0.2832 | 23.1013 | 0.2814 | 23.1013 | 0.2802 | 23.1013 | 0.2793 | 23.1013 | 0.2779 | 23.1013 | 0.2765 |
| 24.2013 | 0.2947 | 24.2013 | 0.2805 | 24.2013 | 0.2788 | 24.2013 | 0.2776 | 24.2013 | 0.2768 | 24.2013 | 0.2763 | 24.2013 | 0.2756 |
| 25.3536 | 0.288 | 25.3536 | 0.2805 | 25.3536 | 0.2788 | 25.3536 | 0.2776 | 25.3536 | 0.2768 | 25.3536 | 0.2757 | 25.3536 | 0.2749 |
| 26.5609 | 0.288 | 26.5609 | 0.2805 | 26.5609 | 0.2788 | 26.5609 | 0.2776 | 26.5609 | 0.2768 | 26.5609 | 0.2757 | 26.5609 | 0.2747 |
| 27.8256 | 0.2867 | 27.8256 | 0.28 | 27.8256 | 0.2782 | 27.8256 | 0.2771 | 27.8256 | 0.2762 | 27.8256 | 0.2751 | 27.8256 | 0.2741 |
| 29.1505 | 0.2773 | 29.1505 | 0.2753 | 29.1505 | 0.2749 | 29.1505 | 0.2745 | 29.1505 | 0.2742 | 29.1505 | 0.2738 | 29.1505 | 0.2732 |
| 30.5386 | 0.2773 | 30.5386 | 0.2727 | 30.5386 | 0.2726 | 30.5386 | 0.2725 | 30.5386 | 0.2724 | 30.5386 | 0.2723 | 30.5386 | 0.2721 |
| 31.9927 | 0.2707 | 31.9927 | 0.271 | 31.9927 | 0.271 | 31.9927 | 0.2711 | 31.9927 | 0.2711 | 31.9927 | 0.2712 | 31.9927 | 0.2712 |
| 33.516 | 0.2707 | 33.516 | 0.2707 | 33.516 | 0.2706 | 33.516 | 0.2706 | 33.516 | 0.2706 | 33.516 | 0.2706 | 33.516 | 0.2706 |
| 35.1119 | 0.27 | 35.1119 | 0.27 | 35.1119 | 0.27 | 35.1119 | 0.2701 | 35.1119 | 0.2701 | 35.1119 | 0.2701 | 35.1119 | 0.2701 |
| 36.7838 | 0.2695 | 36.7838 | 0.2696 | 36.7838 | 0.2696 | 36.7838 | 0.2696 | 36.7838 | 0.2697 | 36.7838 | 0.2697 | 36.7838 | 0.2697 |
| 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 | 38.5353 | 0.2693 |
| 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 | 40.3702 | 0.269 |
| 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2687 | 42.2924 | 0.2688 |
| 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 | 44.3062 | 0.2685 |
| 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 | 46.4159 | 0.2683 |
| 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 | 48.626 | 0.2681 |
| 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 | 50.9414 | 0.2679 |

PTWW067.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 67 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.1098 | 0.0375 | 0.1098 | 0.0345 | 0.1098 | 0.0327 | 0.1098 | 0.0312 | 0.1098 | 0.0298 | 0.1098 | 0.0274 | 0.1098 | 0.0252 |
| 0.115 | 0.0375 | 0.115 | 0.0345 | 0.115 | 0.0327 | 0.115 | 0.0312 | 0.115 | 0.0299 | 0.115 | 0.0277 | 0.115 | 0.0259 |
| 0.1204 | 0.0375 | 0.1204 | 0.0345 | 0.1204 | 0.0331 | 0.1204 | 0.0322 | 0.1204 | 0.0312 | 0.1204 | 0.0294 | 0.1204 | 0.0268 |
| 0.1262 | 0.0431 | 0.1262 | 0.0397 | 0.1262 | 0.0378 | 0.1262 | 0.036 | 0.1262 | 0.0343 | 0.1262 | 0.0314 | 0.1262 | 0.0277 |
| 0.1322 | 0.0505 | 0.1322 | 0.0451 | 0.1322 | 0.042 | 0.1322 | 0.0393 | 0.1322 | 0.0369 | 0.1322 | 0.0327 | 0.1322 | 0.0281 |
| 0.1385 | 0.0561 | 0.1385 | 0.049 | 0.1385 | 0.045 | 0.1385 | 0.0415 | 0.1385 | 0.0384 | 0.1385 | 0.0344 | 0.1385 | 0.0303 |
| 0.1451 | 0.0582 | 0.1451 | 0.0509 | 0.1451 | 0.0474 | 0.1451 | 0.0444 | 0.1451 | 0.0417 | 0.1451 | 0.0373 | 0.1451 | 0.0324 |
| 0.152 | 0.0617 | 0.152 | 0.0546 | 0.152 | 0.0507 | 0.152 | 0.0472 | 0.152 | 0.0442 | 0.152 | 0.0392 | 0.152 | 0.0336 |
| 0.1592 | 0.0619 | 0.1592 | 0.0546 | 0.1592 | 0.0507 | 0.1592 | 0.0472 | 0.1592 | 0.0442 | 0.1592 | 0.0394 | 0.1592 | 0.0347 |
| 0.1668 | 0.0639 | 0.1668 | 0.056 | 0.1668 | 0.0516 | 0.1668 | 0.0479 | 0.1668 | 0.0448 | 0.1668 | 0.04 | 0.1668 | 0.0352 |
| 0.1748 | 0.0639 | 0.1748 | 0.056 | 0.1748 | 0.0516 | 0.1748 | 0.0479 | 0.1748 | 0.0448 | 0.1748 | 0.04 | 0.1748 | 0.0352 |
| 0.1831 | 0.0639 | 0.1831 | 0.056 | 0.1831 | 0.0516 | 0.1831 | 0.0479 | 0.1831 | 0.0448 | 0.1831 | 0.04 | 0.1831 | 0.0364 |
| 0.1918 | 0.064 | 0.1918 | 0.056 | 0.1918 | 0.0516 | 0.1918 | 0.0491 | 0.1918 | 0.0473 | 0.1918 | 0.0442 | 0.1918 | 0.0401 |
| 0.2009 | 0.0641 | 0.2009 | 0.0581 | 0.2009 | 0.0556 | 0.2009 | 0.0533 | 0.2009 | 0.0511 | 0.2009 | 0.0472 | 0.2009 | 0.0422 |
| 0.2105 | 0.0664 | 0.2105 | 0.0603 | 0.2105 | 0.0575 | 0.2105 | 0.0549 | 0.2105 | 0.0525 | 0.2105 | 0.049 | 0.2105 | 0.0448 |
| 0.2205 | 0.078 | 0.2205 | 0.0645 | 0.2205 | 0.0618 | 0.2205 | 0.0594 | 0.2205 | 0.0571 | 0.2205 | 0.0531 | 0.2205 | 0.0482 |
| 0.231 | 0.0931 | 0.231 | 0.0772 | 0.231 | 0.0692 | 0.231 | 0.0628 | 0.231 | 0.0596 | 0.231 | 0.0553 | 0.231 | 0.0502 |
| 0.242 | 0.0931 | 0.242 | 0.0772 | 0.242 | 0.072 | 0.242 | 0.0676 | 0.242 | 0.0636 | 0.242 | 0.0564 | 0.242 | 0.051 |
| 0.2535 | 0.0931 | 0.2535 | 0.0817 | 0.2535 | 0.077 | 0.2535 | 0.0728 | 0.2535 | 0.069 | 0.2535 | 0.0625 | 0.2535 | 0.0547 |
| 0.2656 | 0.0931 | 0.2656 | 0.0839 | 0.2656 | 0.0794 | 0.2656 | 0.0753 | 0.2656 | 0.0716 | 0.2656 | 0.065 | 0.2656 | 0.0571 |
| 0.2783 | 0.0955 | 0.2783 | 0.0842 | 0.2783 | 0.0794 | 0.2783 | 0.0753 | 0.2783 | 0.0716 | 0.2783 | 0.065 | 0.2783 | 0.0574 |
| 0.2915 | 0.1183 | 0.2915 | 0.0982 | 0.2915 | 0.0885 | 0.2915 | 0.081 | 0.2915 | 0.075 | 0.2915 | 0.0664 | 0.2915 | 0.0586 |
| 0.3054 | 0.1496 | 0.3054 | 0.1228 | 0.3054 | 0.1092 | 0.3054 | 0.0981 | 0.3054 | 0.089 | 0.3054 | 0.0756 | 0.3054 | 0.063 |
| 0.3199 | 0.1496 | 0.3199 | 0.1228 | 0.3199 | 0.1092 | 0.3199 | 0.0981 | 0.3199 | 0.089 | 0.3199 | 0.0797 | 0.3199 | 0.07 |
| 0.3352 | 0.1496 | 0.3352 | 0.1228 | 0.3352 | 0.1092 | 0.3352 | 0.0981 | 0.3352 | 0.0927 | 0.3352 | 0.0852 | 0.3352 | 0.0755 |
| 0.3511 | 0.1496 | 0.3511 | 0.1285 | 0.3511 | 0.1168 | 0.3511 | 0.1065 | 0.3511 | 0.0994 | 0.3511 | 0.0891 | 0.3511 | 0.0782 |
| 0.3678 | 0.1677 | 0.3678 | 0.1435 | 0.3678 | 0.13 | 0.3678 | 0.1183 | 0.3678 | 0.112 | 0.3678 | 0.1014 | 0.3678 | 0.0894 |
| 0.3853 | 0.1677 | 0.3853 | 0.1435 | 0.3853 | 0.134 | 0.3853 | 0.1273 | 0.3853 | 0.1213 | 0.3853 | 0.1109 | 0.3853 | 0.0986 |
| 0.4037 | 0.1925 | 0.4037 | 0.1587 | 0.4037 | 0.1415 | 0.4037 | 0.1298 | 0.4037 | 0.1251 | 0.4037 | 0.1163 | 0.4037 | 0.1044 |
| 0.4229 | 0.2358 | 0.4229 | 0.1897 | 0.4229 | 0.1713 | 0.4229 | 0.1551 | 0.4229 | 0.1411 | 0.4229 | 0.1206 | 0.4229 | 0.1079 |
| 0.4431 | 0.3083 | 0.4431 | 0.219 | 0.4431 | 0.1881 | 0.4431 | 0.167 | 0.4431 | 0.1495 | 0.4431 | 0.1263 | 0.4431 | 0.1088 |
| 0.4642 | 0.3407 | 0.4642 | 0.2508 | 0.4642 | 0.2123 | 0.4642 | 0.1837 | 0.4642 | 0.1622 | 0.4642 | 0.1328 | 0.4642 | 0.1192 |
| 0.4863 | 0.3407 | 0.4863 | 0.2548 | 0.4863 | 0.2198 | 0.4863 | 0.1918 | 0.4863 | 0.1692 | 0.4863 | 0.1398 | 0.4863 | 0.1303 |
| 0.5094 | 0.3496 | 0.5094 | 0.2641 | 0.5094 | 0.2311 | 0.5094 | 0.2042 | 0.5094 | 0.182 | 0.5094 | 0.1485 | 0.5094 | 0.1369 |

PTWW067.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 67 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5337 | 0.4063 | 0.5337 | 0.2745 | 0.5337 | 0.2311 | 0.5337 | 0.2042 | 0.5337 | 0.182 | 0.5337 | 0.1529 | 0.5337 | 0.1371 |
| 0.5591 | 0.4063 | 0.5591 | 0.2745 | 0.5591 | 0.2378 | 0.5591 | 0.213 | 0.5591 | 0.194 | 0.5591 | 0.1646 | 0.5591 | 0.1371 |
| 0.5857 | 0.4063 | 0.5857 | 0.2745 | 0.5857 | 0.2385 | 0.5857 | 0.2142 | 0.5857 | 0.1966 | 0.5857 | 0.1681 | 0.5857 | 0.1425 |
| 0.6136 | 0.4438 | 0.6136 | 0.2944 | 0.6136 | 0.2421 | 0.6136 | 0.2213 | 0.6136 | 0.2032 | 0.6136 | 0.1733 | 0.6136 | 0.1425 |
| 0.6428 | 0.4742 | 0.6428 | 0.3514 | 0.6428 | 0.2975 | 0.6428 | 0.2588 | 0.6428 | 0.2323 | 0.6428 | 0.1964 | 0.6428 | 0.1655 |
| 0.6734 | 0.4742 | 0.6734 | 0.3514 | 0.6734 | 0.2975 | 0.6734 | 0.2588 | 0.6734 | 0.2383 | 0.6734 | 0.2137 | 0.6734 | 0.1844 |
| 0.7055 | 0.4742 | 0.7055 | 0.3514 | 0.7055 | 0.2975 | 0.7055 | 0.2588 | 0.7055 | 0.2383 | 0.7055 | 0.2155 | 0.7055 | 0.1892 |
| 0.7391 | 0.4742 | 0.7391 | 0.3514 | 0.7391 | 0.2975 | 0.7391 | 0.2667 | 0.7391 | 0.2438 | 0.7391 | 0.2155 | 0.7391 | 0.1892 |
| 0.7743 | 0.5449 | 0.7743 | 0.3911 | 0.7743 | 0.3284 | 0.7743 | 0.2875 | 0.7743 | 0.2646 | 0.7743 | 0.2323 | 0.7743 | 0.1993 |
| 0.8111 | 0.5449 | 0.8111 | 0.3911 | 0.8111 | 0.3284 | 0.8111 | 0.2996 | 0.8111 | 0.2837 | 0.8111 | 0.2551 | 0.8111 | 0.2205 |
| 0.8497 | 0.5449 | 0.8497 | 0.3911 | 0.8497 | 0.3284 | 0.8497 | 0.3072 | 0.8497 | 0.2942 | 0.8497 | 0.2684 | 0.8497 | 0.2339 |
| 0.8902 | 0.5449 | 0.8902 | 0.3911 | 0.8902 | 0.3604 | 0.8902 | 0.3382 | 0.8902 | 0.318 | 0.8902 | 0.2831 | 0.8902 | 0.2427 |
| 0.9326 | 0.8469 | 0.9326 | 0.5495 | 0.9326 | 0.4554 | 0.9326 | 0.3957 | 0.9326 | 0.3545 | 0.9326 | 0.3003 | 0.9326 | 0.2517 |
| 0.977 | 0.8469 | 0.977 | 0.5495 | 0.977 | 0.4554 | 0.977 | 0.3975 | 0.977 | 0.3585 | 0.977 | 0.3036 | 0.977 | 0.2596 |
| 1.0235 | 0.9107 | 1.0235 | 0.5826 | 1.0235 | 0.5168 | 1.0235 | 0.4731 | 1.0235 | 0.4362 | 1.0235 | 0.3776 | 1.0235 | 0.3164 |
| 1.0723 | 0.9107 | 1.0723 | 0.6542 | 1.0723 | 0.5901 | 1.0723 | 0.535 | 1.0723 | 0.4906 | 1.0723 | 0.4288 | 1.0723 | 0.36 |
| 1.1233 | 1.3081 | 1.1233 | 0.8142 | 1.1233 | 0.6641 | 1.1233 | 0.5708 | 1.1233 | 0.5287 | 1.1233 | 0.4575 | 1.1233 | 0.3904 |
| 1.1768 | 1.3081 | 1.1768 | 0.8142 | 1.1768 | 0.6641 | 1.1768 | 0.5735 | 1.1768 | 0.5393 | 1.1768 | 0.4764 | 1.1768 | 0.4143 |
| 1.2328 | 1.3081 | 1.2328 | 0.8142 | 1.2328 | 0.7174 | 1.2328 | 0.6427 | 1.2328 | 0.577 | 1.2328 | 0.4965 | 1.2328 | 0.439 |
| 1.2916 | 1.3081 | 1.2916 | 0.8822 | 1.2916 | 0.7774 | 1.2916 | 0.6895 | 1.2916 | 0.6157 | 1.2916 | 0.5283 | 1.2916 | 0.4653 |
| 1.353 | 1.3081 | 1.353 | 0.9165 | 1.353 | 0.7774 | 1.353 | 0.6895 | 1.353 | 0.6157 | 1.353 | 0.5556 | 1.353 | 0.4889 |
| 1.4175 | 1.4021 | 1.4175 | 0.9165 | 1.4175 | 0.7774 | 1.4175 | 0.6895 | 1.4175 | 0.6326 | 1.4175 | 0.5795 | 1.4175 | 0.5119 |
| 1.485 | 1.4021 | 1.485 | 0.9165 | 1.485 | 0.7774 | 1.485 | 0.6984 | 1.485 | 0.6672 | 1.485 | 0.6099 | 1.485 | 0.539 |
| 1.5557 | 1.4438 | 1.5557 | 0.9843 | 1.5557 | 0.8409 | 1.5557 | 0.7415 | 1.5557 | 0.6919 | 1.5557 | 0.6323 | 1.5557 | 0.5603 |
| 1.6298 | 1.729 | 1.6298 | 1.0527 | 1.6298 | 0.9055 | 1.6298 | 0.8177 | 1.6298 | 0.7518 | 1.6298 | 0.6519 | 1.6298 | 0.5748 |
| 1.7074 | 1.729 | 1.7074 | 1.0527 | 1.7074 | 0.9055 | 1.7074 | 0.8177 | 1.7074 | 0.7518 | 1.7074 | 0.6652 | 1.7074 | 0.5915 |
| 1.7887 | 1.729 | 1.7887 | 1.0527 | 1.7887 | 0.9055 | 1.7887 | 0.8185 | 1.7887 | 0.7553 | 1.7887 | 0.6808 | 1.7887 | 0.6117 |
| 1.8738 | 1.729 | 1.8738 | 1.0527 | 1.8738 | 0.9055 | 1.8738 | 0.8185 | 1.8738 | 0.7765 | 1.8738 | 0.7113 | 1.8738 | 0.6287 |
| 1.963 | 1.729 | 1.963 | 1.0527 | 1.963 | 0.9055 | 1.963 | 0.8397 | 1.963 | 0.7973 | 1.963 | 0.7229 | 1.963 | 0.6359 |
| 2.0565 | 1.6472 | 2.0565 | 1.0359 | 2.0565 | 0.902 | 2.0565 | 0.8397 | 2.0565 | 0.7973 | 2.0565 | 0.7229 | 2.0565 | 0.6359 |
| 2.1544 | 1.6472 | 2.1544 | 1.0359 | 2.1544 | 0.902 | 2.1544 | 0.8397 | 2.1544 | 0.7973 | 2.1544 | 0.7229 | 2.1544 | 0.6359 |
| 2.257 | 1.3558 | 2.257 | 0.9839 | 2.257 | 0.8903 | 2.257 | 0.8397 | 2.257 | 0.7973 | 2.257 | 0.7229 | 2.257 | 0.6361 |
| 2.3645 | 1.3558 | 2.3645 | 0.9839 | 2.3645 | 0.8903 | 2.3645 | 0.8397 | 2.3645 | 0.7973 | 2.3645 | 0.7229 | 2.3645 | 0.6418 |
| 2.4771 | 1.3558 | 2.4771 | 0.9839 | 2.4771 | 0.8903 | 2.4771 | 0.8363 | 2.4771 | 0.7896 | 2.4771 | 0.7121 | 2.4771 | 0.6484 |
| 2.595 | 1.3558 | 2.595 | 0.9839 | 2.595 | 0.8416 | 2.595 | 0.7692 | 2.595 | 0.745 | 2.595 | 0.7036 | 2.595 | 0.6522 |

PTWW067.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 67 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.7186 | 1.3558 | 2.7186 | 0.9839 | 2.7186 | 0.8416 | 2.7186 | 0.7692 | 2.7186 | 0.745 | 2.7186 | 0.7036 | 2.7186 | 0.6522 |
| 2.848 | 1.3558 | 2.848 | 0.9839 | 2.848 | 0.8416 | 2.848 | 0.7692 | 2.848 | 0.745 | 2.848 | 0.7036 | 2.848 | 0.6522 |
| 2.9836 | 1.3558 | 2.9836 | 0.9839 | 2.9836 | 0.8416 | 2.9836 | 0.7692 | 2.9836 | 0.745 | 2.9836 | 0.7036 | 2.9836 | 0.6522 |
| 3.1257 | 1.3558 | 3.1257 | 0.9586 | 3.1257 | 0.8211 | 3.1257 | 0.7692 | 3.1257 | 0.745 | 3.1257 | 0.7036 | 3.1257 | 0.6522 |
| 3.2745 | 1.3558 | 3.2745 | 0.9586 | 3.2745 | 0.8211 | 3.2745 | 0.751 | 3.2745 | 0.7299 | 3.2745 | 0.6954 | 3.2745 | 0.6492 |
| 3.4305 | 1.3558 | 3.4305 | 0.9586 | 3.4305 | 0.8211 | 3.4305 | 0.751 | 3.4305 | 0.7126 | 3.4305 | 0.681 | 3.4305 | 0.6403 |
| 3.5938 | 1.4127 | 3.5938 | 0.9586 | 3.5938 | 0.8211 | 3.5938 | 0.751 | 3.5938 | 0.6971 | 3.5938 | 0.671 | 3.5938 | 0.6329 |
| 3.7649 | 1.4127 | 3.7649 | 0.9586 | 3.7649 | 0.8211 | 3.7649 | 0.751 | 3.7649 | 0.6954 | 3.7649 | 0.6626 | 3.7649 | 0.6263 |
| 3.9442 | 1.4127 | 3.9442 | 0.9586 | 3.9442 | 0.8211 | 3.9442 | 0.751 | 3.9442 | 0.6954 | 3.9442 | 0.659 | 3.9442 | 0.6182 |
| 4.132 | 1.4127 | 4.132 | 0.9586 | 4.132 | 0.8211 | 4.132 | 0.751 | 4.132 | 0.6954 | 4.132 | 0.6519 | 4.132 | 0.6132 |
| 4.3288 | 1.4127 | 4.3288 | 0.9586 | 4.3288 | 0.8211 | 4.3288 | 0.751 | 4.3288 | 0.6954 | 4.3288 | 0.6467 | 4.3288 | 0.6045 |
| 4.5349 | 1.4127 | 4.5349 | 0.9586 | 4.5349 | 0.8211 | 4.5349 | 0.751 | 4.5349 | 0.6954 | 4.5349 | 0.6383 | 4.5349 | 0.5926 |
| 4.7508 | 1.376 | 4.7508 | 0.9153 | 4.7508 | 0.8211 | 4.7508 | 0.751 | 4.7508 | 0.6954 | 4.7508 | 0.6271 | 4.7508 | 0.5766 |
| 4.977 | 1.1452 | 4.977 | 0.7722 | 4.977 | 0.7324 | 4.977 | 0.6911 | 4.977 | 0.6525 | 4.977 | 0.5927 | 4.977 | 0.5466 |
| 5.214 | 0.9648 | 5.214 | 0.7082 | 5.214 | 0.6425 | 5.214 | 0.6138 | 5.214 | 0.5972 | 5.214 | 0.5647 | 5.214 | 0.5221 |
| 5.4623 | 0.9342 | 5.4623 | 0.7082 | 5.4623 | 0.6425 | 5.4623 | 0.6129 | 5.4623 | 0.5893 | 5.4623 | 0.5516 | 5.4623 | 0.5074 |
| 5.7224 | 0.9342 | 5.7224 | 0.7082 | 5.7224 | 0.6425 | 5.7224 | 0.5954 | 5.7224 | 0.5597 | 5.7224 | 0.5268 | 5.7224 | 0.486 |
| 5.9948 | 0.9342 | 5.9948 | 0.6534 | 5.9948 | 0.6337 | 5.9948 | 0.5864 | 5.9948 | 0.5544 | 5.9948 | 0.5117 | 5.9948 | 0.4626 |
| 6.2803 | 0.9342 | 6.2803 | 0.6534 | 6.2803 | 0.6337 | 6.2803 | 0.5864 | 6.2803 | 0.5504 | 6.2803 | 0.4978 | 6.2803 | 0.448 |
| 6.5793 | 0.9342 | 6.5793 | 0.6534 | 6.5793 | 0.6231 | 6.5793 | 0.5714 | 6.5793 | 0.5325 | 6.5793 | 0.4789 | 6.5793 | 0.4308 |
| 6.8926 | 0.9342 | 6.8926 | 0.5885 | 6.8926 | 0.5443 | 6.8926 | 0.5297 | 6.8926 | 0.5115 | 6.8926 | 0.4747 | 6.8926 | 0.4289 |
| 7.2208 | 0.7892 | 7.2208 | 0.5885 | 7.2208 | 0.5404 | 7.2208 | 0.5146 | 7.2208 | 0.4932 | 7.2208 | 0.4582 | 7.2208 | 0.4179 |
| 7.5646 | 0.7892 | 7.5646 | 0.515 | 7.5646 | 0.4923 | 7.5646 | 0.4748 | 7.5646 | 0.4577 | 7.5646 | 0.4273 | 7.5646 | 0.3917 |
| 7.9248 | 0.7038 | 7.9248 | 0.5002 | 7.9248 | 0.4721 | 7.9248 | 0.4509 | 7.9248 | 0.4342 | 7.9248 | 0.4082 | 7.9248 | 0.3799 |
| 8.3022 | 0.5601 | 8.3022 | 0.4481 | 8.3022 | 0.4293 | 8.3022 | 0.4172 | 8.3022 | 0.4072 | 8.3022 | 0.3901 | 8.3022 | 0.3692 |
| 8.6975 | 0.5437 | 8.6975 | 0.3949 | 8.6975 | 0.3739 | 8.6975 | 0.371 | 8.6975 | 0.3686 | 8.6975 | 0.3626 | 8.6975 | 0.3516 |
| 9.1116 | 0.5437 | 9.1116 | 0.3949 | 9.1116 | 0.3729 | 9.1116 | 0.3608 | 9.1116 | 0.3515 | 9.1116 | 0.3431 | 9.1116 | 0.3349 |
| 9.5455 | 0.5437 | 9.5455 | 0.3949 | 9.5455 | 0.3729 | 9.5455 | 0.3608 | 9.5455 | 0.3515 | 9.5455 | 0.3389 | 9.5455 | 0.3303 |
| 10 | 0.5437 | 10 | 0.3883 | 10 | 0.3729 | 10 | 0.3608 | 10 | 0.3515 | 10 | 0.3389 | 10 | 0.3303 |
| 10.4762 | 0.5437 | 10.4762 | 0.3883 | 10.4762 | 0.3729 | 10.4762 | 0.3608 | 10.4762 | 0.3515 | 10.4762 | 0.3389 | 10.4762 | 0.3284 |
| 10.975 | 0.5437 | 10.975 | 0.3711 | 10.975 | 0.3496 | 10.975 | 0.3401 | 10.975 | 0.3328 | 10.975 | 0.3231 | 10.975 | 0.3197 |
| 11.4976 | 0.5437 | 11.4976 | 0.3711 | 11.4976 | 0.3496 | 11.4976 | 0.3401 | 11.4976 | 0.3328 | 11.4976 | 0.3231 | 11.4976 | 0.3197 |
| 12.045 | 0.5437 | 12.045 | 0.3711 | 12.045 | 0.3496 | 12.045 | 0.3401 | 12.045 | 0.3328 | 12.045 | 0.3231 | 12.045 | 0.3197 |
| 12.6186 | 0.5437 | 12.6186 | 0.3711 | 12.6186 | 0.3496 | 12.6186 | 0.3401 | 12.6186 | 0.3328 | 12.6186 | 0.3231 | 12.6186 | 0.3197 |
| 13.2194 | 0.5437 | 13.2194 | 0.3711 | 13.2194 | 0.3496 | 13.2194 | 0.3401 | 13.2194 | 0.3328 | 13.2194 | 0.3231 | 13.2194 | 0.3197 |

PTWW067.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 67 ~ SLAB-WALL JOINT East-West Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 0.5437 | 13.8489 | 0.3711 | 13.8489 | 0.3496 | 13.8489 | 0.3401 | 13.8489 | 0.3328 | 13.8489 | 0.3231 | 13.8489 | 0.3197 |
| 14.5083 | 0.5437 | 14.5083 | 0.3711 | 14.5083 | 0.3496 | 14.5083 | 0.3401 | 14.5083 | 0.3328 | 14.5083 | 0.3231 | 14.5083 | 0.3197 |
| 15.1991 | 0.5451 | 15.1991 | 0.3711 | 15.1991 | 0.3496 | 15.1991 | 0.3401 | 15.1991 | 0.3328 | 15.1991 | 0.3231 | 15.1991 | 0.3197 |
| 15.9228 | 0.5451 | 15.9228 | 0.3711 | 15.9228 | 0.3496 | 15.9228 | 0.3401 | 15.9228 | 0.3328 | 15.9228 | 0.3231 | 15.9228 | 0.3197 |
| 16.681 | 0.5451 | 16.681 | 0.3711 | 16.681 | 0.3496 | 16.681 | 0.3401 | 16.681 | 0.3328 | 16.681 | 0.3231 | 16.681 | 0.3197 |
| 17.4753 | 0.5451 | 17.4753 | 0.4145 | 17.4753 | 0.384 | 17.4753 | 0.3654 | 17.4753 | 0.3531 | 17.4753 | 0.338 | 17.4753 | 0.3258 |
| 18.3074 | 0.5451 | 18.3074 | 0.4145 | 18.3074 | 0.384 | 18.3074 | 0.3654 | 18.3074 | 0.3531 | 18.3074 | 0.338 | 18.3074 | 0.3258 |
| 19.1791 | 0.5325 | 19.1791 | 0.4145 | 19.1791 | 0.384 | 19.1791 | 0.3654 | 19.1791 | 0.3531 | 19.1791 | 0.338 | 19.1791 | 0.3258 |
| 20.0923 | 0.5325 | 20.0923 | 0.4145 | 20.0923 | 0.384 | 20.0923 | 0.3654 | 20.0923 | 0.3531 | 20.0923 | 0.338 | 20.0923 | 0.3258 |
| 21.049 | 0.5325 | 21.049 | 0.4145 | 21.049 | 0.384 | 21.049 | 0.3654 | 21.049 | 0.3531 | 21.049 | 0.338 | 21.049 | 0.3258 |
| 22.0513 | 0.5093 | 22.0513 | 0.357 | 22.0513 | 0.345 | 22.0513 | 0.3404 | 22.0513 | 0.3377 | 22.0513 | 0.3309 | 22.0513 | 0.3223 |
| 23.1013 | 0.5093 | 23.1013 | 0.357 | 23.1013 | 0.345 | 23.1013 | 0.3371 | 23.1013 | 0.3312 | 23.1013 | 0.3223 | 23.1013 | 0.3135 |
| 24.2013 | 0.4442 | 24.2013 | 0.3461 | 24.2013 | 0.3355 | 24.2013 | 0.3293 | 24.2013 | 0.3248 | 24.2013 | 0.3182 | 24.2013 | 0.3115 |
| 25.3536 | 0.4442 | 25.3536 | 0.3079 | 25.3536 | 0.3069 | 25.3536 | 0.307 | 25.3536 | 0.3072 | 25.3536 | 0.3068 | 25.3536 | 0.3051 |
| 26.5609 | 0.4442 | 26.5609 | 0.3048 | 26.5609 | 0.2996 | 26.5609 | 0.2979 | 26.5609 | 0.2979 | 26.5609 | 0.2986 | 26.5609 | 0.2992 |
| 27.8256 | 0.3666 | 27.8256 | 0.3037 | 27.8256 | 0.2996 | 27.8256 | 0.2979 | 27.8256 | 0.297 | 27.8256 | 0.296 | 27.8256 | 0.2956 |
| 29.1505 | 0.3342 | 29.1505 | 0.3037 | 29.1505 | 0.2996 | 29.1505 | 0.2979 | 29.1505 | 0.297 | 29.1505 | 0.296 | 29.1505 | 0.2951 |
| 30.5386 | 0.3342 | 30.5386 | 0.3037 | 30.5386 | 0.2996 | 30.5386 | 0.2979 | 30.5386 | 0.297 | 30.5386 | 0.296 | 30.5386 | 0.2951 |
| 31.9927 | 0.3088 | 31.9927 | 0.2994 | 31.9927 | 0.2977 | 31.9927 | 0.2968 | 31.9927 | 0.2961 | 31.9927 | 0.2952 | 31.9927 | 0.2943 |
| 33.516 | 0.2961 | 33.516 | 0.2957 | 33.516 | 0.2953 | 33.516 | 0.295 | 33.516 | 0.2948 | 33.516 | 0.2945 | 33.516 | 0.2942 |
| 35.1119 | 0.2952 | 35.1119 | 0.2948 | 35.1119 | 0.2947 | 35.1119 | 0.2946 | 35.1119 | 0.2944 | 35.1119 | 0.2942 | 35.1119 | 0.2939 |
| 36.7838 | 0.2943 | 36.7838 | 0.2943 | 36.7838 | 0.2942 | 36.7838 | 0.2941 | 36.7838 | 0.294 | 36.7838 | 0.2938 | 36.7838 | 0.2936 |
| 38.5353 | 0.2938 | 38.5353 | 0.2937 | 38.5353 | 0.2936 | 38.5353 | 0.2936 | 38.5353 | 0.2935 | 38.5353 | 0.2934 | 38.5353 | 0.2932 |
| 40.3702 | 0.2932 | 40.3702 | 0.2931 | 40.3702 | 0.2931 | 40.3702 | 0.293 | 40.3702 | 0.293 | 40.3702 | 0.2929 | 40.3702 | 0.2928 |
| 42.2924 | 0.2925 | 42.2924 | 0.2926 | 42.2924 | 0.2925 | 42.2924 | 0.2925 | 42.2924 | 0.2925 | 42.2924 | 0.2924 | 42.2924 | 0.2923 |
| 44.3062 | 0.2922 | 44.3062 | 0.2921 | 44.3062 | 0.2921 | 44.3062 | 0.2921 | 44.3062 | 0.292 | 44.3062 | 0.292 | 44.3062 | 0.2919 |
| 46.4159 | 0.2917 | 46.4159 | 0.2916 | 46.4159 | 0.2916 | 46.4159 | 0.2916 | 46.4159 | 0.2916 | 46.4159 | 0.2916 | 46.4159 | 0.2916 |
| 48.626 | 0.2913 | 48.626 | 0.2912 | 48.626 | 0.2912 | 48.626 | 0.2912 | 48.626 | 0.2912 | 48.626 | 0.2912 | 48.626 | 0.2912 |
| 50.9414 | 0.2907 | 50.9414 | 0.2908 | 50.9414 | 0.2908 | 50.9414 | 0.2908 | 50.9414 | 0.2908 | 50.9414 | 0.2908 | 50.9414 | 0.2909 |

PTWW068.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 68 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.1098 | 0.0404 | 0.1098 | 0.0365 | 0.1098 | 0.0342 | 0.1098 | 0.0321 | 0.1098 | 0.0302 | 0.1098 | 0.0271 | 0.1098 | 0.0235 |
| 0.115 | 0.0404 | 0.115 | 0.0365 | 0.115 | 0.0342 | 0.115 | 0.0321 | 0.115 | 0.0302 | 0.115 | 0.0271 | 0.115 | 0.0253 |
| 0.1204 | 0.0404 | 0.1204 | 0.0365 | 0.1204 | 0.0342 | 0.1204 | 0.0321 | 0.1204 | 0.0306 | 0.1204 | 0.0293 | 0.1204 | 0.0274 |
| 0.1262 | 0.0404 | 0.1262 | 0.0365 | 0.1262 | 0.0349 | 0.1262 | 0.034 | 0.1262 | 0.033 | 0.1262 | 0.0313 | 0.1262 | 0.0292 |
| 0.1322 | 0.0404 | 0.1322 | 0.038 | 0.1322 | 0.0368 | 0.1322 | 0.0356 | 0.1322 | 0.0346 | 0.1322 | 0.0328 | 0.1322 | 0.0312 |
| 0.1385 | 0.0409 | 0.1385 | 0.0389 | 0.1385 | 0.0377 | 0.1385 | 0.0368 | 0.1385 | 0.0359 | 0.1385 | 0.0344 | 0.1385 | 0.0325 |
| 0.1451 | 0.0414 | 0.1451 | 0.0395 | 0.1451 | 0.0384 | 0.1451 | 0.0375 | 0.1451 | 0.0366 | 0.1451 | 0.035 | 0.1451 | 0.033 |
| 0.152 | 0.0438 | 0.152 | 0.04 | 0.152 | 0.0384 | 0.152 | 0.0375 | 0.152 | 0.0366 | 0.152 | 0.035 | 0.152 | 0.033 |
| 0.1592 | 0.0461 | 0.1592 | 0.0415 | 0.1592 | 0.0394 | 0.1592 | 0.0375 | 0.1592 | 0.0366 | 0.1592 | 0.035 | 0.1592 | 0.033 |
| 0.1668 | 0.0583 | 0.1668 | 0.0505 | 0.1668 | 0.0462 | 0.1668 | 0.0425 | 0.1668 | 0.0394 | 0.1668 | 0.035 | 0.1668 | 0.033 |
| 0.1748 | 0.0643 | 0.1748 | 0.0565 | 0.1748 | 0.0521 | 0.1748 | 0.0482 | 0.1748 | 0.0448 | 0.1748 | 0.0392 | 0.1748 | 0.033 |
| 0.1831 | 0.0666 | 0.1831 | 0.0582 | 0.1831 | 0.0541 | 0.1831 | 0.0503 | 0.1831 | 0.047 | 0.1831 | 0.0413 | 0.1831 | 0.0351 |
| 0.1918 | 0.0676 | 0.1918 | 0.0584 | 0.1918 | 0.0541 | 0.1918 | 0.0505 | 0.1918 | 0.0472 | 0.1918 | 0.0415 | 0.1918 | 0.0376 |
| 0.2009 | 0.0695 | 0.2009 | 0.0594 | 0.2009 | 0.0541 | 0.2009 | 0.0509 | 0.2009 | 0.0481 | 0.2009 | 0.0431 | 0.2009 | 0.0405 |
| 0.2105 | 0.0719 | 0.2105 | 0.0616 | 0.2105 | 0.0578 | 0.2105 | 0.0543 | 0.2105 | 0.051 | 0.2105 | 0.0476 | 0.2105 | 0.0438 |
| 0.2205 | 0.0815 | 0.2205 | 0.0705 | 0.2205 | 0.0647 | 0.2205 | 0.0596 | 0.2205 | 0.0568 | 0.2205 | 0.0524 | 0.2205 | 0.0475 |
| 0.231 | 0.0953 | 0.231 | 0.0787 | 0.231 | 0.0702 | 0.231 | 0.0666 | 0.231 | 0.0632 | 0.231 | 0.0575 | 0.231 | 0.0509 |
| 0.242 | 0.0977 | 0.242 | 0.084 | 0.242 | 0.0771 | 0.242 | 0.071 | 0.242 | 0.0669 | 0.242 | 0.06 | 0.242 | 0.0529 |
| 0.2535 | 0.1051 | 0.2535 | 0.0906 | 0.2535 | 0.0825 | 0.2535 | 0.0755 | 0.2535 | 0.0694 | 0.2535 | 0.06 | 0.2535 | 0.0529 |
| 0.2656 | 0.1133 | 0.2656 | 0.094 | 0.2656 | 0.0837 | 0.2656 | 0.0755 | 0.2656 | 0.0694 | 0.2656 | 0.06 | 0.2656 | 0.0529 |
| 0.2783 | 0.1133 | 0.2783 | 0.094 | 0.2783 | 0.0837 | 0.2783 | 0.0776 | 0.2783 | 0.0736 | 0.2783 | 0.0666 | 0.2783 | 0.0591 |
| 0.2915 | 0.1133 | 0.2915 | 0.0994 | 0.2915 | 0.093 | 0.2915 | 0.0874 | 0.2915 | 0.0826 | 0.2915 | 0.0745 | 0.2915 | 0.0653 |
| 0.3054 | 0.1163 | 0.3054 | 0.104 | 0.3054 | 0.0971 | 0.3054 | 0.0909 | 0.3054 | 0.0855 | 0.3054 | 0.0765 | 0.3054 | 0.067 |
| 0.3199 | 0.1163 | 0.3199 | 0.104 | 0.3199 | 0.0971 | 0.3199 | 0.0909 | 0.3199 | 0.0864 | 0.3199 | 0.0812 | 0.3199 | 0.0747 |
| 0.3352 | 0.1163 | 0.3352 | 0.1068 | 0.3352 | 0.1025 | 0.3352 | 0.0986 | 0.3352 | 0.095 | 0.3352 | 0.0886 | 0.3352 | 0.0809 |
| 0.3511 | 0.1636 | 0.3511 | 0.1274 | 0.3511 | 0.1102 | 0.3511 | 0.1045 | 0.3511 | 0.1004 | 0.3511 | 0.0933 | 0.3511 | 0.0851 |
| 0.3678 | 0.2398 | 0.3678 | 0.1821 | 0.3678 | 0.1557 | 0.3678 | 0.1356 | 0.3678 | 0.1202 | 0.3678 | 0.0985 | 0.3678 | 0.0858 |
| 0.3853 | 0.2521 | 0.3853 | 0.185 | 0.3853 | 0.1576 | 0.3853 | 0.137 | 0.3853 | 0.123 | 0.3853 | 0.1052 | 0.3853 | 0.0881 |
| 0.4037 | 0.2521 | 0.4037 | 0.185 | 0.4037 | 0.1576 | 0.4037 | 0.137 | 0.4037 | 0.1254 | 0.4037 | 0.1131 | 0.4037 | 0.0996 |
| 0.4229 | 0.2521 | 0.4229 | 0.185 | 0.4229 | 0.1633 | 0.4229 | 0.1471 | 0.4229 | 0.1332 | 0.4229 | 0.1199 | 0.4229 | 0.1082 |
| 0.4431 | 0.3248 | 0.4431 | 0.2299 | 0.4431 | 0.1995 | 0.4431 | 0.1774 | 0.4431 | 0.1605 | 0.4431 | 0.137 | 0.4431 | 0.1162 |
| 0.4642 | 0.3248 | 0.4642 | 0.2299 | 0.4642 | 0.1995 | 0.4642 | 0.1774 | 0.4642 | 0.1605 | 0.4642 | 0.137 | 0.4642 | 0.1162 |
| 0.4863 | 0.3248 | 0.4863 | 0.2299 | 0.4863 | 0.1995 | 0.4863 | 0.1774 | 0.4863 | 0.1605 | 0.4863 | 0.1398 | 0.4863 | 0.123 |
| 0.5094 | 0.3248 | 0.5094 | 0.2299 | 0.5094 | 0.1995 | 0.5094 | 0.1774 | 0.5094 | 0.1605 | 0.5094 | 0.1461 | 0.5094 | 0.1281 |

PTWW068.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 68 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.5337 | 0.3307 | 0.5337 | 0.2342 | 0.5337 | 0.2031 | 0.5337 | 0.1861 | 0.5337 | 0.1756 | 0.5337 | 0.1572 | 0.5337 | 0.1357 |
| 0.5591 | 0.3864 | 0.5591 | 0.2681 | 0.5591 | 0.2359 | 0.5591 | 0.2104 | 0.5591 | 0.1922 | 0.5591 | 0.1683 | 0.5591 | 0.1505 |
| 0.5857 | 0.3864 | 0.5857 | 0.2751 | 0.5857 | 0.2466 | 0.5857 | 0.223 | 0.5857 | 0.2031 | 0.5857 | 0.1791 | 0.5857 | 0.1667 |
| 0.6136 | 0.3864 | 0.6136 | 0.2751 | 0.6136 | 0.2466 | 0.6136 | 0.223 | 0.6136 | 0.2035 | 0.6136 | 0.193 | 0.6136 | 0.1795 |
| 0.6428 | 0.3864 | 0.6428 | 0.2751 | 0.6428 | 0.2466 | 0.6428 | 0.2234 | 0.6428 | 0.2139 | 0.6428 | 0.2039 | 0.6428 | 0.1896 |
| 0.6734 | 0.3953 | 0.6734 | 0.2751 | 0.6734 | 0.251 | 0.6734 | 0.2354 | 0.6734 | 0.2284 | 0.6734 | 0.2154 | 0.6734 | 0.1984 |
| 0.7055 | 0.3953 | 0.7055 | 0.2852 | 0.7055 | 0.2641 | 0.7055 | 0.2526 | 0.7055 | 0.2425 | 0.7055 | 0.2254 | 0.7055 | 0.2061 |
| 0.7391 | 0.6097 | 0.7391 | 0.3987 | 0.7391 | 0.3252 | 0.7391 | 0.2766 | 0.7391 | 0.2575 | 0.7391 | 0.2289 | 0.7391 | 0.208 |
| 0.7743 | 0.6097 | 0.7743 | 0.3987 | 0.7743 | 0.3252 | 0.7743 | 0.2869 | 0.7743 | 0.2696 | 0.7743 | 0.2409 | 0.7743 | 0.2089 |
| 0.8111 | 0.6283 | 0.8111 | 0.4148 | 0.8111 | 0.3607 | 0.8111 | 0.3191 | 0.8111 | 0.2867 | 0.8111 | 0.2409 | 0.8111 | 0.2089 |
| 0.8497 | 0.6283 | 0.8497 | 0.4148 | 0.8497 | 0.3768 | 0.8497 | 0.3473 | 0.8497 | 0.3221 | 0.8497 | 0.2809 | 0.8497 | 0.2363 |
| 0.8902 | 0.6457 | 0.8902 | 0.4214 | 0.8902 | 0.3768 | 0.8902 | 0.3473 | 0.8902 | 0.3236 | 0.8902 | 0.2939 | 0.8902 | 0.2537 |
| 0.9326 | 0.6829 | 0.9326 | 0.4768 | 0.9326 | 0.4187 | 0.9326 | 0.376 | 0.9326 | 0.344 | 0.9326 | 0.299 | 0.9326 | 0.2562 |
| 0.977 | 0.9086 | 0.977 | 0.5785 | 0.977 | 0.4758 | 0.977 | 0.4112 | 0.977 | 0.3674 | 0.977 | 0.3135 | 0.977 | 0.2721 |
| 1.0235 | 0.9086 | 1.0235 | 0.5785 | 1.0235 | 0.517 | 1.0235 | 0.4689 | 1.0235 | 0.429 | 1.0235 | 0.368 | 1.0235 | 0.3069 |
| 1.0723 | 0.9086 | 1.0723 | 0.5886 | 1.0723 | 0.5252 | 1.0723 | 0.4728 | 1.0723 | 0.4295 | 1.0723 | 0.3754 | 1.0723 | 0.318 |
| 1.1233 | 1.2562 | 1.1233 | 0.759 | 1.1233 | 0.6339 | 1.1233 | 0.5449 | 1.1233 | 0.4784 | 1.1233 | 0.3889 | 1.1233 | 0.318 |
| 1.1768 | 1.2562 | 1.1768 | 0.759 | 1.1768 | 0.6339 | 1.1768 | 0.5449 | 1.1768 | 0.4784 | 1.1768 | 0.4006 | 1.1768 | 0.3289 |
| 1.2328 | 1.2562 | 1.2328 | 0.8302 | 1.2328 | 0.7291 | 1.2328 | 0.6491 | 1.2328 | 0.5837 | 1.2328 | 0.4845 | 1.2328 | 0.3864 |
| 1.2916 | 1.2562 | 1.2916 | 0.9189 | 1.2916 | 0.7993 | 1.2916 | 0.7058 | 1.2916 | 0.6308 | 1.2916 | 0.5188 | 1.2916 | 0.4097 |
| 1.353 | 1.2562 | 1.353 | 0.9189 | 1.353 | 0.7993 | 1.353 | 0.7058 | 1.353 | 0.6308 | 1.353 | 0.5188 | 1.353 | 0.4097 |
| 1.4175 | 1.3538 | 1.4175 | 0.9674 | 1.4175 | 0.8219 | 1.4175 | 0.7323 | 1.4175 | 0.6639 | 1.4175 | 0.5631 | 1.4175 | 0.4667 |
| 1.485 | 1.3538 | 1.485 | 0.9674 | 1.485 | 0.8219 | 1.485 | 0.7371 | 1.485 | 0.6874 | 1.485 | 0.5977 | 1.485 | 0.4967 |
| 1.5557 | 1.5417 | 1.5557 | 0.9739 | 1.5557 | 0.8219 | 1.5557 | 0.7371 | 1.5557 | 0.6874 | 1.5557 | 0.5977 | 1.5557 | 0.5028 |
| 1.6298 | 1.6087 | 1.6298 | 1.0257 | 1.6298 | 0.9121 | 1.6298 | 0.8203 | 1.6298 | 0.7505 | 1.6298 | 0.6443 | 1.6298 | 0.5288 |
| 1.7074 | 1.6087 | 1.7074 | 1.0361 | 1.7074 | 0.9722 | 1.7074 | 0.8761 | 1.7074 | 0.795 | 1.7074 | 0.6704 | 1.7074 | 0.5676 |
| 1.7887 | 1.8947 | 1.7887 | 1.0361 | 1.7887 | 0.9722 | 1.7887 | 0.8761 | 1.7887 | 0.795 | 1.7887 | 0.6869 | 1.7887 | 0.5915 |
| 1.8738 | 1.8947 | 1.8738 | 1.0361 | 1.8738 | 0.9722 | 1.8738 | 0.8761 | 1.8738 | 0.795 | 1.8738 | 0.7041 | 1.8738 | 0.6047 |
| 1.963 | 1.8947 | 1.963 | 1.0361 | 1.963 | 0.9722 | 1.963 | 0.8761 | 1.963 | 0.7962 | 1.963 | 0.7116 | 1.963 | 0.6087 |
| 2.0565 | 1.8947 | 2.0565 | 1.0361 | 2.0565 | 0.9722 | 2.0565 | 0.8761 | 2.0565 | 0.7962 | 2.0565 | 0.7116 | 2.0565 | 0.6087 |
| 2.1544 | 1.8947 | 2.1544 | 1.0361 | 2.1544 | 0.9581 | 2.1544 | 0.8481 | 2.1544 | 0.7962 | 2.1544 | 0.7116 | 2.1544 | 0.6087 |
| 2.257 | 1.6082 | 2.257 | 1.0361 | 2.257 | 0.9149 | 2.257 | 0.8481 | 2.257 | 0.7962 | 2.257 | 0.7116 | 2.257 | 0.6087 |
| 2.3645 | 1.6082 | 2.3645 | 0.9942 | 2.3645 | 0.9149 | 2.3645 | 0.8481 | 2.3645 | 0.7962 | 2.3645 | 0.7116 | 2.3645 | 0.6087 |
| 2.4771 | 1.6082 | 2.4771 | 0.9942 | 2.4771 | 0.9149 | 2.4771 | 0.8481 | 2.4771 | 0.7904 | 2.4771 | 0.7069 | 2.4771 | 0.6029 |
| 2.595 | 1.2397 | 2.595 | 0.9942 | 2.595 | 0.9149 | 2.595 | 0.8481 | 2.595 | 0.7904 | 2.595 | 0.6952 | 2.595 | 0.5873 |

PTWW068.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 68 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.7186 | 1.1953 | 2.7186 | 0.9202 | 2.7186 | 0.8531 | 2.7186 | 0.7931 | 2.7186 | 0.7395 | 2.7186 | 0.6495 | 2.7186 | 0.562 |
| 2.848 | 1.0844 | 2.848 | 0.8533 | 2.848 | 0.7801 | 2.848 | 0.7362 | 2.848 | 0.6948 | 2.848 | 0.6221 | 2.848 | 0.5376 |
| 2.9836 | 1.0844 | 2.9836 | 0.8533 | 2.9836 | 0.7663 | 2.9836 | 0.6995 | 2.9836 | 0.6477 | 2.9836 | 0.5712 | 2.9836 | 0.4918 |
| 3.1257 | 1.0608 | 3.1257 | 0.664 | 3.1257 | 0.6109 | 3.1257 | 0.5659 | 3.1257 | 0.5322 | 3.1257 | 0.4875 | 3.1257 | 0.4434 |
| 3.2745 | 1.0608 | 3.2745 | 0.664 | 3.2745 | 0.6109 | 3.2745 | 0.5637 | 3.2745 | 0.523 | 3.2745 | 0.464 | 3.2745 | 0.411 |
| 3.4305 | 1.0608 | 3.4305 | 0.664 | 3.4305 | 0.6109 | 3.4305 | 0.5637 | 3.4305 | 0.523 | 3.4305 | 0.464 | 3.4305 | 0.411 |
| 3.5938 | 1.0608 | 3.5938 | 0.664 | 3.5938 | 0.6109 | 3.5938 | 0.5637 | 3.5938 | 0.523 | 3.5938 | 0.464 | 3.5938 | 0.411 |
| 3.7649 | 1.0608 | 3.7649 | 0.664 | 3.7649 | 0.6109 | 3.7649 | 0.5637 | 3.7649 | 0.523 | 3.7649 | 0.464 | 3.7649 | 0.411 |
| 3.9442 | 1.0608 | 3.9442 | 0.664 | 3.9442 | 0.6109 | 3.9442 | 0.5637 | 3.9442 | 0.523 | 3.9442 | 0.464 | 3.9442 | 0.411 |
| 4.132 | 1.0608 | 4.132 | 0.664 | 4.132 | 0.6109 | 4.132 | 0.5637 | 4.132 | 0.523 | 4.132 | 0.464 | 4.132 | 0.411 |
| 4.3288 | 1.0608 | 4.3288 | 0.664 | 4.3288 | 0.6109 | 4.3288 | 0.5637 | 4.3288 | 0.523 | 4.3288 | 0.464 | 4.3288 | 0.411 |
| 4.5349 | 1.0608 | 4.5349 | 0.664 | 4.5349 | 0.6109 | 4.5349 | 0.5637 | 4.5349 | 0.523 | 4.5349 | 0.464 | 4.5349 | 0.411 |
| 4.7508 | 1.0608 | 4.7508 | 0.664 | 4.7508 | 0.6109 | 4.7508 | 0.5637 | 4.7508 | 0.523 | 4.7508 | 0.464 | 4.7508 | 0.411 |
| 4.977 | 1.0608 | 4.977 | 0.6825 | 4.977 | 0.6131 | 4.977 | 0.5637 | 4.977 | 0.523 | 4.977 | 0.464 | 4.977 | 0.411 |
| 5.214 | 1.0608 | 5.214 | 0.6825 | 5.214 | 0.6131 | 5.214 | 0.5637 | 5.214 | 0.523 | 5.214 | 0.464 | 5.214 | 0.411 |
| 5.4623 | 1.0608 | 5.4623 | 0.6825 | 5.4623 | 0.6131 | 5.4623 | 0.5637 | 5.4623 | 0.523 | 5.4623 | 0.464 | 5.4623 | 0.411 |
| 5.7224 | 1.5414 | 5.7224 | 0.7528 | 5.7224 | 0.6883 | 5.7224 | 0.5675 | 5.7224 | 0.523 | 5.7224 | 0.464 | 5.7224 | 0.411 |
| 5.9948 | 1.5414 | 5.9948 | 0.7528 | 5.9948 | 0.6883 | 5.9948 | 0.5707 | 5.9948 | 0.5166 | 5.9948 | 0.4624 | 5.9948 | 0.411 |
| 6.2803 | 1.5414 | 6.2803 | 0.7528 | 6.2803 | 0.6883 | 6.2803 | 0.5707 | 6.2803 | 0.5135 | 6.2803 | 0.4514 | 6.2803 | 0.4057 |
| 6.5793 | 1.5414 | 6.5793 | 0.7528 | 6.5793 | 0.6883 | 6.5793 | 0.5707 | 6.5793 | 0.5057 | 6.5793 | 0.4473 | 6.5793 | 0.4057 |
| 6.8926 | 1.5414 | 6.8926 | 0.7528 | 6.8926 | 0.6883 | 6.8926 | 0.5707 | 6.8926 | 0.5057 | 6.8926 | 0.4393 | 6.8926 | 0.4057 |
| 7.2208 | 1.2507 | 7.2208 | 0.7528 | 7.2208 | 0.6517 | 7.2208 | 0.5707 | 7.2208 | 0.5057 | 7.2208 | 0.43 | 7.2208 | 0.4057 |
| 7.5646 | 1.1914 | 7.5646 | 0.7042 | 7.5646 | 0.5868 | 7.5646 | 0.5157 | 7.5646 | 0.4615 | 7.5646 | 0.43 | 7.5646 | 0.4057 |
| 7.9248 | 1.0406 | 7.9248 | 0.5548 | 7.9248 | 0.4886 | 7.9248 | 0.4685 | 7.9248 | 0.4529 | 7.9248 | 0.43 | 7.9248 | 0.4057 |
| 8.3022 | 1.0406 | 8.3022 | 0.547 | 8.3022 | 0.4886 | 8.3022 | 0.4685 | 8.3022 | 0.4529 | 8.3022 | 0.43 | 8.3022 | 0.4057 |
| 8.6975 | 0.8232 | 8.6975 | 0.5221 | 8.6975 | 0.4886 | 8.6975 | 0.4685 | 8.6975 | 0.4529 | 8.6975 | 0.43 | 8.6975 | 0.4054 |
| 9.1116 | 0.8232 | 9.1116 | 0.5221 | 9.1116 | 0.4715 | 9.1116 | 0.4536 | 9.1116 | 0.442 | 9.1116 | 0.4229 | 9.1116 | 0.4013 |
| 9.5455 | 0.8232 | 9.5455 | 0.5221 | 9.5455 | 0.4715 | 9.5455 | 0.4536 | 9.5455 | 0.442 | 9.5455 | 0.4229 | 9.5455 | 0.4013 |
| 10 | 0.7266 | 10 | 0.5221 | 10 | 0.4715 | 10 | 0.4536 | 10 | 0.442 | 10 | 0.4229 | 10 | 0.4013 |
| 10.4762 | 0.7266 | 10.4762 | 0.5221 | 10.4762 | 0.4715 | 10.4762 | 0.4318 | 10.4762 | 0.4256 | 10.4762 | 0.4126 | 10.4762 | 0.3942 |
| 10.975 | 0.7266 | 10.975 | 0.5221 | 10.975 | 0.4715 | 10.975 | 0.4261 | 10.975 | 0.412 | 10.975 | 0.3988 | 10.975 | 0.3816 |
| 11.4976 | 0.7266 | 11.4976 | 0.5041 | 11.4976 | 0.4445 | 11.4976 | 0.4109 | 11.4976 | 0.4001 | 11.4976 | 0.3859 | 11.4976 | 0.3714 |
| 12.045 | 0.5193 | 12.045 | 0.4288 | 12.045 | 0.3925 | 12.045 | 0.3815 | 12.045 | 0.3795 | 12.045 | 0.3743 | 12.045 | 0.3648 |
| 12.6186 | 0.5193 | 12.6186 | 0.3891 | 12.6186 | 0.3839 | 12.6186 | 0.3789 | 12.6186 | 0.3746 | 12.6186 | 0.367 | 12.6186 | 0.3574 |
| 13.2194 | 0.5193 | 13.2194 | 0.3754 | 13.2194 | 0.3691 | 13.2194 | 0.3654 | 13.2194 | 0.3624 | 13.2194 | 0.3568 | 13.2194 | 0.3489 |

PTWW068.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~ Figure 68 ~ SLAB-WALL JOINT North-South Responses ~ Elevation 0 ft. ~ Line 12.5 H

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 0.5193 | 13.8489 | 0.3622 | 13.8489 | 0.3539 | 13.8489 | 0.3531 | 13.8489 | 0.3514 | 13.8489 | 0.3468 | 13.8489 | 0.3398 |
| 14.5083 | 0.5193 | 14.5083 | 0.3622 | 14.5083 | 0.3539 | 14.5083 | 0.3479 | 14.5083 | 0.3436 | 14.5083 | 0.3374 | 14.5083 | 0.3305 |
| 15.1991 | 0.5193 | 15.1991 | 0.3331 | 15.1991 | 0.3298 | 15.1991 | 0.3285 | 15.1991 | 0.3274 | 15.1991 | 0.3248 | 15.1991 | 0.3203 |
| 15.9228 | 0.5193 | 15.9228 | 0.3275 | 15.9228 | 0.323 | 15.9228 | 0.3212 | 15.9228 | 0.3191 | 15.9228 | 0.3152 | 15.9228 | 0.3107 |
| 16.681 | 0.5193 | 16.681 | 0.3275 | 16.681 | 0.3163 | 16.681 | 0.3108 | 16.681 | 0.3078 | 16.681 | 0.304 | 16.681 | 0.301 |
| 17.4753 | 0.5193 | 17.4753 | 0.3271 | 17.4753 | 0.3111 | 17.4753 | 0.3037 | 17.4753 | 0.3025 | 17.4753 | 0.2998 | 17.4753 | 0.2959 |
| 18.3074 | 0.4409 | 18.3074 | 0.3004 | 18.3074 | 0.3011 | 18.3074 | 0.2998 | 18.3074 | 0.2981 | 18.3074 | 0.2949 | 18.3074 | 0.2912 |
| 19.1791 | 0.4409 | 19.1791 | 0.2999 | 19.1791 | 0.2901 | 19.1791 | 0.2881 | 19.1791 | 0.2874 | 19.1791 | 0.2867 | 19.1791 | 0.2854 |
| 20.0923 | 0.4409 | 20.0923 | 0.2999 | 20.0923 | 0.286 | 20.0923 | 0.2839 | 20.0923 | 0.2824 | 20.0923 | 0.2815 | 20.0923 | 0.2811 |
| 21.049 | 0.4409 | 21.049 | 0.2999 | 21.049 | 0.286 | 21.049 | 0.2839 | 21.049 | 0.2824 | 21.049 | 0.2803 | 21.049 | 0.2784 |
| 22.0513 | 0.4409 | 22.0513 | 0.2961 | 22.0513 | 0.2857 | 22.0513 | 0.2819 | 22.0513 | 0.279 | 22.0513 | 0.2775 | 22.0513 | 0.2758 |
| 23.1013 | 0.4409 | 23.1013 | 0.2902 | 23.1013 | 0.2857 | 23.1013 | 0.2819 | 23.1013 | 0.279 | 23.1013 | 0.2756 | 23.1013 | 0.2728 |
| 24.2013 | 0.4409 | 24.2013 | 0.2763 | 24.2013 | 0.2687 | 24.2013 | 0.2687 | 24.2013 | 0.2692 | 24.2013 | 0.2691 | 24.2013 | 0.2684 |
| 25.3536 | 0.304 | 25.3536 | 0.271 | 25.3536 | 0.2687 | 25.3536 | 0.267 | 25.3536 | 0.2657 | 25.3536 | 0.264 | 25.3536 | 0.2647 |
| 26.5609 | 0.304 | 26.5609 | 0.271 | 26.5609 | 0.2687 | 26.5609 | 0.267 | 26.5609 | 0.2657 | 26.5609 | 0.264 | 26.5609 | 0.2628 |
| 27.8256 | 0.2808 | 27.8256 | 0.2679 | 27.8256 | 0.2658 | 27.8256 | 0.2641 | 27.8256 | 0.2629 | 27.8256 | 0.2613 | 27.8256 | 0.2603 |
| 29.1505 | 0.2754 | 29.1505 | 0.2584 | 29.1505 | 0.2573 | 29.1505 | 0.2565 | 29.1505 | 0.2559 | 29.1505 | 0.2561 | 29.1505 | 0.2571 |
| 30.5386 | 0.2652 | 30.5386 | 0.2584 | 30.5386 | 0.2573 | 30.5386 | 0.2565 | 30.5386 | 0.2559 | 30.5386 | 0.2553 | 30.5386 | 0.2556 |
| 31.9927 | 0.2557 | 31.9927 | 0.2584 | 31.9927 | 0.2573 | 31.9927 | 0.2565 | 31.9927 | 0.2559 | 31.9927 | 0.2553 | 31.9927 | 0.2549 |
| 33.516 | 0.2539 | 33.516 | 0.2548 | 33.516 | 0.2549 | 33.516 | 0.2548 | 33.516 | 0.2546 | 33.516 | 0.2543 | 33.516 | 0.2539 |
| 35.1119 | 0.2533 | 35.1119 | 0.2532 | 35.1119 | 0.2531 | 35.1119 | 0.2531 | 35.1119 | 0.253 | 35.1119 | 0.2529 | 35.1119 | 0.2527 |
| 36.7838 | 0.252 | 36.7838 | 0.2519 | 36.7838 | 0.2518 | 36.7838 | 0.2518 | 36.7838 | 0.2518 | 36.7838 | 0.2517 | 36.7838 | 0.2516 |
| 38.5353 | 0.2507 | 38.5353 | 0.2507 | 38.5353 | 0.2506 | 38.5353 | 0.2506 | 38.5353 | 0.2506 | 38.5353 | 0.2506 | 38.5353 | 0.2505 |
| 40.3702 | 0.2496 | 40.3702 | 0.2496 | 40.3702 | 0.2496 | 40.3702 | 0.2496 | 40.3702 | 0.2496 | 40.3702 | 0.2496 | 40.3702 | 0.2495 |
| 42.2924 | 0.2486 | 42.2924 | 0.2487 | 42.2924 | 0.2487 | 42.2924 | 0.2487 | 42.2924 | 0.2487 | 42.2924 | 0.2487 | 42.2924 | 0.2487 |
| 44.3062 | 0.2478 | 44.3062 | 0.2479 | 44.3062 | 0.2479 | 44.3062 | 0.2479 | 44.3062 | 0.2479 | 44.3062 | 0.2479 | 44.3062 | 0.2479 |
| 46.4159 | 0.2472 | 46.4159 | 0.2471 | 46.4159 | 0.2471 | 46.4159 | 0.2471 | 46.4159 | 0.2471 | 46.4159 | 0.2471 | 46.4159 | 0.2472 |
| 48.626 | 0.2464 | 48.626 | 0.2464 | 48.626 | 0.2464 | 48.626 | 0.2464 | 48.626 | 0.2464 | 48.626 | 0.2465 | 48.626 | 0.2465 |
| 50.9414 | 0.2458 | 50.9414 | 0.2458 | 50.9414 | 0.2458 | 50.9414 | 0.2458 | 50.9414 | 0.2458 | 50.9414 | 0.2458 | 50.9414 | 0.2458 |

PTEE024.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~
Figure 24E ~ Vertical Responses - Slab/Wall Joints ~ Elevation 0 ft. (Concrete) ~ Enveloped Spectra

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.1098 | 0.0291 | 0.1098 | 0.026 | 0.1098 | 0.0244 | 0.1098 | 0.0229 | 0.1098 | 0.022 | 0.1098 | 0.0212 | 0.1098 | 0.0204 |
| 0.115 | 0.0308 | 0.115 | 0.026 | 0.115 | 0.0244 | 0.115 | 0.0233 | 0.115 | 0.0229 | 0.115 | 0.0221 | 0.115 | 0.0213 |
| 0.1204 | 0.0313 | 0.1204 | 0.0262 | 0.1204 | 0.0245 | 0.1204 | 0.024 | 0.1204 | 0.0236 | 0.1204 | 0.0229 | 0.1204 | 0.0218 |
| 0.1262 | 0.0313 | 0.1262 | 0.027 | 0.1262 | 0.0257 | 0.1262 | 0.0246 | 0.1262 | 0.0241 | 0.1262 | 0.0233 | 0.1262 | 0.0221 |
| 0.1322 | 0.0313 | 0.1322 | 0.0271 | 0.1322 | 0.0258 | 0.1322 | 0.0247 | 0.1322 | 0.0242 | 0.1322 | 0.0234 | 0.1322 | 0.0225 |
| 0.1385 | 0.0313 | 0.1385 | 0.0277 | 0.1385 | 0.0265 | 0.1385 | 0.0254 | 0.1385 | 0.0245 | 0.1385 | 0.0235 | 0.1385 | 0.0225 |
| 0.1451 | 0.0316 | 0.1451 | 0.0294 | 0.1451 | 0.0282 | 0.1451 | 0.027 | 0.1451 | 0.0259 | 0.1451 | 0.0239 | 0.1451 | 0.0225 |
| 0.152 | 0.032 | 0.152 | 0.0299 | 0.152 | 0.0286 | 0.152 | 0.0273 | 0.152 | 0.0262 | 0.152 | 0.0241 | 0.152 | 0.0225 |
| 0.1592 | 0.033 | 0.1592 | 0.031 | 0.1592 | 0.0299 | 0.1592 | 0.0288 | 0.1592 | 0.0277 | 0.1592 | 0.0261 | 0.1592 | 0.0241 |
| 0.1668 | 0.0367 | 0.1668 | 0.0323 | 0.1668 | 0.0312 | 0.1668 | 0.0302 | 0.1668 | 0.0292 | 0.1668 | 0.0276 | 0.1668 | 0.0256 |
| 0.1748 | 0.0507 | 0.1748 | 0.0427 | 0.1748 | 0.0385 | 0.1748 | 0.035 | 0.1748 | 0.0321 | 0.1748 | 0.0284 | 0.1748 | 0.0264 |
| 0.1831 | 0.0586 | 0.1831 | 0.0492 | 0.1831 | 0.0442 | 0.1831 | 0.0399 | 0.1831 | 0.0362 | 0.1831 | 0.0306 | 0.1831 | 0.0266 |
| 0.1918 | 0.0586 | 0.1918 | 0.0492 | 0.1918 | 0.0442 | 0.1918 | 0.0399 | 0.1918 | 0.0362 | 0.1918 | 0.0306 | 0.1918 | 0.0267 |
| 0.2009 | 0.0586 | 0.2009 | 0.0492 | 0.2009 | 0.0442 | 0.2009 | 0.0399 | 0.2009 | 0.0362 | 0.2009 | 0.0323 | 0.2009 | 0.0293 |
| 0.2105 | 0.0586 | 0.2105 | 0.0492 | 0.2105 | 0.0442 | 0.2105 | 0.0399 | 0.2105 | 0.0384 | 0.2105 | 0.0357 | 0.2105 | 0.0322 |
| 0.2205 | 0.0586 | 0.2205 | 0.0492 | 0.2205 | 0.0453 | 0.2205 | 0.0426 | 0.2205 | 0.0406 | 0.2205 | 0.0376 | 0.2205 | 0.0337 |
| 0.231 | 0.0586 | 0.231 | 0.0492 | 0.231 | 0.0458 | 0.231 | 0.0439 | 0.231 | 0.042 | 0.231 | 0.0387 | 0.231 | 0.0352 |
| 0.242 | 0.0586 | 0.242 | 0.0509 | 0.242 | 0.0485 | 0.242 | 0.0463 | 0.242 | 0.0444 | 0.242 | 0.041 | 0.242 | 0.0368 |
| 0.2535 | 0.0648 | 0.2535 | 0.0572 | 0.2535 | 0.0528 | 0.2535 | 0.0488 | 0.2535 | 0.0453 | 0.2535 | 0.041 | 0.2535 | 0.0371 |
| 0.2656 | 0.0731 | 0.2656 | 0.0586 | 0.2656 | 0.0534 | 0.2656 | 0.049 | 0.2656 | 0.0453 | 0.2656 | 0.0424 | 0.2656 | 0.0402 |
| 0.2783 | 0.0816 | 0.2783 | 0.0598 | 0.2783 | 0.0534 | 0.2783 | 0.05 | 0.2783 | 0.0485 | 0.2783 | 0.0459 | 0.2783 | 0.0426 |
| 0.2915 | 0.0816 | 0.2915 | 0.0619 | 0.2915 | 0.058 | 0.2915 | 0.0546 | 0.2915 | 0.0516 | 0.2915 | 0.048 | 0.2915 | 0.0437 |
| 0.3054 | 0.0816 | 0.3054 | 0.0662 | 0.3054 | 0.062 | 0.3054 | 0.0583 | 0.3054 | 0.0548 | 0.3054 | 0.0488 | 0.3054 | 0.0448 |
| 0.3199 | 0.0816 | 0.3199 | 0.0701 | 0.3199 | 0.0659 | 0.3199 | 0.0622 | 0.3199 | 0.0588 | 0.3199 | 0.0531 | 0.3199 | 0.0468 |
| 0.3352 | 0.0871 | 0.3352 | 0.0766 | 0.3352 | 0.0706 | 0.3352 | 0.0658 | 0.3352 | 0.0624 | 0.3352 | 0.0565 | 0.3352 | 0.0496 |
| 0.3511 | 0.0905 | 0.3511 | 0.0805 | 0.3511 | 0.0748 | 0.3511 | 0.0698 | 0.3511 | 0.0653 | 0.3511 | 0.0578 | 0.3511 | 0.0502 |
| 0.3678 | 0.1216 | 0.3678 | 0.0951 | 0.3678 | 0.0823 | 0.3678 | 0.0722 | 0.3678 | 0.0653 | 0.3678 | 0.0578 | 0.3678 | 0.0502 |
| 0.3853 | 0.136 | 0.3853 | 0.1056 | 0.3853 | 0.0918 | 0.3853 | 0.0807 | 0.3853 | 0.0718 | 0.3853 | 0.0587 | 0.3853 | 0.0502 |
| 0.4037 | 0.136 | 0.4037 | 0.1056 | 0.4037 | 0.0918 | 0.4037 | 0.082 | 0.4037 | 0.076 | 0.4037 | 0.0663 | 0.4037 | 0.0569 |
| 0.4229 | 0.136 | 0.4229 | 0.1056 | 0.4229 | 0.0918 | 0.4229 | 0.0848 | 0.4229 | 0.0796 | 0.4229 | 0.0707 | 0.4229 | 0.0609 |
| 0.4431 | 0.136 | 0.4431 | 0.1056 | 0.4431 | 0.0932 | 0.4431 | 0.0884 | 0.4431 | 0.0838 | 0.4431 | 0.0755 | 0.4431 | 0.0652 |
| 0.4642 | 0.1375 | 0.4642 | 0.1059 | 0.4642 | 0.0974 | 0.4642 | 0.0915 | 0.4642 | 0.086 | 0.4642 | 0.0764 | 0.4642 | 0.0667 |
| 0.4863 | 0.1479 | 0.4863 | 0.1238 | 0.4863 | 0.1107 | 0.4863 | 0.0995 | 0.4863 | 0.0901 | 0.4863 | 0.082 | 0.4863 | 0.0725 |
| 0.5094 | 0.181 | 0.5094 | 0.138 | 0.5094 | 0.1214 | 0.5094 | 0.108 | 0.5094 | 0.0971 | 0.5094 | 0.0861 | 0.5094 | 0.0744 |

PTEE024.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~
Figure 24E ~ Vertical Responses - Slab/Wall Joints ~ Elevation 0 ft. (Concrete) ~ Enveloped Spectra

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 0.5337 | 0.2215 | 0.5337 | 0.1602 | 0.5337 | 0.134 | 0.5337 | 0.1151 | 0.5337 | 0.1024 | 0.5337 | 0.0861 | 0.5337 | 0.0744 |
| 0.5591 | 0.2215 | 0.5591 | 0.1602 | 0.5591 | 0.134 | 0.5591 | 0.1151 | 0.5591 | 0.1024 | 0.5591 | 0.0884 | 0.5591 | 0.0754 |
| 0.5857 | 0.2215 | 0.5857 | 0.1602 | 0.5857 | 0.134 | 0.5857 | 0.1151 | 0.5857 | 0.1024 | 0.5857 | 0.094 | 0.5857 | 0.0825 |
| 0.6136 | 0.2215 | 0.6136 | 0.1602 | 0.6136 | 0.134 | 0.6136 | 0.1175 | 0.6136 | 0.1108 | 0.6136 | 0.1001 | 0.6136 | 0.0874 |
| 0.6428 | 0.2268 | 0.6428 | 0.163 | 0.6428 | 0.1365 | 0.6428 | 0.1175 | 0.6428 | 0.1126 | 0.6428 | 0.1027 | 0.6428 | 0.0894 |
| 0.6734 | 0.2268 | 0.6734 | 0.163 | 0.6734 | 0.1377 | 0.6734 | 0.128 | 0.6734 | 0.12 | 0.6734 | 0.1074 | 0.6734 | 0.0928 |
| 0.7055 | 0.2268 | 0.7055 | 0.163 | 0.7055 | 0.1377 | 0.7055 | 0.128 | 0.7055 | 0.12 | 0.7055 | 0.1086 | 0.7055 | 0.0945 |
| 0.7391 | 0.2268 | 0.7391 | 0.163 | 0.7391 | 0.1413 | 0.7391 | 0.1333 | 0.7391 | 0.1253 | 0.7391 | 0.1108 | 0.7391 | 0.0945 |
| 0.7743 | 0.3163 | 0.7743 | 0.2131 | 0.7743 | 0.1804 | 0.7743 | 0.1581 | 0.7743 | 0.1421 | 0.7743 | 0.1213 | 0.7743 | 0.1037 |
| 0.8111 | 0.3163 | 0.8111 | 0.2131 | 0.8111 | 0.1804 | 0.8111 | 0.1581 | 0.8111 | 0.1421 | 0.8111 | 0.1213 | 0.8111 | 0.1064 |
| 0.8497 | 0.3163 | 0.8497 | 0.2131 | 0.8497 | 0.1804 | 0.8497 | 0.1652 | 0.8497 | 0.1528 | 0.8497 | 0.133 | 0.8497 | 0.112 |
| 0.8902 | 0.3163 | 0.8902 | 0.2131 | 0.8902 | 0.1856 | 0.8902 | 0.17 | 0.8902 | 0.1571 | 0.8902 | 0.1368 | 0.8902 | 0.1165 |
| 0.9326 | 0.484 | 0.9326 | 0.298 | 0.9326 | 0.2451 | 0.9326 | 0.2142 | 0.9326 | 0.192 | 0.9326 | 0.1628 | 0.9326 | 0.1368 |
| 0.977 | 0.484 | 0.977 | 0.298 | 0.977 | 0.2451 | 0.977 | 0.2142 | 0.977 | 0.192 | 0.977 | 0.171 | 0.977 | 0.15 |
| 1.0235 | 0.484 | 1.0235 | 0.298 | 1.0235 | 0.2451 | 1.0235 | 0.2142 | 1.0235 | 0.1926 | 1.0235 | 0.1805 | 1.0235 | 0.1621 |
| 1.0723 | 0.484 | 1.0723 | 0.298 | 1.0723 | 0.2615 | 1.0723 | 0.2409 | 1.0723 | 0.2242 | 1.0723 | 0.1989 | 1.0723 | 0.1731 |
| 1.1233 | 0.5753 | 1.1233 | 0.3411 | 1.1233 | 0.2701 | 1.1233 | 0.2409 | 1.1233 | 0.2242 | 1.1233 | 0.1989 | 1.1233 | 0.1746 |
| 1.1768 | 0.5753 | 1.1768 | 0.3734 | 1.1768 | 0.3107 | 1.1768 | 0.2749 | 1.1768 | 0.2469 | 1.1768 | 0.213 | 1.1768 | 0.1874 |
| 1.2328 | 0.5753 | 1.2328 | 0.3807 | 1.2328 | 0.3438 | 1.2328 | 0.3132 | 1.2328 | 0.2882 | 1.2328 | 0.2506 | 1.2328 | 0.2132 |
| 1.2916 | 0.5753 | 1.2916 | 0.4139 | 1.2916 | 0.3646 | 1.2916 | 0.3262 | 1.2916 | 0.2999 | 1.2916 | 0.2601 | 1.2916 | 0.2214 |
| 1.353 | 0.6629 | 1.353 | 0.4139 | 1.353 | 0.3646 | 1.353 | 0.3329 | 1.353 | 0.3146 | 1.353 | 0.2846 | 1.353 | 0.2493 |
| 1.4175 | 0.6629 | 1.4175 | 0.429 | 1.4175 | 0.3788 | 1.4175 | 0.3575 | 1.4175 | 0.3384 | 1.4175 | 0.3064 | 1.4175 | 0.271 |
| 1.485 | 0.6629 | 1.485 | 0.457 | 1.485 | 0.4099 | 1.485 | 0.3825 | 1.485 | 0.3581 | 1.485 | 0.32 | 1.485 | 0.2847 |
| 1.5557 | 0.6629 | 1.5557 | 0.4867 | 1.5557 | 0.4466 | 1.5557 | 0.4193 | 1.5557 | 0.3959 | 1.5557 | 0.3551 | 1.5557 | 0.3075 |
| 1.6298 | 0.8057 | 1.6298 | 0.5109 | 1.6298 | 0.4763 | 1.6298 | 0.4473 | 1.6298 | 0.4224 | 1.6298 | 0.3819 | 1.6298 | 0.335 |
| 1.7074 | 0.8379 | 1.7074 | 0.6416 | 1.7074 | 0.5704 | 1.7074 | 0.5139 | 1.7074 | 0.4676 | 1.7074 | 0.4014 | 1.7074 | 0.3559 |
| 1.7887 | 1.0345 | 1.7887 | 0.7676 | 1.7887 | 0.6799 | 1.7887 | 0.6122 | 1.7887 | 0.5562 | 1.7887 | 0.4772 | 1.7887 | 0.4004 |
| 1.8738 | 1.0345 | 1.8738 | 0.8046 | 1.8738 | 0.7255 | 1.8738 | 0.6502 | 1.8738 | 0.5996 | 1.8738 | 0.5318 | 1.8738 | 0.4441 |
| 1.963 | 1.2645 | 1.963 | 0.838 | 1.963 | 0.7316 | 1.963 | 0.6502 | 1.963 | 0.5996 | 1.963 | 0.5683 | 1.963 | 0.4717 |
| 2.0565 | 1.3932 | 2.0565 | 0.838 | 2.0565 | 0.7316 | 2.0565 | 0.6698 | 2.0565 | 0.6339 | 2.0565 | 0.584 | 2.0565 | 0.4802 |
| 2.1544 | 1.3932 | 2.1544 | 0.838 | 2.1544 | 0.7316 | 2.1544 | 0.6698 | 2.1544 | 0.6389 | 2.1544 | 0.584 | 2.1544 | 0.4802 |
| 2.257 | 1.3932 | 2.257 | 0.838 | 2.257 | 0.7519 | 2.257 | 0.6898 | 2.257 | 0.6389 | 2.257 | 0.584 | 2.257 | 0.4802 |
| 2.3645 | 1.7479 | 2.3645 | 0.9979 | 2.3645 | 0.8154 | 2.3645 | 0.7361 | 2.3645 | 0.6766 | 2.3645 | 0.584 | 2.3645 | 0.4889 |
| 2.4771 | 2.068 | 2.4771 | 1.1705 | 2.4771 | 0.9105 | 2.4771 | 0.7993 | 2.4771 | 0.7332 | 2.4771 | 0.6216 | 2.4771 | 0.5073 |
| 2.595 | 2.142 | 2.595 | 1.1705 | 2.595 | 0.9105 | 2.595 | 0.871 | 2.595 | 0.7663 | 2.595 | 0.6393 | 2.595 | 0.5251 |

PTEE024.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~
Figure 24E ~ Vertical Responses - Slab/Wall Joints ~ Elevation 0 ft. (Concrete) ~ Enveloped Spectra

| Damping Freq. | 0.50% Accel. | Freq. | 2% Accel. | Freq. | 3% Accel. | Freq. | 4% Accel. | Freq. | 5% Accel. | Freq. | 7% Accel. | Freq. | 10% Accel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.7186 | 2.142 | 2.7186 | 1.1705 | 2.7186 | 0.9105 | 2.7186 | 0.871 | 2.7186 | 0.7663 | 2.7186 | 0.6554 | 2.7186 | 0.5385 |
| 2.848 | 2.142 | 2.848 | 1.1705 | 2.848 | 0.9105 | 2.848 | 0.871 | 2.848 | 0.7663 | 2.848 | 0.6554 | 2.848 | 0.5385 |
| 2.9836 | 2.142 | 2.9836 | 1.1705 | 2.9836 | 0.9105 | 2.9836 | 0.871 | 2.9836 | 0.7663 | 2.9836 | 0.6554 | 2.9836 | 0.5385 |
| 3.1257 | 2.142 | 3.1257 | 1.1705 | 3.1257 | 0.9105 | 3.1257 | 0.871 | 3.1257 | 0.7663 | 3.1257 | 0.6554 | 3.1257 | 0.5385 |
| 3.2745 | 1.9687 | 3.2745 | 1.1168 | 3.2745 | 0.9105 | 3.2745 | 0.831 | 3.2745 | 0.7634 | 3.2745 | 0.6554 | 3.2745 | 0.5385 |
| 3.4305 | 1.4171 | 3.4305 | 0.9374 | 3.4305 | 0.8241 | 3.4305 | 0.7591 | 3.4305 | 0.7116 | 3.4305 | 0.628 | 3.4305 | 0.5317 |
| 3.5938 | 1.4171 | 3.5938 | 0.9374 | 3.5938 | 0.8241 | 3.5938 | 0.7511 | 3.5938 | 0.6929 | 3.5938 | 0.6087 | 3.5938 | 0.5317 |
| 3.7649 | 1.4171 | 3.7649 | 0.9374 | 3.7649 | 0.8241 | 3.7649 | 0.7511 | 3.7649 | 0.6929 | 3.7649 | 0.6075 | 3.7649 | 0.5317 |
| 3.9442 | 1.4171 | 3.9442 | 0.9374 | 3.9442 | 0.8199 | 3.9442 | 0.7511 | 3.9442 | 0.6929 | 3.9442 | 0.605 | 3.9442 | 0.5317 |
| 4.132 | 1.4171 | 4.132 | 0.9374 | 4.132 | 0.8199 | 4.132 | 0.7511 | 4.132 | 0.6929 | 4.132 | 0.605 | 4.132 | 0.5317 |
| 4.3288 | 1.4171 | 4.3288 | 0.9374 | 4.3288 | 0.8199 | 4.3288 | 0.7511 | 4.3288 | 0.6929 | 4.3288 | 0.605 | 4.3288 | 0.5317 |
| 4.5349 | 1.4171 | 4.5349 | 0.9374 | 4.5349 | 0.8199 | 4.5349 | 0.7511 | 4.5349 | 0.6929 | 4.5349 | 0.605 | 4.5349 | 0.5317 |
| 4.7508 | 1.4171 | 4.7508 | 0.9374 | 4.7508 | 0.8199 | 4.7508 | 0.7511 | 4.7508 | 0.6929 | 4.7508 | 0.605 | 4.7508 | 0.5317 |
| 4.977 | 1.4171 | 4.977 | 0.9374 | 4.977 | 0.8199 | 4.977 | 0.7511 | 4.977 | 0.6929 | 4.977 | 0.605 | 4.977 | 0.5317 |
| 5.214 | 1.4171 | 5.214 | 0.9374 | 5.214 | 0.8199 | 5.214 | 0.7511 | 5.214 | 0.6929 | 5.214 | 0.605 | 5.214 | 0.5317 |
| 5.4623 | 1.5403 | 5.4623 | 0.9374 | 5.4623 | 0.8199 | 5.4623 | 0.7511 | 5.4623 | 0.6929 | 5.4623 | 0.605 | 5.4623 | 0.5317 |
| 5.7224 | 1.7489 | 5.7224 | 0.9374 | 5.7224 | 0.8199 | 5.7224 | 0.7937 | 5.7224 | 0.7092 | 5.7224 | 0.6012 | 5.7224 | 0.5234 |
| 5.9948 | 1.7489 | 5.9948 | 0.9374 | 5.9948 | 0.8199 | 5.9948 | 0.7937 | 5.9948 | 0.7092 | 5.9948 | 0.6012 | 5.9948 | 0.5079 |
| 6.2803 | 1.7489 | 6.2803 | 0.9374 | 6.2803 | 0.8199 | 6.2803 | 0.7937 | 6.2803 | 0.7092 | 6.2803 | 0.6012 | 6.2803 | 0.5079 |
| 6.5793 | 1.7489 | 6.5793 | 0.9374 | 6.5793 | 0.8199 | 6.5793 | 0.7937 | 6.5793 | 0.7092 | 6.5793 | 0.6012 | 6.5793 | 0.5079 |
| 6.8926 | 1.7489 | 6.8926 | 0.9374 | 6.8926 | 0.8199 | 6.8926 | 0.7937 | 6.8926 | 0.7092 | 6.8926 | 0.6012 | 6.8926 | 0.5079 |
| 7.2208 | 1.6603 | 7.2208 | 0.9374 | 7.2208 | 0.8199 | 7.2208 | 0.7553 | 7.2208 | 0.6892 | 7.2208 | 0.5885 | 7.2208 | 0.5079 |
| 7.5646 | 1.5723 | 7.5646 | 0.9134 | 7.5646 | 0.7926 | 7.5646 | 0.7147 | 7.5646 | 0.6591 | 7.5646 | 0.5747 | 7.5646 | 0.4988 |
| 7.9248 | 1.5723 | 7.9248 | 0.9134 | 7.9248 | 0.7814 | 7.9248 | 0.6958 | 7.9248 | 0.6399 | 7.9248 | 0.564 | 7.9248 | 0.4979 |
| 8.3022 | 1.5723 | 8.3022 | 0.9134 | 8.3022 | 0.7814 | 8.3022 | 0.6958 | 8.3022 | 0.6399 | 8.3022 | 0.564 | 8.3022 | 0.4979 |
| 8.6975 | 1.2382 | 8.6975 | 0.7934 | 8.6975 | 0.6919 | 8.6975 | 0.6496 | 8.6975 | 0.6135 | 8.6975 | 0.5519 | 8.6975 | 0.4907 |
| 9.1116 | 1.2382 | 9.1116 | 0.7934 | 9.1116 | 0.6874 | 9.1116 | 0.6253 | 9.1116 | 0.5914 | 9.1116 | 0.5425 | 9.1116 | 0.4886 |
| 9.5455 | 1.2382 | 9.5455 | 0.7934 | 9.5455 | 0.6874 | 9.5455 | 0.6253 | 9.5455 | 0.5832 | 9.5455 | 0.5235 | 9.5455 | 0.4755 |
| 10 | 1.2382 | 10 | 0.7934 | 10 | 0.6874 | 10 | 0.6253 | 10 | 0.5832 | 10 | 0.5229 | 10 | 0.4655 |
| 10.4762 | 1.2382 | 10.4762 | 0.7934 | 10.4762 | 0.6874 | 10.4762 | 0.6253 | 10.4762 | 0.5832 | 10.4762 | 0.5229 | 10.4762 | 0.4646 |
| 10.975 | 1.1339 | 10.975 | 0.7934 | 10.975 | 0.6874 | 10.975 | 0.6253 | 10.975 | 0.5832 | 10.975 | 0.5219 | 10.975 | 0.4646 |
| 11.4976 | 1.0079 | 11.4976 | 0.6912 | 11.4976 | 0.6174 | 11.4976 | 0.5657 | 11.4976 | 0.5336 | 11.4976 | 0.4943 | 11.4976 | 0.4547 |
| 12.045 | 1.0079 | 12.045 | 0.6323 | 12.045 | 0.5726 | 12.045 | 0.5241 | 12.045 | 0.4881 | 12.045 | 0.4608 | 12.045 | 0.4296 |
| 12.6186 | 1.0079 | 12.6186 | 0.6123 | 12.6186 | 0.5153 | 12.6186 | 0.4854 | 12.6186 | 0.4686 | 12.6186 | 0.44 | 12.6186 | 0.4071 |
| 13.2194 | 1.0079 | 13.2194 | 0.6123 | 13.2194 | 0.5102 | 13.2194 | 0.4731 | 13.2194 | 0.452 | 13.2194 | 0.4197 | 13.2194 | 0.3883 |

PTEE024.grf ~ RPP-WTP Pretreatment Facility ISRS ~ Calc No.: 24590-PTF-S0C-S15T-00057, Rev. A ~ Frequency (cps) ~ Spectral Acceleration (g) ~
Figure 24E ~ Vertical Responses - Slab/Wall Joints ~ Elevation 0 ft. (Concrete) ~ Enveloped Spectra

| Damping | 0.50% | | 2% | | 3% | | 4% | | 5% | | 7% | | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. | Freq. | Accel. |
| 13.8489 | 1.0079 | 13.8489 | 0.6123 | 13.8489 | 0.5102 | 13.8489 | 0.4615 | 13.8489 | 0.4386 | 13.8489 | 0.4022 | 13.8489 | 0.3633 |
| 14.5083 | 1.0079 | 14.5083 | 0.6123 | 14.5083 | 0.5102 | 14.5083 | 0.4547 | 14.5083 | 0.4329 | 14.5083 | 0.3988 | 14.5083 | 0.3633 |
| 15.1991 | 1.0079 | 15.1991 | 0.6123 | 15.1991 | 0.5102 | 15.1991 | 0.4217 | 15.1991 | 0.4105 | 15.1991 | 0.3706 | 15.1991 | 0.3433 |
| 15.9228 | 1.0079 | 15.9228 | 0.6123 | 15.9228 | 0.5102 | 15.9228 | 0.4217 | 15.9228 | 0.4105 | 15.9228 | 0.3706 | 15.9228 | 0.3385 |
| 16.681 | 1.0079 | 16.681 | 0.6123 | 16.681 | 0.5102 | 16.681 | 0.4217 | 16.681 | 0.4105 | 16.681 | 0.3706 | 16.681 | 0.3385 |
| 17.4753 | 1.0079 | 17.4753 | 0.6123 | 17.4753 | 0.5102 | 17.4753 | 0.4217 | 17.4753 | 0.4105 | 17.4753 | 0.3703 | 17.4753 | 0.3348 |
| 18.3074 | 1.0079 | 18.3074 | 0.6123 | 18.3074 | 0.5102 | 18.3074 | 0.4136 | 18.3074 | 0.4017 | 18.3074 | 0.3481 | 18.3074 | 0.3209 |
| 19.1791 | 1.0079 | 19.1791 | 0.6123 | 19.1791 | 0.5102 | 19.1791 | 0.4136 | 19.1791 | 0.4017 | 19.1791 | 0.3481 | 19.1791 | 0.3122 |
| 20.0923 | 0.6551 | 20.0923 | 0.4391 | 20.0923 | 0.419 | 20.0923 | 0.3759 | 20.0923 | 0.3461 | 20.0923 | 0.319 | 20.0923 | 0.2989 |
| 21.049 | 0.6551 | 21.049 | 0.4391 | 21.049 | 0.419 | 21.049 | 0.3759 | 21.049 | 0.3461 | 21.049 | 0.3119 | 21.049 | 0.2909 |
| 22.0513 | 0.6551 | 22.0513 | 0.4391 | 22.0513 | 0.419 | 22.0513 | 0.3759 | 22.0513 | 0.3461 | 22.0513 | 0.3119 | 22.0513 | 0.2881 |
| 23.1013 | 0.4513 | 23.1013 | 0.3434 | 23.1013 | 0.3322 | 23.1013 | 0.3192 | 23.1013 | 0.3064 | 23.1013 | 0.2882 | 23.1013 | 0.278 |
| 24.2013 | 0.4513 | 24.2013 | 0.3354 | 24.2013 | 0.3097 | 24.2013 | 0.2945 | 24.2013 | 0.286 | 24.2013 | 0.2772 | 24.2013 | 0.2733 |
| 25.3536 | 0.4513 | 25.3536 | 0.2912 | 25.3536 | 0.2849 | 25.3536 | 0.2812 | 25.3536 | 0.2777 | 25.3536 | 0.2725 | 25.3536 | 0.269 |
| 26.5609 | 0.4513 | 26.5609 | 0.2865 | 26.5609 | 0.2793 | 26.5609 | 0.2755 | 26.5609 | 0.2728 | 26.5609 | 0.269 | 26.5609 | 0.265 |
| 27.8256 | 0.4513 | 27.8256 | 0.2865 | 27.8256 | 0.2752 | 27.8256 | 0.2694 | 27.8256 | 0.2651 | 27.8256 | 0.2626 | 27.8256 | 0.2598 |
| 29.1505 | 0.4513 | 29.1505 | 0.2865 | 29.1505 | 0.2672 | 29.1505 | 0.2622 | 29.1505 | 0.2586 | 29.1505 | 0.2556 | 29.1505 | 0.2542 |
| 30.5386 | 0.4513 | 30.5386 | 0.2865 | 30.5386 | 0.2637 | 30.5386 | 0.2581 | 30.5386 | 0.2572 | 30.5386 | 0.2554 | 30.5386 | 0.2534 |
| 31.9927 | 0.2716 | 31.9927 | 0.2566 | 31.9927 | 0.2561 | 31.9927 | 0.2556 | 31.9927 | 0.2551 | 31.9927 | 0.2541 | 31.9927 | 0.2527 |
| 33.516 | 0.2543 | 33.516 | 0.2538 | 33.516 | 0.2536 | 33.516 | 0.2533 | 33.516 | 0.253 | 33.516 | 0.2524 | 33.516 | 0.2515 |
| 35.1119 | 0.2519 | 35.1119 | 0.2517 | 35.1119 | 0.2515 | 35.1119 | 0.2514 | 35.1119 | 0.2512 | 35.1119 | 0.2508 | 35.1119 | 0.2502 |
| 36.7838 | 0.2501 | 36.7838 | 0.25 | 36.7838 | 0.2499 | 36.7838 | 0.2498 | 36.7838 | 0.2496 | 36.7838 | 0.2494 | 36.7838 | 0.249 |
| 38.5353 | 0.2486 | 38.5353 | 0.2485 | 38.5353 | 0.2485 | 38.5353 | 0.2484 | 38.5353 | 0.2483 | 38.5353 | 0.2481 | 38.5353 | 0.2479 |
| 40.3702 | 0.2474 | 40.3702 | 0.2473 | 40.3702 | 0.2473 | 40.3702 | 0.2472 | 40.3702 | 0.2472 | 40.3702 | 0.247 | 40.3702 | 0.2468 |
| 42.2924 | 0.2463 | 42.2924 | 0.2463 | 42.2924 | 0.2462 | 42.2924 | 0.2462 | 42.2924 | 0.2461 | 42.2924 | 0.2461 | 42.2924 | 0.2459 |
| 44.3062 | 0.2454 | 44.3062 | 0.2453 | 44.3062 | 0.2453 | 44.3062 | 0.2453 | 44.3062 | 0.2453 | 44.3062 | 0.2452 | 44.3062 | 0.2451 |
| 46.4159 | 0.2446 | 46.4159 | 0.2445 | 46.4159 | 0.2445 | 46.4159 | 0.2445 | 46.4159 | 0.2445 | 46.4159 | 0.2444 | 46.4159 | 0.2444 |
| 48.626 | 0.2438 | 48.626 | 0.2438 | 48.626 | 0.2438 | 48.626 | 0.2438 | 48.626 | 0.2438 | 48.626 | 0.2437 | 48.626 | 0.2437 |
| 50.9414 | 0.2431 | 50.9414 | 0.2431 | 50.9414 | 0.2431 | 50.9414 | 0.2431 | 50.9414 | 0.2431 | 50.9414 | 0.2431 | 50.9414 | 0.2431 |

1

**Table III.10.G.A – Pretreatment Plant Miscellaneous Unit Systems**

| Miscellaneous Unit System Description[a] | Miscellaneous Unit System Designation | Description Drawings | Narrative Description, Tables, & Figures | Maximum Capacity (gallons) |
|---|---|---|---|---|
| **Waste Feed Evaporation Process System**<br><br>FEP-SEP-00001A (Waste Feed Evaporator Separator Vessel)<br><br>FEP-SEP-00001B (Waste Feed Evaporator Separator Vessel) | FEP | **24590-PTF**<br>-3PS-MEVV-T0001, Rev 2<br>-M5-V17T-00004001, Rev 3<br>-M5-V17T-00004002, Rev 3<br>-M6-FEP-00001001, Rev ~~0~~1<br>-M6-FEP-00001002, Rev 0<br>-M6-FEP-00001003, Rev 0<br>-M6-FEP-00002001, Rev 0<br>-M6-FEP-00002002, Rev 0<br>-M6-FEP-00002003, Rev 0<br>-M6-FEP-00003001, Rev 0<br>-M6-FEP-00003002, Rev 0<br>-M6-FEP-00004001, Rev 0<br>-M6-FEP-00004002, Rev 0<br>-M6-FEP-00004003, Rev 0<br>-M6-FEP-00005001, Rev 0<br>-MVD-FEP-P0001, Rev 2<br>-MVD-FEP-P0002, Rev 2<br>-MVD-FEP-P0003, Rev 1<br>~~-MVD-FEP-P0006, Rev 3~~<br>-MVD-FEP-00006- Rev 5<br>~~-MVD-FEP-P0007, Rev 2~~<br>-MVD-FEP-00007, Rev 5<br>-MV-FEP-P0001, Rev 0<br>-MV-FEP-P0002, Rev 0 | Section 4.1.2.2.; Table C-8; and Figures C1-1, C1-2 and C1-02A of Operating Unit Group 10, Addendum C of this Permit. | FEP-SEP-00001A = 14,512<br><br>FEP-SEP-00001B = 14, 512 |

**Table III.10.G.A – Pretreatment Plant Miscellaneous Unit Systems**

| Miscellaneous Unit System Description[a] | Miscellaneous Unit System Designation | Description Drawings | Narrative Description, Tables, & Figures | Maximum Capacity (gallons) |
|---|---|---|---|---|
| FEP-RBLR-00001B (Waste Feed Evaporator Reboiler) | | -M5-V17T-00004002, Rev 3<br>-MED-FEP-P0010, Rev 0<br>-P1-P01T-00001, Rev 7<br>-P1-P01T-P0002, Rev 7 | and C1-02A of Operating Unit Group 10, Addendum C of this Permit. | |
| **Cesium Nitric Acid Recovery Process System**<br><br>CNP-EVAP-00001 (Cesium Evaporator Separator Vessel) | CNP | **24590-PTF**<br>-3PS-MEVV-T0002, Rev 4<br>-M5-V17T-00014, Rev 2<br>M6-CNP-00001, Rev 2<br>-M6-CNP-00002, Rev 2<br>-M6-CNP-00008, Rev 2<br>-M6-CNP-00008001, Rev 0<br>-MV-CNP-P0001, Rev 0<br>-MV-CNP-P0002, Rev 1<br>-MV-CNP-P0005, Rev 0<br>-MVD-CNP-P0003, Rev 1<br>-MVD-CNP-00006, Rev 6<br>-MVD-CNP-P0010, Rev 0<br>-MWD-CNP-P0001, Rev 0<br>-N1D-CNP-P0005, Rev 1<br>-N1D-CNP-P0006, Rev 3<br>-N1D-CNP-P0009, Rev 1<br>-N1D-CNP-P0011, Rev 1<br>-P1-P01T-00001, Rev 8<br>-P1-P01T-P0002, Rev 7<br>-P1-P01T-00003, Rev 4 | Section 4.1.2.6.; Table C-8; and Figures C1-1, C1-2 and C1-02A of Operating Unit Group 10, Addendum C of this Permit. | CNP-EVAP-00001 = RESERVED |

**Table III.10.G.A – Pretreatment Plant Miscellaneous Unit Systems**

| Miscellaneous Unit System Description[a] | Miscellaneous Unit System Designation | Description Drawings | Narrative Description, Tables, & Figures | Maximum Capacity (gallons) |
|---|---|---|---|---|
| | | -MVD-TLP-P0004, Rev 1<br>~~-MVD-TLP-P0005, Rev 2~~<br>-MVD-TLP-00005, Rev 7<br>-MV-TLP-P0001, Rev 1<br>-MV-TLP-P0002, Rev 1<br>-N1D-TLP-P0001, Rev 2<br>-N1D-TLP-P0005, Rev 3<br>-N1D-TLP-P0006, Rev 1<br>-P1-P01T-00001, Rev 7<br>-P1-P01T-P0002, Rev 7<br>-P1-P01T-00003, Rev 4 | | |
| **Treated LAW Evaporation Process System (Cont.)**<br><br>TLP-COND-00001 (Treated LAW Primary Condenser)<br><br>TLP-COND-00002 (Treated LAW Inter-condenser)<br><br>TLP-COND-00003 (Treated LAW After-condenser) | TLP | **24590-PTF**<br>-3PS-MEVV- T0001, Rev 2<br>-M5-V17T-00005, Rev 2<br>-M6-TLP-00001, Rev 3<br>-M6-TLP-00002, Rev 3<br>-M6-TLP-00003, Rev 3<br>-MED-TLP-P0001, Rev 0<br>-MED-TLP-00002, Rev 4<br>-MED-TLP-00003, Rev 4<br>-MV-TLP-P0001, Rev 1<br>-MV-TLP-P0002, Rev 1<br>-N1D-TLP-P0002, Rev 0<br>-N1D-TLP-P0003, Rev 4<br>-P1-P01T-00001, Rev 7 | Section 4.1.2.11; Table C-8; and Figures C1-1, C1-2 and C1-02A of Operating Unit Group 10, Addendum C of this Permit. | N/A |

Quarter Ending June 30, 2013 24590-PTF-PCN-ENV-12-009

# Hanford Facility RCRA Permit Modification Notification Form
## Part III, Operating Unit 10
## Waste Treatment and Immobilization Plant

Index

Page 2 of 4: Hanford Facility RCRA Permit, Part III, Operating Unit 10, Waste Treatment and Immobilization Plant

Replace Piping and Instrumentation Diagrams (P&ID) for the PTF Pretreatment In-Cell Handling (PIH) System, the Spent Resin and Dewatering Process (RDP) System, and the Radioactive Liquid Waste Disposal (RLD) System in Appendix 8.2 of the Dangerous Waste Permit (DWP). Add two new drawings for the RLD System to Appendix 8.2.

| Submitted by Co-Operator: | | Reviewed by ORP Program Office: | |
|---|---|---|---|
| Donna Busche | 4/30/13 | | 5/28/13 |
| D. M. Busche | Date | D. L. Noyes | Date |

Quarter Ending June 30, 2013 24590-PTF-PCN-ENV-12-009

| Hanford Facility RCRA Permit Modification Notification Form | |
|---|---|
| Unit: **Waste Treatment and Immobilization Plant** | Permit Part: **Part III, Operating Unit 10** |

Description of Modification:

The purpose of this Class 1 prime modification is to update the P&IDs for the PTF PIH System; the RDP Spent Resin Slurry Vessels (RDP-VSL-00002A/B/C); and the RLD Process Condensate Tanks (RLD-TK-00006A/B) and Pumps in Appendix 8.2 of the DWP. This modification also adds drawings that illustrate the RLD-TK-00006A/B Spray Wash and the RLD Process Condensate Heater (RLD-HX-00002).

The following P&ID drawings are being submitted to replace the documents currently in Appendix 8.2 and/or to provide an increase in the number of P&ID drawings submitted as a result of converting source drawings into two to five drawings to provide a clearer representation of the system. Two new drawings are to be added to Appendix 8.2.

| Appendix 8.2 | | | |
|---|---|---|---|
| Replace: | 24590-PTF-M6-PIH-P0001, Rev. 0 | With: | 24590-PTF-M6-PIH-00001001, Rev. 0 |
| | | | 24590-PTF-M6-PIH-00001002, Rev. 0 |
| | 24590-PTF-M6-RDP-00001, Rev. 3 | | 24590-PTF-M6-RDP-00001001, Rev. 0 |
| | | | 24590-PTF-M6-RDP-00001002, Rev. 0 |
| | | | 24590-PTF-M6-RDP-00001003, Rev. 0 |
| | | | 24590-PTF-M6-RDP-00001004, Rev. 0 |
| | | | 24590-PTF-M6-RDP-00001005, Rev. 0 |
| | 24590-PTF-M6-RLD-00001, Rev. 2 | | 24590-PTF-M6-RLD-00001001, Rev. 0 |
| | | | 24590-PTF-M6-RLD-00001002, Rev. 0 |
| | | | 24590-PTF-M6-RLD-00001003, Rev. 0 |
| | | | 24590-PTF-M6-RLD-00001004, Rev. 0 |
| | 24590-PTF-M6-RLD-00002, Rev. 3 | | 24590-PTF-M6-RLD-00002001, Rev. 0 |
| | | | 24590-PTF-M6-RLD-00002002, Rev. 0 |
| | | | 24590-PTF-M6-RLD-00002003, Rev. 0 |
| | | New: | 24590-PTF-M6-RLD-00005, Rev. 3 |
| | | | 24590-PTF-M6-RLD-00007001, Rev. 0 |

This modification requests Ecology approval and incorporation into the permit the specific changes to the above DWP documents. Conversion from one to multiple drawings expands the drawings to provide more detail; in general, revision clouds are used to show changes; for drawings that have undergone major revision, no revision clouds are used.

Revisions are the result of ongoing design (changes from vendor preliminary data to vendor detailed design), and general criteria from design verification review. The following identifies the significant changes that have been incorporated:

Significant changes common to most or all P&IDs are summarized below:

- Converted drawings from a single sheet to multi-sheet drawings; or extended number of sheets in multi-sheet drawings
- Modified, deleted, and added notes, holds, drawing index, and references
- Modified support/utility system lines and valves
- Enhanced instrumentation and control presentation
- Incorporated changes from change documentation identified in the Notes section on each drawing

Not submitted with this PCN is drawing 24590-PTF-M6-RLD-00007002 which is one sheet of a new two-sheet drawing. This drawing depicts only the uncontaminated steam condensate vessel RLD-VSL-00167 and associated lines, which do not manage dangerous waste under normal conditions. Please note that the discharge line identified as "Contaminated Steam Condensate PWD-VSL-00033" (line RLD-ZR-10927-S11C-02 at C3/2) is provided in the event of an off-normal event that could contaminate the steam condensate; however, the vessel and lines connected to this vessel do not normally contact tank waste and do not manage dangerous waste.

This PCN updates information in Appendix 8.2 to reflect current design. This DWP component may be re-evaluated to confirm design adequacy. If the re-evaluation results in future design changes, the changes will be reviewed by Ecology in subsequent permit modifications.

The following outstanding change documents have been submitted to Ecology pursuant to permit condition III.10.C.9.h and are maintained in the WTP Operating Record:

24590-PTF-M6-PIH-00001001

- 24590-PTF-M6LN-PIH-00001
- 24590-PTF-M6LN-PIH-00002
- 24590-PTF-M6LN-PIH-00003
- 24590-PTF-M6LN-PIH-00005
- 24590-PTF-M6N-PIH-00029
- 24590-PTF-M6N-PIH-00031
- 24590-PTF-M6PR-PIH-00001

24590-PTF-M6-PIH-00001002

- 24590-PTF-M6N-PIH-00030

24590-PTF-M6-RLD-00002003

- 24590-PTF-M6PR-RLD-00008

24590-PTF-M6-RLD-00005

- 24590-PTF-M6N-RLD-00056
- 24590-PTF-M6PR-10-00006
- 24590-PTF-M6PR-RLD-00003

24590-PTF-M6-RLD-00007001

- 24590-PTF-M6LN-M80T-00066

In accordance with Permit Condition III.10.C.2.e, this permit modification sent to Ecology may include page changes to the Permit, attachments, and permit application supporting documentation.

Quarter Ending June 30, 2013

24590-PTF-PCN-ENV-12-009

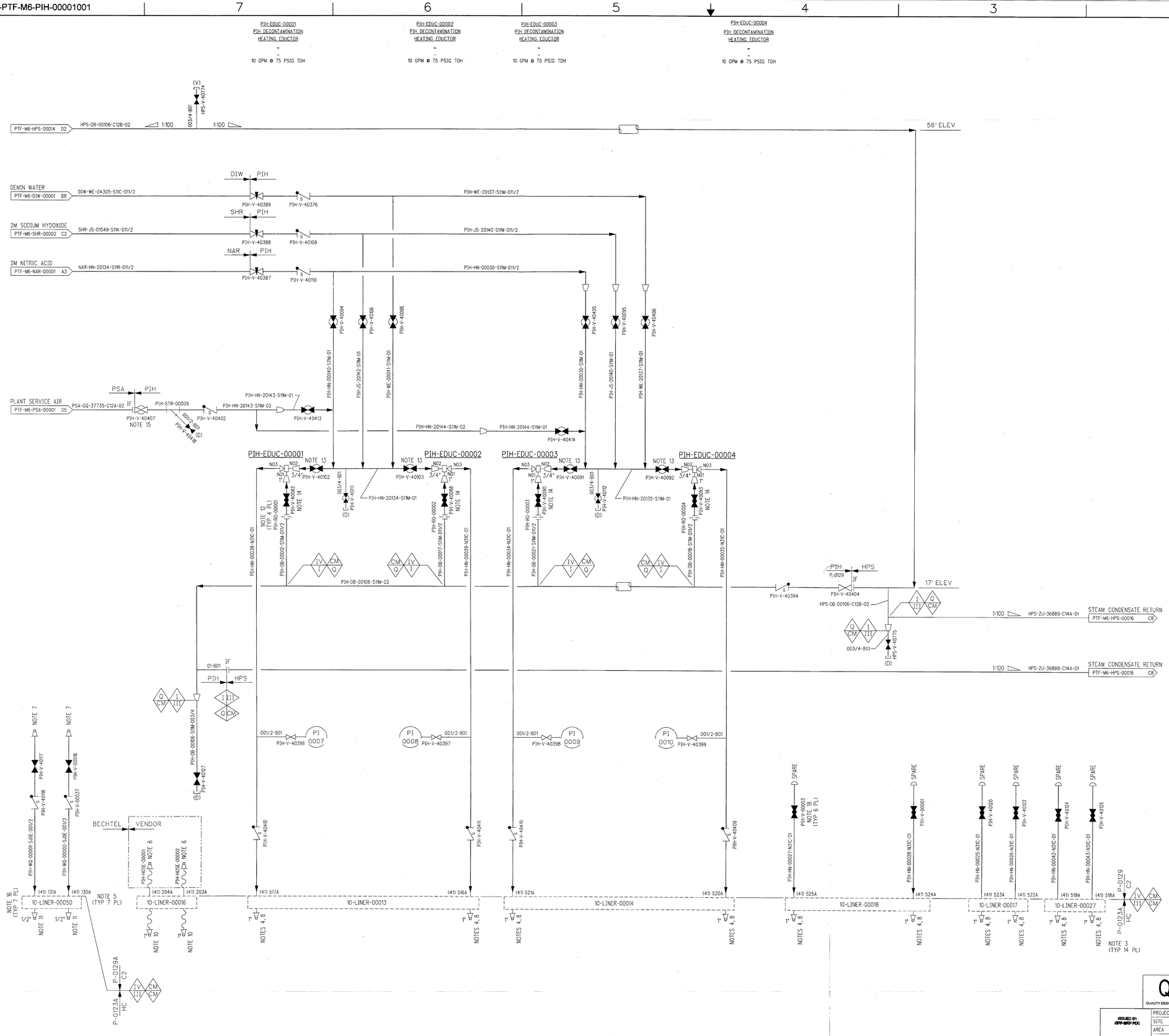
| WAC 173-303-830 Modification Class: | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | | X | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: NA

Enter wording of WAC 173-303-830, Appendix I Modification citation:

In accordance with WAC 173-303-830(4)(d)(i), this modification notification is requested to be reviewed and approved as a Class [1]1 modification. WAC 173-303-830(4)(d)(ii)(A) states, "Class 1 modifications apply to minor changes that keep the permit current with routine changes to the facility or its operation: These changes do not substantially alter the permit conditions or reduce the capacity of the facility to protect human health or the environment. In the case of Class 1 modifications, the director may require prior approval."

| Modification Approved/Concur: ☑ Yes ☐ Denied (state reason below)<br>Reason for denial: | Reviewed by Ecology:<br>S. Dahl — Date: 7/8/13 |
|---|---|




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. THE PRESSURE BOUNDARY FOR COMPONENTS ON THIS DRAWING IS QUALITY LEVEL CM AND SEISMIC CATEGORY SC-IV, UNLESS OTHERWISE NOTED.
3. REMOTE QUICK DISCONNECTS SHALL BE INSTALLED WITH FEMALE CONNECTOR LOCATED ON THE UPSTREAM SIDE AND MALE CONNECTOR ON DOWNSTREAM SIDE.
4. ATTACH LANCE PIH-TOOL-00027 OR PIH-TOOL-00028 FOR DECONTAMINATION AS NEEDED.
5. ENCAST LINERS AND JOGGLE PLUGS ARE QUALITY LEVEL Q AND SEISMIC CATEGORY SC-1.
6. CONNECTION FOR CARBON DIOXIDE PELLET MOBILE $CO_2$ DECONTAMINATION BLAST UNIT IS LOCATED IN MAINTENANCE CORRIDOR (P-0129) TO BE CONNECTED VIA 1 INCH FLEXIBLE HOSE.
7. CONNECTION FOR HIGH-PRESSURE LIQUID WASH LINES TO BE ROUTED TO A CONVENIENT LOCATION CLOSE TO PORTABLE LIQUID PRESSURE WASH SUPPLY SYSTEM (LOCATED IN ROOM P-0129).
8. ROUTE THE LINES ON TOP OF ROOM P-0129A AND PROVIDE PROTECTION FROM ANY FALLING OBJECT. LOCATE THE CONNECTORS ON THE WEST, NORTH AND EAST WALLS WITHIN REACH OF MSN MANIPULATOR. LINE MATERIAL AND THICKNESS NEED TO ACCOUNT FOR TWO PHASE FLOW EROSION AT ELEVATED TEMPERATURES AND NITRIC ACID.
9. PROVIDE DRIP LEGS AT INTERVALS OF APPROXIMATELY 150 FEET, AT ALL LOW POINTS, AND AT ALL NATURAL CONDENSATE COLLECTION POINTS (E.G. BASE OF RISERS). THE NUMBER AND LOCATION OF DRIP LEGS SHOULD BE CONFIRMED BY THE MECHANICAL SYSTEMS ENGINEER. STEAM TRAPS SHOULD BE LOCATED CLOSE TO THE DRAIN POINT.
10. ATTACH LANCE PIH-TOOL-00024 FOR DECONTAMINATION AS NEEDED. REFER TO MECHANICAL HANDLING FOR EQUIPMENT SPECIFICATIONS.
11. ATTACH LANCE PIH-TOOL-00026 FOR DECONTAMINATION AS NEEDED. REFER TO MECHANICAL HANDLING FOR EQUIPMENT SPECIFICATIONS.
12. ORIFICES ON STEAM LINES LEADING TO EDUCTORS ARE FOX SONIC CHOKE (AKA CRITICAL FLOW VENTURIES).
13. VALVES PIH-V-40102, PIH-V-40103, PIH-V-40091, AND PIH-V-40092, ARE TO BE QUICK OPEN VALVES.
14. VALVES PIH-V-40082, PIH-V-40088, PIH-V-40090, AND PIH-V-40093, ARE TO BE OPENED SLOWLY AND LOCATED AT HIGH POINT IN THE LINE.
15. THE SEQUENCE WILL RUN ONLY A SINGLE LOAD AT A TIME FROM THIS RACK. STEAM VALVE PIH-V-40404: SHALL NOT OPEN UNLESS A (1) LOAD VALVE IS OPEN. SHALL NOT OPEN UNLESS THE AIR VALVE IS CLOSED. AIR VALVE PIH-V-40407: SHALL NOT OPEN UNLESS STEAM VALVE IS CLOSED.
16. MECHANICAL HANDLING IS RESPONSIBLE FOR THE DESIGN OF THE JOGGLE PLUGS THROUGH THE LINERS.
17. ALL LINES SHOWN ON THIS DRAWING SHALL BE FREE DRAINING, UNLESS OTHERWISE NOTED.
18. LOCATE VALVE AS CLOSE TO LINER AS POSSIBLE.
19. THIS DRAWING IS CONVERTED FROM SINGLE SHEET TO MULTI-SHEET DRAWING AND IN PART SUPERSEDES 24590-PTF-M6-PIH-00001 REV 1. THIS DRAWING INCLUDES INFORMATION FROM 24590-PTF-M6N-M80T-00037.

## HOLDS/OPEN ITEMS:

1. NONE

## REFERENCE:

1. FOR DETAIL OF JOGGLE PLUGS SEE DRAWING 24590-PTF-MO-M10T-00058, AND FOR LOCATION SEE 24590-PTF-MO-M10T-00056001.
2. FOR 24590-PTF-FH-PIH-TOOL-00024, SEE 24590-PTF-MOD-PIH-00014.
3. FOR 24590-PTF-FH-PIH-TOOL-00026, SEE 24590-PTF-MOD-PIH-00027.
4. FOR 24590-PTF-FH-PIH-TOOL-00027, SEE 24590-PTF-MOD-PIH-00028.
5. FOR 24590-PTF-FH-PIH-TOOL-00028, SEE 24590-PTF-MOD-PIH-00026.

DRAWING INDEX

| DWG NO | TITLE |
|---|---|
| 24590-PTF-M6-PIH-00001001 | IN CELL HANDLING SYSTEM MAINTENANCE CAVE UTILITIES |
| 24590-PTF-M6-PIH-00001002 | IN CELL HANDLING SYSTEM MAINTENANCE CAVE UTILITIES |

REVISION HISTORY

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 0 | ISSUED FOR CONSTRUCTION SEE NOTE 19 | | | CEX | JDM | 7-24-08 |

Q
QUALITY DESIGNATOR

ISSUED BY RPP-WTP PDC

ISSUE STAMP

| | BY | DATE |
|---|---|---|
| PROJECT No. | 24590 | |
| SITE | HANFORD | |
| AREA | 200E | |
| BUILDING No. | 10 | |
| ORIGINATOR | | 7/24/08 |
| CHECKER | | 7/24/08 |
| APPROVER | | 7/24/08 |
| REVIEWER | | 7/24/08 |

CONTENT APPLICABLE TO ALARA? [X] YES [ ] NO
ADR NO. 24590-PTF-ADR-M-03-010 REV: 1
SAFETY SCREEN REQUIRED? [X] YES [ ] NO (TAMS INITIAL IF YES)

SAFETY SCREEN IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GPP-SREG-002

2

"E" SIZE - 44x34
COMPUTER GENERATED - MANUAL CHANGES NOT PERMITTED

BECHTEL

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - PTF
# IN CELL HANDLING SYSTEM MAINTENANCE CAVE UTILITIES

SCALE: NONE

24590-PTF-M6-PIH-00001001

REV 0

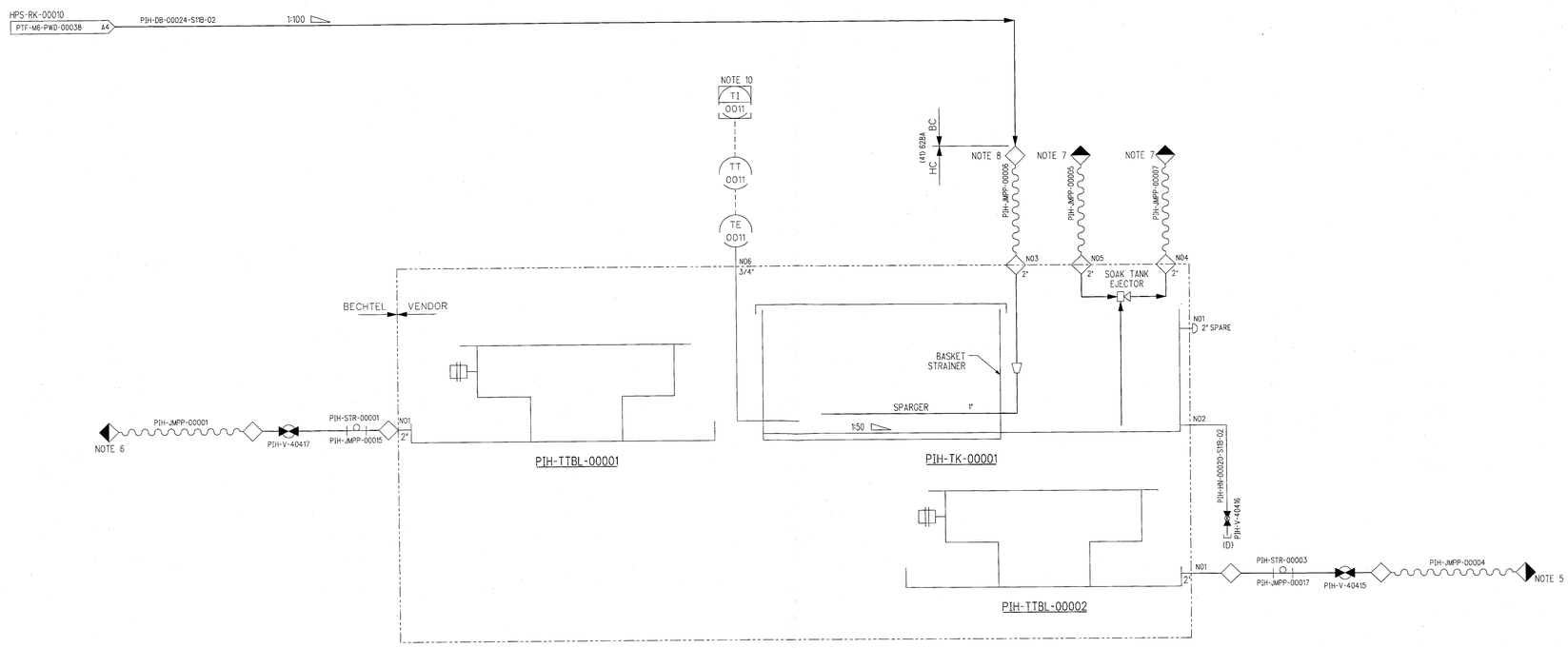
R10931321

07/23/2008 12:26:50 PM

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE exercises, pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

FORM E_SDN.DGN 02/2003

PLOTTED BY: bsavage
C:\Work\Sasmica\dgn\03837\PTFMBPIH0000001.dgn




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL COMPONENTS ON THIS DRAWING IS QUALITY LEVEL CM AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED.
4. REMOTE CONNECTORS SHALL BE INSTALLED WITH FEMALE CONNECTOR LOCATED ON THE UPSTREAM SIDE AND MALE CONNECTOR ON DOWNSTREAM SIDE.
5. TO DRAIN PIH-TTBL-00002 REMOVE PWD-JMPP-00160 (SEE PTF-M6-PWD-00010) AND INSTALL PIH-JMPP-00004.
6. TO DRAIN PIH-TTBL-00001 REMOVE PWD-JMPP-00159 (SEE PTF-M6-PWD-00010) AND INSTALL PIH-JMPP-00001.
7. TO OPERATE PIH SOAK TANK EJECTOR REMOVE PWD-JMPP-00037/42 AND CONNECT PWD-JMPP-00005/7 TO PWD-DB-03025-S11B-02 AND PWD-ZF-01194-S11B-02 RESPECTIVELY (SEE PTF-M6-PWD-00010).
8. TO ADD REAGENTS CONNECT PIH-JMPP-00006 TO NEARBY P-0129A JUMPER CONNECTIONS.
9. REFER TO MECHANICAL HANDLING FOR EQUIPMENT SPECIFICATIONS REGARDING EQUIPMENT PIH-TTBL-00001, PIH-TTBL-00002, AND PIH-TK-00001.
10. WHEN HIGH TEMPERATURE OF 200° F IS REACHED, CLOSE VALVE PWD-YV-0005 LOCATED ON P&ID 24590-PTF-M6-PWD-00038.
11. THIS DRAWING IS CONVERTED FROM SINGLE SHEET TO MULTI-SHEET DRAWING AND IN PART SUPERSEDES 24590-PTF-M6-PIH-00001 REV 1. THIS DRAWING INCLUDES INFORMATION FROM 24590-PTF-M6N-M80T-00037.

## HOLDS/OPEN ITEMS:

NONE

## REFERENCE:

1. FOR DETAIL OF PIH-TK-00001 SEE DPD DRAWING 24590-PTF-MO-PIH-00019001 AND 24590-PTF-MO-PIH-00019002.

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 0 | ISSUED FOR CONSTRUCTION SEE NOTE 11 | RLR | RWS | SPK | ESS | 7-24-08 |

CM
QUALITY DESIGNATOR

REVISION HISTORY

ISSUED BY RPP-WTP PDC

ISSUE STAMP

| | | |
|---|---|---|
| PROJECT No. | 24590 | |
| SITE | HANFORD | |
| AREA | 200E | |
| BUILDING No. | 10 | |

| | BY | DATE |
|---|---|---|
| ORIGINATOR | R. Lance Austin | 7/24/08 |
| CHECKER | R.L. Shaver | 7/24/08 |
| APPROVER | [illegible] | 7-24-08 |
| REVIEWER | [illegible] | 7/24/08 |
| | Calvin Hardy | 7/24/08 |

CONTENT APPLICABLE TO ALARA? [X] YES [ ] NO
ADR NO. 24590-PTF-ADR-M-03-010 REV: 1
SAFETY SCREEN REQUIRED? [X] YES [ ] NO EMS INITIAL IF YES GAT

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - PTF
# IN CELL HANDLING SYSTEM
# MAINTENANCE CAVE
# UTILITIES

SCALE: NONE

24590-PTF-M6-PIH-00001002

REV 0

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

SAFETY SCREEN IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GPP-SREQ-002

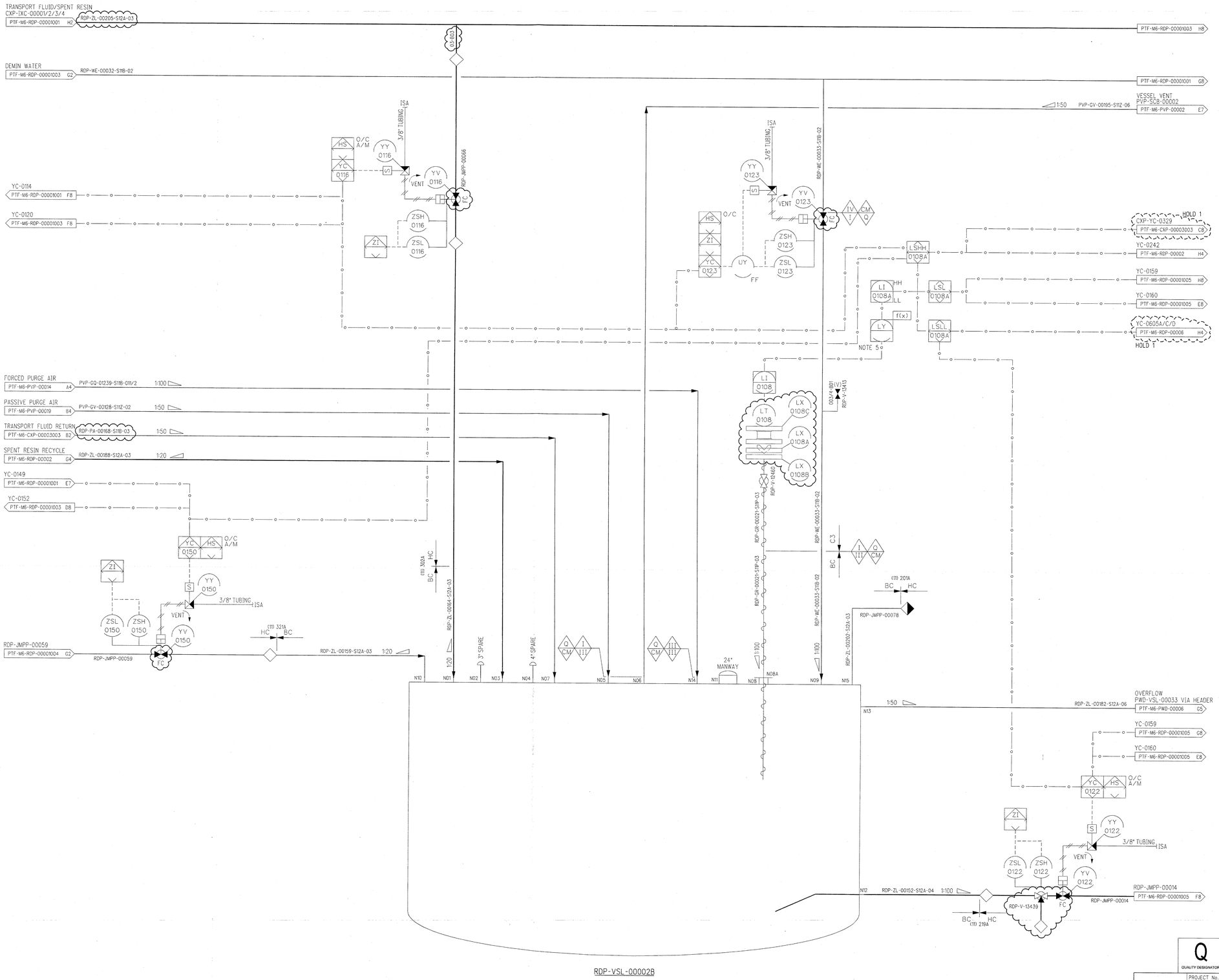
"E" SIZE - 44x34
COMPUTER GENERATED - MANUAL CHANGES NOT PERMITTED

R1093322

07/21/2008 04:02:31 PM

PLOTTED BY: kcsovic
C:\INEA\kcsovic\ptf\ptf\24590\00001002.dgn

FORM E_SDN.DGN 02/2003




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DRAWING ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL SYSTEMS, STRUCTURES AND COMPONENTS ON THIS DRAWING IS QUALITY LEVEL CM AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED.
4. ALL LINES SHOW ON THIS DRAWING SHALL BE FREE DRAINING, EXCEPT BLACK CELL LINES WHICH ARE SELF-DRAINING, UNLESS OTHERWISE NOTED.
5. FUNCTION CONVERTS LEVEL FROM INCHES TO GALLONS.
6. SEE TABLE 1 ON DRAWING 24590-PTF-M6-RDP-00001001 FOR HANDSWITCH ALIGNMENT.
7. THIS DRAWING IS CONVERTED FROM A SINGLE SHEET TO MULTI-SHEET DRAWINGS AND, IN PART, SUPERSEDES 24590-PTF-M6-RDP-00001 REV 4. THIS DRAWING INCLUDES INFORMATION FROM 24590-PTF-M6N-RDP-00032, 24590-PTF-M6N-M80T-00062, -00065, -00107, 24590-PTF-M6N-10-00011, -00002, AND 24590-PTF-M6LN-RDP-00004.

## HOLD/OPEN ITEMS:

1. CONNECTIONS ON HOLD PENDING COMPLETION OF PJM CONTROL DESIGN.

## REFERENCES:

1. 24590-PTF-3YD-RDP-00001, SYSTEM DESCRIPTION FOR THE SPENT RESIN COLLECTION AND DEWATERING PROCESS SYSTEM (RDP).

Q
QUALITY DESIGNATOR

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 7 | DMH | | | | 10/26/11 |

REVISION HISTORY

ISSUED BY RPP-WTP PDC

ISSUE STAMP

| | |
|---|---|
| PROJECT No. | 24590 |
| SITE | HANFORD |
| AREA | 200E |
| BUILDING No. | 10 |

| | BY | DATE |
|---|---|---|
| ORIGINATOR | | 10/26/11 |
| CHECKER | | 10/26/11 |
| APPROVER | | 10/26/11 |
| REVIEWER | | 10/26/11 |
| | | 10-26-11 |

CONTENT APPLICABLE TO ALARA? [XX] YES [ ] NO

ADR NO. 24590-PTF-ADR-FR-03-010 REV: 2

EMS SCREENING REQUIRED? [X] YES [ ] NO | EMS INITIAL IF YES: BW

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GPP-SREQ-002

BECHTEL

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - PTF
# SPENT RESIN COLLECTION AND DEWATERING PROCESS SYSTEM
# RDP-VSL-00002B

SCALE: NONE

24590-PTF-M6-RDP-00001002

REV 0

E SIZE 44x34

COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED

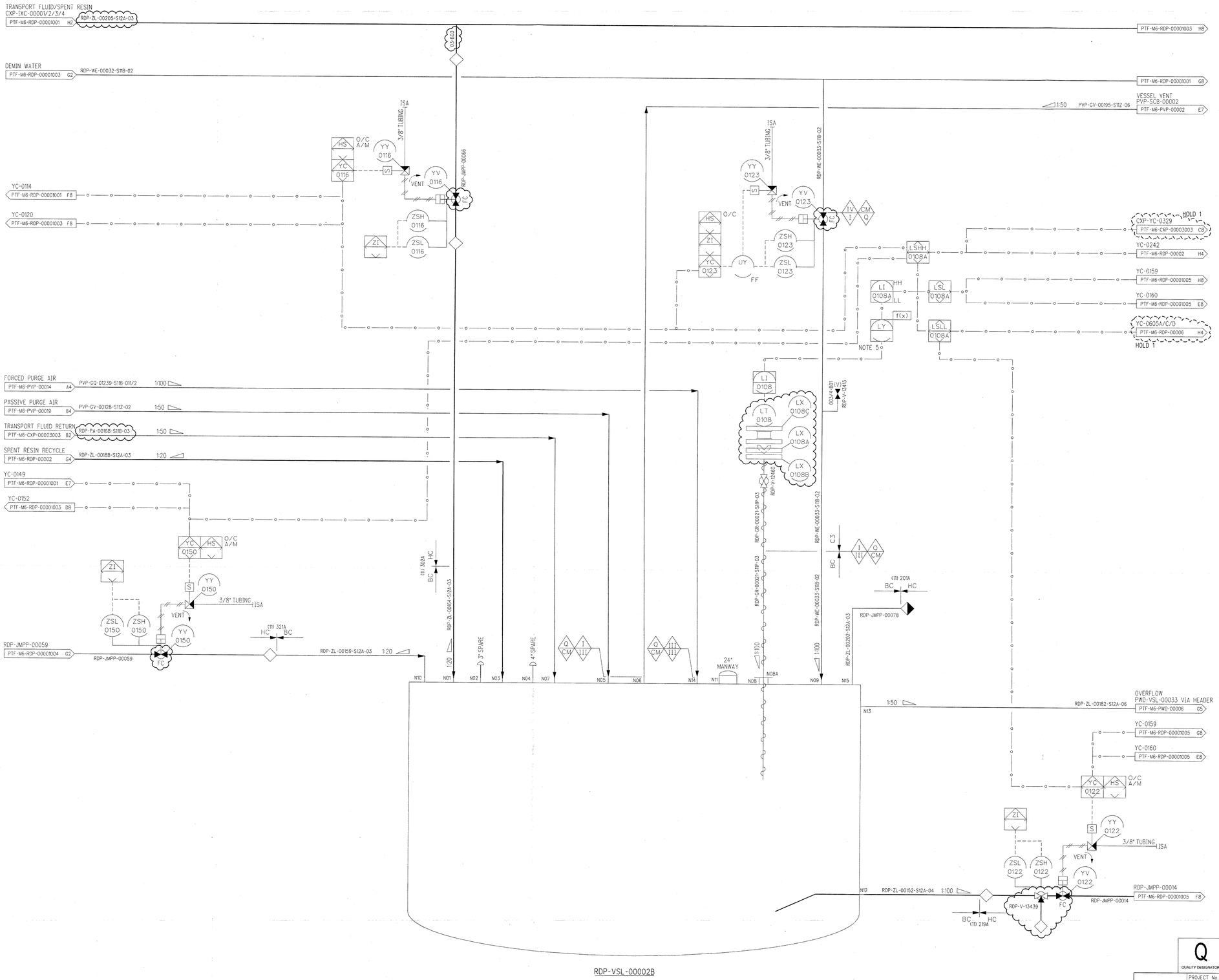
R1142386Z

10/26/2011 9:16:23 AM

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

FORM E_SDN.DGN 02/2009

PLOTTED BY: cdorn C:\Work\cdorn\dmo03537\PTM6RDP00001002.dgn




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DRAWING ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL SYSTEMS, STRUCTURES AND COMPONENTS ON THIS DRAWING IS QUALITY LEVEL CM AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED.
4. ALL LINES SHOW ON THIS DRAWING SHALL BE FREE DRAINING, EXCEPT BLACK CELL LINES WHICH ARE SELF-DRAINING, UNLESS OTHERWISE NOTED.
5. FUNCTION CONVERTS LEVEL FROM INCHES TO GALLONS.
6. SEE TABLE 1 ON DRAWING 24590-PTF-M6-RDP-00001001 FOR HANDSWITCH ALIGNMENT.
7. THIS DRAWING IS CONVERTED FROM A SINGLE SHEET TO MULTI-SHEET DRAWINGS AND, IN PART, SUPERSEDES 24590-PTF-M6-RDP-00001 REV 4. THIS DRAWING INCLUDES INFORMATION FROM 24590-PTF-M6N-RDP-00032, 24590-PTF-M6N-M80T-00062, -00065, -00107, 24590-PTF-M6N-10-00011, -00002, AND 24590-PTF-M6LN-RDP-00004.

## HOLD/OPEN ITEMS:

1. CONNECTIONS ON HOLD PENDING COMPLETION OF PJM CONTROL DESIGN.

## REFERENCES:

1. 24590-PTF-3YD-RDP-00001, SYSTEM DESCRIPTION FOR THE SPENT RESIN COLLECTION AND DEWATERING PROCESS SYSTEM (RDP).

Q
QUALITY DESIGNATOR

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 7 | DMH | | | | 10/26/11 |

REVISION HISTORY

ISSUED BY RPP-WTP PDC

ISSUE STAMP

| | |
|---|---|
| PROJECT No. | 24590 |
| SITE | HANFORD |
| AREA | 200E |
| BUILDING No. | 10 |

| | BY | DATE |
|---|---|---|
| ORIGINATOR | | 10/26/11 |
| CHECKER | | 10/26/11 |
| APPROVER | | 10/26/11 |
| REVIEWER | | 10/26/11 |
| | | 10-26-11 |

CONTENT APPLICABLE TO ALARA? [XX] YES [ ] NO

ADR NO. 24590-PTF-ADR-FR-03-010 REV: 2

EMS SCREENING REQUIRED? [X] YES [ ] NO | EMS INITIAL IF YES: BW

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GPP-SREQ-002

BECHTEL

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - PTF
# SPENT RESIN COLLECTION AND DEWATERING PROCESS SYSTEM
# RDP-VSL-00002B

SCALE: NONE

24590-PTF-M6-RDP-00001002

REV 0

E SIZE 44x34

COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED

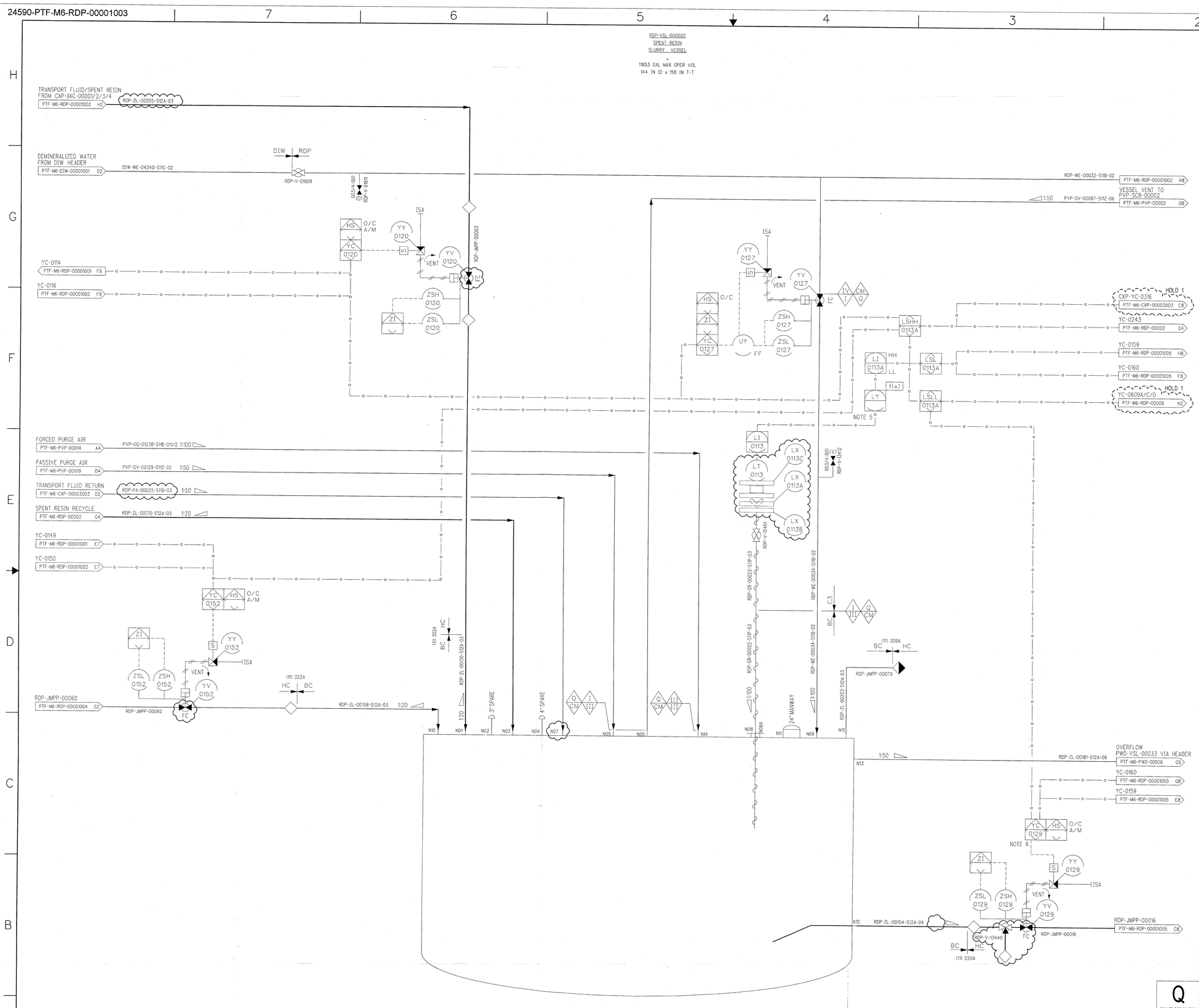
R1142386Z

10/26/2011 9:16:23 AM

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

FORM E_SDN.DGN 02/2009

PLOTTED BY: cdorn C:\Work\cdorn\dmo03537\PTM6RDP00001002.dgn




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DRAWING ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL SYSTEMS, STRUCTURES AND COMPONENTS ON THIS DRAWING IS QUALITY LEVEL CM AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED.
4. ALL LINES SHOW ON THIS DRAWING SHALL BE FREE DRAINING, EXCEPT BLACK CELL LINES WHICH ARE SELF-DRAINING, UNLESS OTHERWISE NOTED.
5. FUNCTION CONVERTS LEVEL FROM INCHES TO GALLONS.
6. SEE TABLE 1 ON 24590-PTF-M6-RDP-00001001 FOR HAND SWITCHES ALIGNMENT.
7. THIS DRAWING IS CONVERTED FROM A SINGLE SHEET TO MULTI-SHEET DRAWINGS AND, IN PART, SUPERSEDES 24590-PTF-M6-RDP-00001 REV 4. THIS DRAWING INCLUDES INFORMATION FROM 24590-PTF-M6N-RDP-00032, 24590-PTF-M6PR-RDP-00004, 24590-PTF-M6N-M8OT-00062, -00065, -00107, 24590-PTF-M6N-10-00002, -00011, AND 24590-PTF-M6LN-RDP-00004.

## HOLD/OPEN ITEMS:

1. CONNECTIONS ON HOLD PENDING COMPLETION OF PJM CONTROL DESIGN.

## REFERENCES:

1. 24590-PTF-3YD-RDP-00001, SYSTEM DESCRIPTION FOR THE SPENT RESIN COLLECTION AND DEWATERING PROCESS SYSTEM (RDP).

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 7 | DWH | | | | 10/26/11 |

REVISION HISTORY

Q QUALITY DESIGNATOR

ISSUED BY RPP-WTP PDC

| | |
|---|---|
| PROJECT No. | 24590 |
| SITE | HANFORD |
| AREA | 200E |
| BUILDING No. | 10 |

ISSUE STAMP

| | BY | DATE |
|---|---|---|
| ORIGINATOR | | 10/26/11 |
| CHECKER | | 10/26/11 |
| APPROVER | | 10/26/11 |
| REVIEWER | | 10/26/11 |
| | | 10-26-11 |

CONTENT APPLICABLE TO ALARA? [XX] YES [ ] NO
ADR NO. 24590-PTF-ADR-PR-03-030 REV: 2

EMS SCREENING REQUIRED? [X] YES [ ] NO EMS INITIAL IF YES

BECHTEL

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - PTF
# SPENT RESIN COLLECTION AND DEWATERING PROCESS SYSTEM
# RDP-VSL-00002C

SCALE: NONE

24590-PTF-M6-RDP-00001003

REV 0

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GPP-SREG-002

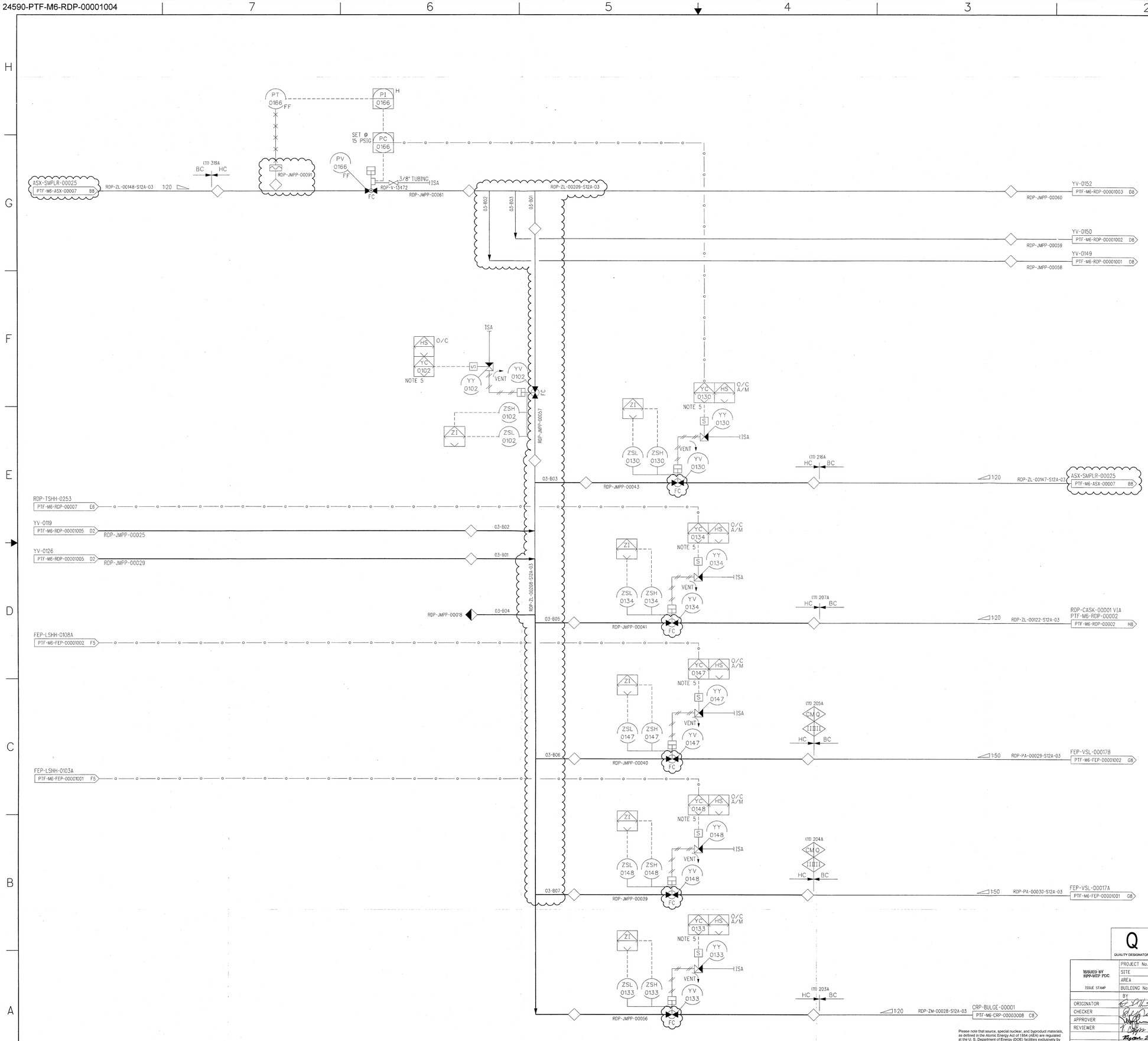
"E" SIZE - 44x34
COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED

10/26/2011 9:20:58 AM

C:\Work\adorn\sms\0.8377-PTF\M6\RDP\00001003.dgn

PLOTTED BY: eldorn

FORM E_SDW.DGN 02/2009




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DRAWING ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL SYSTEMS, STRUCTURES AND COMPONENTS ON THIS DRAWING IS QUALITY LEVEL CM AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED: .
4. ALL LINES SHOW ON THIS DRAWING SHALL BE FREE DRAINING, EXCEPT BLACK CELL LINES WHICH ARE SELF-DRAINING, UNLESS OTHERWISE NOTED.
5. SEE TABLE 1 ON 24590-PTF-M6-RDP-00001001 FOR HAND SWITCHES ALIGNMENT.
6. THIS DRAWING IS CONVERTED FROM A SINGLE SHEET TO MULTI-SHEET DRAWINGS AND, IN PART, SUPERSEDES 24590-PTF-M6-RDP-00001 REV 4. THIS DRAWING INCLUDES INFORMATION FROM 24590-PTF-M6N-RDP-000032, 24590-PTF-M6PN-RDP-00003, 24590-PTF-M6LN-RDP-00004, 24590-PTF-M6N-10-00011, -00051, AND 24590-PTF-M6N-M80T-00076.

## HOLD/OPEN ITEMS:

NONE

## REFERENCES:

1. 24590-PTF-3YD-RDP-00001, SYSTEM DESCRIPTION FOR THE SPENT RESIN COLLECTION AND DEWATERING PROCESS SYSTEM (RDP).

Q
QUALITY DESIGNATOR

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 6 | OWH | | | | 10/26/11 |

REVISION HISTORY

ISSUED BY RPP-WTP PDC

| | |
|---|---|
| PROJECT No. | 24590 |
| SITE | HANFORD |
| AREA | 200E |
| BUILDING No. | 10 |

ISSUE STAMP

BECHTEL

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

| | BY | DATE |
|---|---|---|
| ORIGINATOR | | 10/26/11 |
| CHECKER | | 10/26/11 |
| APPROVER | | 10/26/11 |
| REVIEWER | | 10/26/11 |
| | | 10-26-11 |

# P&ID - PTF
# SPENT RESIN COLLECTION AND DEWATERING PROCESS SYSTEN DISTRIBUTION

CONTENT APPLICABLE TO ALARA? [XX] YES [ ] NO
ADR NO. 24590-PTF-ADR-PR-03-010 REV: 2
EMS SCREENING REQUIRED? [X] YES [ ] NO EMS INITIAL IF YES: EMS

SCALE: NONE

24590-PTF-M6-RDP-00001004

REV 0

R11433864

'E' SIZE - 44x34
COMPUTER GENERATED - MANUAL

10/26/2011 9:22:10 AM

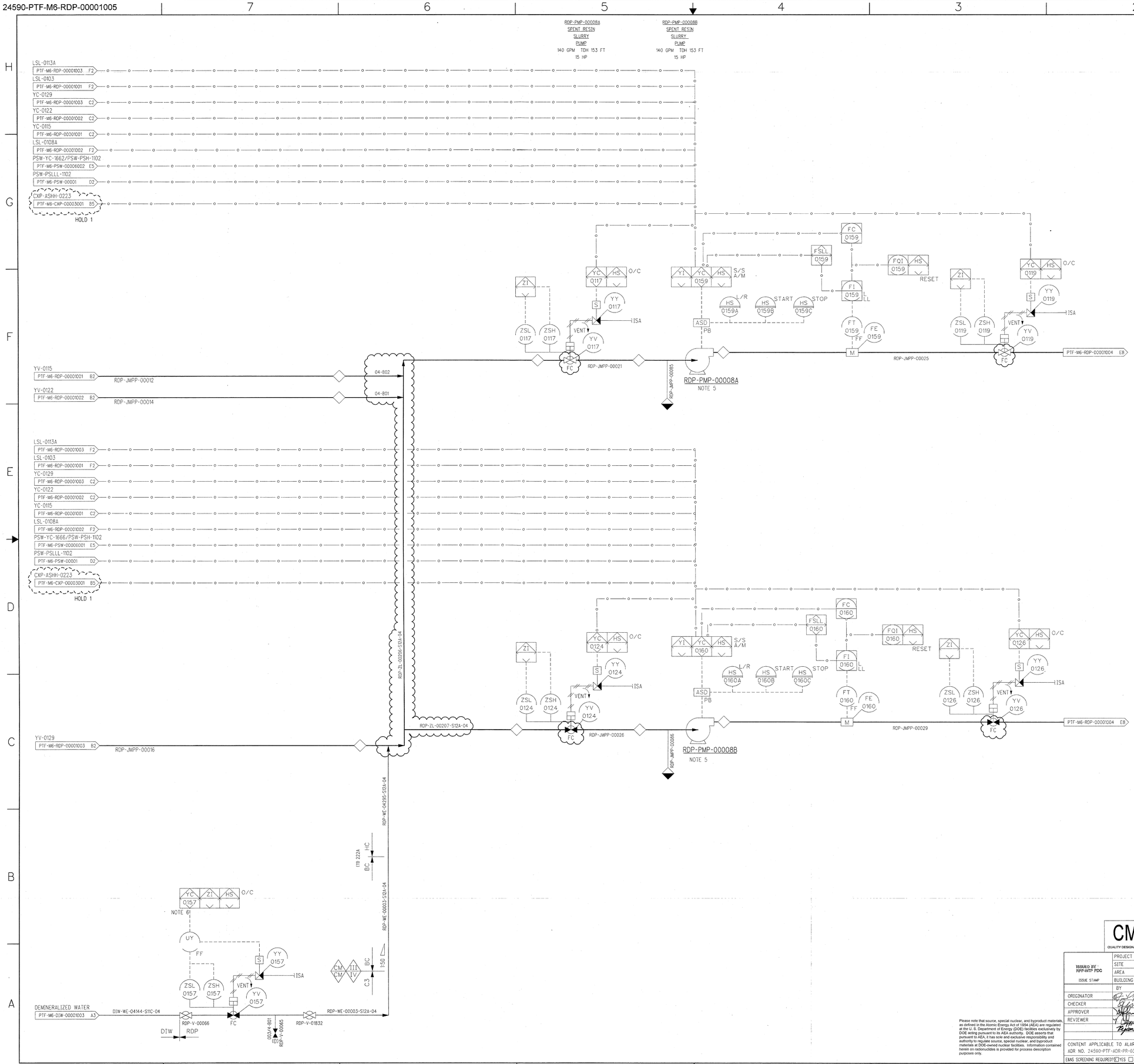
C:\Work\edorn\dms03837\PTF\M6\RDP\00001004.dgn

PLOTTED BY: edorn

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN

FORM E_SDN.DGN 02/2009




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DRAWING ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL SYSTEMS, STRUCTURES AND COMPONENTS ON THIS DRAWING IS QUALITY LEVEL CM AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED.
4. ALL LINES SHOW ON THIS DRAWING SHALL BE FREE DRAINING, EXCEPT BLACK CELL LINES WHICH ARE SELF-DRAINING, UNLESS OTHERWISE NOTED.
5. REFER TO 24590-PTF-M6-PSW-00006002 FOR PUMP SEAL WATER.
6. SEE TABLE 1 ON 24590-PTF-M6-RDP-00001001 FOR HAND SWITCHES ALIGNMENT.
7. THIS DRAWING IS CONVERTED FROM A SINGLE SHEET TO MULTI-SHEET DRAWINGS AND, IN PART, SUPERSEDES 24590-PTF-M6-RDP-00001 REV 4. THIS DRAWING INCLUDES INFORMATION FROM 24590-PTF-M6N-RDP-00032, 24590-PTF-M6LN-RDP-00004, AND 24590-PTF-M6N-10-00011.

## HOLD/OPEN ITEMS:

1. CONNECTIONS ON HOLD PENDING COMPLETION OF PJM CONTROL DESIGN.

## REFERENCES:

1. 24590-PTF-3YD-RDP-00001, SYSTEM DESCRIPTION FOR THE SPENT RESIN COLLECTION AND DEWATERING PROCESS SYSTEM (RDP).

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 7 | DMR | | | | 10/26/11 |

CM — QUALITY DESIGNATOR

REVISION HISTORY

ISSUED BY: RPP-WTP PDC
ISSUE STAMP

| | |
|---|---|
| PROJECT No. | 24590 |
| SITE | HANFORD |
| AREA | 200E |
| BUILDING No. | 10 |

| | BY | DATE |
|---|---|---|
| ORIGINATOR | | 10/26/11 |
| CHECKER | | 10/26/11 |
| APPROVER | | 10/26/11 |
| REVIEWER | | 10/26/11 |
| | | 10-26-11 |

CONTENT APPLICABLE TO ALARA? [XX] YES [ ] NO
ADR NO. 24590-PTF-ADR-PR-03-010 REV: 2
EMS SCREENING REQUIRED? [X] YES [ ] NO EMS INITIAL IF YES

BECHTEL

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - PTF SPENT RESIN COLLECTION AND DEWATERING PROCESS SYSTEM RDP-PMP-00008A/B

SCALE: NONE

24590-PTF-M6-RDP-00001005

REV 0

R1143385

E SIZE - 44x34
COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-PRD-RSES-002

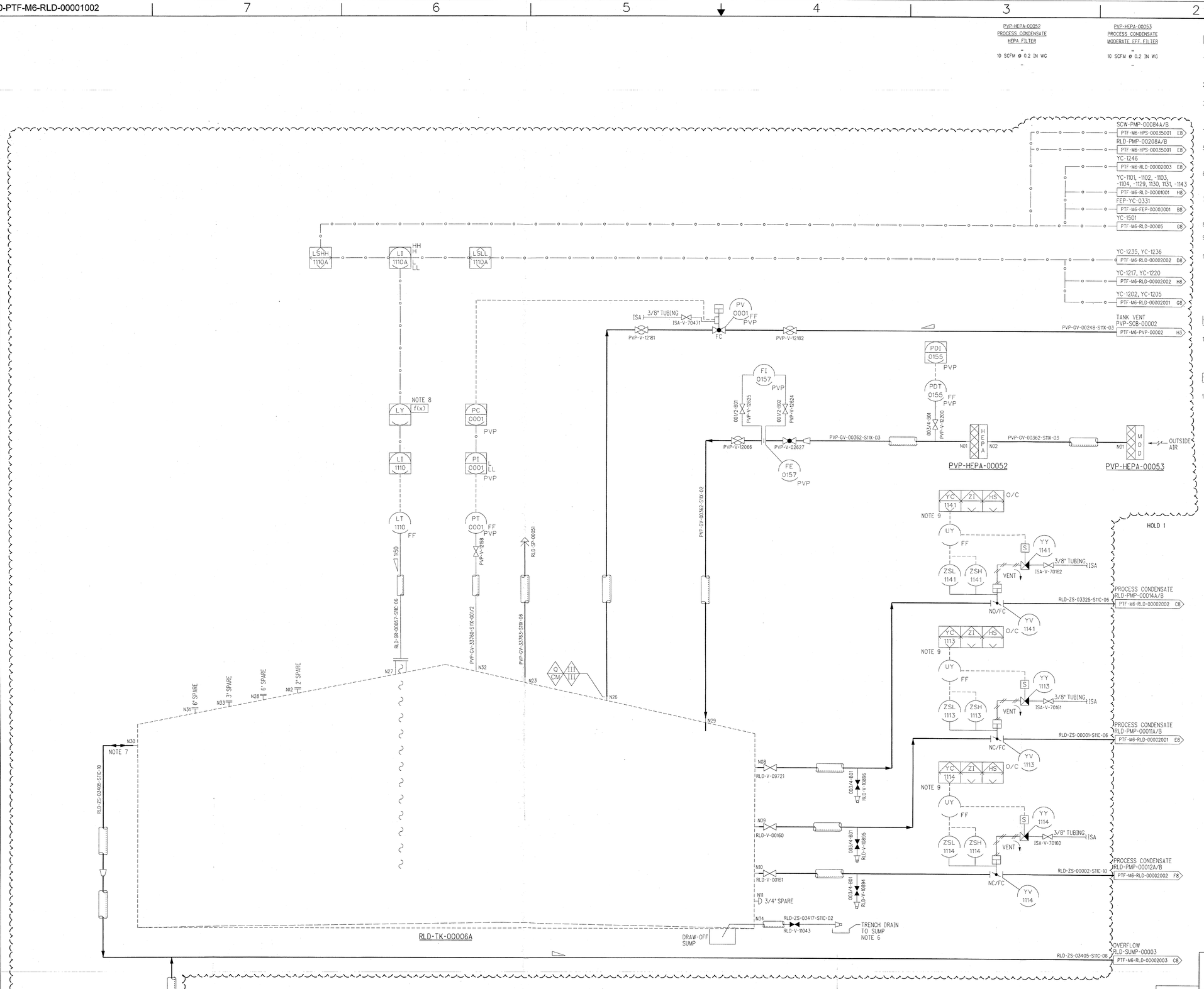
Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

FORM E_SDN.DGN 02/2009

10/26/2011 9:46:09 AM

PLOTTED BY: eidorn

C:\Work\eidorn\dms0383\?\PTM6RDP00001005.dgn




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL COMPONENTS ON THIS DRAWING IS QUALITY LEVEL CM AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED.
4. ALL LINES SHOWN ON THIS DRAWING SHALL BE FREE DRAINING, UNLESS OTHERWISE NOTED.
5. ALL INTERNAL SUPPORTS AND WELDS THAT INTERACT WITH THE PRIMARY CONFINEMENT BARRIER (TANK) SHALL MAINTAIN EQUAL QUALITY LEVEL AND SEISMIC CATEGORY AS THE PARENT TANK.
6. COVERED TRENCH SHALL BE LOCATED BETWEEN RLD-TK-00006A/B FOR DRAINING THE TANK CONTENTS TO RLD-SUMP-00003. PROVIDE A PLATE COVER FOR THE TRENCH PER 24590-WTP-DD-S13T-00002.
7. MAXIMUM OVERFLOW NOZZLE/PIPE ELEVATION SHALL BE LOWER THAN INTERIOR PERIMETER SPRAY RINGS TO PREVENT FLUID FROM CONTAMINATING SPRAY RINGS.
8. FUNCTION CONVERTS TANK LEVEL FROM INCHES TO GALLONS.
9. VALVE IS PULSED CLOSED WHEN ASSOCIATED PUMPS ARE NOT RUNNING.
10. THIS DRAWING IS CONVERTED FROM A SINGLE SHEET TO MULTI-SHEET DRAWINGS AND, IN PART, SUPERSEDES 24590-PTF-M6-RLD-00001 REV 3. THIS DRAWING INCLUDES INFORMATION FROM 24590-PTF-M6N-RLD-00050, 24590-PTF-M6N-M8OT-00099, 24590-PTF-M6LN-RLD-00003, 24590-PTF-M6PR-RLD-00006, AND 24590-PTF-M6PR-10-00005.

## HOLD/OPEN ITEMS:

1. HOLD PENDING CLOSURE OF APPROPRIATE ACTIONS IN 24590-WTP-PIER-MGT-10-0559-C (UNDER DEVELOPMENT).

## REFERENCES:

1. 24590-PTF-3YD-PWD-00001, SYSTEM DESCRIPTION FOR THE PLANT WASH AND DISPOSAL SYSTEM (PWD) AND RADIOACTIVE LIQUID WASTE DISPOSAL SYSTEM (RLD).

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 10 | EK | JS/JK | VLC/TMC | RW | 9/9/11 |

Q QUALITY DESIGNATOR

REVISION HISTORY

ISSUED BY RPP-WTP PDC — INIT DATE — ISSUE STAMP

| | | |
|---|---|---|
| PROJECT No. | 24590 | |
| SITE | HANFORD | |
| AREA | 200E | |
| BUILDING No. | 10 | |

| | BY | DATE |
|---|---|---|
| ORIGINATOR | | 9/9/11 |
| CHECKER | | 9/9/11 |
| APPROVER | | 9/9/11 |
| REVIEWER | | 9/9/11 |
| | | 9-9-11 |

CONTENT APPLICABLE TO ALARA? [X] YES [ ] NO

ADR NO. 24590-PTF-ADR-MS-07-0001 REV: 1

EMS SCREENING REQUIRED? [X] YES [ ] NO EMS INITIAL IF YES

BECHTEL NATIONAL, INC.

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - PTF RADIOATIVE LIQUID WASTE DISPOSAL SYSTEM PROCESS CONDENSATE RLD-TK-00006A

SCALE: NONE

24590-PTF-M6-RLD-00001002

REV 0

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GPP-SREQ-002

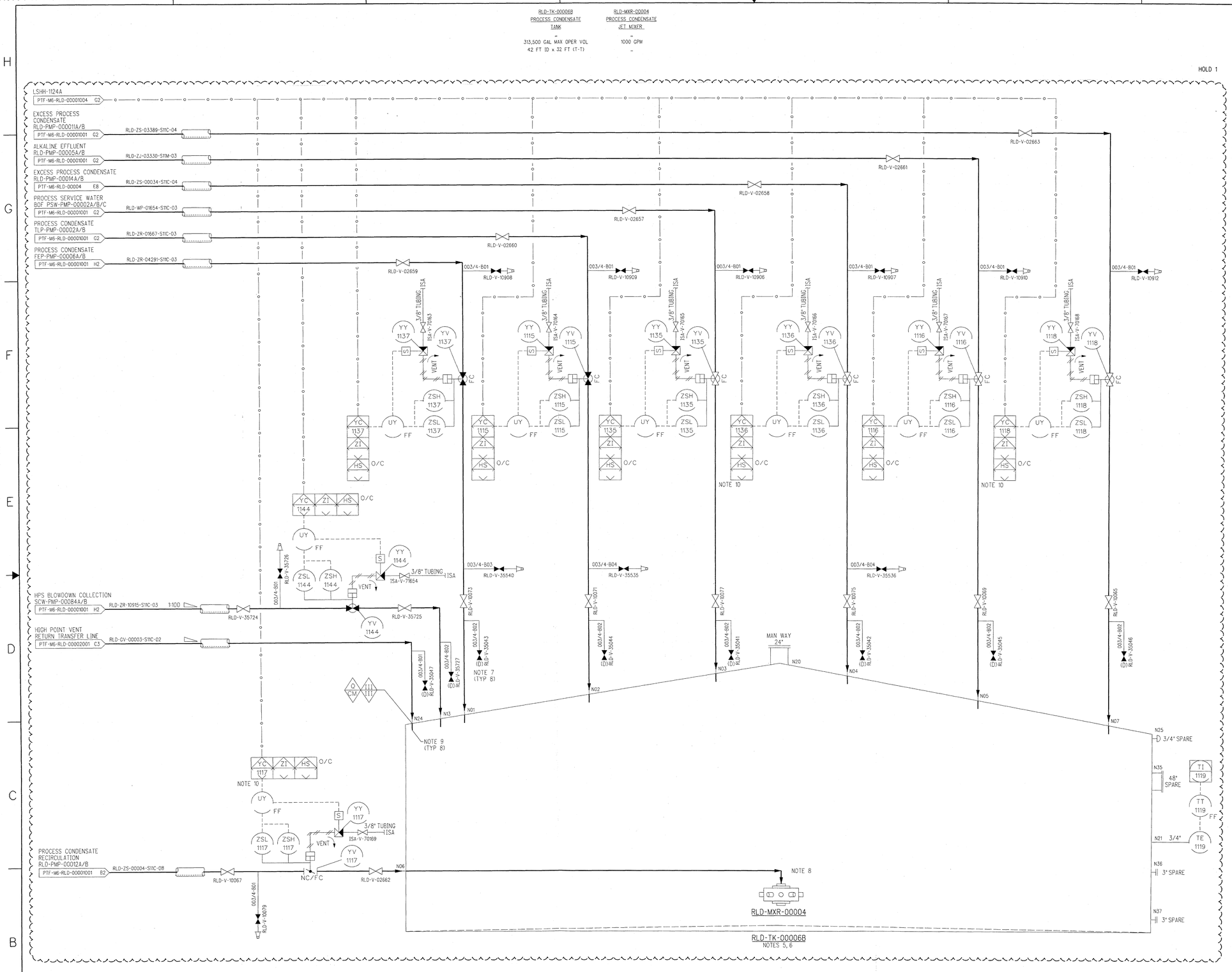
E-SIZE - 44x34
COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED

R11418485

8/15/2011 3:57:09 PM

PLOTTED BY: rdbownes C:\Work\rdbownes\omd\24590-PTF-M6RLD00001002.dgn

FORM E_SDN.DGN 02/2009




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-S0-00001 THROUGH 24590-WTP-M6-S0-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL COMPONENTS ON THIS DRAWING IS QUALITY LEVEL CM AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED.
4. ALL LINES SHOWN ON THIS DRAWING SHALL BE FREE DRAINING, UNLESS OTHERWISE NOTED.
5. ALL INTERNAL SUPPORTS AND WELDS THAT INTERACT WITH THE PRIMARY CONFINEMENT BARRIER (TANK) SHALL MAINTAIN EQUAL QUALITY LEVEL AND SEISMIC CATEGORY AS THE TANK.
6. RLD-TK-00006B WILL BE DEDICATED TO EVAPORATOR OVERHEADS AND WILL SUPPLY THE PTF WITH PROCESS CONDENSATE FOR REUSE WITHIN THE BUILDING. EXCESS PROCESS CONDENSATE WILL BE TRANSFERRED TO RLD-TK-00006A. RLD-TK-00006B RECEIVES MATERIAL FROM RLD-VSL-00017A/B IN ADDITION TO THE EXCESS CONDENSATE..
7. CAP OFF AFTER PIPELINES HAVE BEEN HYDRO TESTED.
8. RLD JET MIXER PIPING TO BE SUPPORTED FOR THE EXPECTED DYNAMIC FORCES DURING THE TRANSITION FROM DRY STAGE TO MIXING STAGE.
9. EXTEND INLET LINES INTO THE TANK AND DIRECT THEM AWAY FROM THE WALL TO PREVENT LIQUID FROM FLOWING DOWN THE WALLS.
10. VALVE PULSED CLOSED WHEN ASSOCIATED PUMPS ARE NOT RUNNING.
11. THIS DRAWING IS CONVERTED FROM A SINGLE SHEET TO MULTI-SHEET DRAWINGS AND, IN PART, SUPERSEDES 24590-PTF-M6-RLD-00001 REV 3. THIS DRAWING INCLUDES INFORMATION FROM 24590-PTF-M6N-RLD-00050, AND 24590-PTF-M6N-M80T-00099, AND 24590-PTF-M6LN-M80T-00010.

## HOLD/OPEN ITEMS:

1. HOLD PENDING CLOSURE OF APPROPRIATE ACTIONS IN 24590-WTP-PIER-MGT-10-0559-C (UNDER DEVELOPMENT).

## REFERENCES:

1. 24590-PTF-3YD-PWD-00001, SYSTEM DESCRIPTION FOR THE PLANT WASH AND DISPOSAL SYSTEM (PWD) AND RADIOACTIVE LIQUID WASTE DISPOSAL SYSTEM (RLD).

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 11 | EK | TTS | WEBBER | RW | 9/9/11 |

REVISION HISTORY

Q QUALITY DESIGNATOR

ISSUED BY RPP-WTP PDC — INIT / DATE — ISSUE STAMP

| | | |
|---|---|---|
| PROJECT No. | 24590 | |
| SITE | HANFORD | |
| AREA | 200E | |
| BUILDING No. | 10 | |

| | BY | DATE |
|---|---|---|
| ORIGINATOR | E. Kirk | 8/8/11 |
| CHECKER | J. Wrenn-Johnson | 8/11/11 |
| APPROVER | R. Webber | 9/9/11 |
| REVIEWER | T. Cooper | 8/12/11 |
| | Bryan Zielski | 9-9-11 |

CONTENT APPLICABLE TO ALARA? [X] YES [ ] NO

ADR NO. 24590-PTF-ADR-MS-07-0001 REV: 1

EMS SCREENING REQUIRED? [X] YES [ ] NO EMS INITIAL IF YES: EK

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GPP-SREQ-002

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that, pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - PTF
# RADIOATIVE LIQUID WASTE DISPOSAL SYSTEM
# PROCESS CONDENSATE
# RLD-TK-00006B

SCALE: NONE

24590-PTF-M6-RLD-00001003

REV 0

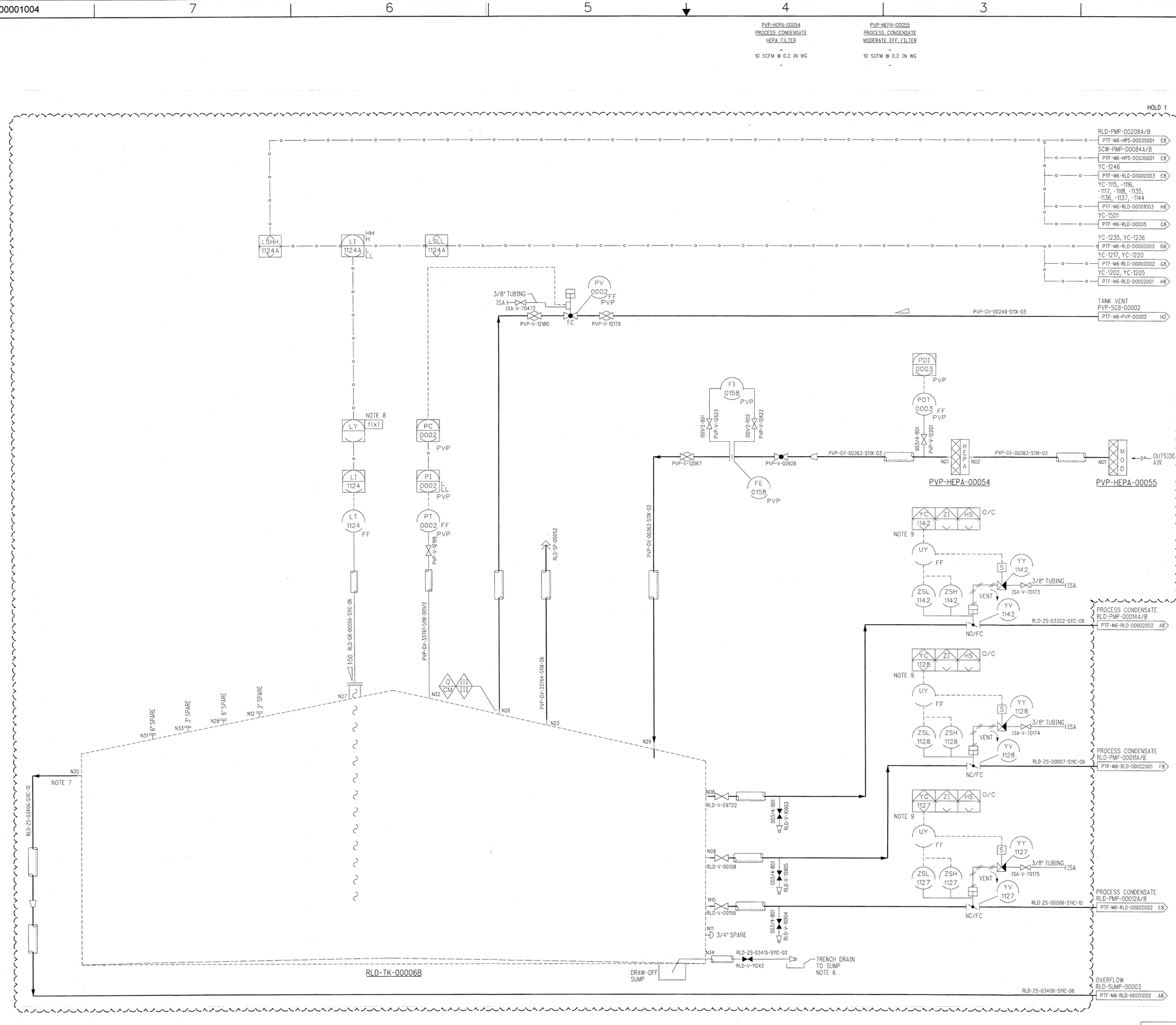
T: SIZE - 44x34
COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED

R1418488

8/3/2011 12:58:26 PM

PLOTTED BY: tdbarnes C:\Work\tdbarnes\dms03837\PTF\M6RLD00001003.dgn

FORM E_SDN.DGN 02/2009




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL COMPONENTS ON THIS DRAWING IS QUALITY LEVEL CM AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED.
4. ALL LINES SHOWN ON THIS DRAWING SHALL BE FREE DRAINING, UNLESS OTHERWISE NOTED.
5. ALL INTERNAL SUPPORTS AND WELDS THAT INTERACT WITH THE PRIMARY CONFINEMENT BARRIER (TANK) SHALL MAINTAIN EQUAL QUALITY LEVEL AND SEISMIC CATEGORY AS THE PARENT TANK.
6. COVERED TRENCH SHALL BE LOCATED BETWEEN RLD-TK-00006A/B FOR DRAINING THE TANK CONTENTS TO RLD-SUMP-00003. PROVIDE A PLATE COVER FOR THE TRENCH PER 24590-WTP-DD-S13T-00002.
7. MAXIMUM OVERFLOW NOZZLE/PIPE ELEVATION SHALL BE LOWER THAN INTERIOR PERIMETER SPRAY RINGS TO PREVENT FLUID FROM CONTAMINATING SPRAY RINGS.
8. FUNCTION CONVERTS TANK LEVEL FROM INCHES TO GALLONS.
9. VALVE IS PULSED CLOSED WHEN ASSOCIATED PUMPS ARE NOT RUNNING.
10. THIS DRAWING IS CONVERTED FROM A SINGLE SHEET TO MULTI-SHEET DRAWINGS AND, IN PART, SUPERSEDES 24590-PTF-M6-RLD-00001 REV 3. THIS DRAWING INCLUDES INFORMATION FROM 24590-PTF-M6N-RLD-00050, 24590-PTF-M6N-M801-00099, 24590-PTF-M6LN-RLD-00003, 24590-PTF-M6PR-RLD-00006, AND 24590-PTF-M6PR-10-00005.

## HOLD/OPEN ITEMS:

1. HOLD PENDING CLOSURE OF APPROPRIATE ACTIONS IN 24590-WTP-PIER-MGT-10-0559-C (UNDER DEVELOPMENT).

## REFERENCES:

1. 24590-PTF-3YD-PWD-00001, SYSTEM DESCRIPTION FOR THE PLANT WASH AND DISPOSAL SYSTEM (PWD) AND RADIOACTIVE LIQUID WASTE DISPOSAL SYSTEM (RLD)

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 10 | EK | JKhandker | Nichol | RW | 9/9/11 |

Q — QUALITY DESIGNATOR

REVISION HISTORY

ISSUED BY RPP-WTP PDC — INIT DATE — ISSUE STAMP

| | | |
|---|---|---|
| PROJECT No. | 24590 | |
| SITE | HANFORD | |
| AREA | 200E | |
| BUILDING No. | 10 | |

| | BY | DATE |
|---|---|---|
| ORIGINATOR | E. Kim | 9/8/11 |
| CHECKER | J Khandker | 9/8/11 |
| APPROVER | Nichol | 9/8/11 |
| REVIEWER | T. Sipes | 9/8/11 |
| | Ryan Zinda | 9-9-11 |

CONTENT APPLICABLE TO ALARA? [X] YES [ ] NO

ADR NO. 24590-PTF-ADR-MS-07-0001 REV: 1

EMS SCREENING REQUIRED? [X] YES [ ] NO EMS INITIAL IF YES: GJS

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GPP-SREQ-002

E-SIZE - 44x34
COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED

BECHTEL

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - PTF
# RADIOATIVE LIQUID WASTE DISPOSAL SYSTEM PROCESS CONDENSATE
# RLD-TK-00006B

SCALE: NONE

24590-PTF-M6-RLD-00001004

REV 0

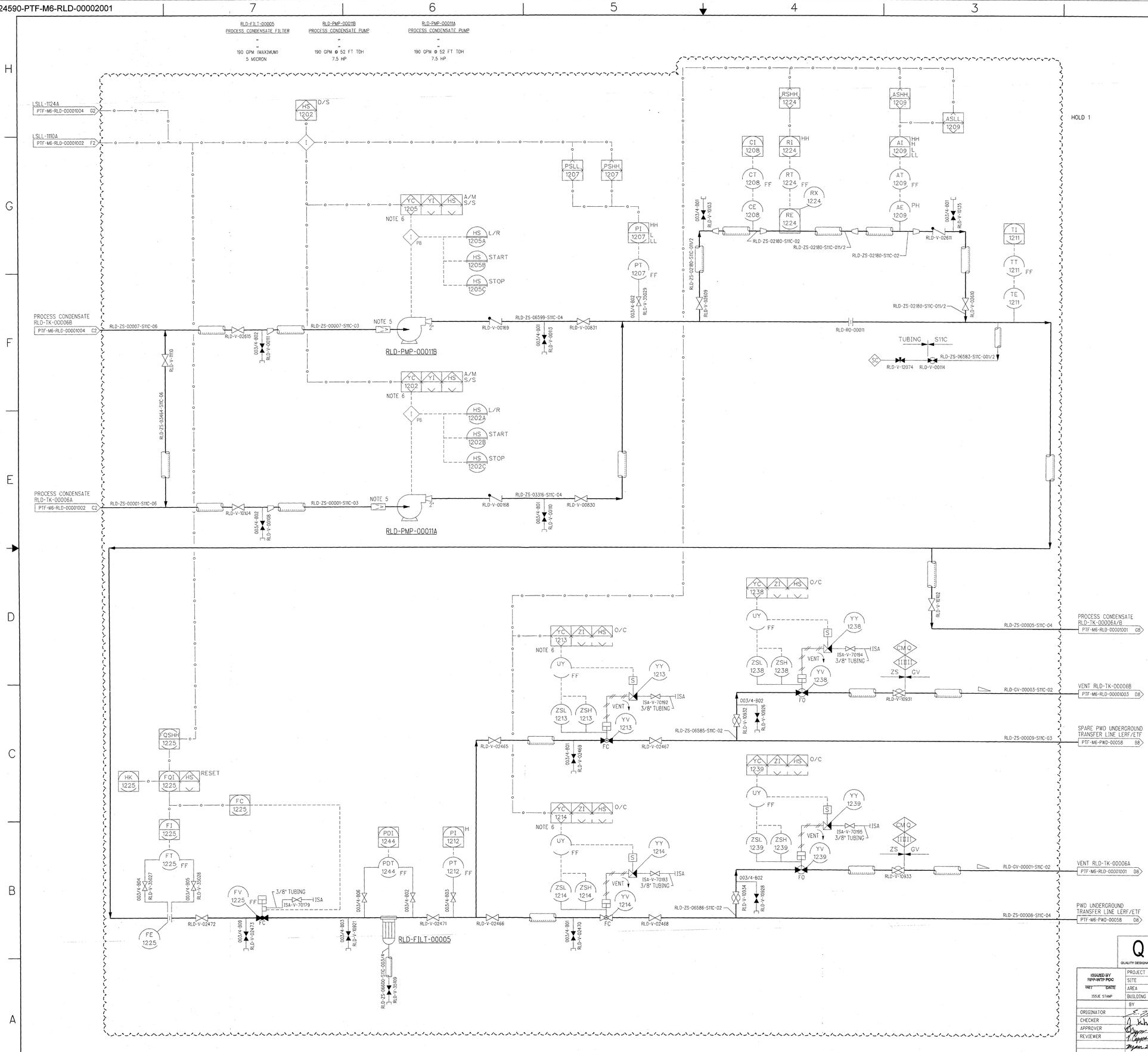
R11418487

8/15/2011 3:56:03 PM

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

FORM E_SDN.DGN 02/2009

PLOTTED BY: tdownes C:\Work\tdownes\ems0.8.13\PTF\M6RLD\00001004.dgn




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL COMPONENTS ON THIS DRAWING IS QUALITY LEVEL CM AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED.
4. ALL LINES SHOWN ON THIS DRAWING SHALL BE FREE DRAINING, UNLESS OTHERWISE NOTED.
5. PROVIDE A REMOVABLE SPOOL PIECE FOR STARTUP STRAINER. STARTUP STRAINER SHALL BE "PILGRIM'S HAT" TYPE.
6. WHEN RLD-PMP-00011A/B ARE NOT RUNNING VALVES YV-1104 (M6-RLD-00001001), YV-1113 (M6-RLD-00001002), YV-1118 (M6-RLD-00001003), YV-1128 (M6-RLD-00001004), YV-1213 AND YV-1214 ARE PULSED CLOSED.
7. THIS DRAWING IS CONVERTED FROM A SINGLE SHEET TO MULTI-SHEET DRAWINGS AND, IN PART, SUPERSEDES 24590-PTF-M6-RLD-00002 REV 4. THIS DRAWING INLUDES INFORMATION FROM 24590-PTF-M6N-RLD-00051, AND 24590-PTF-M6N-M80T-00099.

## HOLD/OPEN ITEMS:

1. HOLD PENDING CLOSURE OF APPROPRIATE ACTIONS IN 24590-WTP-PIER-MGT-10-0559-C (UNDER DEVELOPMENT).

## REFERENCES:

1. 24590-PTF-3YD-PWD-00001, SYSTEM DESCRIPTION FOR THE PLANT WASH AND DISPOSAL SYSTEM (PWD) AND RADIOACTIVE LIQUID WASTE DISPOSAL SYSTEM (RLD)

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

DRAWING INDEX

| DWG NO | TITLE |
|---|---|
| 24590-PTF-M6-RLD-00002001 | RLD SYS PROC COND RLD-PMP-00011A/B |
| 24590-PTF-M6-RLD-00002002 | RLD SYS PROC COND RLD-PMP-00012A/B & 00014A/B |
| 24590-PTF-M6-RLD-00002003 | RLD SYS PROC COND RLD-PMP-00191 |

Q
QUALITY DESIGNATOR

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 7 | | | | | 9/8/11 |

REVISION HISTORY

| ISSUED BY RPP-WTP POC | PROJECT No. | 24590 |
|---|---|---|
| INIT DATE | SITE | HANFORD |
| ISSUE STAMP | AREA | 200E |
| | BUILDING No. | 10 |

| | BY | DATE |
|---|---|---|
| ORIGINATOR | | 8/8/11 |
| CHECKER | | 8/11/11 |
| APPROVER | | 9/9/11 |
| REVIEWER | | 8/12/11 |
| | | 9-9-11 |

CONTENT APPLICABLE TO ALARA? [X] YES [ ] NO
ADR NO. 24590-PTF-ADR-MS-07-0001 REV: 1
EMS SCREENING REQUIRED? [X] YES [ ] NO EMS INITIAL IF YES

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GPP-SEEG-002

"E" SIZE = 44x34
COMPUTER GENERATED = MANUAL DESIGN CHANGES NOT PERMITTED

BECHTEL

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - PTF
# RADIOACTIVE LIQUID WASTE DISPOSAL SYSTEM PROCESS CONDENSATE RLD-PMP-00011A/B

SCALE: NONE

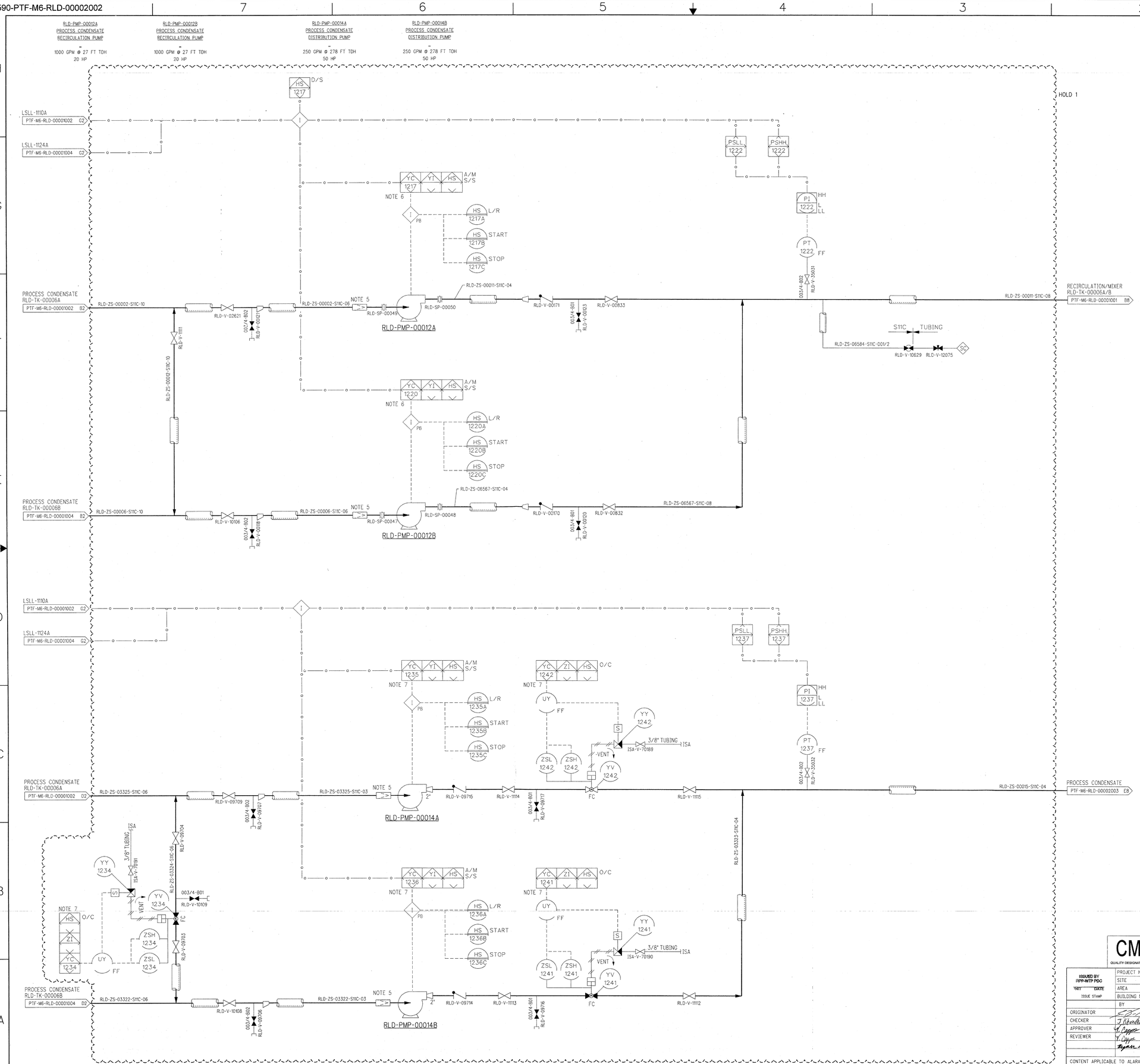
24590-PTF-M6-RLD-00002001

REV 0

R11418489

FORM E_SDNLDGN 02/2009

PLOTTED BY: tdbarnes G:\Work\tdbarnes\dms03837\PTF\M6RLD00002001.dgn 8/4/2011 10:51:14 AM




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL COMPONENTS ON THIS DRAWING IS QUALITY LEVEL CM AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED.
4. ALL LINES SHOWN ON THIS DRAWING SHALL BE FREE DRAINING, UNLESS OTHERWISE NOTED.
5. PROVIDE A REMOVABLE SPOOL PIECE FOR STARTUP STRAINER. STARTUP STRAINER SHALL BE "PILGRIM'S HAT" TYPE.
6. WHEN RLD-PMP-00012A/B ARE NOT RUNNING, VALVES YV-1103 (M6-RLD-00001001), YV-1114 (M6-RLD-00001002), YV-1117 (M6-RLD-00001003), AND YV-1127 (M6-RLD-00001004) ARE PULSED CLOSED.
7. WHEN RLD-PMP-00014A/B ARE NOT RUNNING, VALVES YV-1101 (M6-RLD-00001001), YV-1136 (M6-RLD-00001003), YV-1141 (M6-RLD-00001002), YV-1142 (M6-RLD-00001004), YV-1215, -1228 (M6-RLD-00002003), YV-1234, YV-1241, AND YV-1242 ARE PULSED CLOSED.
8. THIS DRAWING IS CONVERTED FROM A SINGLE SHEET TO MULTI-SHEET DRAWINGS AND, IN PART, SUPERSEDES 24590-PTF-M6-RLD-00002 REV. 4. THIS DRAWING INLUDES INFORMATION FROM 24590-PTF-M6N-RLD-00051, AND 24590-PTF-M6N-M80T-00099.

## HOLD/OPEN ITEMS:

1. HOLD PENDING CLOSURE OF APPROPRIATE ACTIONS IN 24590-WTP-PIER-MGT-10-0559-C (UNDER DEVELOPMENT).

## REFERENCES:

1. 24590-PTF-3YD-PWD-00001, SYSTEM DESCRIPTION FOR THE PLANT WASH AND DISPOSAL SYSTEM (PWD) AND RADIOACTIVE LIQUID WASTE DISPOSAL SYSTEM (RLD)

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

CM
QUALITY DESIGNATOR

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 8 | SK | | | | 9/9/11 |

REVISION HISTORY

ISSUED BY RPP-WTP PDC
TRST DATE
ISSUE STAMP

| | | |
|---|---|---|
| PROJECT No. | 24590 | |
| SITE | HANFORD | |
| AREA | 200E | |
| BUILDING No. | 10 | |

| | BY | DATE |
|---|---|---|
| ORIGINATOR | | 8/8/11 |
| CHECKER | | 8/8/11 |
| APPROVER | | 9/9/11 |
| REVIEWER | | 8/12/11 |
| | | 9-9-11 |

CONTENT APPLICABLE TO ALARA? [X] YES [ ] NO
ADR NO. 24590-PTF-ADR-MS-07-0001 REV: 1
EMS SCREENING REQUIRED? [X] YES [ ] NO EMS INITIAL IF YES

BECHTEL

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - PTF
# RADIOACTIVE LIQUID WASTE DISPOSAL SYSTEM PROCESS CONDENSATE RLD-PMP-00012A/B AND 14A/B

SCALE: NONE

24590-PTF-M6-RLD-00002002

REV 0

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GPP-SREQ-002

TE SIZE - 44x34
COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED

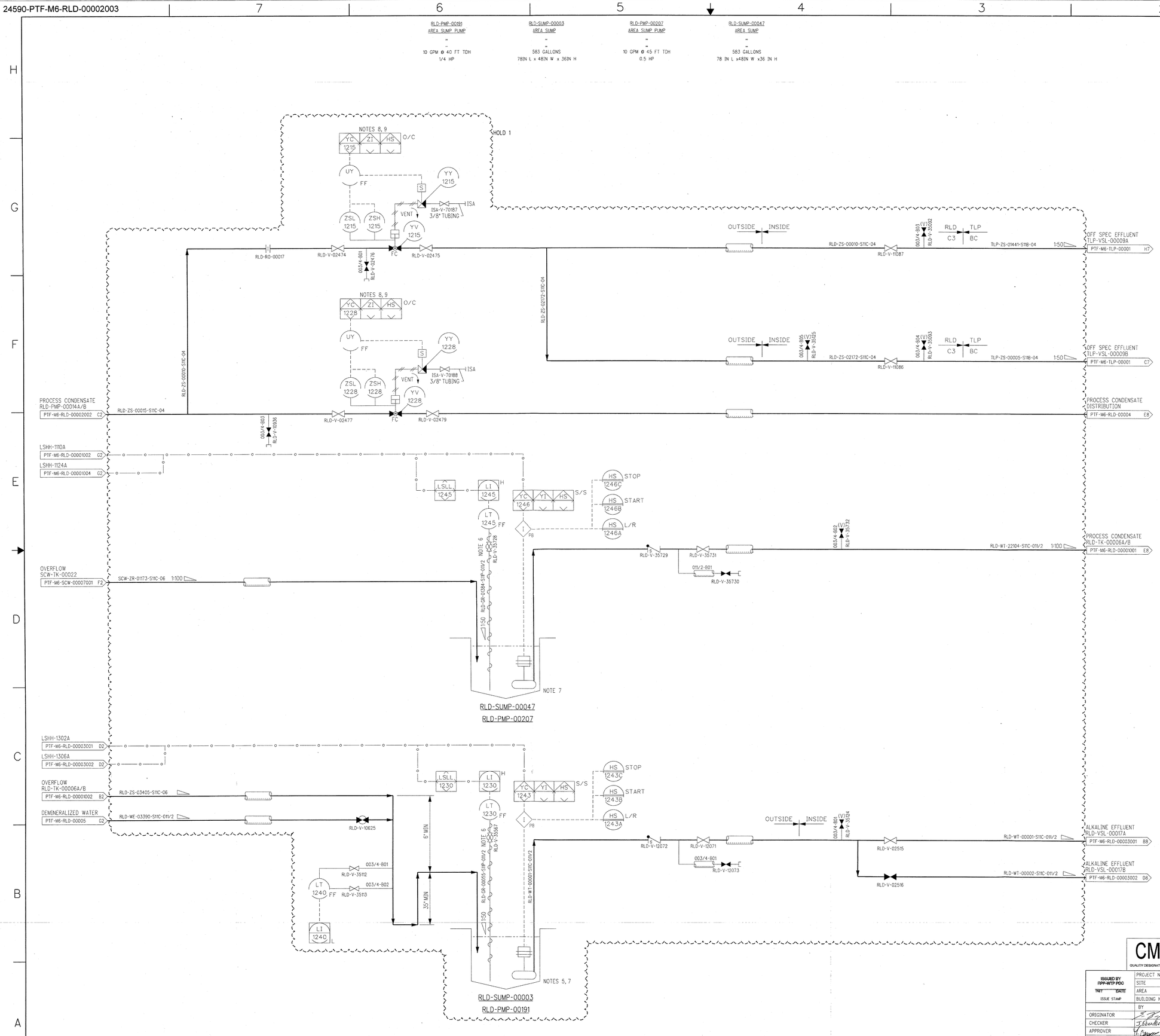
R11418490

8/11/2011 11:05:32 AM

C:\Work\cbcornes\dms03837\PTF\M6R_LD00012002.dgn

PLOTTED BY: cbcornes

FORM E_SDN.DGN 02/2009




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL COMPONENTS ON THIS DRAWING IS QUALITY LEVEL CM AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED.
4. ALL LINES SHALL BE FREE DRAINING, UNLESS OTHERWISE NOTED.
5. COVERED TRENCH SHALL BE LOCATED BETWEEN RLD-TK-00006A/B FOR DRAINING THE TANK CONTENTS TO RLD-SUMP-00003. PROVIDE A PLATE COVER FOR RLD-SUMP-00003 PER 24590-WTP-DD-S13T-00002.
6. A FULL PORT BALL VALVE IS REQUIRED FOR ISOLATION PURPOSE AT TRANSMITTER END OF GUIDE TUBE.
7. INSTALL RADAR-TYPE LEAK DETECTION AND LEVEL MONITORING INSTRUMENT. PROVIDE 1/2" CLEARANCE BETWEEN END OF LEVEL METER WAVE-GUIDE AND SUMP BOTTOM. LEVEL METER WAVE-GUIDE SHALL BE WITHIN 8 INCHES OF THE SUMP CENTER.
8. VALVE PULSED CLOSED WHEN ASSOCIATED PUMPS ARE NOT RUNNING.
9. VALVES YV-1215 AND YV-1228 ARE INTERLOCKED SO THAT ONLY ONE CAN BE OPEN AT ANY GIVEN TIME.
10. THIS DRAWING IS CONVERTED FROM A SINGLE SHEET TO MULTI-SHEET DRAWINGS AND, IN PART, SUPERSEDES 24590-PTF-M6-RLD-00002 REV 4. THIS DRAWING INLUDES INFORMATION FROM 24590-PTF-M6N-RLD-00051, 24590-PTF-M6N-M80T-00077, AND -00099.

## HOLD/OPEN ITEMS:

1. HOLD PENDING CLOSURE OF APPROPRIATE ACTIONS IN 24590-WTP-PIER-MGT-10-0559-C (UNDER DEVELOPMENT).

## REFERENCES:

1. 24590-PTF-3YD-PWD-00001 SYSTEM DESCRIPTION FOR THE PLANT WASH AND DISPOSAL SYSTEM (PWD) AND RADIOACTIVE LIQUID WASTE DISPOSAL SYSTEM (RLD)

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 10 | EK | JTB | | | 9/9/11 |

REVISION HISTORY

CM
QUALITY DESIGNATOR

| ISSUED BY: ISPP-WTP POC | PROJECT No. | 24590 |
|---|---|---|
| INIT DATE | SITE | HANFORD |
| | AREA | 200E |
| ISSUE STAMP | BUILDING No. | 10 |

| | BY | DATE |
|---|---|---|
| ORIGINATOR | | 8/8/11 |
| CHECKER | | 8/9/11 |
| APPROVER | | 9/9/11 |
| REVIEWER | | 8/12/11 |
| | | 9-9-11 |

CONTENT APPLICABLE TO ALARA? [X] YES [ ] NO
ADR NO. 24590-PTF-ADR-MS-07-0001 REV: 1
EMS SCREENING REQUIRED? [X] YES [ ] NO | EMS INITIAL IF YES SAS

BECHTEL
RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - PTF
# RADIOACTIVE LIQUID WASTE DISPOSAL SYSTEM PROCESS CONDENSATE RLD-PMP-00191 AND -00207

SCALE: NONE
24590-PTF-M6-RLD-00002003
REV 0

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GPP-SREQ-002

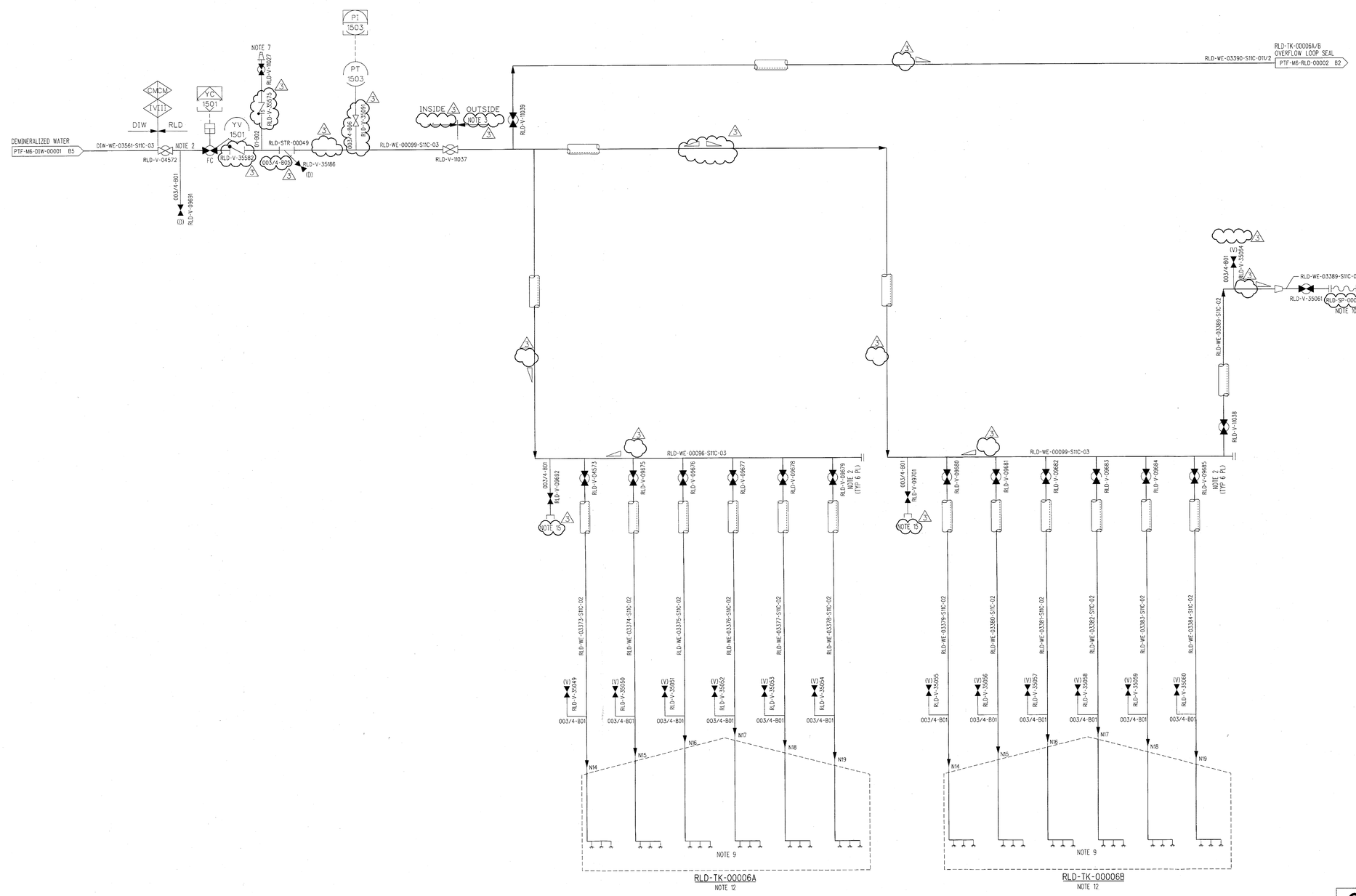
'E' SIZE - 44x34
COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED

R11418491

8/11/2011 12:56:12 PM

PLOTTED BY: tdbarnes C:\Work\tdbarnes\dms03837\PTF\M6RLD00002003.dgn

FORM E_SDN.DGN 02/2009




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. VALVES SHALL BE LOCATED TOGETHER FOR ACCESSIBILITY.
3. ELECTRICAL FREEZE PROTECTION SHALL BE PROVIDED FOR LIQUID FILLED PIPING AND INSTRUMENT SENSING LINES THAT ARE SUBJECT TO FREEZING.
4. DELETED
5. THE PRESSURE BOUNDARY FOR ALL COMPONENTS ON THIS DRAWING IS QUALITY LEVEL CM AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED.
6. DELETED
7. REAGENTS/PLANT WASH/SERVICE AIR PROVIDED AT LOCAL UTILITY STATION.
8. DELETED
9. MAXIMUM OVERFLOW NOZZLE/PIPE ELEVATION SHALL BE LOWER THAN INTERIOR PERIMETER SPRAY RINGS TO PREVENT FLUID FROM CONTAMINATING SPRAY RINGS.
10. PROVIDE FLUSH CONNECTION FOR THE ENCASEMENT OF THE LIQUID EFFLUENT RETENTION FACILITY (LERF) TRANSFER LINES. REFER TO 24590-PTF-M6-PWD-00058, COORDINATE B8/D8.
11. DELETED
12. FOR LAYOUT PURPOSES, NOZZLES N14 THROUGH N19 ARE PENETRATIONS WHICH ENTER THE TANK SHELL AND NOT THE ROOF.
13. REVISION 2: REVISED TO INCORPORATE 24590-PTF-M6N-M80T-00007 & ADD HIGH POINT VENTS AS PER PLANT DESIGN REQUIREMENTS. RELOCATED FLUSH CONNECTION AND ADDED REDUCER AND ISOLATION VALVE, ADDED ROOT VALVE TO PT-1503, CORRECTED TANK SYMBOL, ADDED NOTE 12, REVISED NOTES 3 & 7, REMOVED QUICK CONNECT TAGS, ADDED DRAIN DESIGNATOR & HOLD/OPEN ITEMS SECTION.
14. ALL LINES SHALL BE FREE DRAINING, UNLESS OTHERWISE NOTED.
15. HOSE CONNECTION IS REQUIRED FOR DEMINERALIZED WATER WASH PURPOSES.
16. REVISION 3: REVISED TO INCORPORATE 24590-PTF-M6N-M80T -00037, -00038, AND 24590-PTF-M6N-RLD-00032. REVISED/ADDED/ DELETED NOTES AND REFERENCES.

## HOLD/OPEN ITEMS:

NONE

## REFERENCES:

1. DELETED
2. REFER TO 24590-PTF-M6-RLD-00001 FOR PROCESS INFORMATION. REFER TO 24590-PTF-MT-RLD-00001 FOR PROCESS CONDENSATE TANK ASSEMBLY DRAWINGS.

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 3 | REVISED PER NOTE 16 | SC | TMT | ELS | CER XRH JGA | 6/3/08 |
| 2 | SEE NOTE 13 | SC | JEA | JJ | RV | 11/29/04 |
| 1 | REVISED AS NOTED | RR | RM | JJ | RV | 08/26/03 |
| 0 | ISSUED FOR CONSTRUCTION | RR | AE | N/A | RV | 12-31-02 |

REVISION HISTORY

CM
QUALITY DESIGNATOR

ISSUED BY: ADR-WTP PDC
ISSUE STAMP

| | | |
|---|---|---|
| PROJECT No. | 24590 | |
| SITE | HANFORD | |
| AREA | 200E | |
| BUILDING No. | 10 | |
| | BY | DATE |
| ORIGINATOR | RODOLFO RAMOS | 12-19-02 |
| CHECKER | ALI ELKHADER | 12-19-02 |
| APPROVER | ROBERT VOKE | 12-31-02 |
| REVIEWER | N/A | |

CONTENT APPLICABLE TO ALARA? [X] YES [ ] NO
ADR NO. 24590-PTF-ADR-MS-07-0001 REV: 0
SAFETY SCREEN REQUIRED? [X] YES [ ] NO | EMS INITIAL IF YES GDL

BECHTEL

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - PTF
# RADIOACTIVE LIQUID WASTE DISPOSAL SYSTEM
# PROCESS CONDENSATE
# RLD-TK-00006A/B SPRAY WASH

SCALE: NONE
24590-PTF-M6-RLD-00005
REV 3

R10922348

05/22/2008 10:43:28 AM

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

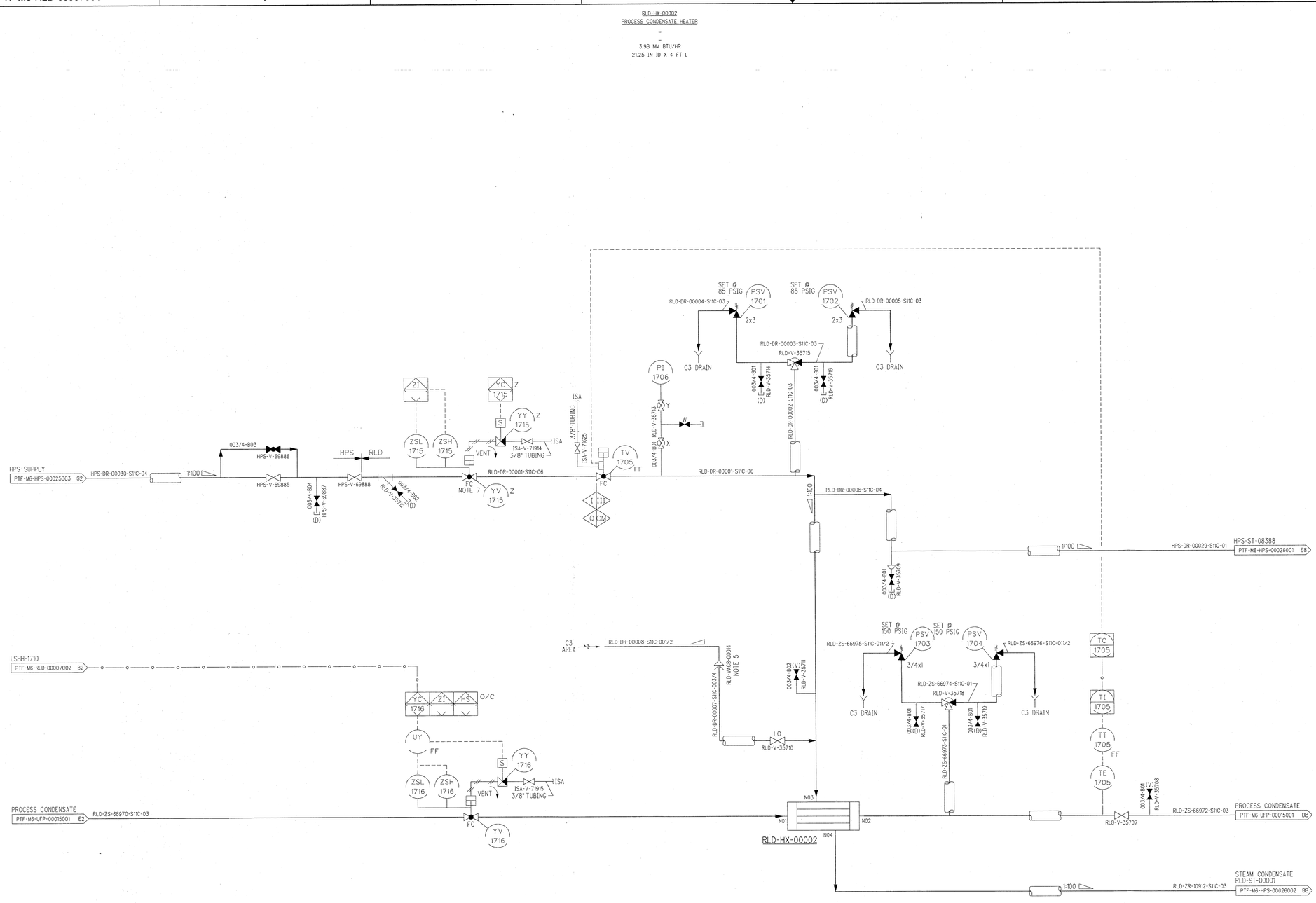
SAFETY SCREEN IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GPP-SREQ-002

"E" SIZE - 44x34
COMPUTER GENERATED - MANUAL CHANGES NOT PERMITTED

FORM E_SDN.DON 02/2003

PLOTTED BY: cdorn
C:\Work\cdorn\dms03837\PTFM6RLD00005.dgn

24590-PTF-M6-RLD-00007001




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL COMPONENTS ON THIS DRAWING IS QUALITY LEVEL CM AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED.
4. ALL LINES SHOWN ON THIS DRAWING SHALL BE FREE DRAINING, UNLESS OTHERWISE NOTED.
5. VACUUM BREAKER WILL BE PLACED ABOVE THE STEAM HEADER. THE VACUUM LINE SHALL BE SELF-DRAINING. ROUTE TO SAFE LOCATION.
6. ALL CONNECTIONS ON THE HIGH PRESSURE STEAM HEADER'S PRESSURE BOUNDARY ARE TO BE WELDED OR FLANGED.
7. SHUT-OFF VALVE INTERLOCKED WITH ROOM TEMPERATURE MONITORS. IN EVENT OF STEAM LINE LEAK OR RUPTURE, VALVE CLOSES.

## HOLD/OPEN ITEM:

NONE

## REFERENCES:

1. 24590-PTF-3YD-PWD-00001, SYSTEM DESCRIPTION FOR THE PLANT WASH AND DISPOSAL SYSTEM (PWD) AND RADIOACTIVE LIQUID WASTE DISPOSAL SYSTEM (RLD).

DRAWING INDEX

| DWG NO | TITLE |
|---|---|
| 24590-PTF-M6-RLD-00007001 | RLD SYS PROCESS CONDENSATE RLD-HX-00002 |
| 24590-PTF-M6-RLD-00007002 | RLD SYS STEAM COND RLD-VSL-00167 |

REVISION HISTORY

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 0 | ISSUED FOR CONSTRUCTION | EK | | RLC | VLC RJJ | 9/9/11 |

Q
QUALITY DESIGNATOR

ISSUED BY RPP-WTP PDC
ISSUE STAMP

| | | |
|---|---|---|
| PROJECT No. | 24590 | |
| SITE | HANFORD | |
| AREA | 200E | |
| BUILDING No. | 00 | |
| | BY | DATE |
| ORIGINATOR | | 8/8/11 |
| CHECKER | | 8/9/11 |
| APPROVER | | 9/9/11 |
| REVIEWER | | 8/12/11 |
| | | 9-9-11 |

CONTENT APPLICABLE TO ALARA? [X] YES [ ] NO
ADR NO. 24590-PTF-ADR-MS-07-0001 REV: 1
EMAS SCREENING REQUIRED? [X] YES [ ] NO EMAS INITIAL IF YES:
SCREENING IS REQUIRED FOR

BECHTEL

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - PTF
# RADIOACTIVE LIQUID WASTE DISPOSAL SYSTEM
# PROCESS CONDENSATE
# RLD-HX-00002

SCALE: NONE

24590-PTF-M6-RLD-00007001

REV 0

"E" SIZE - 44x34

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

PLOTTED BY: tdbarnes C:\Work\tdbarnes\dms03837\PTF\M6\RLD00007001.dgn

Quarter Ending 9/30/13 24590-PTF-PCN-ENV-12-013

# Hanford Facility RCRA Permit Modification Notification Form
## Part III, Operating Unit 10
## Waste Treatment and Immobilization Plant

Index

Page 2 of 4: Hanford Facility RCRA Permit, Part III, Operating Unit 10, Waste Treatment and Immobilization Plant

Update Process Flow Diagrams (PFD) for the PTF Radioactive Liquid Waste Disposal System (RLD) and Cesium Ion Exchange Process System (CXP) in Appendix 8.1 of the Dangerous Waste Permit (DWP).

Update Piping and Instrumentation Diagrams (P&ID) for the PTF HLW Storage and Feed Blending Process System (HLP) and PTF Vessel Vent Process System (PVP) in Appendix 8.2 of the DWP.

Submitted by Co-Operator:

Donna Busche 7/22/13

D. M. Busche Date

Reviewed by ORP Program Office:

8/19/13

D. L. Noyes Date

Quarter Ending 9/30/13 24590-PTF-PCN-ENV-12-013

| Hanford Facility RCRA Permit Modification Notification Form | |
|---|---|
| Unit: **Waste Treatment and Immobilization Plant** | Permit Part: **Part III, Operating Unit 10** |

Description of Modification:

The purpose of this Class 1 prime modification is to update the following PFDs and P&IDs for the RLD, CXP, HLP, and PVP in Appendices 8.1 and 8.2 of the DWP:

| | | | |
|---|---|---|---|
| Appendix 8.1 | | | |
| Replace | 24590-PTF-M5-V17T-00022004, Rev. 2 | With: | 24590-PTF-M5-V17T-00022004, Rev. 3 |
| | | | |
| Delete | 24590-PTF-M5-V17T-00012, Rev. 3 | | NA |
| | | | |
| Appendix 8.2 | | | |
| Replace | 24590-PTF-M6-HLP-00001003, Rev. 0 | With: | 24590-PTF-M6-HLP-00001003, Rev. 1<br>24590-PTF-M6-HLP-00001004, Rev. 0 |
| | 24590-PTF-M6-HLP-00002002, Rev. 0 | | 24590-PTF-M6-HLP-00002002, Rev. 1 |
| | 24590-PTF-M6-HLP-00003002, Rev. 0 | | 24590-PTF-M6-HLP-00003002, Rev. 1 |
| | 24590-PTF-M6-HLP-00003003, Rev. 0 | | 24590-PTF-M6-HLP-00003003, Rev. 1 |
| | | | |
| Delete | 24590-PTF-M6-PVP-P0009, Rev. 0 | | NA |

The referenced PFDs and P&IDs have been revised. They incorporate changes provided in applicable document change forms (e.g., DCN, SCN, SDDR, FCN, FCR, etc.) and changes associated with the resolution to comments on change documents since the issuance of the last revision of the permitted drawings. This modification requests Ecology approval and incorporation into the permit, the specific changes to these PFDs and P&IDs that are indicated by revision notes and clouds. Revisions are the result of ongoing design changes.

Significant changes to the PFDs are summarized below:

24590-PTF-M5-V17T-00022004, Rev. 3

- Modified, deleted, and added notes, holds, and references
- Modified drawing representations of equipment and instruments to align with P&IDs, such as: realigned filter RLD-FILT-00005, and various instruments such as flow indicators; added discharge lines, pressure control valves, pressure and flow indicators, flow totalizers, and valves
- Added inflow streams from secondary steam loop boiler blowdown and effluent from sump RLD-SUMP-00047
- Added new condensate heat exchanger RLD-HX-00002, condensate vessel RLD-VSL-00167, and pump RLD-PMP-00209
- Incorporated changes from change documentation identified in the Notes section

24590-PTF-M5-V17T-00012, Rev. 3

- Delete drawing from DWP. Superceded by drawings 24590-PTF-M5-V17T-00012001 and -00012002, which were submitted in package PTF-015, Rev. 1 and approved by Ecology on February 13, 2012

Quarter Ending 9/30/13 24590-PTF-PCN-ENV-12-013

Significant changes to the P&IDs are summarized below:

24590-PTF-M6-HLP-00001003, Rev. 1 and 24590-PTF-M6-HLP-00001004, Rev. 0

- Converted drawing from a single sheet to multi-sheet drawings. 24590-PTF-M6-HLP-00001003, Rev. 1 shows pump HLP-PMP-00017A and corresponding piping, instruments, and logic controls. New drawing 24590-PTF-M6-HLP-00001004, Rev. 0 depicts pump HLP-PMP-00017B and corresponding piping, instruments, and logic controls
- Modified, deleted, and added notes, holds, and references
- Expanded instruments and logic controls information for pumps HLP-PMP-00017A and -00017B
- Revised equipment, nozzle, instrument and logic control tag numbers
- Revised hot cell nozzles and slope directions for lines to UFP-VSL-00001A/B
- Revised slope directions for air purge lines (UFP-GQ-64326-S11B-01 and UFP-GQ-64327-S11B-01) and wash lines (HLP-ZS-06539-S11B-02 and HLP-ZS-06540-S11B-02)
- Changed flow transmitters from thermal to magnetic type and relocated transmitters before corresponding valves
- Changed on/off jumper plug valves to ball valves
- Revised jumper boundaries and configurations
- Added slope callout for jumper line HLP-PX-00130-S12A-03 (unclouded change in Grid F3; identified in 24590-PTF-M6PR-10-00008)
- Incorporated changes from change documentation identified in the Notes section

24590-PTF-M6-HLP-00002002, Rev. 1

- Modified, deleted, and added notes, holds, and references
- Revised nozzle tag numbers
- Changed flow transmitters from thermal to magnetic type and relocated transmitters before corresponding valves
- Changed on/off jumper plug valves to ball valves
- Added slope callouts for jumper lines HLP-PX-00131-S12A-03 and HLP-PX-00132-S12A-03 (unclouded changes in Grids F3 and C3; identified in 24590-PTF-M6PR-10-00008)
- Changed pipe specification for line PVP-GV-33879 from S11B to S11Z
- Deleted jumpers HLP-JMPP-00006 and HLP-JMPP-00007 and associated instrumentation (empty clouded changes in Grids C3 and F3; identified in Note 22)
- Incorporated changes from change documentation identified in the Notes section

24590-PTF-M6-HLP-00003002, Rev. 1

- Modified, deleted, and added notes, holds, and references
- Expanded instruments and logic controls information for pump HLP-PMP-00019A
- Revised slope direction for wash line HLP-ZS-06519-S11B-02
- Revised nozzle tag numbers
- Changed on/off jumper plug valves to ball valves
- Revised jumper boundaries and configurations
- Revised hot cell nozzle for lines HLP-PC-03400-S12A-03, HLP-PC-00028-S12A-03, HLP-ZF-00035-S11B-03, and UFP-GQ-64325-S11B-02
- Deleted pipe reducer and section from line UFP-GQ-64325-S11B
- Deleted slope callouts for plant wash flush connection lines (empty clouded changes in Grids C7, G7, and H7; identified in 24590-PTF-M6LN-HLP-00035)
- Consolidated jumpers
- Incorporated changes from change documentation identified in the Notes section

Quarter Ending 9/30/13 24590-PTF-PCN-ENV-12-013

24590-PTF-M6-HLP-00003003, Rev. 1

- Modified, deleted, and added notes, holds, and references
- Expanded instruments and logic controls information for pump HLP-PMP-00019B
- Revised slope direction for wash line HLP-ZS-06542-S11B-02
- Revised nozzle tag numbers
- Changed on/off jumper plug valves to ball valves
- Revised hot cell nozzle for lines HLP-PC-03397-S12A-03, HLP-PC-00010-S12A-03, HLP-PC-00011-S12A-03, and UFP-GQ-64324-S11B-02
- Deleted pipe reducer and section from line UFP-GQ-64324-S11B-02 (empty clouded change in Grid D8; identified in 24590-PTF-M6LN-HLP-00009)
- Added slope callout for line UFP-GQ-64324-S11B-02
- Consolidated jumpers
- Deleted spare connection lines to the High-Level Waste Facility (empty clouded changes in Grids G3-G8 and H3-H8; identified in Note 18)
- Incorporated changes from change documentation identified in the Notes section

24590-PTF-M6-PVP-P0009, Rev. 0

- Delete drawing from DWP. There are no DWP equipment or lines. The "bolded" lines on this drawing contain only demineralized (DIW) and are not regulated

The following outstanding change documents have been submitted to Ecology pursuant to Permit Condition III.10.C.9.h and are maintained in the WTP Operating Record:
None

In accordance with Permit Condition III.10.C.2.e, this permit modification sent to Ecology may include page changes to the Permit, attachments, and permit application supporting documentation.

| WAC 173-303-830 Modification Class: | Class 1 | Class [1]1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | | X | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: NA
Enter wording of WAC 173-303-830, Appendix I Modification citation:

In accordance with WAC 173-303-830(4)(d)(i), this modification notification is requested to be reviewed and approved as a Class [1]1 modification. WAC 173-303-830(4)(d)(ii)(A) states, "Class 1 modifications apply to minor changes that keep the permit current with routine changes to the facility or its operation. These changes do not substantially alter the permit conditions or reduce the capacity of the facility to protect human health or the environment. In the case of Class 1 modifications, the director may require prior approval."

Modification Approved/Concur: [X] Yes [ ] Denied (state reason below)

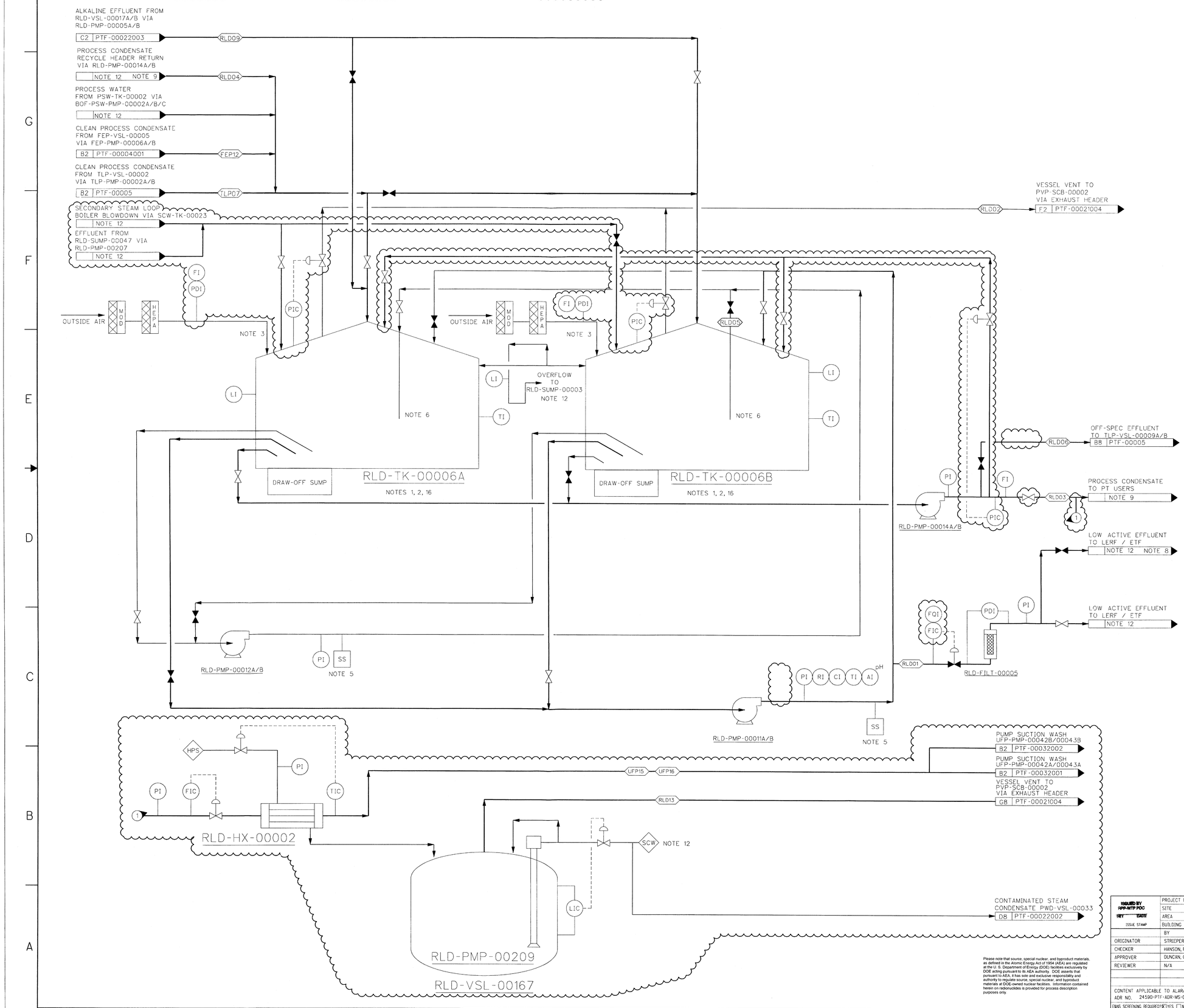
Reason for denial:

Reviewed by Ecology:

for S. Dahl 9/16/13 Date

24590-PTF-M5-V17T-00022004

| COMPONENT TAG NUMBER / DESCRIPTION | RLD-HX-00002 RLD PROCESS CONDENSATE HEAT EXCHANGER | RLD-PMP-00012A/B PROCESS CONDENSATE RECIRCULATION PUMPS | RLD-PMP-00209 RLD CONDENSATE COLLECTION PUMP | RLD-TK-00006A PROCESS CONDENSATE TANK | RLD-VSL-00167 RLD CONDENSATE COLLECTION VESSEL | RLD-TK-00006B PROCESS CONDENSATE TANK | RLD-PMP-00011A/B PROCESS CONDENSATE TRANSFER PUMPS | RLD-PMP-00014A/B PROCESS CONDENSATE DISTRIBUTION PUMPS | RLD-FILT-00005 PROCESS CONDENSATE FILTER |
|---|---|---|---|---|---|---|---|---|---|
| OPERATING DUTY/CAPACITY | 3.98 MM BTU/HR | 1000 GPM | 10 GPM | NA | NA | NA | 190 GPM | 250 GPM | 190 GPM 5 MICRON |
| BATCH VOLUME | NA | NA | NA | 265000 GAL | 264 GAL | 265000 GAL | NA | NA | NA |




## NOTES:

1. THESE TANKS ARE LOCATED OUTSIDE THE PRETREATMENT FACILITY IN A DIKED AREA.
2. PROCESS TANKS SHALL GENERALLY BE EQUIPPED WITH INTERIOR PERIMETER SPRAY RINGS, OR EQUIVALENT FOR DECONTAMINATION OR FLUSHING.
3. TANKS TO HAVE AIR INLET PIPELINE TO PURGE TANK VAPOR SPACE.
4. ONLY MAIN PROCESS CONTROL INSTRUMENTS ARE SHOWN.
5. MANUAL IN-LINE SAMPLE POINT
6. RECYCLE PIPELINES FROM RLD-PMP-00012A/B ARE FITTED WITH JET MIXER.
7. ELECTRICAL FREEZE PROTECTION SHALL BE PROVIDED FOR LIQUID FILLED PIPING AND INSTRUMENT SENSING LINES THAT ARE SUBJECT TO FREEZING.
8. DEDICATED SPARE INTERFACILITY TRANSFER PIPELINE WILL BE PROVIDED.
9. PROCESS CONDENSATE USERS INCLUDE:
   PVP EXHAUST HEADER
   CNP-BRKPT-00001/2
   CNP-VSL-00001/3/4
   CXP-VSL-00004/5
   FEP-VSL-00005
   FEP-VSL-00017A/B
   FRP-VSL-0002A/B/C/D
   HLP-BRKPT-00004/6
   HLP-VSL-00022
   HLP-VSL-00027A/B
   HLP-VSL-0002B
   PVP-VSL-00001
   PWD-BRKPT-00007/8/9/10/15/16/17/19
   PWD-VSL-00015/16/33/43/44
   RDP-VSL-00002A/B/C
   RLD-TK-00006A/B
   RLD-VSL-00017A/B
   TCP-VSL-00001
   TLP-VSL-00002
   TLP-VSL-00009A/B
   UFP-BRKPT-00001A/B
   UFP-BULGE-00001/2/5/6
   UFP-VSL-00001A/B
   UFP-VSL-00002A/B
   UFP-VSL-00062A/B/C
   PWD-EJCTR-00119/120
   VARIOUS PWD/PVP RACKS
   VARIOUS PIPELINE & PUMP FLUSHES
   SPARE PIPELINE
10, 11. DELETED
12. PIPELINES ARE TO/FROM SYSTEMS THAT CURRENTLY DO NOT HAVE PROCESS FLOW DIAGRAMS.
13. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
14. REFER TO 24590-WTP-M5-V17T-00001 FOR PROCESS FLOW DIAGRAM LEGEND & SYMBOLS.
15. REVISION 1: CHANGE TITLE OF PROCESS CONDENSATE VESSELS TO PROCESS CONDENSATE TANKS. ALSO, CHANGE PLANT ITEM NUMBER FROM RLD-VSL-00006-A/B TO RLD-TK-00006-A/B. THIS CHANGE IS TO MATCH THE CHANGE OUTLINED IN 24590-PTF-MSN-RLD-00001.
16. RLD-TK-00006A WILL BE DEDICATED TO EVAPORATOR OVERHEADS AND WILL SUPPLY THE PTF WITH PROCESS CONDENSATE FOR REUSE WITHIN THE BUILDING. EXCESS PROCESS CONDENSATE WILL BE TRANSFERRED TO RLD-TK-00006B. RLD-TK-00006B RECEIVES MATERIAL FROM RLD-VSL-00017A/B IN ADDITION TO THE EXCESS CONDENSATE.
17. REVISION 2: REVISED TO INCORPORATE 24590-PTF-M5N-V17T-00032, -00036, -00052, AND -00061. ADDED FI TO PUMP DISCHARGE LINES. ADDED TI TO RLD-TK-00006A/B. DELETED STREAM TABLE. ADDED/DELETED/REVISED NOTES.
18. REVISION 3: REVISED TO INCORPORATE 24590-PTF-M5N-V17T-00094. ADDED INFLOWS FROM SECONDARY STEAM LOOP BOILER BLOWDOWN. ADDED NEW CONDENSATE HEAT EXCHANGER RLD-HX-00002 AND NEW CONDENSATE VESSEL RLD-VSL-00167.

## HOLD/OPEN ITEMS:

NONE

GENERAL NOTE:
THIS PROCESS FLOW DIAGRAM SHOWS FLOW STREAMS NOT PIPELINES. REFER TO PIPING AND INSTRUMENTATION DIAGRAMS FOR PIPELINE INFORMATION.

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 3 | REVISED PER NOTE 18 | SK | | | | 9/12/11 |
| 2 | REVISED PER NOTE 17 | SC | NJ | ELS | RS | 6/3/08 |
| 1 | ISSUED TO ADD NOTES 13, 14, AND 15 | KP | TAL | GRC | RV | 3/21/03 |
| 0 | ISSUED FOR DESIGN | ELS | RLH | N/A | GD | 07-18-02 |

REVISION HISTORY

ISSUED BY RPP-WTP PDC
REV DATE
ISSUE STAMP

| | | |
|---|---|---|
| PROJECT No. | 24590 | |
| SITE | HANFORD | |
| AREA | 200E | |
| BUILDING No. | 10 | |
| | BY | DATE |
| ORIGINATOR | STRIEPER, EGBERT | 07-18-02 |
| CHECKER | HANSON, ROBERT | 07-18-02 |
| APPROVER | DUNCAN, GARTH | 07-18-02 |
| REVIEWER | N/A | N/A |

CONTENT APPLICABLE TO ALARA? [X] YES [ ] NO
ADR NO. 24590-PTF-ADR-M5-07-0001 REV: 1
EMS SCREENING REQUIRED? [X] YES [ ] NO EMS INITIAL IF YES:

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# PROCESS FLOW DIAGRAM PRETREATMENT RADIOACTIVE LIQUID DISPOSAL/RECYCLE SYSTEM RLD SHEET 4 OF 4

SCALE: NONE
24590-PTF-M5-V17T-00022004
REV 3

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-CPP-SREQ-002

E SIZE - 44x34
COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED

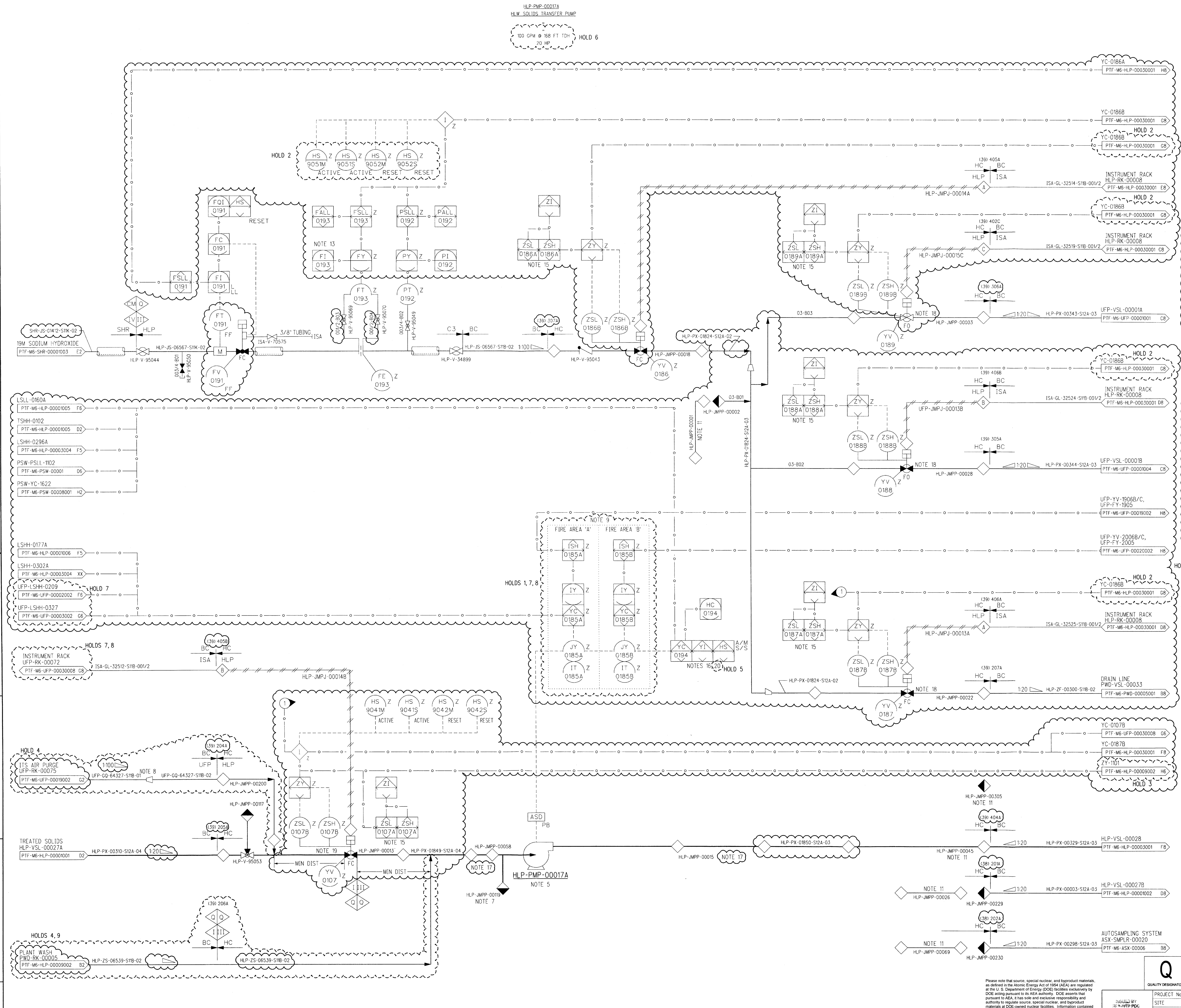
R11418528

8/11/2011 8:19:02 AM

PLOTTED BY: mdritter

C:\Work\mdritter\dms03697\PTF_M5_V17T_00022004_0.dgn

FORM E_SDN.DGN 02/2009




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DRAWING ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL COMPONENTS ON THIS DRAWING IS QUALITY LEVEL Q AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED. FLEXIBLE PNEUMATIC JUMPERS ARE QUALITY LEVEL CM AND SEISMIC CATEGORY SC-IV. ISA PIPING IS QUALITY LEVEL Q AND SEISMIC CATEGORY SC-I FOR FUNCTION.
4. ALL LINES SHOWN ON THIS DRAWING SHALL BE FREE DRAINING, EXCEPT BLACK CELL LINES WHICH ARE SELF-DRAINING, UNLESS OTHERWISE NOTED.
5. REFER TO DRAWING 24590-PTF-M6-PSW-00008001 FOR PUMP SEAL WATER DISTRIBUTION.
6. DELETED
7. PUMP SUCTION DRAIN SHALL HAVE PLUG THAT WILL FILL DRAIN PIPE FLUSH WITH INSIDE WALL OF TRANSFER PIPE. PLUG IS PHYSICALLY ATTACHED TO BLIND JUMPER. PLUG SHALL BE SAME MATERIAL AS PIPE.
8. LOCATE REDUCER NO LOWER THAN 40 FT ELEVATION.
9. SAFETY TIMER TO LIMIT PUMP RUN TIME.
10. DELETED
11. JUMPERS HLP-JMPP-00001, HLP-JMPP-00026, AND HLP-JMPP-00069 TO BE FABRICATED, BUT INSTALLED ONLY ON AN AS-NEEDED BASIS FOR OFF-NORMAL OPERATIONS. FOR THE RESPECTIVE INSTALLATION OF THESE INDIVIDUAL JUMPERS, THE REMOVAL OF HLP-JMPP-00045 AND THE INSTALLATION OF BLIND JUMPER HLP-JMPP-00305 ON THE OPEN END OF HLP-PX-00329-S12A-03 IS REQUIRED.
12. DELETED
13. INDICATOR DESIGN SHALL REPORT BOTH FLOW DIRECTION AND MAGNITUDE.
14. THIS DRAWING IS CONVERTED FROM A SINGLE SHEET TO MULTI-SHEET DRAWINGS AND, IN PART, SUPERSEDES 24590-PTF-M6-HLP-00001, REV 2. THIS IS A MAJOR REVISION, NO REVISION CLOUDS ARE SHOWN. THIS DRAWING MAY INCLUDE INFORMATION FROM 24590-PTF-M6N-HLP-00045, -00062, -00074, -00081, 24590-PTF-M6N-M80T-00017, -00037, AND -00038. ADDED ITS AIR PURGE TO PUMP SUCTION LINE. ADDED 19M SODIUM HYDROXIDE SUPPLY. REVISED TRANSFER PIPING CONFIGURATION. DELETED FE-0143 AND FE-0146. REVISED QUALITY/SEISMIC DESIGNATION.
15. ICN ALARM IS ACTUATED ON POSITION MISMATCH.
16. ON AN HLP-PMP-00017A NOT-RUNNING CONDITION, VALVES HLP-YV-0107, HLP-YV-0186, HLP-YV-0187, HLP-YV-0188, AND HLP-YV-0189 ARE PULSED TO THEIR NORMAL-OPERATING POSITION.
17. REMOVAL OF JUMPER HLP-JMPP-00058 PROVIDES VESSEL HEEL DILUTION/CLEANOUT PUMP HLP-PMP-00022 (FUTURE) SUCTION CONNECTION VIA A FLEXIBLE JUMPER. REMOVAL OF JUMPER HLP-JMPP-00015 PROVIDES HLP-PMP-00022 (FUTURE) DISCHARGE CONNECTION, VIA A FLEXIBLE JUMPER, FOR THE REMOVAL OF NON-NEWTONIAN HEELS. NON-NEWTONIAN HEELS CAN ALSO GO TO DISCHARGE OF HLP-PMP-00019B ON DRAWING 24590-PTF-M6-HLP-00003003. REFER TO DRAWING 24590-PTF-M6-UFP-00002001 FOR HLP-PMP-00022 (FUTURE) DISCHARGE CONNECTION, VIA A FLEXIBLE JUMPER, FOR SENDING NEWTONIAN HEELS TO UFP-VSL-00002A. SEE REFERENCE 2 FOR PUMP DETAILS.
18. VALVES HLP-YV-0187, -0188 AND -0189 ARE INTERLOCKED SUCH THAT ONLY ONE VALVE CAN BE OPENED AT A TIME.
19. VALVE HLP-YV-0107 ON THIS DRAWING AND VALVE HLP-YV-1101 ON DRAWING 24590-PTF-HLP-00009002 ARE INTERLOCKED SUCH THAT ONLY ONE VALVE CAN BE OPENED AT A TIME.
20. HLP-PMP-00017A SHALL BE INTERLOCKED TO PREVENT OPERATION WHEN FLUSH VALVE HLP-YV-1101 ON DRAWING 24590-PTF-M6-HLP-00009002, OR VALVE DIW-YV-1323 OR DIW-YV-1327 ON DRAWING 24590-PTF-M6-DIW-00003003 IS OPEN. (HOLD 5)
21. REVISION 1: INCORPORATED 24590-PTF-M6LN-HLP-00003, -00007, -00010, -00014, -00017, -00019, -00022, -00023, -00026, 24590-PTF-M6N-10-00011, 24590-PTF-M6N-HLP-00089, -00153, AND 24590-PTF-M6PR-10-00008. FURTHER REVISED TO DEPICT OFFSHEET CONTROL SIGNALS FOR HLP-YV-0187, -0188, AND -0189. TRANSFERRED DEPICTION OF HLP-PMP-00017B AND FEED RETURN PORTIONS OF THE DRAWING TO 24590-PTF-M6-HLP-00001004. ADDED NOTE REGARDING IMPLEMENTATION OF VESSEL HEEL DILUTION\CLEAN OUT REQUIREMENTS. ADDED Z POSITION SWITCHES FOR HLP-YV-0186. PHYSICALIZED PIPING HEADERS AND CONSOLIDATED JUMPERS. CHANGED HLP-FE-0193 SENSOR LINE SIZE TO NPS 1/2. RECONCILED WITH SHR DESIGN. ADDED FURTHER C&I ENHANCEMENTS. ADDED/DELETED/REVISED NOTES, HOLDS, AND REFERENCES.

## HOLD/OPEN ITEMS:

1. PENDING PUMP-TIMER AND FLUSH-PURGE ENHANCEMENTS.
2. PENDING SAFETY VALVE INTERLOCK DESIGN.
3. PENDING FLUSH INTERLOCK DESIGN.
4. PENDING RE-EVALUATION OF LINE FLUSHING REQUIREMENTS.
5. PENDING INTEGRATED SAFETY MANAGEMENT REVIEW OF FLUSHING OPERATIONS.
6. PENDING RE-ANALYSIS OF SPRAY LEAK EVENTS FOR PTF.
7. PENDING COMPLETION OF SAFETY-CONTROL SELECTION FOR NON-NEWTONIAN OVERFLOW PROTECTION INTERLOCK (24590-WTP-PIER-MGT-12-0306).
8. PENDING IMPLEMENTATION OF ASX SAMPLER-SUMP-LEVEL NON-NEWTONIAN INTERLOCK.
9. PENDING RESOLUTION OF ACTION REGARDING THE FLUSH/PURGE VALVES BEING LOCATED IN THE HOTCELL (24590-WTP-ATS-MGT-12-0021).

## REFERENCES:


1. 24590-PTF-3YD-HLP-00001, SYSTEM DESCRIPTION FOR THE HLW LAG STORAGE AND FEED BLENDING PROCESS SYSTEM (HLP).
2. 24590-PTF-M6-HLP-00029001, P&ID-PTF HLW LAG STORAGE AND FEED BLENDING PROCESS SYSTEM VESSEL HEEL DILUTION/CLEANOUT HLP-PMP-00022 (FUTURE).


Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

Q — QUALITY DESIGNATOR

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 1 | REVISED PER NOTE 21 | | | | | 5/23/12 |
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 14 | RR | NJ | ES/CL | RS/JM | 10/31/08 |

REVISION HISTORY

| | | |
|---|---|---|
| PROJECT No. | 24590 | |
| SITE | HANFORD | |
| AREA | 200E | |
| BUILDING No. | 10 | |
| | BY | DATE |
| ORIGINATOR | RIDER, ROBERT | 10/30/08 |
| CHECKER | JOHNSON, NGA T | 10/30/08 |
| APPROVER | STEVENS, ROBERT | 10/31/08 |
| REVIEWER | STRIEPER, EGBERT | 10/30/08 |

ISSUE STAMP

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - PTF HLW LAG STORAGE AND FEED BLENDING PROCESS SYSTEM HLP-PMP-00017A

CONTENT APPLICABLE TO ALARA? [X] YES [ ] NO
ADR NO. 24590-PTF-ADR-M-02-005 REV: 7
E&NS SCREENING REQUIRED? [X] YES [ ] NO E&NS INITIAL IF YES

SCALE: NONE

24590-PTF-M6-HLP-00001003 REV 1

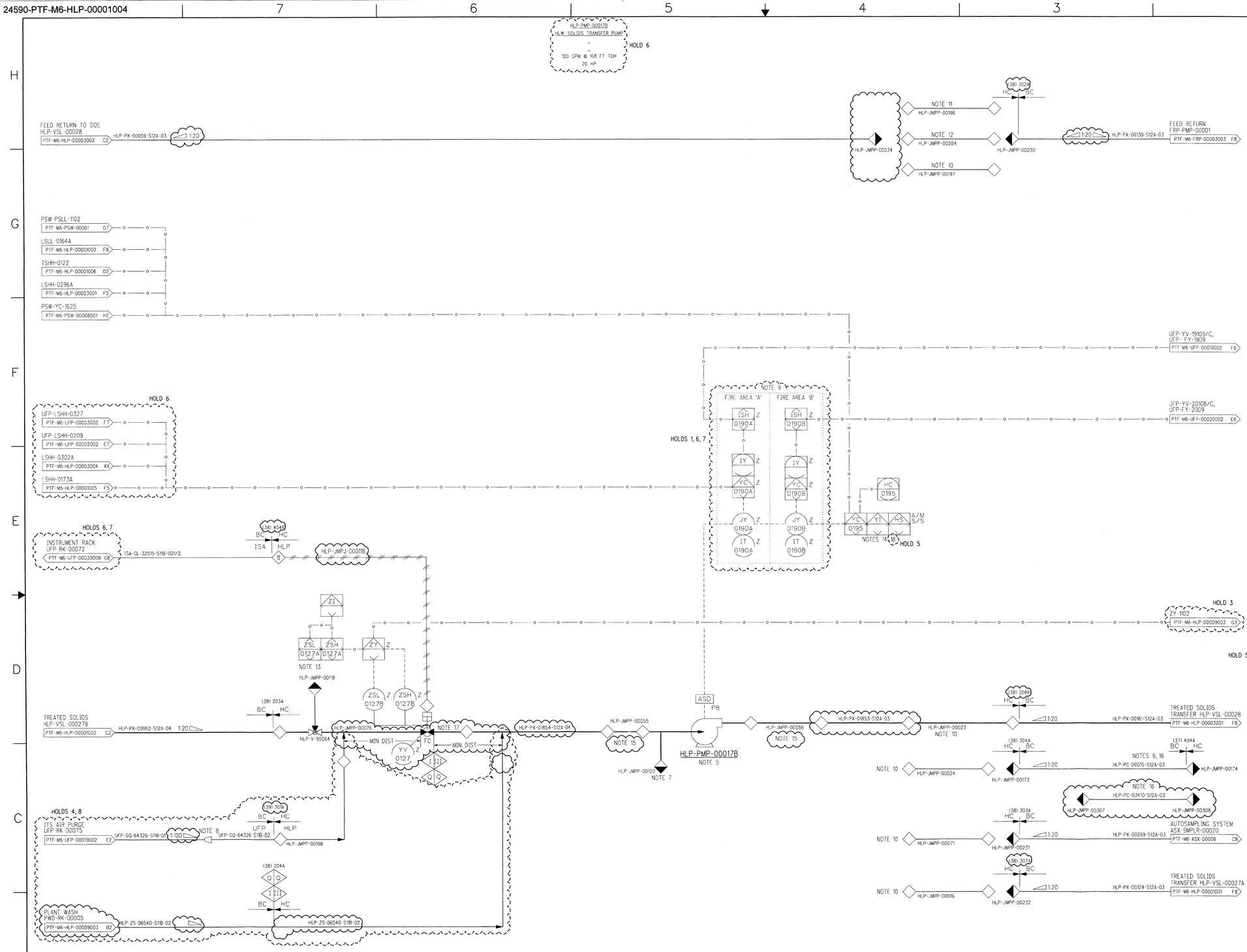
SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GPP-SREG-002

'E' SIZE - 44x34
COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED

4/20/2012 9:38:01 AM



PLOTTED BY: eidorn C:\Work\eidorn\dms03837\PTFM6HLP00001003.dgn




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-S0-00001 THROUGH 24590-WTP-M6-S0-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DRAWING ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL COMPONENTS ON THIS DRAWING IS QUALITY LEVEL Q AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED. FLEXIBLE PNEUMATIC JUMPERS ARE QUALITY LEVEL CM AND SEISMIC CATEGORY SC-IV. ISA PIPING IS QUALITY LEVEL Q AND SEISMIC CATEGORY SC-I FOR FUNCTION.
4. ALL LINES SHOWN ON THIS DRAWING SHALL BE FREE DRAINING, EXCEPT BLACK CELL LINES WHICH ARE SELF-DRAINING, UNLESS OTHERWISE NOTED.
5. REFER TO DRAWING 24590-PTF-M6-PSW-00008001 FOR PUMP SEAL WATER DISTRIBUTION.
6. PIPING PROVIDED FOR INSTALLATION OF FUTURE JUMPER BETWEEN HLP-PC-00015-S12A-03 AND HLP-PC-03400-S12A-03, LOCATED ON 24590-PTF-M6-HLP-00003002. ROUTE PROVIDES TRANSFER PATH FROM HLP-PMP-00017B TO HFP-VSL-00005. IN THE EVENT THAT USE OF THIS ROUTE IS DESIRED, PUMP DESIGN IS TO BE RE-EVALUATED. HLP-PMP-00017B IS DESIGNED TO PERFORM TRANSFERS INTERNAL TO PRETREATMENT ONLY.
7. PUMP SUCTION DRAIN SHALL HAVE PLUG THAT WILL FILL DRAIN PIPE FLUSH WITH INSIDE WALL OF TRANSFER PIPE. PLUG IS PHYSICALLY ATTACHED TO BLIND JUMPER. PLUG SHALL BE SAME MATERIAL AS PIPE.
8. LOCATE REDUCER NO LOWER THAN 40 FT ELEVATION.
9. SAFETY TIMER TO LIMIT PUMP RUN TIME.
10. JUMPERS HLP-JMPP-00016, HLP-JMPP-00024, HLP-JMPP-00071, AND HLP-JMPP-00197 TO BE FABRICATED, BUT INSTALLED ONLY ON AN AS-NEEDED BASIS FOR OFF-NORMAL OPERATIONS. FOR THE RESPECTIVE INSTALLATION OF THESE INDIVIDUAL JUMPERS, THE REMOVAL OF HLP-JMPP-00023 IS REQUIRED FOR CONNECTION OF HLP-PMP-00017B TO THE RESPECTIVE DESTINATION.
11. JUMPER HLP-JMPP-00196 TO BE FABRICATED, BUT INSTALLED ON AN AS-NEEDED BASIS FOR OFF-NORMAL OPERATION. FOR THE INSTALLATION OF THIS JUMPER, THE REMOVAL OF HLP-JMPP-00045 ON 24590-PTF-M6-HLP-00001003 IS REQUIRED FOR CONNECTION OF HLP-PMP-00017A TO FRP-PMP-00001.
12. FOR INSTALLATION OF HLP-JMPP-00204 BETWEEN HLP-PX-00059-S12A-03 AND HLP-PX-00130-S12A-03, REMOVE BLIND JUMPERS HLP-JMPP-00030 AND HLP-JMPP-00034 AND INSTALL JUMPER HLP-JMPP-00204 ON AN AS-NEED BASIS FOR TRANSFER BACK TO DOE/TFC.
13. ICN ALARM IS ACTUATED ON POSITION MISMATCH.
14. ON AN HLP-PMP-00017B NOT-RUNNING CONDITION, VALVE HLP-YV-0127 IS PULSED CLOSED.
15. REMOVAL OF JUMPER HLP-JMPP-00055 PROVIDES VESSEL HEEL DILUTION/CLEANOUT PUMP HLP-PMP-00022 (FUTURE) SUCTION CONNECTION VIA A FLEXIBLE JUMPER. REMOVAL OF JUMPER HLP-JMPP-00056 PROVIDES HLP-PMP-00022 (FUTURE) DISCHARGE CONNECTION, VIA A FLEXIBLE JUMPER, FOR THE REMOVAL OF NON-NEWTONIAN HEELS. NON-NEWTONIAN HEELS CAN ALSO GO TO DISCHARGE OF HLP-PMP-00019B ON DRAWING 24590-PTF-M6-HLP-00003003. REFER TO DRAWING 24590-PTF-M6-UFP-00002001 FOR HLP-PMP-00022 (FUTURE) DISCHARGE CONNECTION, VIA A FLEXIBLE JUMPER, FOR SENDING NEWTONIAN HEELS TO UFP-VSL-00002A. SEE REFERENCE 2 FOR PUMP DETAILS.
16. PIPING PROVIDED FOR INSTALLATION OF FUTURE JUMPERS BETWEEN HLP-PC-00015-S12A-03 AND HLP-PC-03410-S12A-03, AND BETWEEN HLP-PC-03410-S12A-03 AND HLP-PC-03397-S12A-03, ON 24590-PTF-M6-HLP-00003003. ROUTE TO PROVIDE TRANSFER PATH FROM HLP-PMP-00017B TO HFP-VSL-00001. IN THE EVENT THAT USE OF THIS ROUTE IS DESIRED, PUMP DESIGN IS TO BE RE-EVALUTED. HLP-PMP-00017B IS DESIGNED TO PERFORM TRANSFERS INTERNAL TO PRETREATMENT ONLY.

VALVE HLP-YV-0127 ON THIS DRAWING AND VALVE
17. HLP-YV-1102 ON DRAWING 24590-PTF-HLP-00009003 ARE INTERLOCKED SUCH THAT ONLY ONE VALVE CAN BE OPENED AT A TIME.
18. HLP-PMP-00017B SHALL BE INTERLOCKED TO PREVENT OPERATION WHEN FLUSH VALVE HLP-YV-1102 ON DRAWING 24590-PTF-M6-HLP-00009003, OR VALVE DIW-YV-1324 OR DIW-YV-1328 ON DRAWING 24590-PTF-M6-DIW-00003003 IS OPEN.
19. THIS DRAWING DEPICTS PORTIONS OF THE SYSTEM THAT WERE TRANSFERRED FROM 24590-PTF-M6-HLP-00001003, REV 0. THIS DRAWING INCLUDES APPLICABLE INFORMATION FROM 24590-PTF-M6LN-HLP-00003, -00010, -00014, -00019, -00022, -00023, 24590-PTF-M6N-10-00011, 24590-PTF-M6N-HLP-00089, -00153, AND 24590-PTF-M6PR-10-00008. IDENTIFIED IMPLEMENTATION OF VESSEL DILUTION/CLEANOUT REQUIREMENTS. PHYSICALIZED PIPING HEADERS AND CONSOLIDATED JUMPERS. ADDED FURTHER C&I ENHANCEMENTS.

## HOLD/OPEN ITEMS:

1. PENDING PUMP-TIMER AND FLUSH-PURGE ENHANCEMENTS.
2. PENDING SAFETY VALVE INTERLOCK DESIGN.
3. PENDING FLUSH INTERLOCK DESIGN.
4. PENDING RE-EVALUATION OF LINE FLUSHING REQUIREMENTS.
5. PENDING INTEGRATED SAFETY MANAGEMENT REVIEW OF FLUSHING OPERATIONS.
6. PENDING COMPLETION OF SAFETY-CONTROL SELECTION FOR NON-NEWTONIAN OVERFLOW PROTECTION INTERLOCK (24590-WTP-PIER-MGT-12-0306).
7. PENDING IMPLEMENTATION OF ASX SAMPLER-SUMP-LEVEL NON-NEWTONIAN INTERLOCK.
8. PENDING RESOLUTION OF ACTION REGARDING THE FLUSH/PURGE VALVES BEING LOCATED IN THE HOTCELL (24590-WTP-ATS-MGT-12-0021).

## REFERENCES:

1. 24590-PTF-3YD-HLP-00001, SYSTEM DESCRIPTION FOR THE HLW LAG STORAGE AND FEED BLENDING PROCESS SYSTEM (HLP).
2. 24590-PTF-M6-HLP-00029001, P&ID-PTF HLW LAG STORAGE AND FEED BLENDING PROCESS SYSTEM VESSEL HEEL DILUTION/CLEANOUT HLP-PMP-00022 (FUTURE).

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 19 | | | | | 5/23/12 |

REVISION HISTORY

Q
QUALITY DESIGNATOR

| | | |
|---|---|---|
| PROJECT No. | 24590 | |
| SITE | HANFORD | |
| AREA | 200E | |
| BUILDING No. | 10 | |
| ISSUE STAMP | | |

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

| | BY | DATE |
|---|---|---|
| ORIGINATOR | Peter Martinez | 04/20/12 |
| CHECKER | | 4/20/12 |
| APPROVER | | 5/23/12 |
| REVIEWER | | 5-22-12 |
| | Ryan Zilli | 5-22-12 |

CONTENT APPLICABLE TO ALARA? X YES ___ NO
ADR NO. 24590-PTF-ADR-M-02-005 REV: 7
E&NS SCREENING REQUIRED? X YES ___ NO E&NS INITIAL IF YES

# P&ID - PTF
# HLW LAG STORAGE AND FEED BLENDING PROCESS SYSTEM HLP-PMP-00017B AND FEED RETURN

SCALE: NONE

24590-PTF-M6-HLP-00001004

REV 0

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GPP-SREG-002

'E' SIZE - 44x34
COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED

FORM E_SDN.DGN 02/2009

PLOTTED BY: eldorn C:\Work\eldorn\dms03837\PTF\M6\PL0001004.dgn 4/20/2012 9:26:25 AM

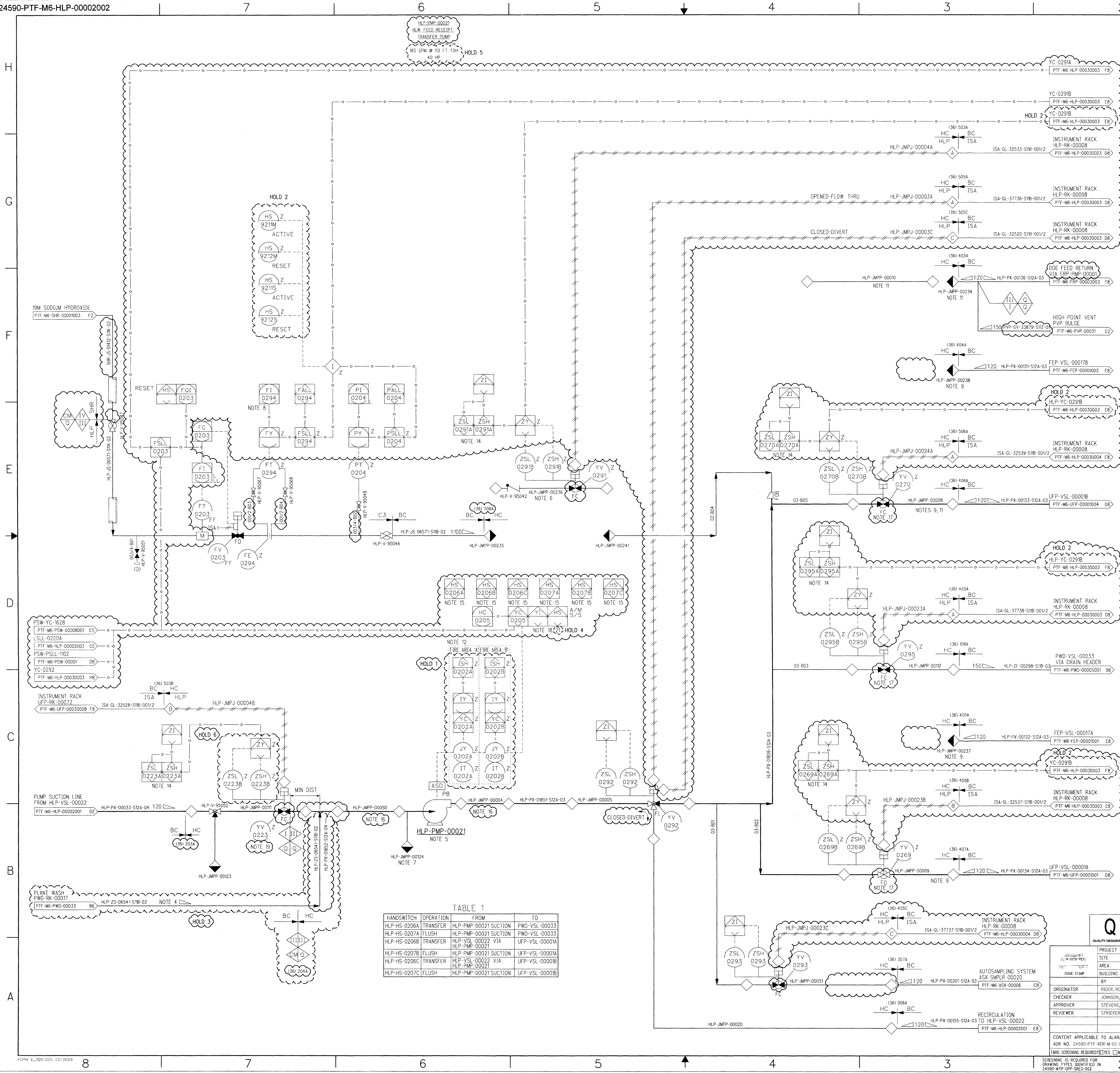



TABLE 1

| HANDSWITCH | OPERATION | FROM | TO |
|---|---|---|---|
| HLP-HS-0206A | TRANSFER | HLP-PMP-00021 SUCTION | PWD-VSL-00033 |
| HLP-HS-0207A | FLUSH | HLP-PMP-00021 SUCTION | PWD-VSL-00033 |
| HLP-HS-0206B | TRANSFER | HLP-VSL-00022 VIA HLP-PMP-00021 | UFP-VSL-00001A |
| HLP-HS-0207B | FLUSH | HLP-PMP-00021 SUCTION | UFP-VSL-00001A |
| HLP-HS-0206C | TRANSFER | HLP-VSL-00022 VIA HLP-PMP-00021 | UFP-VSL-00001B |
| HLP-HS-0207C | FLUSH | HLP-PMP-00021 SUCTION | UFP-VSL-00001B |

## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DRAWING ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL COMPONENTS ON THIS DRAWING IS QUALITY LEVEL Q AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED. FLEXIBLE PNEUMATIC JUMPERS ARE QUALITY LEVEL CM AND SEISMIC CATEGORY SC-IV. ISA PIPING IS QUALITY LEVEL Q AND SEISMIC CATEGORY SC-I FOR FUNCTION, WITH THE EXCEPTION OF THE PNEUMATIC PIPING TO HLP-YV-0292 AND HLP-YV-0293, WHICH IS QUALITY LEVEL CM AND SEISMIC CATEGORY SC-IV.
4. ALL LINES SHOWN ON THIS DRAWING SHALL BE FREE DRAINING, EXCEPT BLACK CELL LINES WHICH ARE SELF-DRAINING, UNLESS OTHERWISE NOTED.
5. REFER TO DRAWING 24590-PTF-M6-PSW-00008001 FOR PUMP SEAL WATER DISTRIBUTION.
6. HLP-JMPP-00236 IS INSTALLED ONLY WHEN REQUIRED TO SUPPORT UPFRONT-LEACHING OPERATIONS.
7. PUMP SUCTION DRAIN SHALL HAVE PLUG THAT WILL FILL DRAIN PIPE FLUSH WITH INSIDE WALL OF TRANSFER PIPE. PLUG IS PHYSICALLY ATTACHED TO BLIND JUMPER. PLUG SHALL BE SAME MATERIAL AS PIPE.
8. INDICATOR DESIGN SHALL REPORT BOTH FLOW DIRECTION AND MAGNITUDE.
9. PIPING ROUTES FROM HLP-VSL-00022 TO FEP-VSL-00017A AND FEP-VSL-00017B WILL BE INCLUDED IN THE DESIGN, BUT JUMPERS TO ENABLE THE USE OF THESE ROUTES WILL NOT BE DESIGNED. IN THE EVENT THAT USE OF EITHER OF THESE ROUTES IS DESIRED, THE ACCEPTABILITY OF SENDING FEED FROM HLP-VSL-00022 TO FEP-VSL-00017A/B WILL REQUIRE EVALUATION.
10. DELETED
11. WHEN TRANSFER TO DOE TANK FARM IS REQUIRED, REMOVE HLP-JMPP-00008, MOVE BLIND JUMPER HLP-JMPP-00234 TO LINE HLP-PX-00133-S12A-03, AND INSTALL HLP-JMPP-00010 BETWEEN HLP-PX-01826-S12A-03 AND HLP-PX-00136-S12A-03.
12. SAFETY TIMER TO LIMIT PUMP RUN TIME.
13. THIS DRAWING IS CONVERTED FROM A SINGLE SHEET TO MULTI-SHEET DRAWINGS AND, IN PART, SUPERSEDES 24590-PTF-M6-HLP-00002, REV 2. THIS IS A MAJOR REVISION, NO REVISION CLOUDS ARE SHOWN. THIS DRAWING MAY INCLUDE INFORMATION FROM 24590-PTF-M6N-HLP-00023, -00042, -00046, -00061, -00074, -00076, 24590-PTF-M6N-M80T-00017, -00037, AND -00038. ADDED 19M SODIUM HYDROXIDE SUPPLY TO PUMP DISCHARGE HEADER. ADDED HIGH POINT VENT. REVISED QUALITY LEVEL/SEISMIC CATEGORY DESIGNATION.
14. ICN ALARM IS ACTUATED ON POSITION MISMATCH.
15. HANDSWITCHES ALIGN THE OPERATIONS IDENTIFIED IN TABLE 1.
16. REMOVAL OF JUMPER HLP-JMPP-00050 PROVIDES VESSEL HEEL DILUTION/CLEANOUT PUMP HLP-PMP-00022 (FUTURE) FLUSH CONNECTION, VIA A FLEXIBLE JUMPER, WHEN SERVICING HLP-VSL-00022. REMOVAL OF HLP-JMPP-00004 PROVIDES HLP-PMP-00022 (FUTURE) DISCHARGE CONNECTION VIA A FLEXIBLE JUMPER. REFER TO DRAWING 24590-PTF-M6-HLP-00002001 FOR HLP-PMP-00022 (FUTURE) SUCTION CONNECTION VIA A FLEXIBLE JUMPER.
17. VALVES HLP-YV-0295, -0269, -0293, AND -0270 ARE INTERLOCKED SUCH THAT ONLY ONE VALVE OPENS AT A TIME.
18. VALVES HLP-YV-0223, -0269, -0270, -0291, -0292, -0293, AND -0295 ARE PULSED TO THEIR NORMAL OPERATING POSITION ON AN HLP-PMP-00021 NOT-RUNNING CONDITION.
19. VALVE HLP-YV-0223 ON THIS DRAWING AND VALVE HLP-YV-1103 ON DRAWING 24590-PTF-M6-PWD-00033 ARE INTERLOCKED SUCH THAT ONLY ONE VALVE CAN BE OPENED AT A TIME.
20. HLP-YV-0291 AND HLP-YV-0293 ARE INTERLOCKED SUCH THAT ONLY ONE VALVE CAN BE OPENED AT A TIME.
21. HLP-PMP-00021 SHALL BE INTERLOCKED TO PREVENT OPERATION WHEN FLUSH VALVE HLP-YV-1103 ON DRAWING 24590-PTF-M6-PWD-00033 IS OPEN. HOLD 4
22. REVISION 1: INCORPORATED 24590-PTF-M6LN-HLP-00003, -00008, -00023, -00026, 24590-PTF-M6N-10-00011, 24590-PTF-M6N-HLP-00085, -00091, 24590-PTF-M6PR-10-00008, AND 24590-PTF-M6LN-M80T-00062. FURTHER REVISED TO DEPICT OFF SHEET CONTROL SIGNALS FOR PNEUMATIC VALVES LOCATED IN THE HOT CELL. ADDED "Z" POSITION SWITCHES FOR HLP-YV-0291. DELETED HLP-JMPP-00006, -00007, AND ASSOCIATED ANCILLARIES. PHYSICALIZED PUMP DISCHARGE MANIFOLD. CONSOLIDATED JUMPERS. ADDED IDENTIFICATION OF HEEL DILUTION/CLEANOUT FEATURES. ADDED/REVISED/DELETED NOTES, HOLDS, AND REFERENCES. RECONCILED WITH SHR DESIGN. FURTHER C&I ENHANCEMENTS.

## HOLD/OPEN ITEMS:

1. PENDING PUMP-TIMER AND FLUSH-PURGE ENHANCEMENTS.
2. PENDING SAFETY VALVE INTERLOCK DESIGN.
3. PENDING RE-EVALUATION OF LINE FLUSHING REQUIREMENTS.
4. PENDING INTEGRATED SAFETY MANAGEMENT REVIEW OF FLUSHING OPERATIONS.
5. PENDING RE-ANALYSIS OF SPRAY LEAK EVENTS FOR PTF.
6. PENDING FLUSH-INTERLOCK DESIGN.

## REFERENCES:

1. 24590-PTF-3YD-HLP-00001, SYTEM DESCRIPTION FOR THE HLW LAG STORAGE AND FEED BLENDING PROCESS SYSTEM (HLP).
2. 24590-PTF-M6-HLP-00029001, P&ID-PTF HLW LAG STORAGE AND FEED BLENDING PROCESS SYSTEM VESSEL HEEL DILUTION/ CLEANOUT HLP-PMP-00022 (FUTURE).

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

REVISION HISTORY

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 1 | REVISED PER NOTE 22 | | | | | 5/23/12 |
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 13 | RJR | NJ | ES/CL | RS/JM | 10/24/08 |

Q
QUALITY DESIGNATOR

| | |
|---|---|
| PROJECT No. | 24590 |
| SITE | HANFORD |
| AREA | 200E |
| BUILDING No. | 10 |

ISSUE STAMP

| | BY | DATE |
|---|---|---|
| ORIGINATOR | RIDER, ROBERT | 10/23/08 |
| CHECKER | JOHNSON, NGA T | 10/23/08 |
| APPROVER | STEVENS, ROBERT | 10/24/08 |
| REVIEWER | STRIEPER, EGBERT | 10/24/08 |

CONTENT APPLICABLE TO ALARA? [X] YES [ ] NO
ADR NO. 24590-PTF-ADR-M-02-005 REV: 7
E&NS SCREENING REQUIRED? [X] YES [ ] NO E&NS INITIAL IF YES

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

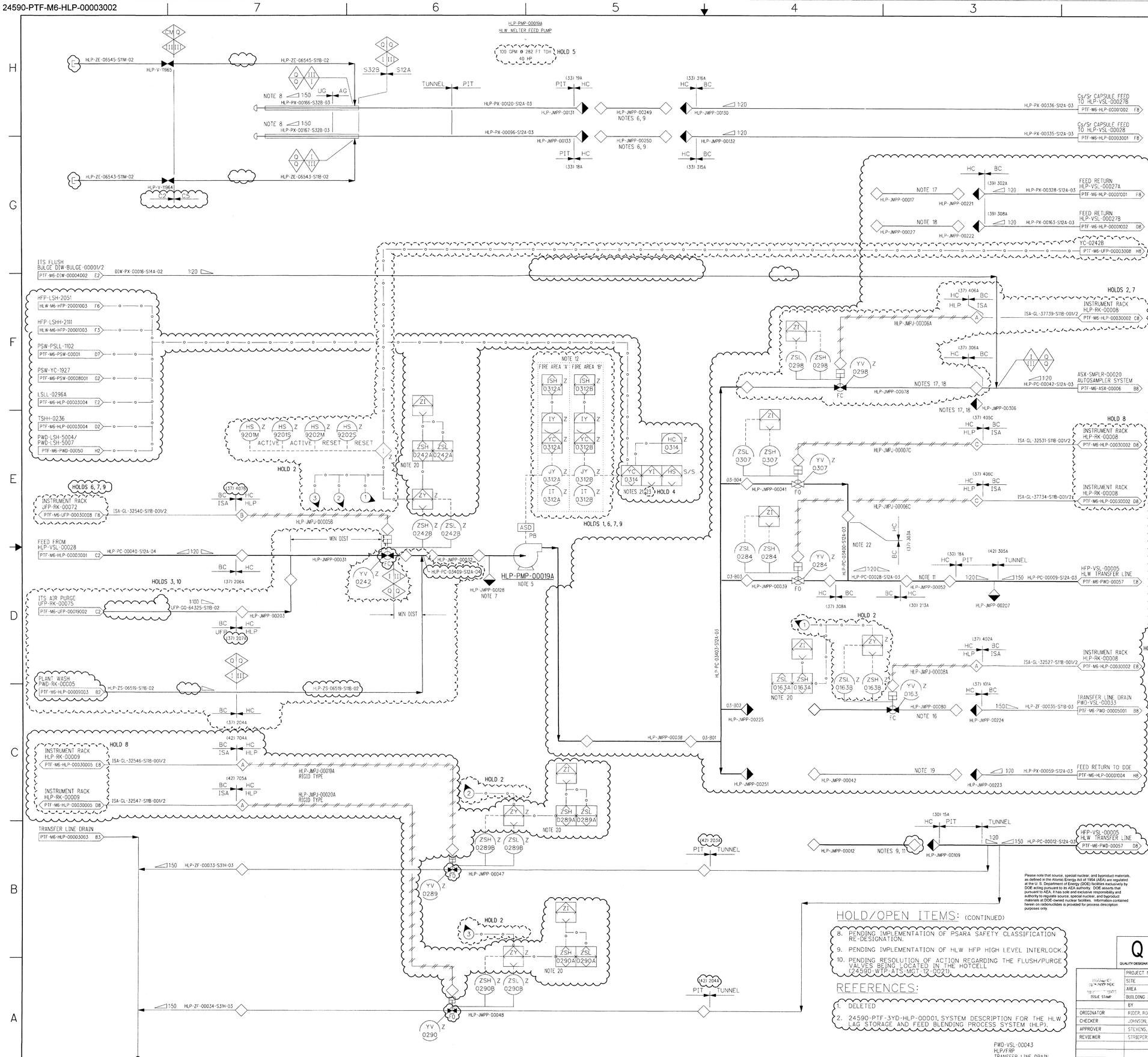
# P&ID - PTF
# HLW LAG STORAGE AND FEED BLENDING PROCESS SYSTEM HLP-PMP-00021

SCALE: NONE
24590-PTF-M6-HLP-00002002
REV 1

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GPP-SREG-002

'E' SIZE - 44x34
COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED

R11161716




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL COMPONENTS ON THIS DRAWING IS QUALITY LEVEL Q AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED. PNEUMATIC JUMPERS ARE QUALITY LEVEL CM AND SEISMIC CATEGORY SC- IV. ISA PIPING IS QUALITY LEVEL Q AND SEISMIC CATEGORY SC-I FOR FUNCTION. HLP-YV-0284, -0289, -0290, -0298, AND -0307 ARE QUALITY LEVEL Q AND SEISMIC CATEGORY SC-I FOR FUNCTION.
4. ALL LINES SHOWN ON THIS DRAWING SHALL BE FREE DRAINING, EXCEPT BLACK CELL LINES WHICH ARE SELF-DRAINING, UNLESS OTHERWISE NOTED.
5. REFER TO DRAWING 24590-PTF-M6-PSW-00008001 FOR PUMP SEAL WATER DISTRIBUTION.
6. FOR FUTURE ADDITION OF FEED FROM INTERMEDIARY FACILITY FOR PROCESSING OF Cs/Sr CAPSULES OR FROM HLW CONCENTRATION FACILITY. INTEGRATED SAFETY MANAGEMENT ON FEED REQUIRED BEFORE IMPLEMENTATION.
7. PUMP SUCTION DRAIN SHALL HAVE PLUG THAT WILL FILL DRAIN PIPE FLUSH WITH INSIDE WALL OF TRANSFER PIPE. PLUG IS PHYSICALLY ATTACHED TO BLIND JUMPER. PLUG SHALL BE SAME MATERIAL AS PIPE.
8. SPARE LINES FOR FUTURE CONNECTIONS SHALL BE CAPPED 5 FT FROM THE FOUNDATION OF THE PRETREATMENT FACILITY.
9. JUMPER WILL BE DESIGNED ONLY, NOT FABRICATED.
10. DELETED
11. FOR INSTALLATION OF HLP-JMPP-00012 BETWEEN HLP-PC-00028-S12A-03 AND HLP-PC-00012-S12A-03, REMOVE HLP-JMPP-00052, MOVE BLIND JUMPER HLP-JMPP-00109 TO THE OPEN CONNECTION OF HLP-PC-00009-S12A-03, AND INSTALL HLP-JMPP-00012 BETWEEN HLP-PC-00028-S12A-03 AND HLP-PC-00012-S12A-03.
12. SAFETY TIMER TO LIMIT PUMP RUN TIME.
13, 14. DELETED
15. THIS DRAWING IS CONVERTED FROM A SINGLE SHEET TO MULTI-SHEET DRAWINGS AND, IN PART, SUPERSEDES 24590-PTF-M6-HLP-00003, REV 2. THIS IS A MAJOR REVISION, NO REVISION CLOUDS ARE SHOWN. THIS DRAWING MAY INCLUDE INFORMATION FROM 24590-PTF-M6N-HLP-00044, -00048, -00060, -00063, -00074, -00081, 24590-PTF-M6N-M80T-00017, -00037, -00038, AND 24590-WTP-FC-P-06-0216. ADDED ITS FLUSH TO SAMPLING LINE AND ITS AIR PURGE TO HLP-PMP-00019A SUCTION LINE. REVISED QUALITY/SEISMIC DESIGNATION.
16. FOR INSTALLATION OF HLP-JMPP-00080 BETWEEN HLP-PC-03403-S12A-03-B02 AND HLP-ZF-00035-S11B-03, REMOVE BLIND JUMPERS HLP-JMPP-00225 AND HLP-JMPP-00224, AND INSTALL JUMPER HLP-JMPP-00080, ON AN AS-NEEDED BASIS FOR DRAINAGE FOLLOWING TRANSFERS BACK TO DOE/TFC.
17. FOR INSTALLATION OF HLP-JMPP-00017 BETWEEN HLP-PC-03403-S12A-03 AND HLP-PX-00328-S12A-03, REMOVE HLP-JMPP-00078, INSTALL BLIND JUMPER HLP-JMPP-00306 ON THE OPEN CONNECTION OF HLP-PC-00042-S12A-03, AND INSTALL HLP-JMPP-00017 BETWEEN HLP-PC-03403-S12A-03 AND HLP-PX-00328-S12A-03.
18. FOR INSTALLATION OF HLP-JMPP-00027 BETWEEN HLP-PC-03403-S12A-03 AND HLP-PX-00163-S12A-03, REMOVE HLP-JMPP-00078, INSTALL BLIND JUMPER HLP-JMPP-00306 ON THE OPEN CONNECTION OF HLP-PC-00042-S12A-03, AND INSTALL HLP-JMPP-00027 BETWEEN HLP-PC-03403-S12A-03 AND HLP-PX-00163-S12A-03.
19. FOR INSTALLATION OF HLP-JMPP-00042 BETWEEN HLP-PC-03403-S12A-03 AND HLP-PX-00059-S12A-03, REMOVE MOVE BLIND JUMPERS HLP-JMPP-00223 AND HLP-JMPP-00251, AND INSTALL HLP-JMPP-00042 ON AN AS-NEEDED BASIS FOR FEED RETURN TO DOE.
20. ICN ALARM IS ACTUATED ON POSITION MISMATCH.
21. VALVES HLP-YV-0242, -0284, -0298, AND -0307 ARE PULSED TO THEIR NORMAL-OPERATING POSITION ON AN HLP-PMP-00019A NOT-RUNNING CONDITION.
22. PIPING PROVIDED FOR INSTALLATION OF FUTURE JUMPER BETWEEN HLP-PC-00015-S12A-03, LOCATED ON 24590-PTF-M6-HLP-00001004, AND HLP-PC-03400-S12A-03. ROUTE IS REQUIRED TO PROVIDE TRANSFER PATH FROM HLP-PMP-00017B TO HFP-VSL-00005.
23. HLP-PMP-00019A SHALL BE INTERLOCKED TO PREVENT OPERATION WHEN FLUSH VALVE HLP-YV-0901 ON DRAWING 24590-PTF-M6-HLP-00009003, OR VALVE DIW-YV-1325 OR DIW-YV-1329 ON DRAWING 24590-PTF-M6-DIW-00003003 IS OPEN.
24. REVISION 1 INCORPORATED 24590-PTF-M6N-HLP-00093, -00153, 24590-PTF-M6LN-00002, -00003, -00009, -00012, -00019, -00022, -00023, -00030, -00035, 24590-PTF-M6LN-M80T-00035, AND 24590-PTF-M6N-10-00011. ADDED DEPICTION OF DIW/HLP SEISMIC INTERFACE, CORRECTED CONTAMINATION AREA LOCATION FOR HLP-V-11965. TRANSFERRED DEPICTION OF PILOT VALVES AND ASSOCIATED CONTROLS TO REMOTE INSTRUMENT RACK DRAWINGS. PHYSICALIZED PIPING HEADERS, CONSOLIDATED JUMPERS. ADDED/DELETED/REVISED NOTES, HOLDS AND REFERENCES. FURTHER C&I ENHANCEMENTS.

## HOLD/OPEN ITEMS:

1. PENDING PUMP-TIMER AND FLUSH-PURGE ENHANCEMENTS.
2. PENDING FLUSH INTERLOCKS, TRANSFER ROUTE INTERLOCKS (HPAV DESIGN), AND HPAV FUNCTIONAL-CRITERIA IDENTIFICATION FOR HLP-YV-0298.
3. PENDING RE-EVALUATION OF LINE FLUSHING REQUIREMENTS.
4. PENDING INTEGRATED SAFETY MANAGEMENT REVIEW OF FLUSHING OPERATIONS.
5. PENDING RE-ANALYSIS OF SPRAY LEAK EVENTS FOR PTF.
6. PENDING COMPLETION OF SAFETY-CONTROL SELECTION FOR NON-NEWTONIAN OVERFLOW PROTECTION INTERLOCK (24590-WTP-PIER-MGT-12-0306).
7. PENDING IMPLEMENTATION OF ASX SAMPLER-SUMP-LEVEL NON-NEWTONIAN INTERLOCK.

## HOLD/OPEN ITEMS: (CONTINUED)

8. PENDING IMPLEMENTATION OF PSARA SAFETY CLASSIFICATION RE-DESIGNATION.
9. PENDING IMPLEMENTATION OF HLW HFP HIGH LEVEL INTERLOCK.
10. PENDING RESOLUTION OF ACTION REGARDING THE FLUSH/PURGE VALVES BEING LOCATED IN THE HOTCELL (24590-WTP-ATS-MGT-12-0021).

## REFERENCES:

1. DELETED
2. 24590-PTF-3YD-HLP-00001, SYSTEM DESCRIPTION FOR THE HLW LAG STORAGE AND FEED BLENDING PROCESS SYSTEM (HLP).

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 1 | REVISED PER NOTE 24 | | | | | 5/23/12 |
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 15 | RR | NJ | ES/CL | RS/JM | 10-31-08 |

Q QUALITY DESIGNATOR

REVISION HISTORY

ISSUE STAMP

| | BY | DATE |
|---|---|---|
| PROJECT No. | 24590 | |
| SITE | HANFORD | |
| AREA | 200E | |
| BUILDING No. | 93 | |
| ORIGINATOR | RIDER, ROBERT | 10-30-08 |
| CHECKER | JOHNSON, NGA T | 10-30-08 |
| APPROVER | STEVENS, ROBERT | 10-31-08 |
| REVIEWER | STRIEPER, EGBERT | 10-30-08 |

CONTENT APPLICABLE TO ALARA? X YES NO
ADR NO. 24590-PTF-ADR-M-02-005 REV: 7
EMS SCREENING REQUIRED? X YES NO EMS INITIAL IF YES:

BECHTEL

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - PTF
# HLW LAG STORAGE AND FEED BLENDING PROCESS SYSTEM
# HLW MELTER FEED
# HLP-PMP-00019A

SCALE: NONE

24590-PTF-M6-HLP-00003002

REV 1

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-GRP-SREQ-002

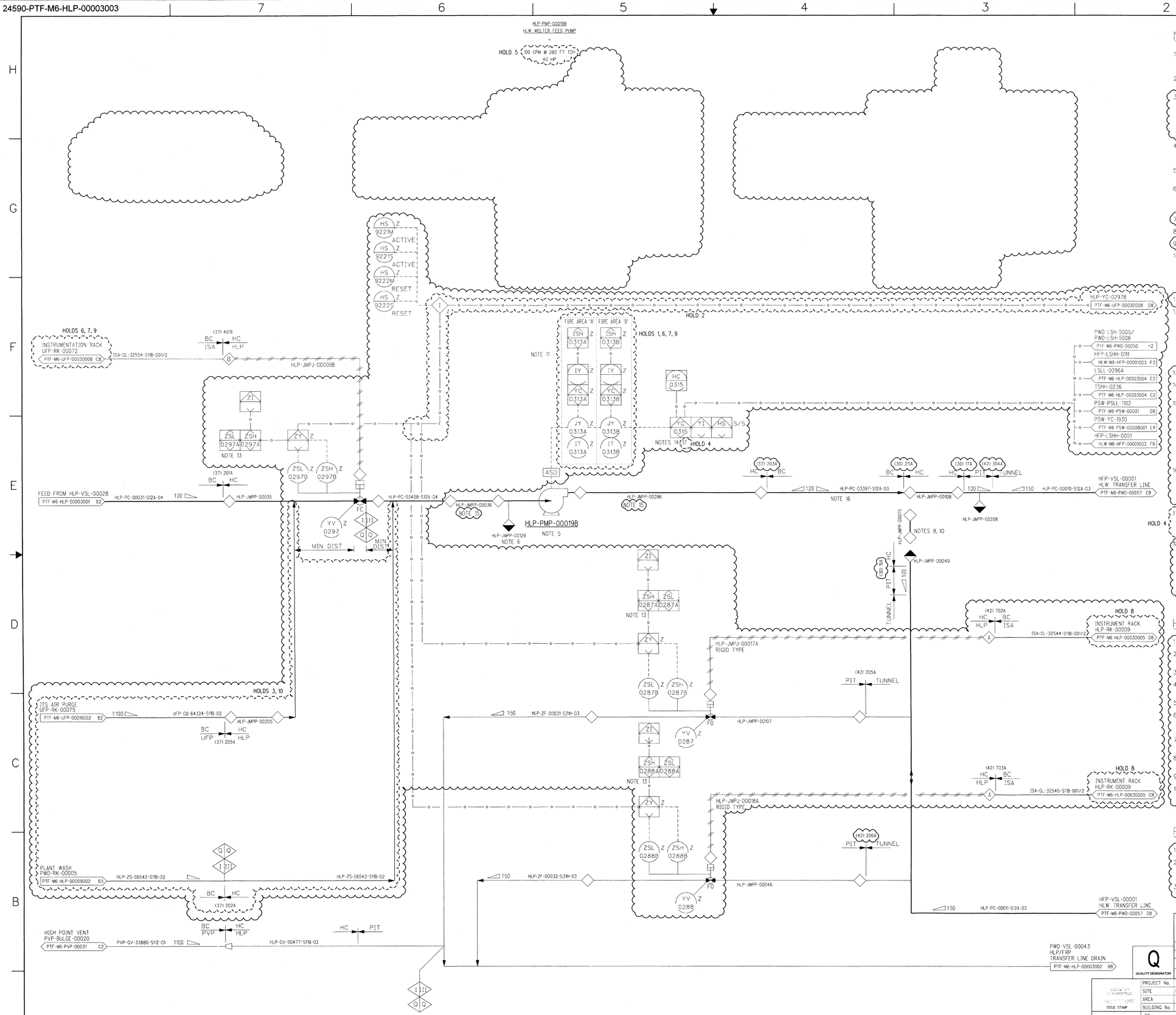
E SIZE - 44x34
COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED

4/20/2012 12:10:44 PM

PLOTTED BY: eldorm

C:\Work\eldorm\cmu\24837\PTF\M6HLP00003002.dgn

FORM E_SSN.DGN 02/2009




## NOTES:

1. SEE DRAWINGS 24590-WTP-M6-50-00001 THROUGH 24590-WTP-M6-50-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
2. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
3. THE PRESSURE BOUNDARY FOR ALL COMPONENTS ON THIS DRAWING IS QUALITY LEVEL Q AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED. PNEUMATIC JUMPERS ARE QUALITY LEVEL CM AND SEISMIC CATEGORY SC-IV. ISA PIPING IS QUALITY LEVEL Q AND SEISMIC CATEGORY SC-I FOR FUNCTION. HLP-YV-0287 AND -0288 ARE QUALITY LEVEL Q AND SEISMIC CATEGORY SC-I FOR FUNCTION.
4. ALL LINES SHOWN ON THIS DRAWING SHALL BE FREE DRAINING, EXCEPT BLACK CELL LINES, WHICH ARE SELF-DRAINING, UNLESS OTHERWISE NOTED.
5. REFER TO DRAWING 24590-PTF-M6-PSW-00008001 FOR PUMP SEAL WATER DISTRIBUTION.
6. PUMP SUCTION DRAIN SHALL HAVE PLUG THAT WILL FILL DRAIN PIPE FLUSH WITH INSIDE WALL OF TRANSFER PIPE. PLUG IS PHYSICALLY ATTACHED TO BLIND JUMPER. PLUG SHALL BE SAME MATERIAL AS PIPE.
7. DELETED
8. JUMPER WILL BE DESIGNED ONLY, NOT FABRICATED.
9. DELETED
10. FOR INSTALLATION OF HLP-JMPP-00075 BETWEEN HLP-PC-03397-S12A-03 AND HLP-PC-00011-S12A-03, REMOVE HLP-JMPP-00108, MOVE BLIND JUMPER HLP-JMPP-00049 TO THE OPEN CONNECTION OF HLP-PC-00010-S12A-03, AND INSTALL HLP-JMPP-00075 BETWEEN HLP-PC-03397-S12A-03 AND HLP-PC-00011-S12A-03.
11. SAFETY TIMER TO LIMIT PUMP RUN TIME.
12. THIS DRAWING IS CONVERTED FROM A SINGLE SHEET TO MULTI-SHEET DRAWINGS AND, IN PART, SUPERSEDES 24590-PTF-M6-HLP-00003, REV 2. THIS IS A MAJOR REVISION, NO REVISION CLOUDS ARE SHOWN. THIS DRAWING MAY INCLUDE INFORMATION FROM 24590-PTF-M6N-HLP-00044, -00048, -00060, -00063, -00074, -00081, 24590-PTF-M6N-M8OT-00017, -00037, -00038, AND 24590-WTP-FC-P-06-0216. ADDED ITS AIR PURGE TO HLP-PMP-00019B SUCTION LINE. REVISED QUALITY/SEISMIC DESIGNATION. ADDED SPARE LINES FOR FUTURE CONNECTION.
13. ICN ALARM IS ACTUATED ON POSITION MISMATCH.
14. VALVE HLP-YV-0297 IS PULSED TO ITS NORMAL-OPERATING POSITION ON AN HLP-PMP-00019B NOT-RUNNING CONDITION.
15. REMOVAL OF JUMPER HLP-JMPP-00036 PROVIDES VESSEL HEEL DILUTION/CLEANOUT PUMP HLP-PMP-00022 (FUTURE) SUCTION CONNECTION VIA A FLEXIBLE JUMPER. REMOVAL OF JUMPER HLP-JMPP-00096 PROVIDES HLP-PMP-00022 (FUTURE) DISCHARGE CONNECTION, VIA FLEXIBLE JUMPER, FOR CLEANOUT OF NON-NEWTONIAN HEELS FROM HLP-VSL-00027A/B AND -00028. SEE DRAWING 24590-PTF-M6-UFP-00002001 FOR HLP-PMP-00022 (FUTURE) DISCHARGE CONNECTION, VIA FLEXIBLE JUMPER, FOR RECEIPT OF NEWTONIAN HEELS. SEE REFERENCE 2 FOR PUMP DETAILS.
16. PIPING PROVIDED FOR INSTALLATION OF FUTURE JUMPERS BETWEEN HLP-PC-00015-S12A-03 AND HLP-PC-03410-S12A-03 ON DRAWING 24590-PTF-M6-HLP-00001004, AND BETWEEN HLP-PC-03410-S12A ON THAT DRAWING AND HLP-PC-03397-S12A-03 ROUTE IS REQUIRED TO PROVIDE TRANSFER PATH FROM HLP-PMP-00019B TO HFP-VSL-00001.
17. HLP-PMP-00019B SHALL BE INTERLOCKED TO PREVENT OPERATION WHEN FLUSH VALVE HLP-YV-1104 ON DRAWING 24590-PTF-M6-HLP-00009002, OR VALVE DIW-YV-1326 OR DIW-YV-1330, ON DRAWING 24590-PTF-M6-DIW-00003003 IS OPEN.
18. REVISION 1: INCORPORATED 24590-PTF-M6N-HLP-00002, -00003, -00004, -00009, -00013, -00019, -00022, 24590-PTF-M6N-ID-00011, 24590-PTF-M6N-HLP-00094, AND -00152. REVISED OFF SHEET CONTROL SIGNALS FOR HLP-YV-0287 AND HLP-YV-0288. IDENTIFIED HEEL DILUTION/CLEANOUT CAPABILITIES. CONSOLIDATED JUMPERS. DELETED HLW CONCENTRATION FACILITY IMPORT/EXPORT CAPABILITES SHOWN ON THIS DRAWING. ADDED/REVISED/DELETED NOTES, HOLDS, AND REFERENCES. FURTHER C&I ENHANCEMENTS.

## HOLD/OPEN ITEMS:

1. PENDING PUMP-TIMER AND FLUSH-PURGE ENHANCEMENTS.
2. PENDING FLUSH INTERLOCKS AND TRANSFER ROUTE INTERLOCKS (HPAV DESIGN).
3. PENDING RE-EVALUATION OF LINE FLUSHING REQUIREMENTS.
4. PENDING INTEGRATED SAFETY MANAGEMENT REVIEW OF FLUSHING OPERATIONS.
5. PENDING RE-ANALYSIS OF SPRAY LEAK EVENTS FOR PTF.
6. PENDING COMPLETION OF SAFETY-CONTROL SELECTION FOR NON-NEWTONIAN OVERFLOW PROTECTION INTERLOCK (24590-WTP-PIER-MGT-12-0306).
7. PENDING IMPLEMENTATION OF ASX SAMPLER-SUMP-LEVEL NON-NEWTONIAN INTERLOCK.
8. PENDING IMPLEMENTATION OF PRELIMINARY SAFETY ANALYSIS REPORT ADDENDUM SAFETY CLASSIFICATION RE-DESIGNATION.
9. PENDING IMPLEMENTATION OF HLW HFP HIGH-LEVEL INTERLOCK.
10. PENDING RESOLUTION OF ACTION REGARDING THE FLUSH/PURGE VALVES BEING LOCATED IN THE HOTCELL (24590-WTP-ATS-MGT-12-0021).

## REFERENCES:

1. DELETED
2. 24590-PTF-M6-HLP-00029001, P&ID-PTF HLW LAG STORAGE AND FEED BLENDING PROCESS SYSTEM VESSEL HEEL DILUTION/CLEANOUT HLP-PMP-00022 (FUTURE).
3. 24590-PTF-3YD-HLP-00001, SYSTEM DESCRIPTION FOR THE HLW LAG STORAGE AND FEED BLENDING PROCESS SYSTEM (HLP).

| REV | DESCRIPTION | ORG | CHKD | RVWD | APVD | DATE |
|---|---|---|---|---|---|---|
| 1 | REVISED PER NOTE 18 | | | | | 5/23/12 |
| 0 | ISSUED FOR CONSTRUCTION, SEE NOTE 12 | RR | NJ | ES/DL | RS/JM | 10/31/08 |

REVISION HISTORY

Q — QUALITY DESIGNATOR

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

| | PROJECT No. | 24590 |
|---|---|---|
| | SITE | HANFORD |
| | AREA | 200E |
| ISSUE STAMP | BUILDING No. | 10 |

| | BY | DATE |
|---|---|---|
| ORIGINATOR | RIDER, ROBERT | 10/30/08 |
| CHECKER | JOHNSON, NGA T | 10/30/08 |
| APPROVER | STEVENS, ROBERT | 10/31/08 |
| REVIEWER | STRIEPER, EGBERT | 10/30/08 |

CONTENT APPLICABLE TO ALARA? [X] YES [ ] NO
ADR NO. 24590-PTF-ADR-M-02-005 REV: 7
EMS SCREENING REQUIRED? [X] YES [ ] NO EMS INITIAL IF YES

BECHTEL

RIVER PROTECTION PROJECT
WASTE TREATMENT PLANT
2435 STEVENS CENTER PLACE
RICHLAND, WA 99354

CONTRACT No: DE-AC27-01RV14136

# P&ID - PTF
# HLW LAG STORAGE AND FEED BLENDING PROCESS SYSTEM
# HLW MELTER FEED
# HLP-PMP-00019B

SCALE: NONE

24590-PTF-M6-HLP-00003003

REV 1

SCREENING IS REQUIRED FOR DRAWING TYPES IDENTIFIED IN 24590-WTP-OPP-SEQ-002

'E' SIZE - 44x34
COMPUTER GENERATED - MANUAL DESIGN CHANGES NOT PERMITTED

4/20/2012 12:41:41 PM

FORM E_SDN.DGN 02/2009

PLOTTED BY: eaton

C:\Work\eaton\dms0287\PTF\M6\P24590300 3.dgn

Quarter Ending June 30, 2013 24590-WTP-PCN-ENV-12-008

# Hanford Facility RCRA Permit Modification Notification Form
## Part III, Operating Unit 10
## Waste Treatment and Immobilization Plant

Index

Page 2 of 3: Hanford Facility RCRA Permit, Part III, Operating Unit 10, Waste Treatment and Immobilization Plant
Replace Engineering Specification for Nuclear Grade High Efficiency Particulate Air (HEPA) Filters (ASME AG-1 Section FK Filters) in Appendix 7.7 of the Dangerous Waste Permit (DWP).

Submitted by Co-Operator:

Donna Busche 6/10/13

D. M. Busche Date

Reviewed by ORP Program Office:

7/15/13

D. L. Noyes Date

Quarter Ending June 30, 2013

24590-WTP-PCN-ENV-12-008

## Hanford Facility RCRA Permit Modification Notification Form

| Unit: | Permit Part: |
|---|---|
| **Waste Treatment and Immobilization Plant** | **Part III, Operating Unit 10** |

Description of Modification:

The purpose of this Class 1 prime modification is to update and replace the following engineering specification in Appendix 7.7 of the DWP:

| Appendix 7.7 | | | |
|---|---|---|---|
| Replace: | 24590-WTP-3PS-MKH0-T0002, Rev. 3 | With: | 24590-WTP-3PS-MKH0-T0002, Rev. 4 |

This modification requests Ecology approval and incorporation into the permit the specific changes to the engineering specification indicated by revision notes. The engineering specification includes changes provided in applicable document change forms (e.g., DCN, SCN, SDDR, FCN, FCR, etc.). In addition, this engineering specification includes changes associated with the resolution to comments on change documents since the issuance of the last revision of the permitted document. This engineering specification update is considered a major document revision and change bars are not shown.

Summary of changes to the engineering specification are summarized below:

- Incorporated changes supporting enhancements to design/fabrication requirements and criteria for HEPA filter testing
- Added Atomic Energy Act (AEA) statement
- Added new subsections in Sections 2 through 8; Tables B-1, B-2, C-1, and C-2; and Appendices B, C, and D to supplement the HEPA filter design and fabrication requirements, including equipment environmental qualifications, metal medium and high strength HEPA filter requirements, and anticipated filter loadings
- Expanded subsections in Sections 1 through 6, 8, and 10 to provide additional reference documents and drawings and clarifications on design requirements, material of construction, fabrication, test, inspection, quality assurance, and required vendor documentation and submittals
- Revised HEPA filter datasheet template in Appendix A

This PCN updates information in Appendix 7.7 to reflect current design. This DWP component may be re-evaluated to confirm design adequacy. If the re-evaluation results in future design changes, the changes will be reviewed by Ecology in subsequent permit modifications.

The following outstanding change documents have been submitted to Ecology pursuant to Permit Condition III.10.C.9.h and are maintained in the WTP Operating Record:

None

In accordance with Permit Condition III.10.C.2.e, this permit modification sent to Ecology may include page changes to the Permit, attachments, and permit application supporting documentation.

Quarter Ending June 30, 2013 24590-WTP-PCN-ENV-12-008

| WAC 173-303-830 Modification Class: | Class 1 | Class 1 | Class 2 | Class 3 |
|---|---|---|---|---|
| Please mark the Modification Class: | | X | | |

Enter relevant WAC 173-303-830, Appendix I Modification citation number: NA

Enter wording of WAC 173-303-830, Appendix I Modification citation:

In accordance with WAC 173-303-830(4)(d)(i), this modification notification is requested to be reviewed and approved as a Class 1 modification. WAC 173-303-830(4)(d)(ii)(A) states, "Class 1 modifications apply to minor changes that keep the permit current with routine changes to the facility or its operation. These changes do not substantially alter the permit conditions or reduce the capacity of the facility to protect human health or the environment. In the case of Class 1 modifications, the director may require prior approval."

Modification Approved/Concur: [X] Yes [ ] Denied (state reason below)

Reason for denial:

Reviewed by Ecology:

ER Skeinald 8/26/13

for S. Dahl Date

Issued by

R50028690

# RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

## ENGINEERING SPECIFICATION

FOR

## Nuclear Grade High Efficiency Particulate Air (HEPA) Filters (ASME AG-1 Section FK Filters)

**Content applicable to ALARA?** ☒ Yes ☐ No

**ADR No.** 24590-WTP-ADR-HV-04-0002 **Rev** 1

**Specification changes retroactive?** ☐ Yes ☒ No ☐ N/A (alpha revision or revision 0)

NOTE: Contents of this document are Dangerous Waste Permit affecting.

| Quality Level |
|---|
| Q |
| DOE Contract No. DE-AC27-01RV14136 |

| REV | DATE | BY | CHECK | REVIEW | E&NS | EGS |
|---|---|---|---|---|---|---|
| 4 | 1/25/13 | J. Tuck | P. Shea | G. Garcia | RF Carlstrom | J. Monahan ~~J. Weamer~~ 1/25/13 |
| 3 | 24 June 2009 | A. Jocson | G. Dunn | G. Garcia | B. Erlandson | J. Julyk |
| 2 | 8 Mar 2006 | P. Sullivan | J. Dick | W. Lawrence | M. Rosenthal | G. Garcia |
| 1 | 19 Aug 2004 | P. Sullivan | J. Dick | G. Garcia | NA | G. Garcia for G. Duncan |
| 0 | 5-Aug 2002 | G. Garcia | L. Solis | J. Sanders | NA | F. Davis |

**SPECIFICATION No.** 24590-WTP-3PS-MKH0-T0002 **Rev** 4

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA) are regulated at the U. S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that pursuant to AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

**Revision History**

| Revision | Reason for Revision |
|---|---|
| 4 | Incorporate alternative system specific testing, pack designs, filter media, and initial five percent efficiency test. Changes support resolution of technical issues identified in 24590-WTP-TIES-ENG-12-0010, *WTP Technical Issues Sheet -October 2012 Update*, Technical Issue 2011-0001, "HEPA Filter Combined Loading Test Failure". Complete Revision No Change bars. |
| 3 | Administrative update to source document to incorporate outstanding changes and supersede permit document no longer required by Project. Incorporated 24590-WTP-3PN-MKH0-00022. Supersedes 24590-WTP-3PS-MKH0-TP002, Rev 3. |
| 2 | Issued to support design qualification testing and production.<br>Completely revised. This revision includes, but is not limited to, changes to incorporate:<br>1) Specification Change Notice 24590-WTP-3PN-MKH0-00018 incorporated as follows:<br>• 1st change: 24590-WTP-SDDR-PROC-05-00116 superceded by 24590-WTP-SDDR-HV-06-00008. This later SDDR is incorporated by reference.<br>• 2nd change: Second sentence "If a date or revision...." not incorporated. Justification: Proposed text would violate procedure 24590-WTP-3DP-G04B-00049 Engineering Specifications, Rev. 10, Article 3.6.2.<br>• 3rd change: Not incorporated. SCN text is no longer consistent with text as presented in RPP-WTP Safety Requirements Document Volume II 24590-WTP-SRD-ESH-01-001-02 Appendix C 35.0 (see Subarticle FK-4100).<br>• 4th change: Not incorporated. SCN text is no longer consistent with text as presented in RPP-WTP Safety Requirements Document Volume II 24590-WTP-SRD-ESH-01-001-02 Appendix C 35.0 (see Table FK-4001). For the Safe Change HEPA filter, the specification requirement article 3.2.4 is stated for a more stringent pressure drop maximum (i.e., 1.3 in.wg.) than the allowed maximum (1.6 in. wg.) as stated in the SRD.<br>• 5th change: Incorporated.<br>• 6th change: Editorial- The correct article cross reference has been made.<br>2) New title to clarify intent of specification on RPP-WTP.<br>3) ASME AG-1 Section FK requirements, replacing Section FC requirements throughout document. Revised edition of ASME N509 from 1989 to 2002. These changes were made in accordance with CCN 128654, Approval of Authorization Basis Amendment Request 24590-WTP-SE-ENS-04-0212 Rev. 1.<br>(Note: There are no SRD implementing codes or standard deviations in the following changes.)<br>4) Requirements to test all HEPA filters in accordance with approved Trend TN-24590-03-01317, "QA Testing of HEPA Filters at DOE Filter Test Facility". Specification Sections 1.2, 1.5, 3.1, 3.2, 6.3, 7.2, 7.3, 7.6 and 8.2.<br>5) Specification requirements for Type 3 HEPA filters (used primarily for safe change HEPA housing vacuum relief during maintenance filter replacement).<br>6) Remote change HEPA filter design cross-reference and criteria related to remote handling process (Specification Section 3.1).<br>7) Expanded discussion regarding filter seismic qualification test plan and test report requirements (Specification Section 3.2).<br>8) Added HEPA Filter Data Sheet (Appendix A).<br>9) Expanded Shipping and Handling Instructions (Specification Section 7.6).<br>10) Clarified code and project required supplier quality assurance (Specification Section 8.2) and submittal requirements (Specification Section 10). |

| Revision | Reason for Revision |
|---|---|
| 1 | Issued to support design development. NOT TO BE USED FOR FABRICATION OF QL-1 OR QL-2 FILTERS.<br><br>Complete Revision. Conforms Spec to Current Project Requirements. Incorporate Spec Change Notice (SCN): 24590-WTP-3PN-MKH0-00004. SCN 24590-WTP-3PN-MKH0-00008 not incorporated. Incorporate Supplier Deviation Disposition Requests (SDDRs): 24590-WTP-SDDR-PROC-04-00134, 24590-WTP-SDDR-PROC-03-0155, and 24590-WTP-SDDR-PROC-03-0193. |
| 0 | Issued for Purchase |

# Notice

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts that, pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

# Contents

Notice ..... ii

1 Scope ..... 1
- 1.1 Project Description and Location ..... 1
- 1.2 Equipment, Material, and Services Required ..... 1
- 1.3 Work by Others ..... 2
- 1.4 Definitions ..... 2
- 1.5 Abbreviations ..... 4
- 1.6 Safety and Quality Classifications ..... 5

2 Applicable Documents ..... 5
- 2.1 ANSI/ASME – American Society of Mechanical Engineers ..... 5
- 2.2 U.S. Department of Energy Standards ..... 6
- 2.3 Other Reference Documents and Drawings ..... 6
- 2.4 WTP Project Design Drawings ..... 6
- 2.5 Informational Reference Documents ..... 8
- 2.6 Design Changes Incorporated By Reference ..... 8

3 Design Requirements ..... 8
- 3.1 General ..... 8
- 3.2 Performance ..... 12
- 3.3 Design Conditions ..... 14
- 3.4 Temperature ..... 14
- 3.5 Aging ..... 14
- 3.6 Equipment Environmental Qualification ..... 15
- 3.7 Supplemental Design Information for Metal Medium HEPA Filters ..... 15
- 3.8 Supplemental Design Information for High Strength HEPA Filters ..... 15

4 Materials ..... 15
- 4.1 Construction ..... 15
- 4.2 Prohibited Materials ..... 16
- 4.3 Material for Metal Medium HEPA Filters ..... 17
- 4.4 Material for High Strength HEPA Filters ..... 17

5 Fabrication ..... 17
- 5.1 General ..... 17
- 5.2 Fabrication of Metal Medium HEPA Filters ..... 18
- 5.3 Fabrication of High Strength HEPA Filters ..... 18

6 Tests and Inspections ..... 18
- 6.1 General ..... 18
- 6.2 Site Tests ..... 19
- 6.3 DOE Filter Test Facility Quality Assurance Testing ..... 19
- 6.4 Testing and Inspection of Metal Medium HEPA Filters ..... 20
- 6.5 Testing and Inspection of High Strength HEPA Filters ..... 20
- 6.6 Additional HEPA Filter Test Requirements ..... 20

7 Preparation for Shipment ..... 20
- 7.1 General ..... 20
- 7.2 Filter Marking and Identification ..... 20
- 7.3 Package Marking and Identification ..... 21

7.4 Packaging ..... 21
7.5 Documentation ..... 21
7.6 Shipping and Handling Instructions ..... 21
7.7 Storage ..... 23
7.8 Shipping of Metal Medium HEPA Filters ..... 23
7.9 Shipping of High Strength HEPA Filters ..... 23

8 Quality Assurance ..... 23
8.1 Supplier Quality Assurance Program ..... 23
8.2 Quality Assurance Requirements Specific to Item ..... 24
8.3 Substitutions ..... 25
8.4 Quality Assurance Requirements for Metal Medium HEPA Filters ..... 26
8.5 Quality Assurance Requirements for High Strength HEPA Filters ..... 26

9 Configuration Management ..... 26

10 Documentation and Submittals ..... 26
10.1 General ..... 26
10.2 Submittals ..... 26
10.3 Drawings ..... 27
10.4 Procedures ..... 27
10.5 Calculations ..... 28
10.6 Manuals ..... 28
10.7 Certificates of Conformance ..... 28
10.8 Schedules ..... 29
10.9 Materials Certificates and Statistics ..... 29
10.10 Data ..... 29

## Tables

**Table 1** **Remote Change Radial Flow HEPA Filter Limiting Criteria** ..... 9
**Table B-1** **Qualification Test Sequence for Metal Medium HEPA Filters** ..... 36
**Table B-2** **Metal Filter Medium - Representative Materials of Construction** ..... 42
**Table C-1** **Test Group and Sequence for High Strength HEPA Filters** ..... 50
**Table C-2** **High Strength Filter Medium Qualification and Production Tests** ..... 57

## Appendices

Appendix A : HEPA Filter Datasheet Template ..... 30
Appendix B : Metal Medium HEPA Filters ..... 32
Appendix C : High Strength HEPA Filters ..... 45
Appendix D : Projected PTF/LAW/HLW HEPA Filter Loading ..... 62

# 1 Scope

## 1.1 Project Description and Location

The River Protection Project - Waste Treatment Plant (RPP-WTP) is a complex of waste treatment facilities where the Department of Energy's (DOE) Hanford site tank waste will be put into stable glass form. The WTP Contractor will design, build, and start up the WTP pretreatment and vitrification facilities for the Office of River Protection (ORP). The waste treatment facilities will pretreat and immobilize the low activity waste (LAW) and high level waste (HLW) currently stored in underground storage tanks at the Hanford Site.

The Hanford Site occupies an area of about 560 square miles and is located along the Columbia River, north of the city of Richland, Washington. The WTP Facility will be constructed at the East End of the 200 East Area of the Hanford Site.

## 1.2 Equipment, Material, and Services Required

The Supplier shall design, fabricate, qualify, and test HEPA Filters in accordance with:

- This specification and the requirements of ASME AG-1 Section FK
- WTP Project HEPA Filter Datasheets (prepared per template, Appendix A)
- HEPA Filter Test Plan, 24590-WTP-3PS-MKH0-T0014

The specification covers the following HEPA Filter types:

- Safe Change HEPA Filters, ASME AG-1, FK-4111 (b), Type 1 Radial Flow HEPA Filters, with Gelatinous Seals, rated for 2,000 ACFM, and as depicted in ASME AG-1-2009, Figure FK-4100-2.
- Remote Change HEPA Filters, ASME AG-1, FK-4111 (d), Type 1 Radial Flow HEPA Filters, with Gelatinous Seals, rated for 2,000 ACFM, and as depicted in ASME AG-1-2009, Figure FK-4100-4.
- ASME AG-1, FK-4113 and FK-4114, Type 3 Axial Flow Filters, with rectangular or circular filter element in an enclosure with inlet and/or outlet connections as depicted in ASME AG-1-2009, Figures FK-4100-7 or FK-4100-8, and used for example as Valved Bleed Filters on Safe Change HEPA Filter housings, or breather filters on process bulges.

Per ASME AG-1, Article FK-3130, filter media for the above filter types shall conform to the requirements of ASME AG-1, Mandatory Appendix FC-I, unless otherwise specified. The selected filter medium pack shall meet the bounding environmental and process conditions of 200 inches WC differential pressure, 100% relative humidity, and 170°F.

Per Section 4.1.1.6, filters may be specified with alternative filter medium packs with respect to ASME AG-1 Mandatory Appendix FC-I. The filter medium may include reinforced HEPA filter medium with glass cloth backing, boron silicate microfiber high strength reinforced microfiber,

sintered metal, or other options. Additional non-mandatory information for alternative metal medium HEPA filters and high strength HEPA filters are described in Appendix B and Appendix C, respectively. The filter medium may be fabricated with separators, spacers, or other structural mechanical devices to maintain a rigid filter pack as required to prevent filter pleat collapse for the bounding conditions of 200 inches WC differential pressure, 100% relative humidity, and 170°F.

System specific testing and ASME AG-1 required qualification testing, as modified for the resistance to pressure test using liquid flows as documented in the HEPA Filter Test Plan, 24590-WTP-3PS-MKH0-T0014, shall be performed and certified by an independent test facility. Production of the WTP Radial Flow HEPA Filters shall not commence until the qualification tests are successfully completed and the results are accepted by the Buyer.

This specification also incorporates select supplemental requirements from Department of Energy (DOE) standard, DOE-STD-3020-2005, *Specification for HEPA Filters Used by DOE Contractors*. This specification includes requirements to conduct independent quality assurance testing at a DOE Filter Test Facility (FTF). With the exception of replacement of FTF failed filters, the Supplier is not responsible for FTF applicable specification requirements. Reference Section 6.3 of this specification for FTF failed filter requirements. Reference Section 7.2 and 7.3 for FTF labeling requirements.

## 1.3 Work by Others

1.3.1 Material unloading and storage at job site

1.3.2 Installation labor

## 1.4 Definitions

1.4.1 Certificate of Conformance. A written statement, signed by a qualified party, certifying that items or services comply with specific requirements.

1.4.2 Challenge Aerosol. Poly-disperse droplets used as challenge aerosol for testing installed HEPA filters for leaks. The poly-disperse aerosol used for leak testing of systems differs in size from the 0.3 micrometer mono-disperse DOP aerosol used for efficiency testing of individual HEPA filters by manufacturers.

1.4.3 Filter Burst Strength. A typical value of filter pressure differential at which a filter design has been proven to fail as indicated by an irreversible increase in aerosol penetration.

1.4.4 Filter Medium. The fiber matrix in a filter which captures suspended particles from an air or a gas stream. The plural form of "filter medium" is "filter media."

1.4.5 Grab Ring. Ring provided at the inlet of a Remote Change HEPA Filter to facilitate insertion and removal operations by remote systems.

1.4.6 HEPA Filter. High Efficiency Particulate Air Filter. A throwaway, extended medium dry type filter with a rigid casing. The filter shall exhibit a particle removal efficiency of 99.97% when tested with essentially mono-dispersed 0.3 micrometer diameter test aerosol particles. Test aerosol particles shall be DOP (dioctyl phthalate), DOS (dioctyl sebacate) or PAH (poly-alpha olefin).

1.4.7 High Strength HEPA Filter: A HEPA filter having a significantly higher filter burst strength, than filters qualified to the performance requirements of ASME AG-1 Sections FC and Section FK. The higher strength results from an inherently greater ultimate tensile strength of the filter medium and enhanced filter pack robustness and stability. Definition does not include metal filter medium, which would also provide a high filter burst strength but is treated separately in this specification.

1.4.8 High Strength HEPA Filter Medium. A non-metal HEPA filter medium having a significantly higher ultimate tensile strength than a filter medium qualified to the performance requirements of Appendix FC-I of ASME AG-1 Article FC.

1.4.9 Metal Medium HEPA Filter. A device having one HEPA filter element formed from a sintered metal filter medium assembled in an ASME AG-1 Section FK Type 1 radial flow HEPA filter configuration, for removing suspended particles from air or gas that is passed through the filter.

1.4.10 Process Bulge. A confinement structure to provide for the safe operation and maintenance of "hands-on" maintainable process equipment such as pumps, valves, instruments and associated equipment.

1.4.11 Production Test. A test made on an individual production item to verify its performance in accordance with specified requirements.

1.4.12 Qualification Tests. Test performed on HEPA filters, prior to production, by an independent test facility in accordance with the requirements of ASME AG-1, Article FK-5100 except the resistance to pressure test is replaced with a high pressure liquid flow test.

1.4.13 Remote Change. Remote change implies that the Remote Change HEPA filter requires an integral grab ring that works in conjunction with a mechanical filter handling tool as required for remote installation and removal.

1.4.14 Safe Change. Safe change implies that the Safe Change HEPA filter can be manually installed and removed by an operator without remote equipment and without breaking confinement.

1.4.15 Type 1. Radial flow HEPA filters as defined by ASME AG-1 Article FK-4100 and FK-4111. Also referred to as "Safe Change" and "Remote Change" HEPA filters throughout this specification.

1.4.16 Type 3. Axial flow rectangular or circular enclosed filters as defined by ASME AG-1 Article FK-4100, FK-4113, and FK-4114.

1.4.17 Water Column (WC). The units for air pressure typically expressed in inches of water column height (e.g., 2.5 inches WC).

## 1.5 Abbreviations

1.5.1 ACFM, Actual Cubic Feet per Minute

1.5.2 ANSI, American National Standards Institute

1.5.3 ASHRAE, American Society of Heating, Refrigerating and Air-Conditioning Engineers

1.5.4 ASME, American Society of Mechanical Engineers

1.5.5 ASTM, American Society for Testing and Materials

1.5.6 CAS, Chemical Abstract Service

1.5.7 CM, Quality Level "CM" (for commercial material)

1.5.8 DOE, Department of Energy

1.5.9 EEQ, Equipment Environmental Qualification

1.5.10 FTF, Department of Energy Filter Test Facility

1.5.11 HEPA, High Efficiency Particulate Air (Filter)

1.5.12 PPOE, Parent Piece of Equipment

1.5.13 RPP-WTP, River Protection Project - Waste Treatment Plant

1.5.14 Q, Quality Level "Q" (meeting quality requirements of ASME NQA-1)

1.5.15 SDDR, Supplier Deviation Disposition Request

1.5.16 SC-I, SC-II, SC-III, and SC-IV, Seismic Categories

1.5.17 SC, Safety Class

1.5.18 SS, Safety Significant

1.5.19 UL, Underwriters Laboratories, Inc.

1.5.20 WC, Water Column

### 1.6 Safety and Quality Classifications

Type 1 HEPA filters provided under this Specification are expected to meet RPP-WTP Project requirements for one of the following applications:

- Safety Class (SC) or Safety Significant (SS), Quality Level Q, Air Permit, and Seismic Category SC-I or SC-II service in a WTP Remote Change HEPA Filter Housing.
- SC or SS, Quality Level Q, Air Permit, and Seismic Category SC-I or SC-II service in a WTP Safe Change HEPA Filter Housing.
- Non-safety or Air Permit, Quality Level Q, and Seismic Category SC-III or SC-IV service in a WTP Safe Change HEPA Filter Housing.

Type 3 HEPA filters provided under this Specification are Non-safety, Commercial Material (CM) components and are not credited for seismic purposes (SC-IV) unless otherwise stated in the procurement documentation.

# 2 Applicable Documents

The following documents form a part of this specification to the extent specified herein. In the event of conflict between the document referenced herein and the contents of this specification, the Buyer shall be notified of the conflict. The latest document edition and addenda shall apply unless otherwise noted. For the codes and standards listed below, the specific revision or effective date identified, as well as the specific revision or effective date of codes and standards that they incorporate by reference (daughter codes and standards), shall be followed. The effective dates and revisions listed in Section 2 shall apply to subsequent references to the codes and standards within this specification.

### 2.1 ANSI/ASME – American Society of Mechanical Engineers

2.1.1 ASME AG-1-1997 with ASME AG-1a-2000 Addenda, Code on Nuclear Air and Gas Treatment (herein referred to as ASME AG-1).

2.1.2 ASME N509-2002, Nuclear Power Plant Air Cleaning Units and Components.

2.1.3 ASME N510-1989, Reaffirmed 1995, Testing of Nuclear Air Treatment Systems.

2.1.4 ASME NQA-1-89, Quality Assurance Program Requirements for Nuclear Facilities.

2.1.5 UL-586-1990, Underwriters Laboratories Inc., Test Performance of High Efficiency Particulate, Air Filter Units.

2.1.6 ASME NQA-1-2004 Quality Assurance Requirements for Nuclear Facility Applications. (Limited Application - Packaging and Storage Requirements Only)

2.1.7 ASME AG-1 Section FK, Special Round and Duct Connected HEPA Filters (Section FK was approved by the ASME Board on Nuclear Codes and Standards in 2005, and is available in ASME AG-1-2009).

## 2.2 U.S. Department of Energy Standards

2.2.1 DOE-STD-3020-2005, Specification for HEPA Filters Used by DOE Contractors

2.2.2 DOE-STD-3025-99, Quality Assurance Inspection and Testing of HEPA Filters

## 2.3 Other Reference Documents and Drawings

2.3.1 24590-WTP-3PS-MKH0-T0001, Engineering Specification for HVAC Safe Change HEPA Filter Housings.

2.3.2 24590-WTP-3PS-MKH0-T0003, Engineering Specification for HVAC Remote Change HEPA Filter Housings.

2.3.3 24590-HLW-3PS-MQL0-T0003, Engineering Specification for Filter/Filter Lid Grapples.

2.3.4 24590-WTP-M0-M10T-00023, PTF/HLW Vitrification System PFH/HFH Design Proposal Drawing Filter Grapple.

2.3.5 24590-WTP-3PS-G000-T0001, Supplier Quality Assurance Program Requirements.

2.3.6 24590-WTP-3PS-G000-T0003, Engineering Specification for Packaging, Handling, and Storage Requirements.

2.3.7 24590-WTP-3PS-G000-T0015, Engineering Specification for Environmental Qualification of Mechanical Equipment. This specification is for information only and is not a direct requirement for this specification. Reference Section 3.6 for clarification.

2.3.8 WTP Project HEPA Filter Datasheets (prepared per template, Appendix A, and included with purchase requisition).

2.3.9 24590-WTP-RPT-ENG-12-047. High Efficiency Particulate Air (HEPA) Filter Test Plan.

## 2.4 WTP Project Design Drawings

The assembled HEPA filters shall be designed to be installed in the current design of the WTP filter housings, and shall reflect the overall dimensions, tolerances, and all required interfaces depicted in the following documents.

2.4.1 24590-QL-POA-MKH0-00003-03-01, Drawing - Shop Detail Safe Change Gel Seal.

2.4.2 24590-QL-POA-MKH0-00003-03-05, Drawing - Outline Drawing Safe Change Filter Datasheet.

2.4.3 24590-QL-POA-MKH0-00003-03-09, Drawing - Assembly Safe Change Gel Seal.

2.4.4 24590-QL-POA-MKH0-00003-03-00013, Drawing - Detail Remote Change Type 1, Urethane Sealant.

2.4.5 24590-QL-POA-MKH0-00003-03-00014, Drawing - Assembly Remote Change Type 1, Urethane Sealant.

2.4.6 24590-QL-POA-MKH0-00003-03-00017, Drawing - Remote Change Type 1 HEPA Filter.

2.4.7 24590-QL-POA-MKH0-00001-04-23, Drawing - LAW C5V Safe Change HEPA Filter Housing Assembly Details 4 Filter Unit.

2.4.8 24590-QL-POA-MKH0-00001-04-05, Drawing - LAW C5V Safe Change HEPA Filter Retainer Detail.

2.4.9 24590-QL-POA-MKH0-00001-04-00035, Drawing - LAW/LAB Safe C2V and C3V Safe Change HEPA Filter Housing Assembly Details 4 Filter Unit.

2.4.10 24590-QL-POA-MKH0-00001-04-00041, Drawing - LAW/LAB C2V and C3V Safe Change HEPA Filter Retainer Detail.

2.4.11 24590-QL-POA-MKH0-00001-04-00052, Drawing - LAB C5V Safe Change HEPA Filter Retainer Detail.

2.4.12 24590-QL-POA-MKH0-00001-04-00053 , Drawing - Safe Change HEPA Filter Housing Assembly Details 4 Filter Unit.

2.4.13 24590-QL-POA-MKH0-00001-04-00133, Drawing - Safe Change HEPA Filter Housing Assembly Details 4 Filter Unit.

2.4.14 24590-QL-POA-MKH0-00001-04-00140, Drawing - Safe Change HEPA Filter Housing Assembly Details 4 Filter Unit for -115 Inches WC.

2.4.15 24590-QL-POA-MKH0-00001-04-00141, Drawing - Safe Change HEPA Filter Housing Assembly Details 4 Filter Unit for -115 Inches WC.

2.4.16 24590-QL-POA-MKH0-00002-07-00074, Drawing - HLW C5V/PJV Remote Change HEPA Filter Housing Assembly Details 5 Filter Unit.

2.4.17 24590-QL-POA-MKH0-00002-07-00124, Drawing - HLW HOP Remote Change HEPA Filter Housing Assembly Details 2 Filter Unit.

### 2.5 Informational Reference Documents

The following codes and standards are not specifically invoked on the WTP Project, but were used to the extent referenced herein or by ASME AG-1 as a source of information in development of technical and performance requirements.

2.5.1 DOE-HDBK-1169-2003, DOE Nuclear Air Cleaning Handbook

### 2.6 Design Changes Incorporated By Reference

2.6.1 24590-WTP-SDDR-HV-06-00008 (Supersedes 24590-WTP-SDDR-PROC-05-00116)

# 3 Design Requirements

References to ASME AG-1 Section FK requirements are made throughout this specification. The Section FK references and requirement excerpts provided herein are not intended to imply non-applicability of any Section FK requirement that is not specifically included. Unless explicitly stated otherwise, all ASME AG-1, Section FK requirements apply.

### 3.1 General

3.1.1 This specification relates to Type 1 and Type 3 HEPA filters as specified in ASME AG-1 Section FK. More specifically, the Type 1 HEPA filters are further described as Safe Change and Remote Change Radial Flow HEPA Filters with a maximum rated airflow of 2,000 ACFM (950 liters per second) per filter and suitable for manual and remote change housing installations, respectively. Type 3 HEPA filters design requirements are further described in Section 3.1.17 and 3.1.18.

3.1.2 Type 1 HEPA filter performance requirement design criteria as identified in ASME AG-1 Table FK-4000-4 and resistance to 200 inches WC differential pressure, 100% relative humidity, and 170°F.

3.1.3 Safe Change Radial Flow HEPA Filters shall include a gelatinous seal and be suitable for horizontal installation in multi-filter cabinet style housings specified in 24590-WTP-3PS-MKH0-T0001, Engineering Specification for HVAC Safe Change HEPA Filter Housings. In addition, the assembled safe change HEPA filters shall be designed to be installed in the current design of the WTP Safe Change HEPA Filter Housing, and shall reflect overall dimensions and interfaces as depicted on WTP Project drawings (Section 2.4). The filter Supplier shall provide a seal rated for a differential pressure range of 1 inch WC to 200 inches WC. The filter Supplier shall submit to the Buyer a test report as objective evidence that the seal is suitable for a differential pressure range of 1 inch WC to 200 inches WC.

3.1.4 Remote Change Radial Flow HEPA Filters shall include a gelatinous seal and be suitable for vertical installation in remotely operated multi-filter cabinet style housings

specified in 24590-WTP-3PS-MKH0-T0003, Engineering Specification for HVAC Remote Change HEPA Filter Housings. In addition, the assembled remote change HEPA filters shall be designed to be installed in the current design of the WTP Remote Change HEPA Filter Housing, and shall reflect overall dimensions and interfaces as depicted on WTP Project drawings (Section 2.4). The filter Supplier shall provide a seal rated for a differential pressure range of 1 inch WC to 200 inches WC. The filter Supplier shall submit to the Buyer a test report as objective evidence that the seal is suitable for a differential pressure range of 1 inch WC to 200 inches WC.

3.1.5 For design development purposes, limiting criteria for Remote Change Radial Flow HEPA Filters are shown in Table 1, below. These criteria may be superseded by Supplier design drawings submitted for Buyer review and permission to proceed. The Supplier design drawings will be used to document the final design.

**Table 1 Remote Change Radial Flow HEPA Filter Limiting Criteria**

| Criteria | Basis Statement |
|---|---|
| The outer diameter (OD) of the filter, inclusive of all design features (e.g. seal channel) and fabrication tolerances, shall not exceed 21 inches. | Export of waste filter from facility C5 cave requires use of remote equipment, export basket, and 55-gallon waste container. This process limits the dimensions of the waste item (i.e., filter). |
| The length of the filter, inclusive of all design features and fabrication tolerances, shall not exceed 26-1/2 inches. | The current design of the export basket limits the filter size which may be inserted into the basket. The basket is inserted into a 55-gallon waste container. |

3.1.6 Design of the Type 1 Safe Change and Remote Change Radial Flow HEPA filters shall conform to applicable portions of ASME AG-1, Section FK, and applicable portions of the documents listed in Section 2 of this specification. Where conflicts between the Supplier's design and ASME AG-1, Section FK, exist, the Supplier shall identify the respective code articles that do not apply and notify the Buyer via a Supplier Deviation Disposition Request prior to initiation of filter design qualification testing. For filter designs that have been previously qualification tested, the Supplier shall notify the Buyer of code conflicts during design submittal review (e.g., prior to fabrication). Deviations to ASME AG-1 Section FK requirements identified within this Specification do not require Buyer notification.

3.1.7 As required by ASME AG-1, Article FK-3130, the filter medium shall comply with ASME AG-1, Article FC, Mandatory Appendix FC-I and shall also comply with Section 4.1.1.6 whereby the medium shall maintain performance at 200 inches WC differential pressure, 100% relative humidity, and 170°F.

3.1.8 Type 1 filter packs shall comply with ASME AG-1, FK-4111. Other ASME AG-1 Section FK articles pertaining to filter pack design also apply (e.g., FK-4116, FK-4120, and FK-4130).

3.1.9 Installation and removal of the safe change HEPA filter shall be based on bag-in bag-out procedure.

3.1.10 Installation and removal of the remote change HEPA filter shall be based upon use of a sequencing grapple that is remotely positioned onto the filter using a crane and hook. The remote change HEPA filter requires an integral grab ring that shall work in conjunction with a filter grapple. The physical configuration of the remote change HEPA filter grab ring shall match the filter grapple. It shall be the Supplier's responsibility to confirm the physical configuration and interfaces of the grapple, remote change HEPA filter, filter grab ring, and filter housing to ensure the assembly meets all tolerance requirements. Reference 2.3.2, 2.3.3, and 2.3.4 for interface requirements.

3.1.10.1 The Supplier shall complete a structural capability test on the remote change HEPA filter using a static load of 1500 pounds.

3.1.10.2 The structural capability test is intended to simulate the loads associated with the grapple operating sequence, and shall include a weight of 1500 pounds associated with the weight of the sequencing grapple, crane hook, and crane cable block.

3.1.10.3 The structural capability test shall be completed with a remote change HEPA filter oriented, as installed, open end up.

3.1.10.4 The 1500 pound static weight shall be applied six (6) times to the remote change HEPA filter. The weight shall be applied uniformly.

3.1.10.5 The structural capability test fixture shall be sized to support a remote change HEPA filter and shall include a knife edge seal. The filter shall be supported by the knife edge only. The 1500 pound load shall be centered on a 15 inch diameter surface. The load shall be aligned with the vertical centerline of the filter. As a suggestion, the test fixture could be manufactured from a 24 or 26 inch diameter pipe, 36 inches in length, with the knife edge welded to one end of the pipe. The knife edge shall be aligned in the center of the filter gelatinous seal material.

3.1.10.6 Before initiating the structural capability test, the Supplier shall confirm the flatness tolerance of the remote change HEPA filter by taking measurements every 60 degrees using a straight edge and feeler gauges. The measurements shall be recorded and submitted to the Buyer if requested.

3.1.10.7 After the structural capability test, the Supplier shall demonstrate that the remote change HEPA filter is capable of withstanding the static load without permanent deformation or deterioration and provide "like-new" filter performance after the structural capability test.

3.1.11 The Safe Change Radial Flow HEPA Filters shall use a gel filled channel located on the inner diameter of the filter inlet. The channel shall be manufactured from ASME AG-1 compatible material and either fully integrated into the filter inlet flange (preferred) or affixed in position using a continuous seal weld. The construction method shall ensure that the gel channel remains in place and does not contribute to filter bypass during operation or fail structurally during filter installation and removal.

3.1.12 The Remote Change Radial Flow HEPA Filters shall use a gel filled channel located on the outer diameter of the filter inlet. The channel shall be manufactured from ASME AG-1 compatible material. The construction method shall ensure that the gel channel remains in place and does not contribute to filter bypass during operation or fail structurally during filter installation and removal.

3.1.13 Filter seals shall perform the following functions:

3.1.13.1 Provide a leak tight seal between the filter and the mating surface in the HEPA filter housing. See Section 2.4 for dimensional drawings of filters that are dimensionally compatible with current housing designs.

3.1.13.2 Accommodate maximum fabrication tolerances of the housings mating knife edge without compromising seal integrity.

3.1.13.3 The gel seal material shall remain in the gel seal channel during installation and removal cycles that would be normally expected to occur during operation of the system, as well as during design basis seismic events.

3.1.14 Handles on Safe Change Radial Flow HEPA Filters used for installation and removal shall:

3.1.14.1 Facilitate manual handling without damage to the filter.

3.1.14.2 Be attached to withstand installation and removal loads.

3.1.15 Grab Rings on Remote Change Radial Flow HEPA Filters used for installation and removal shall:

3.1.15.1 Facilitate remote mechanical handling without damage to the filter.

3.1.15.2 Be attached to withstand installation and removal loads.

3.1.15.3 Be compatible with remotely operated mechanical systems (provided by others) to facilitate insertion and removal operations by remote systems.

3.1.16 The design of the remote change HEPA filter shall include internal and external grille retention strips. The purpose for the retention strip is to ensure the filter end caps do not separate.

3.1.17 The Type 3 HEPA filters are axial flow filters with a maximum rated airflow and pressure drop as specified on the related equipment datasheets. Type 3 HEPA filters are typically intended for non-safety related use as vacuum relief (e.g., bleed) filters for manual Safe Change HEPA housing maintenance, or for process bulge breather or inlet filters, and are typically not subjected to deleterious environments. Type 3 Axial Flow HEPA Filters shall conform to applicable portions of ASME AG-1, Section FK and applicable portions of the documents listed in Section 2 of this specification, except as otherwise specified on equipment datasheets or procurement documentation. Type 3 Axial Flow HEPA Filters shall be compatible with the equipment interface. For Type 3 filter designs that have been previously qualification tested, the Supplier shall notify the Buyer of code conflicts during design submittal review (e.g., prior to fabrication).

3.1.18 Connection fittings selected for fabrication of Type 3 HEPA filters, intended for use as vacuum relief (e.g., bleed) filters, shall be compatible with the couplers specified for use on the Safe Change HEPA housings (Reference 2.3.1) or other equipment (e.g., process bulges) as applicable.

3.1.19 All filters shall be inspected and tested at a DOE FTF prior to Buyer acceptance.

## 3.2 Performance

The performance of Safe Change and Remote Change Radial Flow HEPA Filters shall conform to applicable portions of ASME AG-1, Section FK, and applicable portions of the documents listed in Section 2 of this specification, including, but not limited to the following requirements:

3.2.1 Filter Medium Efficiency: ASME AG-1, FK-1130: 99.97% when tested with an aerosol of essentially 0.3 micron diameter test aerosol particles.

3.2.2 Seismic: ASME AG-1, FK-4300. Type 1 HEPA filters shall be seismically qualified as part of the filter housing by the proof testing method in accordance with ASME AG-1, Article FK-4300 and AA-4350. The acceptance criteria shall be per FK-4300.

3.2.2.1 The specification for the parent piece of equipment (e.g., filter housing) shall be used to document Buyer seismic test and load criteria to be used for this qualification testing.

3.2.2.2 The Supplier may submit a prior report qualifying use of a filter in a given installation provided that the Supplier can prove the following:

(a) The equipment proposed to be used on the WTP Project is identical to that used in the prior qualification report. If they are not identical, the Seller shall demonstrate how the differences would not affect the seismic qualification.
(b) The WTP Project equipment functional requirements during and after the Design Basis Event (DBE) are similar or less stringent than those in the prior qualification report.

(c) Potentially significant aging mechanisms related to equipment performance as identified for the prior qualification report bound the aging characteristics expected for the given WTP system installation.

(d) The equipment support used in the testing is identical to that proposed for use on the WTP Project, and, prior qualification report based on Total Response Spectrum envelopes the WTP Required Response Spectrum.

3.2.2.3 A seismic qualification test plan shall be provided to the Buyer for review and approval prior to testing. This test plan shall be a submittal requirement of the parent piece of equipment specification (i.e., filter housing specification) and is not a submittal requirement of this specification.

3.2.3 System specific testing shall be required by an independent test facility in accordance with WTP Project HEPA Filter Datasheets prior to acceptance and production.

3.2.4 Qualification Testing: ASME AG-1, FK-5100, except the resistance to pressure test. Article FK-5140, shall be replaced with the resistance to pressure using the liquid flow test. Testing prior to acceptance and production, and certified by an independent test facility.

3.2.5 Resistance to Airflow: The following alternate criteria are approved for use for Type 1 HEPA filter designs regarding ASME AG-1 Articles FK-4100 and FK-5110. These resistance criteria apply when tested in accordance with paragraph FK-5120.

3.2.5.1 Article FK-4100 Code Requirement Text: The total media area provided within the filter pack shall be such that the maximum media velocity is 5 feet per minute at the rated flow. <u>Accepted WTP Replacement Requirement Test for Article FK-4100</u>: The total filter medium area provided within the RPP-WTP radial filter pack shall be such that the maximum filter medium velocity is 6.5 feet per minute at the rated airflow. For alternative HEPA medium, such as the high strength glass fiber and the steel fiber medium, the lowest possible media velocity will be considered.

3.2.5.2 Table FK-4000-1 Code Requirement Text: Type 1 Radial Flow HEPA Filter Nominal Rating: Maximum Resistance of 1.3 inches WC at 2000 ACFM maximum rated airflow. <u>Accepted WTP Replacement Requirement Text for Table FK-4000-1</u>: For Type 1 Remote Change HEPA Filter Only, Nominal Rating: Maximum Resistance of 1.55 inches WC at 2000 ACFM maximum rated airflow. Table FK-4000-1 requirements continue to apply as-is to Type 1 Safe Change HEPA filters. For alternative HEPA media such as the high strength glass fiber and the steel fiber medium the lowest possible media resistance will be considered.

3.2.6 Test Aerosol Penetration: ASME AG-1, FK-5120, 0.03% at rated (i.e., maximum) flow rate and 5% of rated flow rate, where rated flow rate is 2,000 ACFM.

3.2.7 Resistance to Rough Handling: ASME AG-1, FK-5130.

3.2.8 Resistance to Pressure: ASME AG-1, FK-5140, shall be replaced with the liquid flow test.

3.2.9 Resistance to Heated Air: ASME AG-1, FK-5150. Underwriters Laboratories test results or UL 586 designation shall be traceable to the actual design. Qualification based on the same filter medium or similar filter designs tested by UL is not acceptable as objective evidence of compliance with FK-5150.

3.2.10 Spot Flame Resistance: ASME AG-1, FK-5160. Underwriters Laboratories test results or UL 586 designation shall be traceable to the actual design. Qualification based on the same filter medium or similar filter designs tested by UL is not acceptable as objective evidence of compliance with FK-5160.

3.2.11 Supplier performed production inspection and testing shall be in accordance with ASME AG-1, Articles FK-5500 and FK-5600.

3.2.12 All production testing results are subject to validation through FTF quality assurance testing.

### 3.3 Design Conditions

3.3.1 Anticipated filter service conditions of 200 inches WC differential pressure, 100% relative humidity, and 170°F.

3.3.2 HEPA filters are not to be used for installations where there is a possibility of condensation forming on them, unless otherwise indicated on the WTP Project HEPA Filter Datasheets. This restriction applies only to HEPA filters using the standard glass fiber medium and not to the reinforced glass fiber medium or steel fiber medium.

### 3.4 Temperature

As a minimum, per ASME AG-l, Article FK-1121, filters built to Section FK shall be acceptable for continuous use at a maximum operating temperature of 250°F, unless more stringent temperature requirements are specified on system specific WTP Project HEPA Filter Datasheets.

### 3.5 Aging

The maximum life for a HEPA filter specified below is based upon guidance in the DOE Nuclear Air Cleaning Handbook (Reference 2.5.1 Section 3.3.8.1) for HEPA filters using standard glass fiber medium specified in ASME, FC-1.

The maximum total life (storage and in-service) for a HEPA filter is considered to be 10 years from the date of manufacture for applications in dry systems and 5 years in applications where the filter has the potential to become wet (e.g., more than once for short periods). If a filter gets wet, it should be replaced expeditiously.

The maximum life for a HEPA filter using high strength HEPA medium or steel fiber medium is expected to be significantly greater than the values for standard glass fiber medium specified above. The Supplier shall provide evidence to justify recommended shelf life and service life of filters.

### 3.6 Equipment Environmental Qualification

3.6.1 Equipment environmental qualification (EEQ) is performed on HEPA filter housings in accordance with specification 24590-WTP-3PS-G000-T0015, Engineering Specification for Environmental Qualification of Mechanical Equipment. EEQ requirements apply to HEPA filter housings that are classified Safety Class (SC) or Safety Significant (SS). The HEPA filters are consumable components that support the safety function of the corresponding HEPA filter housing .

3.6.2 HEPA filters shall be tested in accordance with Section 6 of this specification. The environmental conditions for the ventilation or process airstreams in which the filters are located are listed on system-specific WTP Project HEPA Filter Datasheets for normal, abnormal, and post-DBE conditions. Specification 24590-WTP-3PS-G000-T0015 does not apply to HEPA filter qualification.

### 3.7 Supplemental Design Information for Metal Medium HEPA Filters

Additional non-mandatory design information for Metal Medium HEPA Filters is provided in Appendix B.

### 3.8 Supplemental Design Information for High Strength HEPA Filters

Additional non-mandatory design information for High Strength HEPA Filters is provided in Appendix C.

## 4 Materials

### 4.1 Construction

4.1.1 Materials of construction for the Safe Change and Remote Change Radial Flow HEPA Filters shall conform to ASME AG-1, Article FK-3000, and applicable portions of the documents listed in Section 2 of this specification.

4.1.1.1 Type 1: ASME AG-1, FK-1121 Type A, C, or D filter medium pack with urethane adhesive. Types A and D prescribe separators as part of the filter medium pack. Alternative separator designs are also acceptable, with Buyers approval, if they can be qualified by testing per the requirements of this specification. This filter type shall be developed and qualification tested for each type of housing (Remote Change and Safe Change).

Reference the Material Requisition 24590-QL-MRA-MKH0-00003 for quantity required.

4.1.1.2 Type 3: ASME AG-1, FK-1121 Type C filter medium pack with urethane adhesive. Reference the Material Requisition 24590-QL-MRA-MKH0-00001 for quantity required.

4.1.1.3 Case Material Thickness and Material Type: ASME AG-1, FK-3110: ASTM A240 Type 304 or 304L (annealed) is preferred, however, alternate materials subject to Article FK-3220 requirements and Buyer review may be proposed for use.

4.1.1.4 Grilles: ASME AG-1, FK-3170: ASTM F 1267 Type II Class 3 Expanded Stainless Steel fabricated from Type 304L (annealed) stainless steel sheets as specified in ASTM A666. The finish of the expanded metal grille shall have no sharp edges. The Supplier shall provide expanded metal grilles with mechanical treatment (e.g., sand blasting) or chemical treatment.

4.1.1.5 Gasket Material: Gelatinous Seal per ASME AG-1, FK-3122.

4.1.1.6 Filter Medium: ASME AG-1, FK-3130 with hydrofluoric acid resistant filter medium formulation. Per FK-3130, the filter medium shall conform to the requirements of Mandatory Appendix FC-I and be resistant to 200 inches WC differential pressure, 100% relative humidity, and 170°F. Alternatively, the Buyer may specify HEPA filter medium that meets the requirements in ASME AG-1 FK-3130 and is resistant to 200 inches WC differential pressure, 100% relative humidity, and 170°F using metal fiber medium, reinforced glass fiber medium, or other options. Additional information for metal medium and high strength medium is given in Appendix B and C respectively.

4.1.1.7 Adhesive: ASME AG-1, FK-3150.

## 4.2 Prohibited Materials

4.2.1 For materials in contact with stainless steel, the following shall apply: Low melting point metals (i.e., lead, zinc, tin, antimony, cadmium, mercury) shall not exceed 1% by weight, with mercury not exceeding 50 parts per million. Halides shall not exceed 200 parts per million. This prohibition applies to use of tools, fixtures, paints, coatings and sealing compounds, and any other equipment or materials used by the Supplier during handling, assembly, and storage of stainless steel parts or components.

4.2.2 Asbestos shall not be included in any component of the Safe Change and Remote Change Radial Flow HEPA Filter.

### 4.3 Material for Metal Medium HEPA Filters

Additional non-mandatory information on material for Metal Medium HEPA Filters is provided in Appendix B.

### 4.4 Material for High Strength HEPA Filters

Additional non-mandatory information on material for High Strength HEPA Filters is provided in Appendix C.

# 5 Fabrication

## 5.1 General

5.1.1 Fabrication of the Type 1 Safe Change and Remote Change Radial Flow HEPA Filters shall be as specified in ASME AG-1, Article FK-6000 with the following exceptions.

5.1.1.1 Article FK-6211 (a) Code Requirement Text: Type 1 filter flange and end cap tolerances shall meet the following criteria: parallel within 1/16 in. (1.6 mm), square to the filter centerline axis to within 1/16 in. (1.6 mm) over the total filter length, flat within 1/16 in. (1.6 mm). Accepted WTP Replacement Requirement Test for Article FK-6211 (a): Type 1 filter flange and end cap tolerances shall meet the following criteria: parallel within 1/8 in., flat within 1/16 in. Circular run-out of inlet flange with respect to outlet end cap shall not exceed 3/32 in.

5.1.1.2 Article FK-6212 (a) Code Requirement Text: Type 1 filter length shall be ±1/16 in. (1.6 mm), filter sealing ring diameter ±1/16 in. (1.6 mm), sealing face diameter +1/32 in./-0 in. (+0.8 mm/-0 mm), concentricity shall be 1/16 in. (1.6 mm), all other dimensions ±1/16 in. (±1.6 mm). Accepted WTP Replacement Requirement Text for Article FK-6212 (a): Type 1 filter length shall be (+0/-1/8 in.), circular run-out of filter flange with respect to the filter end cap shall be within 3/32 in., all other dimensions ±1/16 in. with exception that design filter medium to grille (i.e., faceguard) gap shall be ±1/8 in. (i.e., to maintain a minimum filter medium to grille gap of 1/8 in. For the reinforced glass fiber medium and the steel fiber medium, there shall be no gap between the filter medium and the grill to prevent media ballooning at high air flow resistance.

5.1.2 Fabrication of the Type 3 axial flow rectangular or circular HEPA filters shall be as specified in ASME AG-1, Article FK-6000 unless otherwise accepted by the Buyer (e.g., Supplier Deviation Disposition Request).

### 5.2 Fabrication of Metal Medium HEPA Filters

Additional non-mandatory fabrication information for Metal Medium HEPA Filters is provided in Appendix B.

### 5.3 Fabrication of High Strength HEPA Filters

Additional non-mandatory fabrication information for High Strength HEPA Filters is provided in Appendix C.

# 6 Tests and Inspections

### 6.1 General

6.1.1 The test and inspection of Type 1 and Type 3 HEPA Filters shall conform to ASME AG-1, Article FK-5000 except the resistance to pressure test, FK-5140, shall be replaced with the high pressure liquid flow test. Refer to Section 3.2 for specific test requirements.

6.1.2 The Suppliers test and inspection personnel shall be formally trained to perform assigned duties in accordance with the Suppliers training qualifications program. This program shall be documented and shall be in accordance with recognized standards.

6.1.3 Type 1 Safe Change and Remote Change Radial Flow HEPA Filters shall require qualification testing prior to acceptance and production. Filter testing shall be performed and certified by an independent test facility as specified by ASME AG-1, Article FK-5100 except the resistance to pressure test, FK-5140, shall be replaced with the high pressure liquid flow test. Type 3 HEPA filters may be qualified as specified by ASME AG-1, Article FK-5300, or based on the prior qualification of a similar qualified Type 2 circular axial flow filter as specified by ASME AG-1, Article FK-5200. Type 1 Safe Change and Remote Change Radial Flow HEPA Filters and Type 3 HEPA filters shall be seismically qualified under a separate requirement in the Materials Requisition for the HEPA filters. Type 1 Safe Change and Remote Change Radial Flow HEPA Filters shall also be qualified by an independent test laboratory in additional tests to determine (1) filter loading capacity of three aerosol sizes and (2) resistance to particle loading under high temperature and humidity conditions as specified in 24590-WTP-3PS-MKH0-T0014, Rev A, High Efficiency Particulate (HEPA) Filter Test Plan.

6.1.4 Each Type 1 and Type 3 HEPA Filter shall bear the UL-586 label indicating successful testing of these filter types in conformance with UL procedures as required by ASME AG-1.

6.1.5 Each Type 1 and Type 3 HEPA Filter manufactured for delivery shall be inspected and production tested in accordance with ASME AG-1, Sections FK-5500 and

FK-5600. The results of the production test shall be marked on the label of each filter. Additional attributes to be inspected for Type 1 HEPA Filters are circular run-out and parallelism. Reference Article 5.1.1.

6.1.6 The Supplier shall provide objective evidence acceptable to the Buyer that the requirements of ASME AG-1 Mandatory Appendix FC-I, Articles I-3000 and I-5000, have been satisfied. Reference ASME AG-1 Mandatory Appendix FC-I-4120. Otherwise, the Supplier shall provide objective evidence acceptable to the Buyer that an alternative filter medium meets or exceeds these requirements.

## 6.2 Site Tests

Buyer's startup personnel will perform in-place tests after initial installation. Supplier shall provide startup assistance at Buyer's request.

## 6.3 DOE Filter Test Facility Quality Assurance Testing

6.3.1 Uniform Commercial Code (UCC) requirements governing acceptance and disposition of nonconforming goods apply. If during FTF receipt inspection, a filter is identified as damaged and unacceptable for use, the FTF shall contact the buyer and seller (supplier) and inform them of the damage immediately.

6.3.2 FTF inspection and testing shall be performed in accordance with DOE-STD-3020-2005. As a condition of acceptance, all production filters must successfully pass FTF inspection and testing requirements per sections 6 and 7 of DOE-STD-3020-2005. Testing at the FTF of filters fabricated to support design development or qualification is not required unless otherwise requested by the buyer. Testing at the FTF of filters fabricated to support design development for Phase 1 tests specified in 24590-WTP-3PS-MKH0-T0014, High Efficiency Particulate (HEPA) Filter Test Specification is not required. Testing at the FTF of filters is required for all other qualification tests.

6.3.3 FTF shall prepare a report to document the test results and apply permanent test labels on the filter case and the filter shipping carton.

6.3.4 Rejected filters shall be addressed in accordance with DOE-STD-3020-2005.

6.3.5 If filter(s) fail inspection or testing, the FTF shall notify both the buyer and supplier. The supplier shall be responsible for either replacing failed filter(s), or crediting the buyer, unless other accommodations are agreed upon between the buyer and the supplier.

6.3.6 After completion of required inspections and tests, but <u>immediately</u> preceding repackaging of the filter, FTF personnel shall re-inspect the fluid seal (if so equipped) to verify the gelatinous seal was not inadvertently damaged during FTF handling.

6.3.7 FTF shall repack accepted filters in a manner comparable to the original packaging received.

6.3.8 FTF activities involving packaging, shipping and storage of HEPA filters shall conform to ASME AG-1 Article FK-7000 requirements (i.e., Level B per ASME NQA-1-2004).

### 6.4 Testing and Inspection of Metal Medium HEPA Filters

Additional non-mandatory test and inspection information for Metal Medium HEPA Filters is provided in Appendix B.

### 6.5 Testing and Inspection of High Strength HEPA Filters

Additional non-mandatory test and inspection information for High Strength HEPA Filters is provided in Appendix C.

### 6.6 Additional HEPA Filter Test Requirements

ASME AG-1 provides requirements for the design, construction, and performance of clean nuclear grade HEPA filters. Materials of construction prescribed in ASME AG-1 protect the function of the HEPA filters from a wide range of exhaust airstream conditions due to upstream processes normally found in nuclear facilities.

WTP accident conditions could exceed the structural strength of a standard ASME AG-1 HEPA filter. Therefore, additional test criteria, over and above what ASME AG-1 requires, must be imposed on the WTP HEPA filters to handle the range of WTP specific process conditions.

WTP HEPA filters will be tested under combined parameters for temperature, relative humidity, and aerosol loading at a subcontracted test facility. The Supplier shall comply with the combined parameters for testing of WTP HEPA filters documented in the High Efficiency Particulate Air (HEPA) Filter Test Plan, 24590-WTP-RPT-ENG-12-047.

## 7 Preparation for Shipment

### 7.1 General

HEPA Filters shall be packaged, shipped, handled, and stored in accordance with ASME AG-1, Article FK-7000, and in accordance with requirements of Reference 2.3.4.

### 7.2 Filter Marking and Identification

7.2.1 Each HEPA Filter shall be identified in accordance with requirements of ASME AG-1, Article FK-9100. The marking and labeling requirements of Reference 2.3.4 are also applicable.

7.2.2 Filter nameplates shall be affixed to the filter end cap in the most readily visible location.

7.2.3 In addition to the information required by ASME AG-1 FK-9100, filter labeling shall include the following information:

- Date of Penetration Test
- Purchase Order (PO) Number and PO Line Item Number
- Procurement Specification Number and Revision
- FTF Test Label (applied by FTF personnel)

7.2.4 Review purchase order to ensure additional filter identification and labeling requirements are not applicable.

### 7.3 Package Marking and Identification

7.3.1 Marking and labeling for each filter carton shall conform to the requirements of ASME AG-1 Article FK-9200.

7.3.2 In addition to the information required by ASME AG-1, FK-9200, filter package marking shall include the following information:

- Project Number, Purchase Order (PO) Number and PO Line Item Number
- Filter Serial Number
- Procurement Specification Number and Revision
- FTF Test Label (applied by FTF personnel)
- Marking or label indicating the need for special storage environment (e.g., "Special Storage Requirements: ASME NQA-1-2004 Level B Storage or Equivalent is Required").

### 7.4 Packaging

Packaging shall be in accordance with ASME AG-1, Article FK-7000. The packaging requirements of Reference 2.3.4 are also applicable.

### 7.5 Documentation

Reference Section 10 of this Specification. Shipping documentation shall accurately reflect specific traceability to the items being shipped.

### 7.6 Shipping and Handling Instructions

7.6.1 Shipping and Handling of items shall be in accordance with ASME AG-1, Article FK-7000.

7.6.2 Filters shall not be shipped by rail unless prior approval is obtained from the Buyer (Reference 2.5.1 Appendix A.). For large shipments, it is recommended that the entire shipment be shipped in a sealed dedicated trailer. At all times, the filters must be

handled with care and oriented properly. Handling requirements (unique to filters) shall be clearly visible on the shipping carton.

7.6.3 Unless otherwise approved by the buyer, filters shall be shipped palletized or crated to minimize unit handling, particularly at public carrier interchange points. Standard pallet sizes shall be used by the supplier.

7.6.4 No other materials shall be placed on top of the filters during shipment. A packing list shall be glued securely to the outside of one carton. The packing list shall clearly state if the shipment is a partial shipment. When requested and authorized by the buyer, airfreight shipments shall also be palletized in accordance with this specification.

7.6.5 Arrangements shall be made by the Supplier to ensure filters are shipped directly to the DOE-FTF. Note: Filters fabricated to support design development or qualification are not required to be shipped to the DOE-FTF.

7.6.6 The carrier shall be instructed that the buyer's personnel will be responsible for unloading filters at the buyer's receiving facility.

7.6.7 The following information, taken from the content of Appendix A of Reference 2.5.1, is provided for those arranging shipment of HEPA filters. It should be considered as guidance information only.

Handling at interchange stations should be controlled to prevent temporary storage in conditions that would subject the filters to dampness, excessive heat or cold or rapidly changing temperatures. Proper attention to orientation of the cartons should be maintained consistent with the filter package instruction. Another control is to require that the filters be packed properly in a scaled truck trailer body or in a sealed containerized freight unit, not to be opened until arrival at the specified delivery point. Unloading should be performed by personnel who have been thoroughly instructed in the proper care and handling of HEPA filters. Mixed load shipments should be avoided.

7.6.8 The following information, taken from the content of Appendix A of Reference 2.5.1, is provided for those receiving and unloading HEPA filters. It should be considered as guidance information only.

As the shipment is being unloaded, each carton should be inspected for external damage and improper positioning in the cargo space (i.e., the carton placed with arrow direction horizontally). Damaged cartons, including those with corners dented and those improperly oriented in the truck, should be set aside for particularly careful inspection of their contents. Damage will be more prevalent when filter units are loaded with mixed cargoes or are shipped in a partially loaded carrier. The filter unit must be removed carefully from its carton. The acceptable method for removal is to open the top flaps of the container after removing the sealing tape. With flaps folded back, the carton should be inverted or upended gently to place the exposed end of the filter unit on a flat surface, preferably the floor. The surface must be clear of

protrusions. Withdraw the carton from the filter unit. Attempts to remove the filter unit from the carton by grasping below the exposed filter case can result in irreparable damage if fingers puncture the delicate filter materials.

If conflicting handling instructions are provided by the filter manufacturer, the manufacturer's instructions shall prevail.

### 7.7 Storage

HEPA Filters shall be stored in a controlled environment consistent with Level B as identified in ASME AG-1 Article FK-7000 and as described in DOE-HDBK-1169-2003, Section A.4.

### 7.8 Shipping of Metal Medium HEPA Filters

Additional non-mandatory shipment information for Metal Medium HEPA Filters is provided in Appendix B.

### 7.9 Shipping of High Strength HEPA Filters

Additional non-mandatory shipment information for High Strength HEPA Filters is provided in Appendix C.

# 8 Quality Assurance

### 8.1 Supplier Quality Assurance Program

8.1.1 The supplier shall have in place a Quality Assurance program meeting the requirements of ASME NQA-1-1989 marked as applicable in the Supplier Quality Assurance Program Requirements Datasheet attached to the Material Requisition. The Supplier shall submit his Quality Assurance Manual with the Supplier's bid documentation.

8.1.2 The successful bidder must pass a pre-award survey by the Buyer. Supplier shall demonstrate that their quality program is in compliance with the procurement quality requirements listed in the Supplier Quality Assurance Program Requirements Datasheet. The Supplier's Quality Assurance Program, reviewed and accepted by the Buyer, shall apply to every sub-tier supplier to the Supplier. The Supplier shall allow Bechtel, its agent, and DOE access to their or any sub-tier supplier's, facility, and records pertaining to the purchase order for the purpose of Quality Assurance Audits and Surveillance at mutually agreed times.

8.1.3 All items shall be manufactured in accordance with the Supplier's Quality Assurance program that meets the requirements of ASME NQA-1-1989, and has been previously evaluated and accepted by the Buyer's Quality Assurance Organization.

8.1.4 Supplier shall submit their Quality Assurance program and work plan to Buyer for approval and permission to proceed prior to commencement of work. The work plan shall include documents and procedures to implement the work and include a matrix of essential Quality Assurance elements cross referenced with the documents/procedures.

## 8.2 Quality Assurance Requirements Specific to Item

8.2.1 Rejected Filters. The Buyer shall notify the Supplier of rejected filters, including the nature of the rejection. Unless otherwise negotiated between the Supplier and Buyer, the Supplier shall provide replacement filters until the stipulated quantity of filters is found acceptable. The Supplier shall provide, at the discretion of the Buyer, replacement filters or credit for any rejected filters.

8.2.2 The Buyer may elect to have qualification testing or verification of materials performed on any filters furnished to them. Failure of any filter submitted for qualification testing to meet specification requirements shall be cause for a reevaluation of the Supplier's quality assurance program.

8.2.3 Qualification Test Evidence. The Supplier shall show documented evidence that qualification tests have been conducted in accordance with ASME AG-1 Article FK-5100, except the resistance to pressure test in FK-5140 shall be replaced with the liquid flow test, and Mandatory Appendix FC-I or equivalent.

8.2.4 Identification of Items with Part Number/Model Number. All filters and filter packages shall be identified with the serial number and model number. Identification shall be in conformance with sections 7.2 and 7.3 of this specification.

**Note:** The following specification items are necessary to satisfy Bechtel Buyer G-321-V Form submittal requirements.

8.2.5 Quality Verification Documents shall be submitted in the form and quantities shown on Form G-321-V, Quality Verification Document Requirements of the procurement package.

8.2.6 Certificate of Conformance. Each shipment shall be accompanied by one copy of the Supplier's Certificate of Conformance, which meets or exceeds the requirements of ASME AG-1, Article FK-8200. The Certificate of Conformance shall include copies of all filter case material certifications.

The Supplier/Manufacturer shall provide documentation that is legible and reproducible. Supplier's/Manufacturer's authorized representative responsible for quality shall sign the Certificate of Conformance. The Certificate of Conformance shall indicate the appropriate Purchase Order/Contract Order number under which the material, equipment, item, or service is being supplied.

8.2.7 Identification of Items with Product Datasheet. The supplier shall submit a legible copy of the product datasheet (e.g., drawing, catalog page, brochure) that provides adequate information to enable the Buyer to verify the form and function of the item procured. One copy of the documentation, unless otherwise specified, shall accompany the applicable item(s) shipped.

8.2.8 Production Inspection and Test Report. The Supplier shall submit legible, reproducible copies of the production test results and Section 6.1 of this specification. The report(s) shall include the following:

- Identification of the applicable inspection and/or test procedure utilized.
- Resulting data for all characteristics evaluated, as required by the governing inspection/test procedure.
- Traceability to the item inspected/tested, (i.e., serial number, part number, etc.).
- Signature of the Supplier's authorized representative or agency that performed the inspections/tests.
- One copy of the documentation, unless otherwise specified, shall accompany the applicable item(s) shipped.

8.2.9 Filter Test Facility (FTF) Inspection and Test Report. A report or datasheet prepared by FTF personnel for each order. Minimum content requirements for this report are contained in Reference 2.2.2. Also, refer to Section 6.3.2 and 6.3.3 of this specification.

## 8.3 Substitutions

8.3.1 Supplier shall be required to identify and promptly document all deviations from the requirements of the procuring documents. In addition, the Supplier shall be required to describe the recommended disposition based on appropriate analysis. Submittals of request for deviations from lower tier suppliers shall be through the prime supplier to the Buyer.

8.3.2 Supplier proposed deviations from procurement documents shall be initiated by use of the Supplier Deviation Disposition Request (SDDR) form attached to the Material Requisition.

8.3.3 As required in ASME AG-1 Article FK-5100, new or revised filter designs shall require qualification testing prior to acceptance and production. Furthermore, FK-3220 states that alternative materials found acceptable by the qualification tests of FK-5000, and the design requirements of FK-4000 and Article AA, will be acceptable for fabrication of HEPA filters. It is the responsibility of the Supplier to inform the Buyer when Buyer selected designs and/or materials deviate from these two requirements of ASME AG-1.

### 8.4 Quality Assurance Requirements for Metal Medium HEPA Filters

Additional non-mandatory quality assurance information for Metal Medium HEPA Filters is provided in Appendix B.

### 8.5 Quality Assurance Requirements for High Strength HEPA Filters

Additional non-mandatory quality assurance information for High Strength HEPA Filters is provided in Appendix C.

# 9 Configuration Management

Each HEPA Filter shall be tagged in accordance with Section 7.2 of this specification.

# 10 Documentation and Submittals

### 10.1 General

Supplier shall submit to Buyer Engineering and Quality Verification documents in the forms and quantities shown in Form G-321-E, Engineering Document Requirements, and Form G-321-V, Quality Verification Document Requirements, attached to the Material Requisition.

### 10.2 Submittals

Submittals for HEPA Filters shall include:

10.2.1 Product catalog datasheets with product description, service application, and limitations for all components.

10.2.2 Materials of construction for all components.

10.2.3 Pressure drop performance curves indicating PRESSURE DROP (Inch WC) versus FLOWRATE (ACFM).

10.2.4 HEPA filter maximum allowable pressure drop.

10.2.5 Recommended HEPA filter maximum shelf life and basis for this information.

10.2.6 Gasket material radiation tolerance.

10.2.7 Weight.

10.2.8 Filter dimensions.

10.2.9 Material Safety Datasheets.

10.2.10 Manufacturers Certificate of Conformance covering the ASME, ASTM, or other material specification, grade, class, (as applicable) for each material used in the filter designs.

10.2.11 Design Qualification Test Report prepared to support qualification of filter designs in accordance with ASME AG-1 Article FK-5100 and system specific WTP Project HEPA Filter Datasheets. Provide a Certificate of Conformance with this test report that summarizes Section FK conformance status of the filter designs. Reference ASME AG-1 Article FK-8200.

10.2.12 Objective evidence acceptable to the Buyer that the requirements of ASME AG-1 Mandatory Appendix FC-I, Articles I-3000 and I-5000, have been satisfied. Otherwise, the Supplier shall provide objective evidence acceptable to the Buyer that an alternative filter medium meets or exceeds these requirements.

10.2.13 Copies of the ASME AG-1, FK-5600 Production Test results.

10.2.14 Filter Inspection Record and Packaging Certificate to satisfy ASME AG-1 Articles FK-6300 and FK-5500.

10.2.15 Objective evidence, in the form of a test report, acceptable to the Buyer that the seal between the filter and filter housing knife edge is suitable for a pressure differential range of 1 inch WC to 200 inches WC.

## 10.3 Drawings

10.3.1 All drawings shall be submitted as CAD drawings in MicroStation, or MicroStation convertible format.

10.3.2 Drawings showing the following information shall be submitted to Buyer for review prior to fabrication:

10.3.2.1 The outline dimensions of the HEPA Filter, including outline and detail drawings for each component.

10.3.2.2 Details of construction and fabrication drawings including fabrication tolerances.

10.3.2.3 The weight of individual components.

10.3.2.4 The ASTM or equivalent designation for materials.

## 10.4 Procedures

Procedures to be submitted shall include:

10.4.1 Test procedures to support FK-5100 Qualification and FK-5600 Production Testing.

10.4.2 Test procedures or work plans to demonstrate compliance with system specific WTP Project HEPA Filter Datasheets.

10.4.3 Supplier's filter inspection, packaging, and shipping preparation procedure(s) as required to meet the intent of ASME AG-1 Articles FK-5500, FK-6300, and FK-7000.

10.4.4 Supplier recommendations (e.g., procedure) for receiving inspection and storage.

## 10.5 Calculations

Calculations to be submitted shall include applicable engineering data, calculations, and performance charts that demonstrate compliance with this Specification.

## 10.6 Manuals

Manuals and instructions to be submitted shall include a copy of the Supplier's Quality Assurance Manual.

## 10.7 Certificates of Conformance

10.7.1 The Supplier shall provide Certificates of Conformance complying with ASME AG-1 FK-8200. The following clarifications apply:

10.7.1.1 In regard to conflicts between the Supplier's design and ASME AG-1 Sections FK, the Supplier shall identify the respective code articles that do not apply. This may be accomplished by direct reference on the Certificate of Conformance to Buyer accepted submittal drawings or Supplier Deviation Disposition Request(s).

10.7.1.2 Copies of all filter case material certifications shall be provided. These certifications shall state all applicable material standards with year or edition to permit compliance assessment with Article FK-2000.

10.7.2 Furnish UL-586 certificate to meet evidence requirement of Article FK-5160.

10.7.3 The Supplier shall provide a Certificate of Conformance with objective evidence that the materials used for the selected glass fiber medium, or reinforced glass fiber medium, or steel fiber medium for Type I Safe Change and Remote HEPA Filters conform to:

10.7.3.1 ASME AG-1, Mandatory Appendix FC-I, Filter Media: Fire Resistance, High Efficiency.

10.7.3.2 The chemical constituents identified in Appendix D.

10.7.3.3 The chemical constituents identified on the current revisions of the HEPA Filter Data Sheets.

10.7.3.4 Objective evidence shall include, but not be limited to, documentation of chemical resistance and/or chemical reactivity of filter medium to the above identified constituents with specific emphasis on those constituents that are particularly aggressive to glass fiber medium, or reinforced glass fiber medium, or steel fiber medium.

## 10.8 Schedules

Lists and schedules shall include schedule of engineering, material purchase, and fabrication. Lists and schedules shall be submitted to the Buyer's Expediter.

## 10.9 Materials Certificates and Statistics

Reference Section 10.7 of this Specification.

## 10.10 Data

10.10.1 The Supplier shall provide HEPA Filter performance datasheets or design drawings that include the following data.

10.10.1.1 Name of manufacturer, make, model number

10.10.1.2 Filter medium area

10.10.1.3 Pleat depth, pleat length

10.10.1.4 Capacity, initial resistance, temperature rating

10.10.1.5 Dimensions with fabrication tolerances

10.10.1.6 Seal diameter

10.10.1.7 Weight

10.10.1.8 Materials of construction

10.10.1.9 Sealant type

10.10.1.10 Gasket materials

# Appendix A:

# HEPA Filter Datasheet Template

| **Quality Level Q (no exceptions)** | | |
|---|---|---|
| RPP-WTP Facility & System:<br><br>**Facility / System**<br><br>ASME AG-1, Section FK Filter Type 1<br><br>Safe or Remote Change :<br><br>Filter Housing Quantity:<br>Filter Quantity:<br><br>Safety Classification:<br>Seismic Category: | Generic (RPP-WTP) Spare Part? | ☐ Yes<br>☐ No |
| | Dedicated Facility Spare Part? | ☐ Yes<br>☐ No |
| | Potential for Wetting? | ☐ Yes<br>☐ No |
| | Potential for Corrosive Atmosphere? | ☐ Yes<br>☐ No |
| | Potential exposure to $HNO_3$ | ☐ Yes<br>☐ No |
| | Potential exposure to caustic materials | ☐ Yes<br>☐ No |
| | Potential exposure to HF | ☐ Yes<br>☐ No |
| | Potential exposure to NOX | ☐ Yes<br>☐ No |
| | Potential for High Temperature (>200°F) | ☐ Yes<br>☐ No |
| Recommended Manufacturer: **Flanders**<br>Manufacturer's part number (as furnished): * | | |
| **Performance Requirements** | | |
| **Temperature** | Normal minimum °F (°C): ___ Normal Maximum °F (°C): ___ | |
| | Abnormal maximum Operating °F (°C):___<br>Maximum DBE °F (°C) ___ | |
| **System Airflow Rate** | **Normal minimum** design flow: | |
| | **Normal maximum** design flow: | |
| | **DBE**: N/A: | |
| **Relative Humidity** | | |
| RH corresponding to normal minimum temperature | ___% | |
| RH corresponding to normal maximum temperature | ___% | |
| RH corresponding to abnormal maximum temperature | ___% | |
| RH corresponding to DBE maximum temperature | ___% | |

| | |
|---|---|
| **Chemical Exposure** (Concentration data for corrosive environments) | Normal operating condition:<br>Upset condition & duration: |
| **Filter medium** | |
| **Systems Max Static Pressure (Inches WC)** | |
| **Particulate Load (grams)** | |
| **Pressure Spikes** | |
| **Structural Capability** | |
| **Radiation** | |
| **Biological Exposure** | |

**Datasheet Referenced Notes:**

**General Notes:**

**Additional Instructions:**

- Vendor to fill in data fields marked with (*) asterisk

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 0 | | Issued for Purchase | | | | | |
| **Rev** | **Date** | **Purpose** | **Originator/System Engineer** | **Checked** | **EQ** | **E&NS** | **Approved** |

# Appendix B:

# Metal Medium HEPA Filters

## B-1 Scope

B-1.1 SCOPE. This non-mandatory appendix provides information for the materials, design, inspection, fabrication, packing, shipping, storage, and quality assurance of metal medium Type 1 radial flow High Efficiency Particulate Air (HEPA) filters used in nuclear safety and process related air and gas treatment systems in nuclear facilities. This information supplements the main body of this specification. This appendix describes metal medium HEPA filters for use in the WTP Remote Change HEPA Filter Housings.

B-1.2 PURPOSE. The purpose of this non-mandatory appendix is to assure that filters of metal filter medium used in nuclear air and gas treatment systems are acceptable in all aspects of materials, design, inspection, fabrication, packing, shipping, storage, and quality assurance.

B-1.3 APPLICABILITY. This non-mandatory appendix applies to metal medium HEPA filters that have application in a radioactive environment with HEPA filter efficiency. This specification applies to metal medium HEPA filters with the following fabrication:

B-1.3.1 Filters in which the sealing between metal filter medium and is accomplished by the use of urethane potting compound.

B-1.3.2 Manufactured using the filter medium materials in Section B-9, Metal HEPA Filter Medium.

B-1.3.3 Wherein the urethane potting compound used is suitable for air streams at temperatures up to 250°F.

B-1.4 DEFINITIONS AND TERMS

B-1.4.1 Metal Filter Medium. The metallic porous particle removing material made from sintered fibers or powders. For a given filter this may be a homogeneous material or combination of materials.

B-1.4.2 Metal medium HEPA filter. A device having one filter element formed from metal filter medium assembled in an ASME AG-1 Section FK Type 1 radial flow HEPA filter configuration for removing suspended particles from air or gas that is passed through the metal filter medium.

B-1.4.3 High Efficiency Particulate Air (HEPA) Filter. A filter having a minimum efficiency of 99.97% when tested with an aerosol of essentially

monodispersed 0.3 micrometer dioctyl phthalate (DOP), dioctyl sebacate (DOS), or equivalent aerosol particles.

B-1.4.4 Penetrometer. A device for generating essentially mono-disperse 0.3 micrometer DOP or DOS or equivalent aerosol particles for evaluating the aerosol penetration and air resistance of fabricated metal HEPA filters. The Q76, Q107, and Q127 penetrometers are examples of suitable penetrometers.

B-1.4.5 Test Aerosol. Dispersion of particles in air containing a sufficient quantity of the most penetrating particle size based upon the filter medium structure, the air velocity, and the particle composition, as described in IEST-RP-CC007.1. For metal medium HEPA filters, the test aerosol is 0.3 micrometer DOP or DOS or equivalent aerosol.

# B-2 Materials

B-2.1 ALLOWABLE MATERIALS. Materials shall conform to the material specifications listed in ASME AG-1, Article FK-3110.

B-2.1.1 CASE MATERIALS. The case shall be made from stainless steel Type 409, 304, 304L, 316, or 316L per ASTM A 240. Material thicknesses shall be sufficient to meet the performance requirements in this specification (e.g., test aerosol penetration, resistance to airflow, seismic qualification, qualification testing, resistance to rough handling, resistance to pressure, resistance to heated air, spot flam resistance, and certificate of conformance).

B-2.1.2 GELATINOUS SEAL. Gelatinous seals shall be self-adhesive and self-healing cured gel seals made of poly-di-methyl-siloxane.

B-2.1.3 FILTER MEDIUM. The filter medium of metal medium HEPA filters shall conform to the requirements of SECTION B-9, Metal HEPA Filter Medium.

B-2.1.4 GRILLES. Metal medium radial HEPA filters shall be fitted with internal and external perforated grilles or flattened expanded metal grilles as shown in ASME AG-1, Figure FK-4100-2 and FK-4100-4. Flattened expanded metal grilles shall conform to ASTM F1267 fabricated from the materials indicated in ASME AG-1, Article FK-3110. Grilles shall be 18 gauge (minimum).

B-2.1.5 ADHESIVES. Adhesives used to seal the metal filter medium to the hardware forming the filter element to the case shall be self-extinguishing when cured after direct contact with an open flame, as evidenced by testing in accordance with the spot flame test or UL-586. Adhesives may limit operating conditions for metal medium HEPA filters. Employment of adhesive material shall be accompanied by a statement of use restrictions.

B-2.2 GENERAL MATERIAL REQUIREMENTS. All materials used shall have properties and composition suitable for the application as defined by WTP Project HEPA Filter Datasheets. The general material requirements of ASME AG-1, Article FK-3200 shall apply.

# B-3 Design

B-3.1 GENERAL DESIGN. The assembled metal medium HEPA filters shall be designed to be installed in the current design of the WTP Remote Change HEPA Filter Housing, including overall dimensions and interfaces (e.g., gelatinous seal and lifting grapple).

B-3.2 METAL MEDIUM HEPA FILTERS. Metal medium HEPA filters shall be constructed to designs prepared by the Supplier in sufficient detail to provide a complete basis for manufacture in accordance with operating parameters set forth in the WTP Project HEPA Filter Datasheets.

B-3.3 METAL FILTER MEDIUM

B-3.3.1 Metal filter medium covered by this section is available in various combinations of sintered metal powder, sintered metal fiber and integral wire mesh. Each type of filter medium has characteristic operating parameters, particularly pressure drop for a given filter medium velocity. Each category of filter medium can be fabricated from a variety of alloys. The filter medium can be selected for physical and chemical durability along with operating characteristics.

B-3.3.2 The metal filter medium shall conform to Section B-9, Metal HEPA Filter Medium.

B-3.3.3 Only the Supplier of the metal filter medium may correct defects in the metal filter medium as identified in Workmanship, Section B-9.8. Corrected or repaired defects shall not exceed 0.0625 inches in diameter. Correction or repairs shall be performed prior to any filter element fabrication steps, and shall be performed as follows:

B-3.3.3.2 Defects shall be corrected using materials exhibiting the same applicability as the potting compound employed.

B-3.3.3.3 Corrections and repairs to the filter medium shall be verified by testing the assembled filter element containing the corrected filter medium using Test Aerosol Penetration, Section B-3.6 and the appropriate test method.

B-3.4 SPLICES. Any side seams shall be either all metal heat bonded or sealed using adhesives exhibiting the same applicability as the potting compound employed. No splices or

patches in the filter media pack are allowed. Joining of the two ends in a radial flow filter pack is acceptable.

B-3.5 PERFORMANCE REQUIREMENTS. Designs shall be qualified in accordance with Section B-4.

B-3.6 TEST AEROSOL PENETRATION. The total test aerosol penetration through the filter medium, housing, and gasket shall be not greater than 0.03% of upstream concentration when tested at rated airflow accordance with Test Aerosol Penetration, Section B-4.3.

B-3.7 RESISTANCE TO AIRFLOW. The resistance to airflow at the rated airflow of the clean filter shall not exceed 3.0 inches WC, when tested in accordance with Resistance to Airflow, Section B-4.2. Maximum rated airflow shall be as defined in Section 3.1.1 or as specified by Buyer.

B-3.8 GELATINOUS SEAL. The gelatinous seal shall be designed in accordance with ASME AG-1, Article FK-4142.

B-3.9 GRILLES. Metal medium radial flow HEPA filters shall be fitted with internal and external support grilles around the filter media per Section B-2.5.

# B-4 Inspection and Testing

B-4.1 QUALIFICATION TESTING

B-4.1.1 The assembled metal medium HEPA filter shall require qualification testing prior to acceptance and production. The assembled filter design shall be re-qualified at least every 5 years. Tests shall be performed and certified by an independent test facility or at a Supplier's facility under oversight of a suitably qualified independent entity. A summary report shall be prepared by the independent entity. A copy of this report shall be maintained by the Supplier for inspection by the Buyer. The qualification samples shall be tested against all the requirements herein.

B-4.1.2 Qualification of Metal Medium HEPA Filters.

B-4.1.3 All test filters shall be manufactured using the same methods, materials, equipment, and processes as will be used during production.

B-4.1.4 The filters submitted for qualification testing will also be considered to be representative of filters of the same manufacture processes and materials if the following conditions are met:

B-4.1.4.1 They are of the same design.

B-4.1.4.2 They are manufactured in the same manner.

B-4.1.4.3 They are manufactured using the same filter medium.

B-4.1.4.4 They will be subjected to the same range of differential pressures.

B-4.1.4.5 They have an element diameter considered equivalent to the filter elements being represented.

B-4.1.5 Metal medium HEPA filters shall be tested in accordance with the sequence detailed in Table B-1.

B-4.1.6 The filters used in the qualification sample shall be run sequentially through the tests in the order given in Table B-1.

B-4.1.6.1 If the Supplier intends to deliver filters with a seam in the filter medium, both of the qualification samples shall contain a seam.

B-4.1.6.2 Each filter in the qualification sample shall be visually examined for defects.

B-4.1.7 The qualification samples shall be tested for all the requirements of this specification. Failure of any filter to comply with the requirements of this section shall be cause for the rejection of the qualification sample.

**Table B-1 Qualification Test Sequence for Metal Medium HEPA Filters**

| Requirement | Test Paragraph |
|---|---|
| Resistance to rated airflow | Section B-4.2 |
| Test aerosol penetration at rate airflow and at 5% of rated airflow | Section B-4.3 |
| Resistance to rough handling | Section B-4.4 |
| Resistance to heated air | Section B-4.6 |
| Resistance to pressure | Section B-4.5 |
| Resistance to rated airflow | Section B-4.2 |
| Test aerosol penetration at rated airflow | Section B-4.3 |
| Resistance to spot flame | Section B-4.7 |
| NOTE: Two Filters shall be tested sequentially as described in Qualification Testing, Section B-4.1. | |

B-4.2 RESISTANCE TO AIRFLOW. The resistance to airflow of the clean filter shall meet the requirements of Section B-3.7 when tested in accordance with Test Aerosol Penetration, Section B-4.3.

B-4.3 TEST AEROSOL PENETRATION.

B-4.3.1 The resistance to airflow and test aerosol penetration shall be determined by MIL-STD-282 for efficiencies between 99.97% - 99.99% at particle aerosol diameter of 0.3 micrometer.

B-4.3.2 Modifications to the listed test methods may be required for metal medium HEPA filters having high pressure drops. For example any unit operated and tested at filter medium velocities sufficient to produce pressure drops in excess of 10 inches WC. The increase, if any, in filter pressure drop during the test shall be less than 5% of the initial pressure drop for the filter design to be accepted.

B-4.3.3 For HEPA filters, the total test aerosol penetration through the filter for 0.3 micrometer aerosols shall be no greater than 0.03% of upstream concentration at rated airflow and at 5% of rated airflow.

B-4.4 RESISTANCE TO ROUGH HANDLING.

B-4.4.1 The metal medium HEPA filters shall be tested on a rough handling machine for 15 minutes at 3/4 inches total amplitude at 200 cycles per minute in accordance with Test Method 105.10 of MIL-STD-282.

B-4.4.2 The metal medium HEPA filter shall be placed on the machine in the orientation designated for shipment.

B-4.4.3 At the conclusion of the shaking period, the filter shall be visually examined for damage.

B-4.4.4 Cause for rejection shall include cracked or warped housings, cracked or warped filter medium, or cracked welds. Critical areas for inspection include end cap welds, seam welds and, for pleated elements, pleat edge cracks. After the rough handling test, the same filter shall meet the requirements of Resistance to Airflow, Section B-4.2 and Test Aerosol Penetration, Section B-4.3.

B-4.5 RESISTANCE TO PRESSURE.

All filter test requirements will be detailed in the High Efficiency Particulate Air (HEPA) Filter Test Plan, 24590-WTP-RPT-ENG-12-047. The specific test protocol for the new high-strength filters (both reinforced glass fiber medium and steel fiber medium) will be the particle loading tests at the subcontracted filter test facility up to 50 inches WC. The particle loading tests will be followed by a high pressure liquid flow test with an added pressure equal to the maximum static pressure under which a WTP HEPA filter can operate. After the high pressure liquid flow test, the filter will be dried and tested for efficiency and pressure differential at rated flow and twenty percent (20%) of rated flow. The high pressure liquid flow test is analogous to the ASME AG-1 wet over-pressure test.

B-4.6 RESISTANCE TO HEATED AIR

B-4.6.1 For resistance to heated air, the metal medium HEPA filter shall be subjected to the rated flow of air heated sufficiently such that the filter exhaust air

temperature has reached the rated maximum temperature 250°F ±10°F designated for the filter for no less than 60 minutes.

B-4.6.2 The heated air test is conducted with air exiting the filter being released at ambient pressure. Thermocouples are used to measure the uniformity of the temperature across the inlet to the filter. The physical size and mass of the unit to be tested will dictate equipment and methods required to conduct testing. The filter shall be wrapped in insulation to minimize the heat loss.

B-4.6.3 Following exposure, the filters shall meet the requirements in Resistance to Airflow, Section B-4.2 and Test Aerosol Penetration, Section B-4.3.

## B-4.7 SPOT FLAME RESISTANCE

B-4.7.1 The metal medium HEPA filter shall be mounted in the test duct and the airflow adjusted to rated airflow. The filter housing shall be removed in this test to allow access to the filter medium. A gas flame from a Bunsen burner shall be directed against the upstream face of the unit.

B-4.7.2 The Bunsen burner shall be adjusted to produce a flame with a blue cone 2.5 inches long with a tip temperature of 1750°F ±50°F, as measured by a thermocouple inserted in the flame. The tip of the cone shall be so applied that it touches the surface of the filter medium at a distance of not less than 2 inches from the filter case. The flame shall be applied for 5 minutes at each of three separate locations on the filter face.

B-4.7.3 Testing of filter elements having seams shall be conducted with the Bunsen burner flame directed onto a portion of a seam in such a manner that the tip of the blue cone contacts the seam and sealing material. The flame shall be applied for a period of 5 minutes. The test shall be repeated upon in a similar fashion where the filter medium is joined to the coupling device at the top of the element. After removal of the test flame at each point of application, there shall be no sustained flaming on the downstream face of the unit.

B-4.7.4 An Underwriters' Laboratories (UL-586) label shall be acceptable objective evidence of compliance with Structural Requirements, Section B-4.8.

## B-4.8 STRUCTURAL AND SEISMIC QUALIFICATION REQUIREMENTS.

B-4.8.1 Each filter or filter component in the sample shall be evaluated for structural integrity. Each filter or filter component shall satisfy that no structural damage shall be evident by visual examination. Airflow resistance and aerosol penetration requirements of Resistance to Airflow, Section B-4.2 and Test Aerosol Penetration, Section B-4.3.shall be met.

B-4.8.2 In the case of Remote Change metal medium HEPA filters, the filter shall be qualified to withstand grapple loads by testing.

B-4.8.3 The metal medium HEPA filters shall be seismically qualified by test in accordance with ASME AG-1, Article FK-4300.

B-4.9 FILTER INSPECTION. Each filter shall be visually inspected to show conformance to size specification, and inspection to verify that the sticker indicates it has been tested and meets the flow rate, penetration, and resistance specification. Additional attributes to be inspected are length, width, concentricity, adherence of gelatinous seal, and proper channel fill with gel to tolerances as shown on WTP design drawings in Section 2.4. The filter medium shall be inspected to ensure that there are no holes, splices, or patches (for exception see Section B-3.4, Splices).

B-4.10 PRODUCTION TESTING. Each filter manufactured for delivery shall be tested for test aerosol penetration and resistance to airflow in accordance with Resistance to Airflow, Section B-4.2 and Test Aerosol Penetration, Section B-4.3. The results of these tests and the test method shall be marked on the label of each filter.

# B-5 Fabrication

B-5.1 GENERAL REQUIREMENTS. The metal medium HEPA filter shall be assembled from the materials designated in the Materials, Section B-2 in strict accordance with the design requirements established in the Design, Section B-3. Following assembly, the filter shall be inspected and qualified in accordance with Inspection and Testing, Section B-4. Production filters shall conform to Inspection, Section B-4.9.

B-5.2 FABRICATION AND ASSEMBLY. The general requirements for fabrication, installation and repair are contained in ASME AG-1, Article AA-6000.

B-5.3 TOLERANCES. Tolerances shall be as indicated in ASME AG-1, Section FK, unless otherwise stated on supplier design drawings accepted by the Buyer, and except as modified per Section 5.1.1 of this specification.

B-5.4 WORKMANSHIP. The assembled metal medium HEPA filter shall be free from foreign matter (dirt, oil, or viscous material) and damage, such as distorted or cracked case, deformation, or sagging of the filter medium, separators and faceguards, cracks in adhesive, and cracks, or holes in exposed portions of the filter medium. All required fasteners shall be securely installed. All the dimensional and performance requirements of this specification shall be directed toward achieving the highest quality and workmanship possible.

# B-6 Packaging, Shipping, and Storage

B-6.1 Packaging, shipping, and storage shall be in accordance with ASME AG-1 Article AA-7000 and ANSI/ASME NQA-1 Level B. Metal medium HEPA filters shall be individually packaged. Cartons shall have extra shock absorbing material at the corners of the filter that centers the filter within the carton to prevent damage.

B-6.2 Filters shall be placed in the carton with the pleats vertical. The carton should be placed on skids or otherwise packed in such a manner that the pleats remain vertical during shipment.

B-6.3 The metal medium HEPA filters with gelatinous seals shall be packaged in a manner to prevent the gelatinous compound from sticking to the packaging material. A means shall be provided to prevent the gelatinous seal from being gouged or pulled out of the continuous channel when the filter is removed from the shipping carton or plastic bag.

B-6.4 The carton shall be clearly marked for proper orientation.

# B-7 Quality Assurance

Quality Assurance shall conform to the requirements of ASME AG-1, Article AA-8000 and the following:

B-7.1 RESPONSIBILITY. The Supplier has the responsibility of providing all specified information and of assuring that the quality control, and detailed examination and tests required by this specification, are performed at the stages of construction necessary to permit them to be meaningful.

B-7.2 CERTIFICATE OF CONFORMANCE. The Certificate of Conformance shall state that the metal medium HEPA filters conform to this specification.

# B-8 Nameplates

B-8.1 FILTER MARKING. Marking or labeling of each metal medium HEPA filter shall be on the top of the filter when the pleats are vertical, of such size and legibility that it can be read at a distance of 3 feet. As a minimum, the following information shall be provided:

(a) Supplier's name or symbol
(b) Model number
(c) Serial number
(d) Rated flow capacity
(e) Direction of airflow for penetration and pressure drop tests, no less than 6 inches high
(f) Pressure drop, in inches of water at one hundred percent (100%) rated flow
(g) Overall penetration at rated flow
(h) Overall penetration at five percent (5%) of rated flow
(i) UL label indicating successful testing per UL-586 if UL-586 if applicable

B-8.2 PACKAGE MARKING. Marking or labeling of each shipping container (carton containing one metal medium HEPA filter) shall be of such size and type that it can be read at a distance of 6-feet. As a minimum, the following information shall be provided:

(a) Supplier's name or symbol

(b) Arrows and "THIS SIDE UP" indicating orientation for shipping and storage and "FRAGILE" in letters no less than 6 inches high.

(c) Filter model number

(d) Purchase order number or other identifying mark requested by Buyer.

# B-9 Metal HEPA Filter Medium

B-9.1 SCOPE. This specification section establishes requirements for the manufacture of high efficiency, fire resistant, metal filter medium for use in the construction of HEPA filters.

B-9.2 REQUIREMENTS. In order to ensure continuous, high efficiency particle removal during filter service, the inspection and testing of a metal HEPA filter medium shall include requirements for the strength and other performance criteria of the filter medium.

B-9.3 FORM AND SIZE

B-9.3.1 FORM. The metal filter medium for a given filter construction may be furnished flat or as recommended by the Supplier.

B-9.3.2 SIZE. The dimensions of the sheet filter medium shall be recommended by the Supplier and approved by the Buyer.

B-9.3.3 SPLICES. For fabricating filters, splices in sheet filter medium shall be by welding, or brazing, or other all metal heat bonding techniques, or by sealing using adhesives exhibiting the same characteristics in service as the potting compound to be employed.

B-9.4 METAL FILTER MEDIUM COMPOSITION

B-9.4.1 The metal filter medium can be manufactured by the sintering of metal powders or fibers or a combination. It is recognized that:

B-9.4.1.1 The properties and performance characteristics of this type of metal filter medium differ significantly and can represent a selection advantage for different applications.

B-9.4.1.2 Various metal compositions can be used in the manufacture of metal filter medium providing an additional dimension of options for corrosion resistance and durability.

B-9.4.2 The Supplier shall recommend and justify the type of filter medium to be used and its metallic composition. The Supplier shall coordinate their recommended filter medium selection with the Buyer. The Supplier shall submit their recommended filter medium selection and justification to the

Buyer for approval. Table B-2 below provides a representative listing of metals that are commonly used in the manufacture of metal filter medium. This listing is not intended to be comprehensive since new alloys continue to be developed and specialty filter medium can be manufactured from uncommon metals.

| **Table B-2 Metal Filter Medium - Representative Materials of Construction** | | |
|---|---|---|
| 304 Stainless Steel | 316L Stainless Steel | FeCr Alloy |
| Haynes HR-120 Alloy | Hastelloy C-22 | Inconel 601 |
| Monel 400 | Nickel 200 | UNS NO6059 |

B-9.5 AIRFLOW RESISTANCE. The pressure drop across the metal filter medium shall meet the requirements of Section B-3.7.

B-9.6 TEST AEROSOL PENETRATION.

B-9.6.1 The penetration of the metal filter medium by DOP or DOS of 0.3 micrometer particle size shall not exceed 0.03%, as determined by comparing upstream with downstream aerosol concentration with the air and aerosol mixture having the flow specified in the Design, Section B-3, when tested as specified in Inspection and Testing, Section B-4 using a Q-127 or Q-76 penetrometer.

B-9.6.2 Aerosol penetration, when determined as stated in Test Aerosol Penetration, Section B-4.3, shall not exceed penetration values in Section B-4.3. Testing of pleated filter medium shall be accomplished using filter elements fabricated with representative folding patterns and final geometry. The penetration of the filter medium by the test aerosol shall not exceed the penetration values in Test Aerosol Penetration, Section B-9.6 after the filter medium is folded as required in Folding, Section B-9.7, when tested as specified in Airflow Resistance and Test Aerosol Penetration, Section B-9.11.1.

B-9.7 FOLDING CHARACTERISTICS. Metal filter medium to be pleated shall show no tears, breaks, or cracks when folded into the pleated configuration that will be employed in the final geometry of the filter element.

B-9.8 WORKMANSHIP. The metal filter medium shall be free from contamination (foreign matter), or damage, such as tears, cracks, holes, abrasions, corrosion, and punctures.

B-9.9 QUALITY ASSURANCE PROVISIONS

B-9.9.1 SUPPLIER'S RESPONSIBILITY. Unless otherwise specified, the Supplier is responsible for the performance of all inspection requirements as specified herein.

B-9.9.2 OBJECTIVE EVIDENCE. The supplier shall provide objective evidence acceptable to the Buyer that the requirements have been satisfied.

B-9.10 QUALIFICATION

B-9.10.1 SAMPLE. A qualification sample of sheet or tube filter medium sufficient to conduct the qualification tests in this section shall be manufactured using the same methods, materials, equipment and processes as will be used during regular production.

B-9.10.2 MATERIAL CHANGE. Any change in materials or source of materials after qualification shall require a requalification of a standardized qualification metal medium HEPA filter element composed of the new materials.

B-9.10.3 REVERIFICATION OF QUALIFICATION. The metal filter medium shall be re-qualified at least every five (5) years. Tests shall be performed and certified by an independent test facility.

B-9.11 TEST PROCEDURES

B-9.11.1 AIRFLOW RESISTANCE AND TEST AEROSOL PENETRATION. For flat metal filter medium, three test specimens with an exposed test area of 16 square inches shall be tested for airflow resistance and test aerosol penetration at a flow that corresponds to the rated flow of the unit to be assembled. Samples shall be processed by any heat treatment methods (annealing, etc.) representative of actual filter fabrication prior to testing.

B-9.11.2 WATER REPELLENCY. This test shall be required for the filter medium to be used in metal medium HEPA filters only. For flat metal filter medium, three test specimen rectangles 2.75 inches by 5.5 inches shall be conditioned and tested for water repellency using the Q101 Water Repellency Indicator. The two surfaces of each test specimen shall be identified as top and bottom. The specimen shall then be cut into two equal squares. The top surface of one square and the bottom surface of the other square shall be tested. The lesser of the two results shall be considered the water repellency of the specimen. The water pressure which results is a visible penetration shall be noted.

B-9.11.3 THICKNESS. The thickness of the metal filter medium shall be in accordance with TAPPI T411-OM-97 or Supplier's stated standards, where applicable.

B-9.11.4 BENDING CHARACTERISTICS FOR PLEATED METAL MEDIUM HEPA FILTERS:

B-9.11.4.1 EXAMINATION. Eight test specimens, cut 12 inches long and 6 inches wide, shall be bent 180 degrees around a 0.1875-inch wide mandrel. Four (4) specimens with the inlet side of the filter medium and four specimens with the exhaust side of the filter medium against the mandrel shall be bent. Examine the bent specimen for compliance with Metal HEPA Filter Medium, Folding Characteristics, Section B-9.7.

B-9.11.4.2 TEST. After examination the bent filter medium shall be unbent and the center of each test specimen containing the bend shall be tested for aerosol penetration in accordance with Metal HEPA Filter Medium, Test Procedures, Section B-9.11 for compliance with Metal HEPA Filter Medium, Folding Characteristics, Section B-9.7.

B-9.12 ACCEPTANCE OR REJECTION CRITERIA. If a sample fails when tested as specified in Section B-9.11, "Test Procedures", the lot represented shall be rejected.

B-9.13 QUALITY CONFORMANCE INSPECTION. Each batch of metal filter medium shall be examined for defects. Defects sufficient to require rejection include: abrasion marks, greater than 0.25 inches in diameter; cuts, holes, tears, punctures exceeding 0.0625 inches; thick or thin spots greater than 0.25 inches; burn holes, charring, or scorching; width plus (+) 0.25 inches out of specification; excessive number of splices; an excessive number of creases or fiber aggregates greater than 0.1875 inches; and excessive contamination (foreign matter) exceeding an area 0.15 inches by 0.25 inches.

B-9.14 PACKAGING AND SHIPPING

B-9.14.1 PACKAGING. Packaging shall conform to level B of ASME NQA-1 suitable for storage under level B of ASME NQA-1.

B-9.14.2 SHIPPING. Metal filter medium prepared for shipping shall bear packaging clearly identifying repair materials used and consistent filter types consistent with Namplates, Section B-8. This information shall be carried through in a manner consistent with Namplates, Section B-8 to the packaging of any finished goods prepared from said filter medium and shipped. Shipping of the filter medium shall be undertaken to assure the quality of the product upon arrival at the purchaser. Shipping containers shall comply with the rules and regulations applicable to the mode of transportation being utilized.

# Appendix C:

# High Strength HEPA Filters

## C-1 Scope

C-1.1 SCOPE. This non-mandatory appendix provides information for the performance, design, fabrication, inspection, acceptance testing, and quality assurance for high strength, Type 1 radial flow high efficiency particulate air (HEPA) filters used in air or gas treatment systems in nuclear facilities. This information supplements the main body of this specification. This appendix describes high strength HEPA filters for use in the WTP Remote Change HEPA Filter Housing or the WTP Safe Change HEPA Filter Housing.

C-1.2 PURPOSE. The purpose of this non-mandatory appendix is to ensure that high strength HEPA filters are acceptable in all aspects of design and operation.

C-1.3 APPLICABILITY. This non-mandatory appendix applies to extended medium, dry type, high strength filters for use in air and gas streams operating at no more than 250°F maximum continuous temperature. One type of high strength HEPA filter and two levels of filter pack strength and robustness are addressed in this section.

C-1.4 DEFINITIONS AND TERMS

C-1.4.1 High Strength HEPA Filter. A HEPA filter as qualified according to this section to have a significantly higher filter burst strength, than filters qualified to the performance requirements of ASME AG-1 Articles FC and FK. The higher strength results from an inherently greater ultimate tensile strength of the filter medium and enhanced filter pack robustness and stability. Definition does not include metal medium filters, which would also provide a higher filter burst strength but are treated separately in Appendix B.

C-1.4.2 High Strength HEPA Filter Medium. A non-metal HEPA filter medium qualified, according to this specification, to have a significantly higher ultimate tensile strength than a filter medium qualified to the performance requirements of ASME AG-1, Article FC, Appendix FC-I.

C-1.4.3 Filter Medium. The fiber matrix in a filter, which captures suspended particles from an air, or a gas stream. The plural form of "filter medium" is "filter media."

# C-2 Materials

## C-2.1 ALLOWABLE MATERIALS

C-2.1.1 CASE MATERIALS. The case shall be made from stainless steel Type 409, 304, 304L, 316, or 316L per ASTM A 240. Stainless steel sheet shall have minimum thickness equal to 0.0720 inches.

C-2.1.2 FASTENERS. Consideration should be given when selecting the proper filter fasteners serving seismic and other unusual requirements. Approved fasteners used for the assembly of high strength HEPA filter cases are listed below:

C-2.1.2.1 Stainless steel bolts, 300 series per ASTM A 320 or ASTM A 193

C-2.1.2.2 Stainless steel nuts, 300 series per ASTM A 194

C-2.1.2.3 Stainless steel lock washers, 300 series per ASME B18.21.1/ B18.21.1.2M

C-2.1.2.4 Stainless steel plain washers, 300 series per ASME B18.22.1/ B18.22M

C-2.1.2.5 Stainless steel rivets, 300 series per ASTM A 581

C-2.1.3 GELATINOUS SEAL. Gelatinous seals shall be self-adhesive and self-healing cured gel seals made of poly-di-methyl-siloxane.

C-2.1.4 FILTER MEDIUM. The filter medium shall conform to the requirements of High Strength HEPA Filter Medium in this specification.

C-2.1.5 GRILLES. High strength radial flow HEPA filters shall be fitted with internal and external perforated grilles or flattened expanded metal grilles as shown in ASME AG-I, Figure FK-4100-2 and FK-4100-4. Flattened expanded metal grilles shall conform to ASTM F1267 fabricated from the materials indicated in ASME AG-1, Article FK-3110. Grilles shall be 18 gauge (minimum).

C-2.1.6 ADHESIVES. Adhesives used to fasten gaskets to the filter case, and to seal the filter pack or faceguards to the case, shall be self-extinguishing.

C-2.1.7 SEPARATORS

C-2.1.7.1 If required, aluminum separators shall be made from corrugated aluminum, 0.0015 inch minimum thickness, conforming to ASTM B209, Alloy 5052 H338, 3003 H18, or 1100 H18 aluminum.

C-2.1.7.2 If required, acid resistant aluminum separators shall be made from corrugated aluminum, 0.0015 inch minimum thickness, conforming to ASTM B 209, Alloy 5052 H39, 3003 H19, or 1145

H19 aluminum coated on both surfaces with a vinyl-epoxy coating. The coating should be tinted to verify the coverage of the separator.

C-2.1.7.3 If required, stainless steel separators shall be made from corrugated stainless steel, 0.0012 inch minimum thickness, conforming to ASTM A 580 stainless steel.

C-2.1.8 COATING. Aluminum separators shall meet the following tests after application of the coating to the separator:

C-2.1.8.1 The coating shall meet or exceed an adhesion rating of 3A when tested using Method A (X Cut Tape Test) of ASTM D 3359. The X-cut specimen shall be inspected for removal of coating where the 3A adhesion rating equates to jagged removal along the X cut incision up to 1/16 inch.

C-2.1.8.2 Off-gas volatiles, as determined by thermo-gravimetric analysis, shall not exceed 5% by weight when a 2 inch ±0 inch high by 2 inch ±0 inch wide sample of the coated separator is subjected to temperatures from 70°F to 1,800°F.

C-2.1.8.3 The coated separator shall pass a flexibility test in accordance with FED STD 141D, Method 6221.

C-2.2 GENERAL MATERIAL REQUIREMENTS. All materials used shall have properties and composition suitable for the application as defined by WTP Project HEPA Filter Datasheets. The general material requirements of ASME AG-1, Article FK-3200 shall apply.

# C-3 Design

C-3.1 GENERAL DESIGN.

C-3.1.1 In order to ensure continuous, high efficiency particle removal during filter service, the design and construction of high strength HEPA filters shall incorporate requirements for the strength, physical integrity, and other performance criteria of filter components and component materials. The high strength HEPA filters are characterized by a folded filter medium in a radial flow configuration as indicated by the ASME AG-1 Section FK, Type 1 filter. The design shall consider the following two classes of high strength HEPA filters characterized by:

C-3.1.1.1 A high strength filter medium only, and

C-3.1.1.2 A high strength filter medium with additional design features to enhance pack robustness and stability by inhibiting loosening of the filter pack.

C-3.1.2 The assembled metal medium HEPA filters shall be designed for installation and use in the current design of the WTP Remote Change HEPA Filter Housing or the WTP Safe Change HEPA Filter Housing, including overall dimensions and interfaces (e.g., gelatinous seal on both designs, and lifting grapple on Remote Change housing design).

C-3.2 SPLICES AND PATCHES. No splices or patches in the pleated filter medium of the pack are allowed. Joining of the two ends in the radial flow filter pack is acceptable.

C-3.3 FILTER CASE. Filter cases are used to enclose the pack of the high strength filter. All case joints shall be sealed.

C-3.4 HIGH STRENGTH FILTER PACKS. Filter packs shall be made by folding the high strength filter medium to the required depth, with the reinforcement layer located on the pack downstream side. If required, the folded filter medium shall be supported with corrugated separators. If required, the filter medium pack shall be recessed by a minimum of 1/8 inch within the exposed ends of the separators. If required, separator fixed ends, when viewed from the upstream and downstream faces, shall be embedded in the adhesive/sealant. If required, the separators shall not extend beyond the ends of the case when the filter pack is bonded to the case. The filter pack shall be rigid within the case and shall be perpendicular to two opposite parallel sides of the case. The top and bottom of the pack shall be sealed in a reservoir of potting adhesive at least 1/16 inch deep, once the pack is installed in the filter case. Separators (if required) and filter medium shall not vary more than 1/4 inch from a straight line connecting the fixed ends. Abrupt deviations, as defined by a maximum deviation of one-half the pleat-to-pleat distance along any 2 inch length of pleat, are not acceptable.

C-3.5 GELATINOUS SEAL. The gelatinous seal shall be designed in accordance with ASME AG-1, Article FK-4142.

C-3.6 SEPARATORS. The separator material (if required) shall be capable of withstanding continuous service under all specified operating conditions without swelling, sagging, or melting.

C-3.7 GRILLES. High strength radial flow HEPA filters shall be fitted with internal and external support grilles around the filter media per Section C-2.1.5.

C-3.8 TEST AEROSOL PENETRATION. The total test aerosol penetration through the assembled filter shall not be greater than 0.03% of upstream concentration when tested at rated airflow and at 5% of rated flow when tested in accordance with the Inspection and Testing section of this specification. Filters with a rated airflow of less than 125 CFM shall be tested at the rated airflow only.

C-3.9 RESISTANCE TO AIRFLOW. The resistance to airflow at the rated airflow of the clean high strength filter shall not exceed 1.55 inches WC, when tested in accordance with the Inspection and Testing section of this specification. Rated airflow shall be as defined in Section 3.1.1 or as specified by Buyer.

# C-4 Inspection and Testing

C-4.1 FILTER INSPECTION

C-4.1.1 Each high strength HEPA filter in a qualification or production sample shall be visually inspected to show conformance to Section C-5, Fabrication, of this specification, and to verify that the sticker indicates it has been tested and meets the flow rate, penetration, and flow resistance. Additional attributes to be inspected are: length, depth, height, concentricity, and adherence of gaskets. The high strength filter medium shall be inspected to ensure there are no holes, splices, or patches. Section C-3.2, Splices and Patches.

C-4.1.2 Each filter in a sample shall be visually examined for any defects. The acceptance criterion for the filter pack is no visual indication of damage to the filter medium, no tears on the surface edge of the filter pleats, and no tears where the filter pack is embedded in the adhesive at the top and bottom of the filter case, or where it is sealed to the two sides of the case. The acceptance criterion for the metal case is no visual indication of dents or deformation. The acceptance criterion for the gel channel is no visual indication of dents that may interfere with proper sealing. The acceptance criterion for the gelatinous sealant is no visual indication of gouges or separation from the gel channel, and proper channel fill with gel to tolerances as shown on WTP design drawings in Section 2.4.

C-4.1.3 Acceptance shall be contingent upon no visual indications of improper assembly, physical damage, structural distress, or any degradations that would impair the ability of a component to perform its intended function.

C-4.2 QUALIFICATION TESTING.

C-4.2.1 The assembled filter shall require qualification testing prior to acceptance and production. The assembled filter design shall be re-qualified at least every 5 years. Tests shall be performed and certified by an independent test facility. The qualification samples shall be tested against all the requirements herein below.

C-4.2.2 Each high strength filter in the qualification sample shall be visually examined for defects. A qualification sample consists of 8 (eight) high strength filters, or 4 (four) filters if the Supplier is providing objective evidence of compliance with UL 586.

C-4.2.3 The high strength HEPA filters shall be manufactured using the same methods, materials, equipment, and processes as will be used during production. Failure of any filter to comply with any of the requirements of this specification shall be cause for the rejection of the qualification sample.

C-4.2.4 The Supplier shall provide the supplier's name and part number, or name for materials that do not have a referenced industry specification in this document, to the Independent Filter Test Laboratory at the time of qualification.

C-4.2.5 The filters used in the qualification sample shall be run sequentially through the tests in the order given in Table C-1.

**Table C-1 Test Group and Sequence for High Strength HEPA Filters**

| Quantity | Requirement |
|---|---|
| 4 | Resistance to rated airflow (Section C-4.3) |
| | Test aerosol penetration at 100% and 5% of rated airflow (Section C-4.4) |
| | Resistance to rough handling (Section C-4.5) |
| | Resistance to pressure (Section C-4.6) |
| | Test aerosol penetration at 100% and 5% of rated airflow (Section C-4.4) |
| NOTE: The tests shall be conducted in the order listed above. | |

C-4.3 RESISTANCE TO AIRFLOW. The clean filter resistance to airflow meet the requirements of Section C-3.9 when tested at actual air conditions in accordance with the requirements below.

C-4.4 TEST AEROSOL PENETRATION.

C-4.4.1 The test aerosol penetration shall be determined in accordance with Table C-1. The test conditions shall be actual air conditions.

C-4.4.2 The total aerosol penetration through the assembled filter shall be no greater than 0.03% of upstream concentration at rated airflow and at 5% of rated airflow when challenged with 0.3 micrometer diameter particles.

C-4.4.3 Suitable penetrometers include the Q 76. Penetrometers using laser particle counters in accordance with the methods and procedures of IEST RP CC 007 are also acceptable. When using a penetrometer with a particle counter the penetration of the 0.3 micrometer particle size shall be reported. Acceptable aerosol materials for the Q 76 or the Q 107 penetrometer are di-octyl-phthalate (DOP), di-octyl-sebacate (DOS), and 4 centistoke poly-alpha-olephin (PAO). If using a penetrometer with a particle counter, the aerosol material shall be 4 centistoke poly-alpha-olephin (PAO) or as defined in IEST RP CC 007.

## C-4.5 RESISTANCE TO ROUGH HANDLING

C-4.5.1 High strength filters shall be tested on a rough handling machine for 15 minutes at 3/4 inch total amplitude at 200 cycles per minute in accordance with Test Method 105.110 of MIL STD 282. The filter shall be placed on the machine with the faces and pleats in a vertical position.

C-4.5.2 At the conclusion of the shaking period, the filter shall be visually examined for damage. Cause for rejection shall include cracked or warped cases, loose corners or joints, cracked adhesive, loose or deformed filter medium, separators, or faceguards.

## C-4.6 RESISTANCE TO PRESSURE

All filter test requirements will be detailed in the High Efficiency Particulate Air (HEPA) Filter Test Plan, 24590-WTP-RPT-ENG-12-047. The specific test protocol for the new high-strength filters (both reinforced glass fiber medium and steel fiber medium) will be the particle loading tests at the subcontracted filter test facility up to 50 inches WC. The particle loading tests will be followed by a high pressure liquid flow test with an added pressure equal to the maximum static pressure under which a WTP HEPA filter can operate. After the high pressure liquid flow test, the filter will be dried and tested for efficiency and pressure differential at rated flow and twenty percent (20%) of rated flow. The high pressure liquid flow test is analogous to the ASME AG-1 wet over-pressure test.

## C-4.7 RESISTANCE TO HEATED AIR

C-4.7.1 For resistance to heated air, the high strength filter shall be installed in the test chamber and subjected to 40% or greater rated flow of air heated to 700°F ±50°F for no less than 5 minutes. Ramping to this temperature shall be accomplished in no more than 15 minutes.

C-4.7.2 Following exposure to heated air and cooling of the filter in place, the filter shall be tested in accordance with ASME AG-1 Article TA-4634 at rated flow for test aerosol penetrations through the assembled filter. The penetration shall not exceed 0.03%.

C-4.7.3 Either an Underwriters Laboratories' label, which through its traceable UL control number, or a UL 586 designation shall be objective evidence of compliance.

## C-4.8 SPOT FLAME RESISTANCE

C-4.8.1 The high strength filter shall be mounted in the test duct and the airflow adjusted to rated airflow. A gas flame from a Bunsen burner shall be directed against the upstream face of the unit. The Bunsen burner shall be adjusted to produce a flame with a blue cone 2.5 inches long with a tip temperature of 1750°F ±50°F, as measured by a thermocouple inserted in the flame. The tip of the cone shall be so applied that it touches the surface of the filter medium

at a distance of not less than 2 inches from the filter case. The flame shall be applied for 5 minutes at each of three separate locations on the filter face.

C-4.8.2 The Bunsen burner flame shall then be directed into a top corner of the filter unit in such a manner that the tip of the blue cone contacts the case, filter pack, and sealing materials. The flame shall be applied for a period of 5 minutes. The test shall be repeated upon the opposite top corner of the sample filter unit.

C-4.8.3 After removal of the test flame at each point of application, there shall be no sustained flaming on the downstream face of the unit.

C-4.8.4 Either an Underwriters Laboratories label, which through its traceable UL control number, or a UL 586 designation shall be objective evidence of compliance.

C-4.9 STRUCTURAL AND SEISMIC QUALIFICATION REQUIREMENTS.

C-4.9.1 Each filter or filter component in the sample shall be evaluated for structural integrity. Each filter or filter component shall satisfy that no structural damage shall be evident by visual examination.

C-4.9.2 In the case of Remote Change high strength medium HEPA filters, the filter shall be qualified to withstand grapple loads by testing.

C-4.9.3 The assembled high strength HEPA filter shall be seismically qualified by testing in accordance with ASME AG-1, Article FK-4300.

C-4.10 REQUIREMENTS FOR RESIDUAL PHYSICAL INTEGRITY. Each component in the high strength filter shall be visually inspected for residual physical integrity after each test performed. It shall be confirmed during all visual examinations that each filter in the sample remains free of contaminants and degradations in conformance with Section C-5, Fabrication, requirements in this specification.

C-4.11 PRODUCTION TESTING. Each high strength filter manufactured for delivery shall be inspected according to requirements in this section and tested for test aerosol penetration and resistance to airflow in accordance with this specification. Test results shall be marked on the label of each filter.

# C-5 Fabrication

C-5.1 GENERAL REQUIREMENTS. The high strength HEPA filter shall be assembled from the materials designated in Section C-2, Materials, of this specification in accordance with the design requirements established in Section C-3, Design, of this specification. Following assembly, filters for qualification shall be inspected and qualified in accordance with Section C-4, Inspection and Testing, requirements in this specification.

Production testing of qualified high strength filters shall conform to Section C-4, Inspection and Testing, requirements in this specification.

C-5.2 MANUFACTURE AND ASSEMBLY. The general requirements for fabrication and installation are contained in ASME AG-1 Articles AA-6200 and AA-6300.

C-5.3 TOLERANCES. Tolerances shall be as indicated in ASME AG-1, Section FK, unless otherwise stated on supplier design drawings accepted by the Buyer, and except as modified per Section 5.1.1 of this specification.

C-5.4 INSTALLATION OF HIGH STRENGTH FILTER MEDIUM. The high strength filter medium shall be fastened to the sides and ends of the filter case with adhesive to completely seal the edges of the filter medium to the filter case. Patching of holes or tears in the filter medium shall not be permitted.

C-5.5 WORKMANSHIP. The high strength filter shall be free from foreign matter (dirt, oil, or viscous material) and damage, such as distorted or cracked case, deformation, or sagging of the filter medium, separators and faceguards, cracks in adhesive, and cracks, or holes in exposed portions of the filter medium. All required fasteners shall be securely installed. All the dimensional and performance requirements of this specification shall be directed toward achieving the highest quality and workmanship possible.

# C-6 Packaging, Shipping, and Storage

C-6.1 Packaging, shipping, and storage shall be in accordance with ASME AG-1 Article AA-7000 and ANSI/ASME NQA-1 Level B. High strength filters shall be individually packaged. Cartons shall have extra shock absorbing material at the corners of the filter that centers the filter within the carton to prevent damage.

C-6.2 Filters shall be placed in the carton with the pleats vertical. The carton should be placed on skids or otherwise packed in such a manner that the pleats remain vertical during shipment.

C-6.3 HEPA filters with gelatinous seals shall be packaged in a manner to prevent the gelatinous compound from sticking to the packaging material. A means shall be provided to prevent the gelatinous seal from being gouged or pulled out of the continuous channel when the filter is removed from the shipping carton or plastic bag.

C-6.4 Cartons for high strength HEPA filters shall not be stacked more than 6.5-feet high during packaging, handling, shipping, and storage.

C-6.5 The carton shall be clearly marked for proper orientation.

# C-7 Quality Assurance

C-7.1 Quality Assurance shall conform to the requirements of ASME AG-1, Article AA-8000 and the following.

C-7.2 RESPONSIBILITY. The Supplier has the responsibility of providing all specified information and of assuring that the quality control, and detailed examination and tests required by this specification, are performed at the stages of construction necessary to permit them to be meaningful.

C-7.3 CERTIFICATE OF CONFORMANCE. The Certificate of Conformance shall state that the high strength filters conforms to this specification.

# C-8 Nameplates

C-8.1 Filter Marking. Marking or labeling of each high strength filter shall be on the top of the filter when the pleats are vertical, of such size and legibility that it can be read at a distance of 6-feet. As a minimum, the following information shall be provided:

C-8.1.1 Manufacturer's name or symbol

C-8.1.2 Model number

C-8.1.3 Serial number

C-8.1.4 Rated flow capacity

C-8.1.5 Direction of airflow for penetration and pressure drop tests, no less than 6 inches high

C-8.1.6 Pressure drop, in inches of water at one hundred percent (100%) rated flow

C-8.1.7 Overall penetration at rated flow

C-8.1.8 Overall penetration at five percent (5%) of rated flow

C-8.1.9 UL label indicating successful testing per UL 586 if UL 586 if applicable

C-8.2 PACKAGE MARKING. Marking or labeling of each shipping container (carton containing one high strength filter) shall be of such size and type that it can be read at a distance of 6 feet. As a minimum, the following information shall be provided:

C-8.2.1 Manufacturer's name or symbol

C-8.2.2 Arrows and "THIS SIDE UP" indicating orientation for shipping and storage and "FRAGILE" in letters no less than 6 inches high.

C-8.2.3 Filter model number

C-8.2.4 Purchase order number or other identifying mark requested by Buyer.

# C-9 High Strength HEPA Filter Medium

C-9.1 SCOPE. This specification section establishes requirements for the manufacture of high strength, high efficiency, fire resistant, filter medium for use in the construction of high strength HEPA filters.

C-9.2 REQUIREMENTS. In order to ensure continuous, high efficiency particle removal during filter service, the inspection and testing of a high strength HEPA filter medium shall include requirements for the strength and other performance criteria of the filter medium.

C-9.3 FORM AND SIZE

C-9.3.1 FORM. The high strength filter medium shall be furnished in rolls. The filter medium shall be tightly and evenly wound on nonreturnable fiber or paperboard cores with a minimum inside diameter of 3 1/16 inch ±1/8 inch and a minimum wall thickness of 3/8 inch.

C-9.3.2 SIZE. The width of the roll shall be specified at the time of procurement. The tolerance on the specified width shall be plus (+) 1/4 inch and minus (-) zero inches. The weight or length of filter medium on the roll shall be clearly marked on the outside of the roll.

C-9.4 SPLICES. The location of splices within the rolls shall be marked with paper tabs of contrasting color extending from each end of the roll. The number of splices permitted per roll shall not exceed the whole number obtained by dividing the length of the roll (measured in ft) by 1000.

C-9.5 PHYSICAL AND CHEMICAL

C-9.5.1 AIRFLOW RESISTANCE. The pressure drop across the high strength filter medium shall meet the requirements of Section C-3.9 with ambient room temperature airflow through the filter medium at a velocity of 10.5 feet per minute, when tested as specified in Section C-9.15, TEST PROCEDURES.

C-9.5.2 TEST AEROSOL PENETRATION. The penetration of the high strength filter medium by a test aerosol of 0.3 micrometer light scattering particle size shall not exceed 0.03%, as determined by the ratio of the downstream to upstream aerosol concentration when testing in accordance with Section C-9.15, TEST PROCEDURES, with ambient temperature airflow through the filter medium at a velocity of 10.5 feet per minute.

C-9.6 TENSILE STRENGTH

C-9.6.1 Tensile Strength and Elongation. The average ultimate tensile strength of the high strength filter medium shall be not less than 38 pounds per inch width in the machine direction, not less than 32 pounds per inch width in the cross direction, and the average elongation in both directions shall be no less than 0.5% at rupture when tested.

C-9.6.2 Tensile Strength After Heated Air. The average ultimate tensile strength of the high strength filter medium shall be not less than 24 pounds per inch width in the cross direction after exposure to heated air at 700°F ±50°F in a forced draft oven for 5 minutes when tested.

C-9.6.3 Wet Tensile Strength. The average ultimate tensile strength of the wet high strength filter medium, after being twice folded around a 0.19 inch diameter mandrel and soaked for 15 minutes in water at room ambient temperature, shall be not less than 16 pounds per inch width in the cross direction when tested.

C-9.6.4 Tensile Strength After Gamma Irradiation. The average ultimate tensile strength of the high strength filter medium shall not be less than 16 pounds per inch width in either the machine or cross direction after the filter medium is exposed to gamma irradiation for an integrated dose of $6.0 \times 10^7$ to $6.5 \times 10^7$ rads at a dosage rate not to exceed $2.5 \times 10^6$ rads per hour when tested.

C-9.7 WATER REPELLENCY

C-9.7.1 Initial Water Repellency. The average water repellency of the high strength filter medium shall not be less than 20 inches WC with no single value being less than 18 inches WC when tested.

C-9.7.2 Water Repellency After Gamma Irradiation. The average water repellency of the high strength filter medium shall be no less than 6 inches WC with no single value being less than 5 inches WC after the filter medium is exposed to an integrated dose of $6.0 \times 10^7$ to $6.5 \times 10^7$ rads at a dose rate not to exceed $2.5 \times 10^6$ rads per hour when tested.

C-9.8 THICKNESS. The thickness of the high strength filter medium shall be a minimum of 0.015 inches and a maximum of 0.040 inches when measured.

C-9.9 COMBUSTIBLE MATERIAL. The combustible material in the high strength filter medium shall not exceed 7.5% by weight when tested.

C-9.10 FLEXING CHARACTERISTICS

C-9.10.1 Examination After Flexing. The high strength filter medium shall show no tears, breaks, cracks, or fiber separation after it is drawn back and forth, five times, around a 0.19 inch (4.8 mm) diameter mandrel and moving through an arc of at least 180 degrees.

C-9.10.2 Test Aerosol Penetration After Flexing. The penetration of the high strength filter medium by test aerosol of 0.3 micrometer light scattering particle size shall not exceed 0.03% after the filter medium is drawn back and forth, when tested as specified in Section C-9.13.2.1, Airflow Resistance and Test Aerosol Penetration.

C-9.11 MILDEW RESISTANCE. If a mildew resistant filter medium is required the filter medium shall show no growth when tested as specified in Section C-9.13.2.7, Test for Mildew Resistance. This test is only required if requested explicitly by the Buyer of the filter medium. A filter medium requiring mildew inhibitor shall be re-qualified for mildew resistance at least every five years by an independent test facility.

C-9.12 WORKMANSHIP. The high strength filter medium shall be free from contamination (foreign matter), thick or thin spots, wrinkles, and damage, such as tears, cracks, holes, abrasions, and punctures.

C-9.13 INSPECTION AND TESTING

C-9.13.1 QUALIFICATION TESTING

C-9.13.1.1 SAMPLE. A qualification sample of 10 linear feet, full width, shall be manufactured using the same methods, materials, equipment and processes as will be used during regular production. This sample shall be tested for the properties specified in Table C-2.

**Table C-2 High Strength Filter Medium Qualification and Production Tests**

| Filter Medium Property | Test Req. | Test Procedure | Qualification Test | Production Test |
|---|---|---|---|---|
| Airflow Resistance | C-9.5.1 | C-9.13.2.1 | X | X |
| Test Aerosol Penetration | C-9.5.2 | C-9.13.2.1 | X | X |
| Tensile Strength and Elongation | C-9.6.1 | C-9.13.2.2 (a) | X | X |
| Tensile Strength After Heated Air | C-9.6.2 | C-9.13.2.2 (b) | X | |
| Wet Tensile Strength | C-9.6.3 | C-9.13.2.2 (c) | X | X |
| Tensile Strength After Gamma Irradiation | C-9.6.4 | C-9.13.2.2 (d) | X | |
| Initial Water Repellency | C-9.7.1 | C-9.13.2.3 (a) | X | X |
| Water Repellency After Gamma Irradiation | C-9.7.2 | C-9.13.2.3 (b) | X | |
| Thickness | C-9.8 | C-9.13.2.4 | X | X |
| Combustible Material | C-9.9 | C-9.13.2.5 | X | X |
| Examination After Flexing | C-9.10.1 | C-9.13.2.6 (a) | X | |
| Test Aerosol Penetration After Flexing | C-9.10.2 | C-9.13.2.6 (b) | X | |
| Workmanship | C-9.12 | C-9.13.3 | X | X |

C-9.13.1.2 MATERIAL CHANGE. Any change in materials or source of materials after qualification shall require a new qualification sample.

C-9.13.1.3 REVERIFICATION OF QUALIFICATION. A high strength filter medium shall be re-qualified at least every five (5) years. Tests shall be performed and certified by an independent test facility.

C-9.13.2 QUALIFICATION TEST PROCEDURES

C-9.13.2.1 AIRFLOW RESISTANCE AND TEST AEROSOL PENETRATION. Three test specimens shall be tested for airflow resistance and aerosol penetration at a filter medium velocity of 10.5 feet per minute using a Penetrometer (e.g., Q 127) according to ASTM D737 and ASTM D2986. Optionally, the Most Penetrating Particle Size penetration may be determined according to IEST RP CC021.1.

C-9.13.2.2 TENSILE STRENGTH

(a) Tensile Strength and Elongation. Ten test specimens, five taken in each direction, shall be tested for ultimate tensile strength and elongation at rupture in accordance with TAPPI Standard T494 except that the test specimens shall 1.00 inches ± 0.05 inches wide with sides parallel within 4/1000 inch and long enough to be clamped in the jaws when the test span is 4.0 inches ±0.2 inches, leaving enough length so that any slack can be removed from the strip before clamping. Use a motorized tensile testing machine that has a constant rate of elongation and a flat jaw clamping device. The rate of separation of the jaws shall be set at 0.5 inches per minute or at a rate that will complete the test in 10 seconds ± 2 seconds, whichever is greater. The rate shall be constant to ±4%.

(b) Tensile Strength After Heated Air. Four test specimens 6 inches by 6 inches shall be subjected to heated air using a suitable commercial forced draft oven, capable of allowing full circulation of air to each test specimen. The test specimen shall be placed in the oven for five minutes after the temperature has reached 700°F ± 50°F. After the exposure, the specimen shall be removed from the oven and conditioned in accordance with TAPPI Standard T402. One test strip, 1.00 inch ± 0.05 inches wide with sides parallel within 4/1000 inch and long enough to be clamped in the jaws when the test span is 4.0 inches ±0.2 inches, leaving enough length so that any slack can be removed from the strip before clamping taken in the cross direction width shall be tested for ultimate tensile strength in accordance with Section C-9.13.2.2(a), Tensile Strength and Elongation.

(c) Wet Tensile Strength. Three test specimens, 1.00 inches ±0.05 inches wide with sides parallel within 4/1000 inch and long enough to be clamped in the jaws when the test span is 4.0 inches ± 0.2 inches, leaving enough length so that any slack can be removed from the strip before clamping taken in the cross direction width shall be submerged in water at a depth of 10 inches for 15 minutes and then tested for ultimate tensile strength as specified in Section C-9.13.2.2(a), Tensile Strength and Elongation.

(d) Tensile Strength after Gamma Irradiation. Six (6) test specimens 7 inches by 3 inches ±0.2 inches, three (3) with the 7 inch side in the machine, and three (3) with the 7 inch side in the cross direction, shall be exposed to irradiation in a ventilated chamber as specified in Section C-9.5.4, Tensile Strength after Gamma Irradiation. A test strip, 1.00 inches ± 0.05 inches wide with sides parallel within 4/1000 inch and long enough to be clamped in the jaws when the test span is 4.0 inches ± 0.2 inches, leaving enough length so that any slack can be removed from the strip before clamping taken from each of these specimens shall be tested for ultimate tensile strength in accordance with Section C-9.13.2.2(a), Tensile Strength and Elongation.

C-9.13.2.3 WATER REPELLENCY

(a) Initial Water Repellency. Three test specimens 2 ¾ ±⅛ x 5 ½ ±¼ inch shall be conditioned in accordance with TAPPI T402 and tested for water repellency using the Q 101 Water Repellency Test (125 8 1). The two surfaces of each test specimen shall be identified as top and bottom. The specimen shall then be cut into two 2 ¼ ±⅛ x 2 ¼ ±⅛ inch squares. The top surface of one and the bottom surface of the other square shall be tested. The lesser of the two results shall be considered the water repellency of the specimen.

(b) Water Repellency After Gamma Irradiation. Three test specimens 7 ±¼ x 5 ±¼ inches shall be exposed to irradiation in a ventilated chamber as specified in Section C-9.6.4, Tensile Strength after Gamma Irradiation and subsequently tested in accordance with Section C-9.13.2.3(a), Initial Water Repellency.

C-9.13.2.4 THICKNESS. The thickness of samples of a high strength filter medium shall be determined in accordance with TAPPI T411.

C-9.13.2.5 COMBUSTIBLE MATERIAL. The percentage of material combusted from the sample shall be determined as specified in the IEST RP CC021.1.

C-9.13.2.6 FLEXING CHARACTERISTICS.

(a) Examination After Flexing. Eight test specimens, 6 ±¼ x 12 ±¼ inches in the machine direction shall be bent perpendicular to the machine direction over a 3/16 ±1/32 inch mandrel so that 10 ±½ inch of filter medium are drawn five times through an arc of 180°. Four specimens with the screen/wire side against the mandrel and four specimens with the felt side against the mandrel. Examine the flexed filter medium 10 ±½ inch section for compliance with Section C-9.10.1, Examination After Flexing.

(b) Test Aerosol Penetration After Flexing. The penetration of the high strength filter medium by test aerosol of 0.3 micrometer light scattering particle size shall not exceed 0.03% after the filter medium is drawn back and forth as required in Section C-9.10.1, Examination After Flexing, when tested as specified in Section C-9.10.2, Test Aerosol Penetration After Flexing.

C-9.13.2.7 TEST FOR MILDEW RESISTANCE. When mildew resistance is required, the filter medium shall be tested in accordance with MIL STD 810G, Method 508.6.

C-9.13.3 WORKMANSHIP. Each roll of high strength filter medium shall be inspected for defects. Defects such as abrasions greater than 1/4 inch diameter; burn holes, charring or scorching from the drying operation; and deviations outside the width tolerance are reasons for rejection. All the dimensional and performance requirements of this specification shall be directed toward achieving the highest quality and workmanship possible.

C-9.13.4 PRODUCTION TESTING

C-9.13.4.1 PRODUCTION LOT. A production lot shall consist of the rolls of filter medium produced sequentially by one manufacturer using the same methods, materials, equipment, processes, and design. The production lot is assigned a lot number or identifier to permit traceability to test results and reports.

C-9.13.4.2 SAMPLING. At minimum, a full width sample shall be taken every fourth set for testing. A set consists of the amount of linear filter medium needed to produce a final roll by the full width utilized of the manufacturing equipment. If a production lot is smaller than four sets, the beginning and end of the lot shall be sampled for testing. A purchaser may require more frequent testing from the filter medium supplier based on process capability or experience with the supplier.

C-9.13.4.3 TESTS. Each sample taken as specified shall be tested for the properties specified in Table C-2, Filter Medium Qualification and Production Tests.

C-9.14 QUALITY ASSURANCE PROVISIONS

C-9.14.1 RESPONSIBILITY FOR INSPECTION

C-9.14.2 SUPPLIER'S RESPONSIBILITY. Unless otherwise specified in the contract or purchase order, the Supplier is responsible for the performance of all inspection requirements as specified herein.

C-9.14.3 OBJECTIVE EVIDENCE. The Supplier shall provide objective evidence acceptable to Buyer that the Section C-9, High Strength HEPA Filter Medium, specification requirements have been satisfied.

C-9.15 PACKAGING, SHIPPING, AND STORAGE

C-9.15.1 PACKAGING. Packaging shall conform to Level B of ASME NQA 2 suitable for storage under Level B of ASME NQA 2.

C-9.15.2 SHIPPING. Shipping of the high strength filter medium shall be undertaken to ensure the quality of the product upon arrival at the purchaser. Shipping shall comply with the rules and regulations applicable to the mode of transport being utilized.

# Appendix D:

# Projected PTF/LAW/HLW HEPA Filter Loading

The tables below provides a listing of the anticipated HEPA filter gas-phase chemical and particulate loadings at the inlet of the HEPA filters.

With the exception of the Pretreatment HEPA Filters (PVP-HEPA-00012A/B) loads, these results reflect the anticipated constituent concentrations experienced during normal operations, as predicted by the Aspen Process Performance Simulation (APPS) runs performed for the Process Inputs Basis of Design (PIBOD), 24590-WTP-DB-PET-09-001, Revision 1.

The temperature and relative humidity conditions listed in the table represent the maximum values realized from the set of 23 runs performed for the PIBOD. Again, these values reflect normal operating conditions for the WTP.

The HLW HEPA filter values were obtained using the "Bounding Flowsheet" scenario presented in 24590-HLW-M4C-HOP-00011, Revision 1 and the associated Engineering Calculation Change Notice, 24590-HLW-M4E-HOP-00006.

The LAW HEPA filter values were obtained using the "Bounding Flowsheet - 3 Melters" scenario presented in 24590-LAW-M4C-LOP-00001, Revision 1 and the associated/relevant ECCN, 24590-LAW-M4E-LOP-00009.

The results presented for the PJV HEPA filter loadings were obtained using bounding results from the APPS runs performed for the PIBOD, 24590-WTP-DB-PET-09-001, Revision 1.

The PVV HEPA filter constituent concentrations reflect those predicted for the "normal operating conditions with all vessels at max solids contribution" case, as presented in Tables 8-1 and 8-10 of 24590-PTF-M4C-M11T-00001, Revision C.

The gas-phase concentrations listed in the table below are in units of parts per million by volume (ppmV); the particulate loadings are in units of mass-based parts per million (ppm) in units of milligrams per kilogram (mg/kg). Other than the conservative assumptions that went into the inputs and assumptions used to generate the conditions and compositions for the streams, none of these results reflect adjustment to include any safety-factor and/or design margin values.

Appendix D (Continued)

WTP PTF/LAW/HLW HEPA Filter Inlet Stream Conditions During Normal Operations

| Component | Inlet Stream | Mass Flow (kg/hr) | Flow (ACFM) | T (°F) | Relative Humidity |
|---|---|---|---|---|---|
| HOP-HEPA-00001A/B & -00002A/B | HOP17 | 3555 | 3012 | 160 | 38.7 |
| HOP-HEPA-00007A/B & -00008A/B | HOP17 | 3555 | 3012 | 160 | 38.7 |
| PJV-HEPA-00004A/B & -00005A/B | PJV33 | 3855 | 2270 | 98 | 27 |
| LVP-HEPA-00001A/B, -00002A/B & -00003A | LVP04 | 11400 | 9544 | 182 | 28 |
| PJV-HEPA-00003A/B | PJV13a | 6170 | 3830 | 202 | 2 |
| PJV-HEPA-00001A/G & -00002A/F | PJV08 | 88000 | 49200 | 82 | 70 |
| PVV-HEPA-00004A/B | PVP07d | 316 | 200 | 185 | 2 |
| PVV-HEPA-00001A/B & -00002A/B | PVP07a | 3890 | 2400 | 87 | 70 |

| Component | Inlet Stream | ppmV | | | | | |
|---|---|---|---|---|---|---|---|
| | | $NH_3$ | VOC/SVOC | Hg | HCl | HF | $SO_2$ |
| HOP-HEPA-00001A/B & -00002A/B | HOP17 | 14 | ~0 | 9.8 | 3.7 | 6.2 | 2.4 |
| HOP-HEPA-00007A/B & -00008A/B | HOP17 | 14 | ~0 | 9.8 | 3.7 | 6.2 | 2.4 |
| PJV-HEPA-00004A/B & -00005A/B | PJV33 | 0 | 0.00035 | ~0 | 0.012 | 0.04 | 0.011 |
| LVP-HEPA-00001A/B, -00002A/B & -00003A | LVP04 | 42.7 | 192 | 3.88 | 45.5 | 2.81 | 4.76 |
| PJV-HEPA-00003A/B | PJV13a | 0 | 0 | 0 | 0 | 0 | 0 |
| PJV-HEPA-00001A/G & -00002A/F | PJV08 | 0 | 0.108 | 0.00004 | 0.139 | 0.167 | 0.132 |
| PVV-HEPA-00004A/B | PVP07d | 0 | 0 | 0 | 0 | 0 | 0 |
| PVV-HEPA-00001A/B & -00002A/B | PVP07a | 0 | 0.021 | ~0 | 0.027 | 0.039 | 0.026 |

Appendix D (Continued)

WTP PTF/LAW/HLW HEPA Filter Inlet Stream Conditions During Normal Operations

| Component | Inlet Stream | Particulate (ppm) |
|---|---|---|
| HOP-HEPA-00001A/B & -00002A/B | HOP17 | 0.0059 |
| HOP-HEPA-00007A/B & -00008A/B | HOP17 | 0.0059 |
| PJV-HEPA-00004A/B & -00005A/B | PJV33 | 1.01 |
| LVP-HEPA-00001A/B, -00002A/B & -00003A | LVP04 | 21.32 |
| PJV-HEPA-00003A/B | PJV13a | 0 |
| PJV-HEPA-00001A/G & -00002A/F | PJV08 | 1.01 |
| PVV-HEPA-00004A/B | PVP07d | 0 |
| PVV-HEPA-00001A/B & -00002A/B | PVP07a | 4.81 |

| Component | Inlet Stream | References |
|---|---|---|
| HOP-HEPA-00001A/B & -00002A/B | HOP17 | 24590-HLW-M4C-HOP-00011, Rev. 1, "Bounding Flowsheet" case |
| HOP-HEPA-00007A/B & -00008A/B | HOP17 | 24590-HLW-M4C-HOP-00011, Rev. 1, "Bounding Flowsheet" case |
| PJV-HEPA-00004A/B & -00005A/B | PJV33 | 24590-WTP-DB-PET-09-001, Rev. 1 (PIBOD Run 1) |
| LVP-HEPA-00001A/B, -00002A/B & -00003A | LVP04 | 24590-LAW-M4C-LOP-00001, Rev. 3, "Bounding Flowsheet, 3 Melters" case |
| PJV-HEPA-00002A/B | PJV13a | 24590-WTP-DB-PET-09-001, Rev. 1 (PIBOD Run 1) |
| PJV-HEPA-00012 | PJV08 | 24590-WTP-DB-PET-09-001, Rev. 1 (PIBOD Run 1) |
| PVV-HEPA-00004A/B | PVP07d | 24590-WTP-DB-PET-09-001, Rev. 1 (PIBOD Run 1) |
| PVV-HEPA-00001A/B & -00002A/B | PVP07a | 24590-PTF-M4C-M11T-00001, Rev. C (p. 74 & 91); 24590-WTP-DB-PET-09-001, Rev. 1 (PIBOD Run 01) |